Theoretical and Applied Economics
Volume XXIII, No. 1(606)/2016, Spring

Contents

Mircea Dinu
Tel.: (+4) 031.432.96.02
Fax: (+4) 021.210.73.10
E-mail: comenzi@edecon.ro

Data base indexation:
EconLit
http://www.aeaweb.org
Research Papers in Economics (RePEc)
http://www.ideas.repec.org
http://econpapers.repec.org
Directory of Open Access Journals (DOAJ)
http: //www.doaj.org
EBSCO Publishing
http://www.ebscohost.com
International Consortium for the Advancement of Academic Publication (ICAAP)
http://www.icaap.org
Cabell's Directories
http://www.cabells.com
CNCSIS B+

www.economieteoreticasiaplicata.ro; www.ectap.ro

Reception of texts: economia.ta@edeconomica.com

ISSN 1841-8678 (Print)
ISSN 1844-0029 (Online)

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 5-14

Female entrepreneurial activity in Romania

Annamária DÉZSI-BENYOVSZKI
Babeş-Bolyai University Cluj-Napoca, Romania
annamaria.benyovszki@econ.ubbcluj.ro
Tünde Petra SZABÓ
Babeş-Bolyai University Cluj-Napoca, Romania
petra.szabo@econ.ubbcluj.ro
Ágnes NAGY
Babeş-Bolyai University Cluj-Napoca, Romania
agnes.nagy@econ.ubbcluj.ro

Abstract. *The aim of this study is to analyse the female entrepreneurial activity in Romania. We will compare the socio-demographic characteristics, the entrepreneurial attitudes and perceptions of female early-stage entrepreneurs and the female employees in order to highlight the main differences. Using a logistic regression we will identify the main influencing factors of the probability of becoming a female early-stage entrepreneur.*

Keywords: Female Entrepreneurship; Socio-demographic Characteristics; Perceptual Variables; Influencing Factors.

JEL Classification: M13; J16; C21.

1. Introduction

Despite of female entrepreneurship represents an important engine of economic growth for developing countries (De Vita et al., 2014), there is a lack in the literature regarding the factors that influence a woman to be involved in entrepreneurship in case of developing countries.

The first articles regarding the female entrepreneurs appeared in the literature in the late 1970s. These studies provide a perspective approach to the subject. These studies reveal differences in business characteristics, motives of entrepreneurial endeavor, evaluations of main barriers to starting and maintaining entrepreneurial activities, personality traits, management style, socio-demographic characteristics, gender, and business performance.

The aim of this study is to compare the socio-demographic characteristics, the entrepreneurial attitudes and perceptions of female early-stage entrepreneurs and the female employees, respectively to answer the question regarding the differences between the female entrepreneurs and the female employees in Romania.

This article adds to the literature by analysing the characteristics of female entrepreneurs from a developing country and by emphasising the main differences between the female employees and entrepreneurs.

The paper is structured as follows. First we discuss the literature on female entrepreneurship, followed by the description of the variables and the methodology used in our analysis. Section 4 presents the empirical results. Finally are presented the conclusions of this paper.

2. Literature review

It has been shown that the role of female entrepreneurs has increased (De Vita et al., 2014). Female entrepreneurs are increasingly important contributors to entrepreneurial activity and economic growth (Brush et al., 2010; Powell and Eddleston, 2013).

Women are less inclined to select entrepreneurship which is dominated by males such that women are positioned as interlopers in the field (Ahl, 2006; Wee and Brooks, 2012; Klyver et al., 2013; Ahl and Nelson, 2015).

The nature of female entrepreneurship has often been explained in terms of household and family responsibilities (Verheul et al., 2009; Wood and Eagly, 2010; Powell and Eddleston, 2013). There is a contradiction in the literature regarding the impact of the work-life balance in case of female entrepreneurs. Some scholars consider that family responsabilities could play a pushing role in choosing entrepreneurship, since entrepreneurship could be their only way to avoid unemployment (De Vita et al., 2014), flexible working hours could be an important motive for women to engage in self-employment (Longstreth et al., 1987, Brush, 1992, Shelton, 2006), childcare concerns (Georgellis and Wall, 2005, Kirkwood and Tootell, 2008). According to the other group of researchers entrepreneurship is less attractive than employment, due to the increased

household and childcare expenses and the security of employment (Özcan, 2011; Georgellis et al. 2007; Haapanen and Tervo, 2009; Millán et al., 2014).

Therefore the analysis of the main characteristics of female entrepreneurs can be useful for developing successful entrepreneurship-related policies and for understanding a country's competitiveness and growth potential (De Vita et al., 2014).

The impact of age upon choosing entrepreneurship increases until a threshold point, after that it has a negative effect, younger people had less experience, while as people get older, they attach less value to future earnings (Euwals, 2001; Taylor 2004; Lévesque and Minniti, 2006; Block and Sandner, 2009; Verheul et al., 2009).

Education is found to be strongly associated with entrepreneurial success (Acs et al., 2007; Andersson, 2010; Block and Sandner, 2009; Van Praag et al. 2013; Millán et al., 2014). According to Barreneche García (2014) a high educational level provides individuals with the knowledge and tools necessary to create a business, while helping budding entrepreneurs identify market opportunities (Castaño et al., 2015). Educational attainment is positively linked with income for entrepreneurs, with a slightly higher impact on women (Van der Sluis et al., 2005).

Many studies show that successful entrepreneurship is more strongly related to previous entrepreneurial experience rather than formal education (Dencker et al., 2009; Martin et al., 2013; Toft-Kehler et al., 2014, Elert et al., 2015). Female entrepreneurs have less favorable perceptions of themselves and the entrepreneurial environment, as compared with male entrepreneurs (Langowitz and Minniti, 2007).

The social network is an important factor in fostering entrepreneurship. Female entrepreneurs tend to have less industry-related experience, less access to financial capital (Brush et al., 2006), and less influential social networks (Morris et al., 2006). Andersson (2010) showed that social networks are a key mechanism for acquiring entrepreneurial resources (Jayawarna et al., 2015).

Fear of failure can dominate the choices of individuals, potential entrepreneurs decide first whether to enter into risky entrepreneurship or opt for a safe employment wage (Morgan and Sisak, 2016). Female entrepreneurs are more risk-averse and have lower job creation rates (Boden and Nucci, 2000; Burke et al., 2002; Marlow and Swail, 2014).

Opportunity identification implies that entrepreneurs use creative processes to perceive new ideas and to put them into action (Dimov, 2007; Gielnik at al., 2012). Opportunity recognition skill is inevitable for an entrepreneur who wishes to create ventures that outlive the entrepreneur (Wasdani and Mathew, 2014).

This article tends to fulfill the gap in the literature regarding of socio-demographic characteristics and perceptions of female entrepreneurs and female employees based on empirical data.

3. Methodology and data

The individual level data were collected from Global Entrepreneurship Monitor (GEM) Romanian Adult Population Survey (APS) database on 2011-2012 time periods. Our representative sample contains 1735 adults from Romania aged between 18 and 64 years, from which 110 are early-stage entrepreneurs. The definition of early-stage entrepreneur according to GEM is identified as nascent (individuals who are actively planning a new venture) or young business entrepreneurs (entrepreneurs who at least partly own and manage a new business that is between 4 and 42 months old and have not paid salaries for longer than this period).

In order to identify the main influencing factors of becoming an early-stage entrepreneur, we used logistic regression. The functional form of the regression is the following:

$$\pi(X) = \frac{e^{g(X)}}{1 + e^{g(X)}},$$

where $\pi(X) = P(Y = 1|X)$ is the conditional probability, Y is the dependent variable, X is the vector of the explanatory variables, and $g(X) = \beta_0 + \beta_1 x_1 + \cdots + \beta_n x_n$ is the linear combination of the explanatory variables.

The explanatory variables can be grouped in two categories: socio- demographic factors and perceptual factors (entrepreneurial attitudes and perceptions). Table 1 presents the analysed explanatory variables.

Table 1. *The socio-demographic and the perceptual variables*

Socio-demographic variables		
EDUC	Educational attainment	1=some secondary; 2=secondary degree; 3=post secondary; 4=graduate experience
HHINC	Household income	1= lower 33%, 2= middle 33%, 3= upper 33%
AGE	Age category	1=18-24; 2=25-34; 3=35-44; 4=45-54; 5=55-64
Perceptual variables		
KNOWEN	Knows someone who started a business in the last two years.	0=no; 1=yes
OPPORT	Sees good opportunity for starting a business in the next six months.	0=no; 1=yes
SUSKILL	Has the required knowledge and skills to start a business.	0=no; 1=yes
FRFAIL	Fear of failure prevents from starting a business.	0=no; 1=yes
EQUALI	Most people prefer that everyone had a uniform standard of living.	0=no; 1=yes
NBGOOD	Most people consider starting a new business a desirable career choice	0=no; 1=yes
NBSTAT	Those successful at starting a new business have a high level of status and respect.	0=no; 1=yes
NBMEDI	There are many stories in the public media about successful new businesses.	0=no; 1=yes

Source: Elaborate by the authors based on GEM Adult Population Survey.

4. Empirical results

The total early-stage entrepreneurial activity rates for women are highest in factor-driven economies where GDP per capita is low, rates decrease in efficiency-driven economies as GDP per capita increases. This could be attributed to expanding industrialization. Large established firms play an increasingly important role in the economy, providing stable employment for a growing number of people as a viable alternative to self-employment, thus displacing potential entrepreneurial activity (Kelley et al., 2015).

Table 2 presents the distribution of the female employees and early-stage entrepreneurs by age, household income and educational attainment in Romania in the analysed 2011-2012 time period.

Table 2. *The distribution of the female employees and early-stage entrepreneurs by age, household income and educational attainment, 2011-2012 (%)*

		Employee	Early-stage entrepreneur
Age category	18-24 years	17.39	12.02
	25-34 years	24.38	39.36
	35-44 years	18.77	19.08
	45-54 years	21.91	23.57
	55-64 years	17.55	5.97
Household income	Lower 33%	36.17	13.89
	Middle 33%	37.81	35.25
	Upper 33%	26.02	50.85
Educational attainment	Some secondary	32.07	9.29
	Secondary degree	39.89	34.05
	Post secondary	24.14	37.72
	Graduate experience	3.90	18.94

Note: The significant differences are highlighted with bold.
Source: Own calculations based on GEM Romania, APS, 2011-2012.

We can observe that there is a significant difference between the percentage of female employees and entrepreneurs aged between 25-34 years, respectively 55-64 years. The female early-stage entrepreneurs are more prevalent in 25-34 age category, and less prevalent in 55-64 age category. This result is in accordance with the findings of Levesque and Minniti (2006), Block and Sandner (2009), Verheul et al. (2009). The female employees are almost equally distributed among age categories. The household income of female early-stage entrepreneurs is significantly higher than of female employees. More than a half of the early-stage entrepreneurs have at least post secondary degree, while this proportion in case of female employees is only around a quarter.

Table 3 presents the perceptions and attitudes of female employees and female early-stage entrepreneurs toward entrepreneurial environment. The entrepreneurial network of the early-stage entrepreneurs is significantly bigger than of the employees, 61.07% of early-stage entrepreneurs affirm that knows someone who started a business in the last

two years before the survey. Half of the early-stage entrepreneurs consider that there are good opportunities for starting a business in the area they live. The opportunity recognition of female early-stage entrepreneurs is significantly higher than of female employees. Almost three quarters of female early-stage entrepreneurs consider that they possess the required skills and knowledge to start a new venture. The self confidence of female employees is significantly lower. Female employees consider the entrepreneurial environment more favorable. There is no significant difference between the risk aversion of female early-stage entrepreneurs and female employees, almost half of them consider that fear of failure prevents them from starting a business.

Table 3. *Perceptions regarding the entrepreneurial environment, 2011-2012 (%)*

	Employee	Early-stage entrepreneur
Knows someone who started a business in the last two years.	20.87	61.07
Sees good opportunity for starting a business in the next six months.	31.57	50.23
Has the required knowledge and skills to start a business.	28.40	74.38
Fear of failure prevents from starting a business.	48.87	48.09
Most people prefer that everyone had a uniform standard of living.	66.23	62.98
Most people consider starting a new business a desirable career choice	71.38	61.16
Those successful at starting a new business have a high level of status and respect.	75.56	60.15
There are many stories in the public media about successful new businesses.	58.29	49.13

Note: The significant differences are highlighted with bold.
Source: Own calculations based on GEM Romania, APS, 2011-2012

Table 4 shows the result from the logit model. The probability of becoming an early-stage entrepreneur is influenced by the educational level, the size of the entrepreneurial network, the opportunity recognition, respectively the self-confidence of individuals.

Table 4. *Logit model of the probability of becoming an early-stage entrepreneur, 2011-2012*

	Coefficient	p-value
GEMEDUC	0.425	0.004
KNOWEN	1.051	0.000
OPPORT	0.550	0.027
SUSKIL	1.513	0.000
Constant	-5.005	0.000
Nagelkerke R^2	0.228	
Correctly classified rate	92.5%	

As it can be seen, a few variables exhibit a strong influence on the probability of becoming an early-stage entrepreneur. Each influencing factor has a positive sign, which means that if the individual has a higher educational attainment, knows persons who started a business in the previous two years of the survey, sees good opportunities for starting a business and consider that he/she possess the required skills and knowledge for

start a new venture, than the individual will become with a higher probability an early-stage entrepreneur.

The estimated regression suggests that the model correctly classify 92.5% of the early-stage entrepreneurs in our sample. Hosmer and Lemeshow test indicate the goodness-of-fit of the model with p-value greater than 0.05. Therefore, the model adequately describes the data.

5. Conclusions

Despite the fact, that the role of female entrepreneurs is increasing, there is a lack in the literature regarding the differences between the female entrepreneurs and female employees. This study fulfills this gap in the case of a country which is relatively neglected in the literature of female entrepreneurship.

Our research show that the typical female early-stage entrepreneur in Romania is aged between 25-34 years, with household income in upper tertile, has high educational attainment and rich entrepreneurial network, recognize the opportunities for starting a business, and considers that he/she possess the required skills and knowledge for starting a business.

In comparison with employees, female early-stage entrepreneurs have higher educational level, have bigger entrepreneurial network, have better opportunity recognition, and are more self-confident regarding the skills and knowledge to start a business. We found no significant differences between the risk aversion of female early-stage entrepreneurs and female employees in Romania.

As further research it should be a great interest the difference between female entrepreneurial employees and other female employees, respectively how can be improved the opportunity recognition of female entrepreneurial employees and female early-stage entrepreneurs?

References

Acs, Z.J., Armington, C. and Zhang, T. (2007). The determinants of new-firm survival across regional economies: The role of human capital stock and knowledge spillover. *Regional Science*. 86(3). pp. 367-391.

Ahl, H. (2006). Why research on women entrepreneurship needs new directions. *Entrepreneurship: Theory and Practice*. 30(5). pp. 595-622.

Ahl, H. and Nelson, T. (2015). How policy positions women entrepreneurs: A comparative analysis of state discourse in Sweden and the United States. *Journal of Business Venturing.* 30 (2). pp. 273-291.

Andersson, P. (2010). Exits from Self-Employment: Is there a native-immigrant difference in Sweden? *International Migration Review.* 44(3). pp. 539-559.

Barreneche García, A. (2014). Analyzing the determinants of entrepreneurship in European cities. *Small Business Economics*, 42(1). pp. 77-98.

Block, J. and Sandner, P. (2009). Necessity and opportunity entrepreneurs and their duration in self-employment: evidence from German micro data. *Journal of Industry, Competition and Trade*. 9(2). pp. 117-137.

Boden, R.J. and Nucci, A.R. (2000). On the survival prospects of men's and women's new business ventures. *Journal of Business Venturing*. 15(4). pp. 347-362.

Brush, C.G. (1992). Research on women business owners: Past trends, a new perspective and future directions. *Entrepreneurship Theory and Practice.* 16(4). pp. 5-30.

Brush, C.G., Carter, N.M., Gatewood, E.J., Greene, P.G. and Hart, M.M. (Eds.) (2006). *Growth-oriented Women Entrepreneurs and Their Businesses: A Global Research Perspective*. Edward Elgar. Cheltenham, UK.

Brush, C.G., de Bruin, A., Gatewood, E.J. and Henry, C. (Eds.) (2010). *Women Entrepreneurs and the Global Environment for Growth: A Research Perspective.* Edward Elgar. Cheltenham, UK.

Burke, A.E., FitzRoy, F.R. and Nolan, M.A. (2002). Self-employment wealth and job creation: The roles of gender, nonpecuniary motivation and entrepreneurial ability. *Small Business Economics.* 19(3). pp. 255-270.

Castaño, M.-S., Méndez, M.T. and Galindo, M.-Á. (2015). The effect of social, cultural, and economic factors on entrepreneurship. *Journal of Business Research.* 68 (7). pp. 1496-1500.

De Vita, L., Mari, M. and Poggesi, S. (2014). Women entrepreneurs in and from developing countries: Evidences from the literature. *European Management Journal*. 32(3). pp. 451-460.

Dencker, J.C., Gruber, M. and Shah, S.K. 2009. Pre-entry knowledge, learning, and the survival of new firms. *Organization Science.* 20(3). pp. 516-537.

Dimov, D. (2007). Beyond the single-person, single-insight attribution in understanding entrepreneurial opportunities. *Entrepreneurship Theory and Practice.* 31(5). pp. 713-731.

Elert, N., Andersson, F.W. and Wennberg, K. (2015). The impact of entrepreneurship education in high school onlong-term entrepreneurial performance. *Journal of Economic Behavior & Organization*. 111 (1). pp. 209-223.

Euwals, R. 2001. Female labour supply, flexibility of working hours, and job mobility. *Economic Journal*. 111(471). pp. C120-C134.

Georgellis, Y. and Wall, H. (2005). Gender differences in self-employment. *International Review of Applied Economics.*19 (3). pp. 321-342.

Georgellis, Y., Sessions, J.G. and Tsitsianis, N. (2007). Pecuniary and non-pecuniary aspects of self-employment survival. *Quarterly Review of Economics and Finance.* 47(1). pp. 94-112.

Gielnik, M.M., Frese, M., Graf, J.M. and Kampschulte, A. (2012). Creativity in the opportunity identification process and the moderating effect of diversity of information. *Journal of Business Venturing*. 27(5). pp. 559-576.

Haapanen, M. and Tervo, H. (2009). Self-employment duration in urban and rural locations. *Applied Economics*. 41(9). pp. 2449-2461.

Jayawarna, D., Jones, O. and Marlow, S. (2015). The influence of gender upon social networks and bootstrapping behaviours. *Scandinavian Journal of Management.* 31 (3). pp. 316-329.

Kelley, D., Brush, C., Greene, P., Herrington, M., Ali, A. and Kew, P. (2015). Women's Entrepreneurship 2015.

Kirkwood, J. and Tootell, B. (2008). Is entrepreneurship the answer to achieving work–family balance?. *Journal of Management & Organization*. 14 (3). pp. 285-302.

Klyver, K., Nielsen, S. and Evald, M. (2013). Women's self-employment: An act of institutional (Dis) integration? A multilevel cross county study. *Journal of Business Venturing.* 28(4). pp. 474-488.

Langowitz, N. and Minniti, M. (2007). The entrepreneurial propensity of women. *Entrepreneurship Theory and Practice*. 31(3). pp. 341-364.

Lévesque, M. and Minniti, M. (2006). The effect of aging on entrepreneurial behavior. *Journal of Business Venturing*. 21(2). pp. 177-194.

Longstreth, M., Stafford, K. and Mauldin, T. (1987). Selfemployed women and their families: Time use and socioeconomic characteristics. *Journal of Small Business Management*. 25(3). pp. 30-37.

Marlow, S. and Swail, J. (2014). Gender, risk and finance: why can't a woman be more like a man?. *Entrepreneurship & Regional Development: An International Journal*. 26(1-2). pp. 80-96.

Martin, B.C., McNally, J.J. and Kay, M.J. (2013). Examining the formation of human capital in entrepreneurship: a meta-analysis of entrepreneurship education outcomes. *Journal of Business Venturing.* 28(2). pp. 211-224.

Morris, M.H., Miyasaki, N.N., Watters, C.E. and Coombes, S.M. (2006). The dilemma of growth: understanding venture size choices of women entrepreneurs. *Journal of Small Business Management*. 44 (2). pp. 221-244.

Millán, J. M., Congregado, E. and Román, C. (2014). Persistence in entrepreneurship and its implicationsfor the European entrepreneurial promotion policy. *Journal of Policy Modeling.* 36(1). pp. 83-106.

Morgan, J. and Sisak, D. (2016). Aspiring to succeed: A model of entrepreneurship and fear of failure. *Journal of Business Venturing.* 31(1). pp. 1-21.

Özcan, B. 2011. Only the lonely? The influence of the spouse on the transition to self-employment. *Small Business Economics*. 37(4). pp. 465-492.

Powell, G. and Eddleston, K.A. (2013). Linking family-to-business enrichment and support to entrepreneurial success: Do female and male entrepreneurs experience different outcomes?. *Journal of Business Venturing.* 28 (2). pp. 261-280.

Shelton, L.M. (2006). Female entrepreneurs, work–family conflict and venture performance: new insights into the work–family interface. *Journal of Small Business Management.* 44 (2). pp. 285-297.

Taylor, M.P. 2004. Self-employment in Britain: When, who and why?. *Swedish Economic Policy Review*. 11(2). pp. 139-173.

Toft-Kehler, R., Wennberg, K. and Kim, P.H. (2014). Practice makes perfect: entrepreneurial-experience curves and venture performance. *Journal of Business Venturing*. 29(4). pp. 453-470.

Van der Sluis, J., Van Praag, M. and Vijverberg, W. (2005). Entrepreneurship selection and performance: A meta-analysis of the impact of education in developing economies. *World Bank Economic Review.* 19. pp. 225-261.

Van Praag, C.M., Van Witteloostuijn, A. and Van der Sluis, J. (2013). The higher returns to formal education for entrepreneurs versus employees. *Small Business Economics.* 40(2). pp. 375-396.

Verheul, I., Carree, M. and Thurik, R. (2009). Allocation and productivity of time in new ventures of female and male entrepreneurs. *Small Business Economics*. 33(3). pp. 273-291.

Wasdani, K.P. and Mathew, M. (2014). Potential for opportunity recognition along the stages of entrepreneurship. *Journal of Global Entrepreneurship Research.* 2(7). pp. 1-24.

Wee, L. and Brooks, A. (2012). Negotiating gendered subjectivity in the enterprise culture: Metaphor and entrepreneurial discourses. *Gender, Work and Organisation.* 19(6). pp. 573-591.

Wood, W. and Eagly, A.H. (2010). Gender, In: Fiske, S.T., Gilbert, D.T., Lindzey, G. (Eds.), 5th edition, *Handbook of Social Psychology.* Vol. 1. Oxford University Press. New York. pp. 629-667.

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 15-40

Analysis of the causal link between wages and prices in UK

Adriatik HOXHA
University of Prishtina
adriatik.hoxha@gmail.com

Abstract. *As a matter of fact, the consensus of empirical evidence on the wage-price causal relationship reveals that there are two opposing groups of economists supporting conflicting hypotheses with respect to the flow of causality. Equally importantly, the literature review suggests that there is at least some consensus in the fact that inferences of researchers depend on the sample length, type of data employed, applied econometric model, or at the same time the relationship may be subject to the dynamics of economic cycles. In the light of these arguments, this paper conducts an empirical investigation of the wage-price causal relationship in UK by utilizing VAR and VECM models. Prior to designing and estimating econometric models the relevant stationarity tests for the wage, price and productivity variables have been performed. In summary, all three time series data are non-stationary and thus need to be differenced once in order to render them stationary. Correspondingly, the relevant cointegration tests have been performed and they provide robust evidence in support of a strong cointegration relationship between wages and prices. Additionally, respective restrictions on the parameters of estimated models have also been applied in order to derive the most parsimonious model. Regardless of the fact that VAR models tentatively indicate unilateral causality running from prices to wages, the VECM analysis only suggests a strong cointegration relationship and negates short-run causality in any direction. Accordingly, the estimated models have been subjected to diagnostic testing procedures, and these tests firmly indicate that estimated results are statistically robust. At the same time the restricted VECM model provides estimate on the basis of which it can be argued that the assumption of rational expectations in the wage-price relationship is perfectly valid.*

Keywords: Granger Causality, Cointegration, VAR, VECM.

JEL Classification: C39, E31, J30.

1. Introduction

Obviously, the modern analysis of philosophical discussion of causality began in the 18th century with Hume (1739). He made the scientific hunt for causes possible, by freeing the concept of causality from the metaphysical chains that his predecessors had used to pin it down. Furthermore, Haavlemo (1994) has also contributed in advancing the causality analysis by emphasizing that economic theory must be always formulated in stochastic terms. Over time, the applicability of causality concept has been ever increasingly used in social sciences as well as in the field of economics. As a perfect illustration of this is Granger (1969) paper "*Investigating Causal Relations by Econometric Models and Cross Spectral Methods*". In the same fashion, the issue of causal relationship between wages and prices has been intensively discussed in the literature. Nevertheless, despite enormous empirical efforts that have been invested in resolving the issue on who the cause is and who the effect is, the consensus is still far from being reached. In fact, there are two groups of economists. The first group argues in favor of hypothesis that causality runs from wages to prices, while the second one argues that causality runs from prices to wages. In summary, the evidence from literature is still conflicting and there is empirical evidence in support of both hypotheses.

The aim of this paper is to analyze empirically the pattern of causality in United Kingdom (UK). The paper is organized as follows: s*ection 2* reviews the literature on causality, *first*, literature on causality from the theoretical perspective, and *second*, focuses on empirical studies that have specifically examined causality between wages and prices; *section 3* explains the methodology that has been utilized in examining the causal relationship; s*ection 4* describes the variables and data that have been employed in this study, as well as the results of stationarity tests; *section 5*, presents Vector Autoregressive (VAR) model analysis and respective robustness checks; *section 6*, presents *Vector Error Correction Model (VECM)* analysis as well as diagnostic tests; finally, *Section 7* concludes by summarizing the main findings.

2. Review of the causal relationship

The purpose of this review is to present some theoretical definitions, characteristics and arguments on causality, in general, and on the wage-price causal relationship, in particular. In the first place, causality is a relevant concept both in natural and social sciences. As it has already been emphasized, the modern analysis of philosophical discussion of causality began in the 18th century with Hume (1739). In his view, causality is a regular succession of event-types: one thing invariably following another. His definition of causality runs as follows: "*We may define a CAUSE to be 'an object precedent and contiguous to another, and where all the objects resembling the former are placed in like relations of precedence and contiguity to those objects, that resemble the latter*". In fact, it was the 20th century and especially its last decades that saw its gained prominence in economics. Certainly, one of the most prominent modern studies on causality analysis in economics was conducted by Granger (1969) in the seminal paper "*Investigating Causal Relations by Econometric Models and Cross Spectral Methods*".

An important follow-up analysis of causality was carried out by Ashley et al. 1980, who had analyzed causality between advertising and aggregate consumption. They provide the following definition of causality: *"Let Ω_n represent all the information available in the universe at time n. Suppose that at time n optimum forecasts are made of X_{n+1} using all the information in Ω_n and also using all of this information apart from the present values of Y_{n-j}, $j \geq 0$ of the series Y_t. If the first forecast, using all the information, is superior to the second, than the series Y_t has some special information about X_t not available elsewhere, and Y_t is said to cause X_t"*.

Importantly, is is very well understood in economics is that existence of a statistical relationship between two variables does not prove causality or direction of influence. Furthermore, in context of time series data, it may be possible to exploit the fact that time does not run backwards (so called "*time arrow*"). This relies on assertion that future cannot cause the past, and it is an *a priori* and fundamental feature of the way in which one orders its experience and not either an observed regularity or an analytic truth, (Gilbert, 2004). Table 2.1 provides a short summary of some studies that have examined in depth the causality issue in economics. Certainly, these studies can relatively encompass the significant developments in recent years.

Table 2.1. *A summary of some studies on causality presented in chronological order*

Studies	Title	Context/Method
Ashley, Granger and Schmalensee (1980)	Advertising and Aggregate Consumption	Granger causality; Box-Jenkins technique
Sims (1999)	Granger Causality	Definitions; causality and exogeneity.
Jung and Seldon (1995)	The Macroeconomic relation between Advertising and consumption	Granger causality, Error Correction Model;
Gilbert (2004)	Economic Causality	Economic causation, intervention and exogeneity; VAR modeling practice;
LeRoy (2004)	Causality in Economics	Formal analysis of causal relations; graphical analysis; definitions on causality.
Andersson (2005)	Testing for Granger Causality in the presence of measurement errors	Problems of Granger-tests; consequences on forecastability.

Empirical facts on the wage, price and productivity relationship – Undoubtedly, the issue of causality between wages and prices is one of the central questions in macroeconomics. The purpose of this review is to identify the key ideas or facts explaining the causal relationship between wages and prices. Certainly, it is sensible to assess what has been addressed so far on the relevant questions and problems related to the analysis of the relationship between wages and prices. There have been a number of studies that have analyzed the wage-price relationship, and in fact most of those studies have employed US data. Table 2.2 presents a summary of relevant studies on this relationship. The available studies focusing on the wage-price causality have used various methodologies and can be broadly divided into two groups. The *first group* of studies focuses on estimation of the wage and price causal effects by using data from various economic sectors, whereas the *second group* estimates the effect of wages on inflation by using aggregate (national) level data. Alternatively, with regard to the direction of effect the empirical studies can be divided into two groups. The *first group* of studies provides

evidence in favor of hypothesis that causality runs from wages to prices, whereas the *second* group suggests that causality runs from prices to wages.

Table 2.2. *A summary of some studies on the wage, price and productivity relationship presented in chronological order*

Studies	Title	Context/Method
Moschos (1983)	Aggregate Price Responses to Wages and Productivity Changes: Evidence from U.S.	Error Correction Model (ECM); Instrumental Variable (IV);
Emery and Chang (1996)	Do Wages Help Predict Inflation?	Granger causality ECM (Error Correction Model)
Palley (1999)	The U.S. Inflation Process: Does Nominal Wage Inflation cause Price Inflation, Vice-versa, or neither	Granger Causality;
Hess and Schweitzer (2000)	Does Wage Inflation Cause Price Inflation	Granger causality; ECM (Error Correction Model)
Garcia and Restrepo (2001)	Price and Wage inflation in Chile	ECM (Error Correction Model)
Jonsson and Palmqvist (2004)	Do higher wages Cause Inflation?	Two Sector Dynamic General Equilibrium (DGE) Model
Strauss and Wohar (2004)	The linkage between, prices wages and productivity: a panel study of manufacturing industries	Granger Causality; Panel Model;
Lemos (2004)	The Effect of Minimum Wage on Prices	Review of empirical research
Pu, Flaschel and Chihying (2006)	A Causal Analysis of the Wage-Price Spiral	Granger causality VAR (Vector Autoregressive) Model
Goretti (2008)	Wage-Price setting in New EU Member States	ECM (Error Correction Model); and Panel Model;

A common feature of most of these studies is that many researchers have utilized the Granger-causality concept. Regarding econometric models applied in examining the long-run relationship between wages and prices, the review of literature suggests that it is the *Error Correction Models (ECM)* that dominates over alternative econometric methods. While it is commonly acknowledged in the literature that wages and prices move strongly together, Hess and Schweitzer (2000) argue that there is a sharp division amongst economists on whether wages cause prices or vice-versa. In order to explain such a causal relation, economists very often use the "Granger-causality" by examining whether the lagged values of one series (say wages) have a significant in-sample explanatory power for another variable (say prices). Additionally, both variables may Granger-cause one another, in which case one can conclude only that both economic series are determined simultaneously. If this is the case, the researcher may be unable to infer that one series has independent causal effect on the other. Frequently, the issue becomes more complex if variables in question are cointegrated, which is the case when the levels of the series move together over the long-run, even though the individual series are best modeled in growth terms. In that case, the researcher must be careful to include the error correction terms in Granger-causality tests so as to allow the series to catch up with one another. The significance of the ECM terms in Granger-causality tests simply reflects the fact that the series in question are driven to return to a long-run equilibrium relationship that it is non-causal. In addition to this, the researchers conclusions on the causal relationship often depend on the sample length, the number of explanatory variables used (including

the number of lags of each variable) and in particular the measure of prices used, (Hess and Schweitzer, 2000).

Correspondingly, Emery and Chang (1996) empirically highlight the fact that significance of Granger causal relationship also depends on the choice of price series, and it is relevant to any researcher to avoid data mining whilst designing econometric models. In addition to this, Lemos (2004) argues that a fundamental reason why there has been a lack of evidence in favor of hypothesis that wages cause prices may be the fact that international literature has mainly utilized the data from US where the price effects are small. The selection of different variables may also play a significant role on the strength of results as well. For example, money supply indicators are often found to contain essential information for forecasting the future behavior of prices, and that needs to be considered as it may ultimately improve the robustness of model. Above all, when analyzing the causal relation between wages and prices, it is relevant to control for labor productivity, i.e. supply effects. Finally, it is important to emphasize Palley (1999) argument that causal relationship also varies through business cycles, i.e. causality order between prices and wages may alter over time. With all these facts in mind, next the focus shifts on methodological issues.

3. Methodology

Generally speaking, the biggest challenge in empirical research is to design a model which truly represents a certain data generating process (DGP) or economic phenomena. Potential presence of cointegration relationship between two or more variables not only makes harder, but certainly it makes more complex and challenging the process of model building. Regardless of the fact that various econometric models often produce highly significant parameters, it is the regression diagnostics, in particular the presence of autocorrelation, non-normality or ARCH that consequently cast serious doubts on the statistical and/or theoretical robustness of certain econometric models. For this reason, it is this limitation of remedying these post regression issues that necessitates application of more sophisticated models that are able to analyze more adequately complex relationships, such as that between prices and wages. Certainly, the VAR and VECM models are frequently applied in examining models with more than one endogenous variable. With this in mind, the aim of this study is to examine whether the causal relationship between wages and prices in the UK holds, in what directions it flows, is it statistically robust in fact, and is it in compliance with prior theoretical expectations.

Mathematical relationship of prices, wages and productivity – can be expressed in various functional forms. *First*, wage can be expressed as a function of price and marginal productivity of labor, i.e. W = P * MPL or W = f (P, MPL), where, W-wages, P-prices, and MPL - productivity. *Second*, price can be expressed as a function of wage and productivity, i.e. P = W / MPL or P = f (W, MPL). *Thirdly*, real wage (wages/prices) can be expressed as a function of productivity, i.e. W / P = MPL or W / P = f (MPL). In addition to this, one may transform these equations into natural logarithms, thus obtaining the following forms: *first*, (ln W = ln P + ln MPL), i.e. wage equation indicates that

wages are positively related to prices as well as marginal productivity of labor; *second*, (ln P = ln W – ln MPL), i.e. price equation indicates that prices are positively related to wages and negatively related to productivity, and *third* (ln(W/P) = ln MPL), i,e, real wages are positively related to productivity.

In this study wages and prices will be treated as endogenous variables due to the fact that when they enter the model their values are determined from within the model or the system of equations. In fact, there are numerous studies that have explicitly studied price wage causal relationship, (see for example Moschos, 1983; Emery and Chang, 1996; Palley, 1999; Hess and Schweitzer, 2000; DeGrauwe, 2003; Strauss and Wohar, 2004). Other variables may also be considered and included in the model. Nevertheless, increasing the number of variables and equations does not necessarily lead to a better model as by doing so it becomes harder to capture the dynamic and inter-temporal relations between relevant variables due to the loss of power. As a matter of fact, in some forecast comparisons univariate time series models were found to outperform large scale econometric models. Specifically, Lütkhepohl and Krätzig (2004) suggest that a possible reason for the failure of larger models is their insufficient representation of the dynamic interactions in a system of variables.

In contrast to wages and prices, productivity will be set as an exogenous variable as its value is determined outside the model. In the first place, it is well known from the Solow (1959) model that output depends on the level of technology, capital and labor. In addition to these factors one may also add human capital and land as additional factors of production, which subsequently also have significant impact on productivity. Furthermore, there are a number of studies that have comprehensively examined the productivity and its dynamics over time. Additionally, Smolny (2000) provides an empirical review on the sources of productivity growth by employing German sectoral data, with particular emphasis on allowing for inter-industry spillovers and scale economies at the aggregate level, as well as for scale economies associated with human capital at the sectoral level. Additionally he argues that business cycle affects observed productivity changes in the short-run and in the long run. Furthermore, Stiroh (2001) analyzes productivity growth by examining the key distinctions between the neoclassical and new growth theories. In his analysis of the neoclassical view, the exogenous technical progress drives long-run productivity growth as capital suffers from diminishing returns. In contrast, the new growth models yield long-run growth endogenously, either by avoiding diminishing returns to capital or by explaining technical progress internally. On the other side, Doraszelski and Jaumandreu (2013) examine relation between R&D and productivity, and their study provides account of endogenous productivity growth. Thus, on the basis of these facts, there is little doubt that productivity is determined outside the model.

Applied econometric models –this study will utilize two models, *first*, it will present VAR analysis, and s*econd*, VECM analysis. Prior to estimating these models it will also examine the respective model selection criteria for determining the lag order and/or lagged differences, and in the case of VECM also test for the rank of cointegration.

Nonetheless, taking into account space limitations only the relevant results will be presented in very concise way.

4. Data

Having already examined and determined mathematical equations as well as selected econometric models that will be applied in this study, the focus now shifts on explanation of data that will represent respective variables as well as conduct the analysis of their stationary properties. Specifically, this study will employ quarterly data covering period 1996:Q1-2007:Q4. *First*, Wage (W) variable represents *Labor Cost Index (LCI)* quarterly data, i.e. wages and salaries in industry and services (excluding public administration), nominal value, seasonally adjusted and adjusted data by working days. *Second*, Price (P) variable represents *Harmonized Index of Consumer Prices (HICP),* quarterly data. *Third*, Productivity (Q) variable is represented by the quarterly index representing *person based labor productivity* for total economy at constant prices (fixed composition), seasonally adjusted, not working day adjusted, total, ECU/euro, index. Hereinafter, wage, price and productivity variables are denoted as WUK, PUK and QUK, respectively. The source of data for all three variables is EUROSTAT. Detailed description of all variables has been presented in Table A4.1 in appendix.

For the purpose of conducting adequate and meaningful regression analysis it is necessary to employ graphical and formal stationarity (unit root) tests for the respective time series data. In Figure A4.1 in appendix the plots of log-levels and first difference of log-levels have been presented. Obviously, the visual analyses of plots of levels clearly indicate that time series data may not be stationary, i.e. time series data are integrated of order 1 or I(1), and that deterministic trend may be present in the levels of the respective data. In contrast, the first difference of log-levels of data clearly indicate stationarity, i.e. time series data are integrated of order zero or I(0). There are several formal unit root tests available such as Augmented Dickey-Fuller (ADF), Schmidt-Phillips, Phillips-Perron test for processes with level shift or Kwiatkowski, Phillips, Schmidt and Shin (KPSS) tests, (Lütkepohl and Krätzig, 2004). Taking into account the fact that plots of the time series data under consideration indicate no major disturbances for the sample period, formal unit root analysis will rely on ADF test procedure. In simple form the Augmented Dickey-Fuller (ADF) unit root test can be expressed as,

$$\Delta y_t = \phi y_{t-1} + \Sigma^{p-1}_{j-1}\, \alpha^*_j\, \Delta_{yt-j} + \mu_0 + u_t \qquad (4.1)$$

where $\varphi = -\alpha(1)$ and $\alpha^*_j = -(\alpha_{j+1} + \cdots + \alpha_p)$. In this model we wish to test the pair of hypotheses H_0: $\varphi = 0$ versus H_1 :$\varphi < 0$. The ADF test statistic is based on the t-statistic of the coefficient φ from an OLS estimation of above written equation, (Fuller, 1976; Dickey and Fuller, 1979. It does not have an asymptotic standard normal distribution, but it has a nonstandard limiting distribution. Critical values have been obtained by simulation, and they are available, for instance, in Fuller (1976) and Davidson and MacKinnon (1993). It turns out, however, that the limiting distribution depends on the deterministic terms that have to be included. Therefore, different critical values are used when a constant or linear trend term is added in. On the other hand, including seasonal

dummies in addition to constant or linear trend does not result in further changes in the limiting distribution, (see Note 1 of Table 4.1). In these tests a decision on the AR order or, equivalently, on the number of lagged differences of y_t has to be made. This choice may be based on the model selection criteria *(*AIC – Akaike Information Criterion; FPE – Final Prediction Error; HQC – Hannan-Quinn Criterion; and SC – Schwarz Criterion; Lütkhepohl and Krätzig, 2004), or a sequential testing procedure may be used that eliminates insignificant coefficients sequentially starting from some high-order model (Ng and Perron (1995). In addition to this, the suggested numbers of lagged differences by respective model selection criteria have been estimated and are presented in Table A4.2 in appendix.

Table 4.1. *Augmented Dickey-Fuller (ADF) test with one and zero lagged differences*

Variable	**μ_0**		**$\mu_0 + \mu_1$**		**μ_0 + sd**		**$\mu_0 + \mu_1$ + sd**	
lag diff	1	0	1	0	1	0	1	0
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LWUK	-0.43	-0.47	-2.92	**5.60	-0.41	-0.47	-2.75	**-5.38
LPUK	2.03	0.47	0.38	-1.73	2.29	1.84	0.67	0.38
LQUK	-1.28	-1.23	-1.49	-2.10	-1.22	-1.15	-1.46	-2.00
DLWUK	**-7.99	**-13.7	**-7.92	**-13.5	**-7.69	**-13.4	**-7.62	**-13.2
DLPUK	**-4.74	**-14.7	**-5.22	**-15.3	**-3.46	**-6.42	**-4.01	**-7.03
DLQUK	**-6.55	**-8.90	**-6.72	**-8.95	**-6.35	**-8.40	**-6.50	**-8.44

Note 1: μ_0 – constant; **μ_1** – trend; and **sd** – seasonal dummies. Critical values for columns (2), (3), (6) and (7): ** - significant at 1% = -3.43; * - significant at 5% = -2.86; Critical values for columns (4), (5), (8) and (9): ** - significant at 1% = -3.96; * - significant at 5% = -3.41.

Note 2: *column (2) and (3)* $\mu_0 \neq 0$: $\Delta y_t = \phi y_{t-1} + \Sigma^{p-1}_{j-1} \alpha^*_j \Delta y_{t-j} + \mu_0 + u_t$; *column (4) and (5)* $\mu_0 \neq 0$, $\mu_1 \neq 0$: $\Delta y_t = \phi y_{t-1} + \Sigma^{p-1}_{j-1} \alpha^*_j \Delta y_{t-j} + \mu_0 + \mu_1 t + u_t$; *column (6) and (7)* $\mu_0 \neq 0$, sd $\neq 0$: $\Delta y_t = \phi y_{t-1} + \Sigma^{p-1}_{j-1} \alpha^*_j \Delta y_{t-j} + \mu_0 + \pi_j s_i + u_t$; *column (8) and (9)* $\mu_0 \neq 0$, $\mu_1 \neq 0$, sd $\neq 0$: $\Delta y_t = \phi y_{t-1} + \Sigma^{p-1}_{j-1} \alpha^*_j \Delta y_{t-j} + \mu_0 + \mu_1 t + \pi_j s_i + u_t$.

Additionally, the Augmented Dickey Fuller (ADF) test procedure has been performed for log-levels and first differences of log-levels while using 1) constant, 2) constant and trend, 3) constant and seasonal dummies, and 4) constant, trend and seasonal dummies. Respective tests have been performed using one and zero lagged differences, (see Note 2 of Table 4.1). In the same way as plots, formal tests suggest that all three time series data need to be differenced once in order to render them into stationary time series. Specifically, the test value of 2.03 for LPUK in column (2) of Table 4.1 indicates that H_0 that there is unit root cannot be rejected at any level of significance. On the other side, the test value of -4.74 for DLPUK in column (2) of Table 4.1 indicates that H_0 that there is unit root can be rejected at 1 percent level of significance (l.s.). For LWUK in the test with zero lags the unit root hypothesis can be rejected when constant and trend (column 5), as well as when constant, trend and seasonal dummies (column 9) are fitted. Nonetheless, on the basis of overall evidence provided by the ADF test procedure it can be clearly argued that unlike log-levels the first differences of variables are stationary at 1 percent l.s.

5. VAR Estimation

In order to empirically investigate the pattern of causality between wages and prices in UK it is necessary to perform thorough econometric analysis. In addition to this, it is also

required to subject all the models to a sequence of specification criteria and diagnostic tests in order to design statistically and theoretically robust models. This section presents the analysis of two VAR models, *first*, using log-levels (VAR^L) and *second*, using first differences of log-levels of variables (VAR^D). Even though, it is possible to estimate and present results of the unrestricted VAR models, as it will be done in the case of VECM model, considering space limitations and the fact that little information is lost by omitting them from analysis, only the parsimonious VAR models will be presented next. Quarterly seasonal dummies (S1, S2, and S3) and trend (t) have been fitted in both models. Concerning determination of optimal number of lags, searched up to 10 lags of levels, all four model selection criteria AIC, FPE, HQC and SC suggest fitting one lag for VAR^L and zero lags for VAR^D, (see Table 5.1). However, for the purpose of avoiding potential under-fitting of the VAR^D model one lag has been fitted. It is worth mentioning that while AIC frequently overestimates the number of lags, the SC provides the most consistent estimates. Furthermore, the Sequential Elimination of Regressors (SER) procedure employing SC has been utilized in both models in order to eliminate those regressors that lead to the largest reduction of information criteria, (Lütkepohl and Krätzig, 2004; Lütkepohl et al. 2006).

Table 5.1. *Determination of optimal number of lags for VAR models*

Model	AIC	FPE	HQC	SC
(1)	(2)	(3)	(4)	(5)
VAR^L	1	1	1	1
VAR^D	8	0	0	0

VAR^L - Considering that data sample includes observations from 1996:Q1 to 2007:Q4, i.e. T = 48, and by taking into account that one lag for endogenous and exogenous variables has been fitted in the model, then the total number of observations is T = 47. Complete results of this model have been presented in column (2) of Table 5.2. For example, the coefficient measuring impact of $LPUK_{t-1}$ on LWUK is interpreted as follows: if prices in the previous period increase by 1 percent, on average and ceteris paribus, the wages will increase by 0.41 percent. Additionally, three stars indicate that coefficient is significant at 1 percent l.s. The estimated productivity coefficient indicates statistically significant and positive effect on wages, specifically impact of $LQUK_{t-1}$ on LWUK is 0.56 and it is significant at 1 percent l.s., which effect is also in compliance with prior theoretical expectations. In contrast, $LQUK_{t-1}$ has no statistical impact on LPUK. From the coefficients of deterministic terms, those of seasonal dummies for LWUK are statistically insignificant, whereas trend coefficient is significant at 1 percent l.s. In contrary, coefficients of seasonal dummies for LPUK are significant at 1 percent, whereas trend coefficient is at 10 percent l.s. Thus, the evidence provided by VAR^L model suggests that there is unilateral causal relationship running from prices to wages, and not vice versa.

Table 5.2. *Estimated coefficients of the VAR models*

	VAR^{L}			**VAR^{D}**		**VAR^{VECM}**	
	LWUK	LPUK		DLWUK	DLPUK	DLWUK	DLPUK
(1)	(2)		(3)	(4)		(5)	
$LWUK_{t-1}$	-	-	$DLWUK_{t-1}$	***-0.56	-	0.26	-0.04
				[-4.75]		[0.00]	[0.00]
$LPUK_{t-1}$	***0.41	***1.00	$DLPUK_{t-1}$	**0.87	-	0.19	1.04
	[4.76]	[5192.7]		[2.12]		[0.00]	[0.00]
$LWUK_{t-2}$	n/a	n/a	$DLWUK_{t-2}$	n/a	n/a	0.55	0.00
						[0.00]	[0.00]
$LPUK_{t-2}$	n/a	n/a	$DLPUK_{t-2}$	n/a	n/a	0.000	0.00
						[0.00]	[0.00]
LQUK	-	-	DLQUK	-	-	-	-
$LQUK_{t-1}$	***0.56	-	$DLQUK_{t-1}$	***0.66	-	n/a	n/a
	[6.56]	-		[3.08]	-		
S_1	-	***-0.01	S_1	-	***-0.00	0.00	-0.01
		[-7.45]			[-4.78]	[0.00]	[0.00]
S_2	-	***0.01	S_2	-	***0.01	0.00	0.00
		[5.20]			[6.94]	[0.00]	[0.00]
S_3	-	***-0.01	S_3	-	***-0.00	0.00	-0.01
		[-5.38]			[-2.68]	[0.00]	[0.00]
Trend (t)	***0.01	*0.00	Trend (t)	**0.00	***0.00	0.00	0.00
	[56.79]	[1.71]		[3.82]	[6.75]	[0.00]	[0.00]

Note 1: *** - significant at 1 %; ** - significant at 5 %; * - significant at 10 %; n/a –respective coefficient has not been estimated in the model. Numbers in brackets represent t ratios.
Note 2: VAR^{VECM} coefficients in column (5) have been derived from the VECM.

VAR^{D} - Now the sample includes only the observations from 1996:Q3 to 2007:Q4, as owing to one lagged difference fitted for both endogenous and exogenous variables in the model, as well as one degree of freedom lost with first difference transformation, then the total number of observations is T = 46. Complete results of this model have been presented in column (4) of Table 5.2. The coefficient which shows impact of prices ($DLPUK_{t-1}$) on wages (DLWUK) is interpreted as follows: if prices in the previous period increased by 1 percent, on average and ceteris paribus, the wages in the present period will increase by 0.87 percent. Additionally, two stars indicate that coefficient is significant at 5 percent l.s. In the same way as VAR^{L}, the estimated productivity coefficient in this model indicates positive and statistically significant effect on wages, specifically impact of $DLQUK_{t-1}$ on DLWUK is 0.66 and it is significant at 1 percent l.s. Once more, as in the previous model the $DLQUK_{t-1}$ has no statistically significant impact on DLPUK. From coefficients of deterministic terms, those of seasonal dummies for DLWUK are statistically not significant, whereas trend coefficient is significant at 1 percent l.s. On the other side, coefficients of seasonal dummies as well as trend coefficient for DLPUK are significant at 1 percent l.s. Hence, the evidence provided by VAR^{D} model suggests that there is unilateral causal relation running from prices to wages, and not vice versa.

Diagnostic tests - full details have been presented in appendix in Figure A5.1 and column (2) of Table A5.1 for *VAR^{L}*, respectively in Figure A5.2 and column (3) of Table A5.1 for *VAR^{D}*. First, the visual inspection of the plots of residuals, standardized residuals,

correlation, autocorrelation and cross-correlation of residuals does not raise any concerns regarding the statistical adequacy of both models. Additionally, the formal diagnostic tests only reaffirm the previous assertion, thus on the basis of evidence from diagnostic tests it can be argued that these results are statistically robust. Specifically, Breusch–Godfrey test (Breusch, 1978; Godfrey, 1978) with 5 lags suggests no potential problems with residual autocorrelation, with test statistic being 23.09 and p-value 0.28 for VAR^{L}, and respectively 20.65 and 0.42 for VAR^{D}. Furthermore, all the tests for non-normality (Doornik and Hansen, 1994; Lütkepohl, 1993; Jarque-Bera, 1987), as well as ARCH-LM tests with 16 lags and Multivariate ARCH-LM tests with 5 lags raise no concerns regarding potential statistical issues in these models. Respective test statistics of all the mentioned diagnostic criteria are low and their p-values are sufficiently higher than the critical level of 0.10.

6. VECM Estimation

In case that two or more variables have a common stochastic trend, it may possible that there are linear combinations of them that are I(0). If that is the case then variables are cointegrated. In other words, a set of I(1) variables is called cointegrated if there is a linear combination of them that is I(0). Occasionally it is convenient to consider systems with both I(1) and I(0) variables. Thereby the concept of cointegration is extended by calling any linear combination that is I(0) a cointegration relation, although this terminology is not in the spirit of the original definition because it can happen that a linear combination of I(0) variables is called a cointegration relation. Although sometimes the VAR model may be suitable in accommodating variables with stochastic trends, it is not the most suitable type of model if interest centers on the cointegration relations, because they do not appear explicitly in those models, (Lütkhepohl and Krätzig, 2004). Thus, the VECM model that will be presented subsequently is a more convenient setup for analyzing variables with common stochastic trend. By the same token it may also be a more suitable model setup for analyzing the causal relationship between wages and prices in UK.

Determination of cointegration rank - rk (Π) – Complete results of cointegration tests have been presented in Table 6.1. Specifically, *Johansen Trace Test* and *Saikkonen and Lütkhepohl* test have been carefully utilized in examining the cointegration properties of LWUK and LPUK. Tests have been performed using quarterly seasonal dummy variables. Furthermore, as suggested by information criteria, tests have been performed with two and one lagged differences. In addition to this, the case with a) intercept, b) intercept plus trend, and c) orthogonal trend (the trend that is confined to some individual variables but is absent from the cointegration relations) have been performed for both types of cointegration test. When applying Johansen Test with two lagged differences the null hypothesis (H_0) that rk (Π) = 0, in favor of (H_1) that rk (Π) = 1, is rejected only in the case with intercept, with test statistic of 48.36 being significant at 1 percent l.s. When two lagged differences are used in the case when intercept plus trend and orthogonal trend are used the H_0 that rk(Π) = 0 cannot be rejected at any l.s. However, when the test is

employed with one lagged difference the H_0 can be rejected in both cases when intercept and intercept plus trend are included in the testing procedure, specifically the values of test statistics of 82.18 and 40.61 respectively are significant at 1 percent l.s. In contrast the H_0 that rk(Π) = 0 cannot be rejected at any reasonable l.s. in the case of orthogonal trend.

Similarly the evidence from Saikkonen and Lütkhepohl test indicates that rk (Π) = 1. When two lagged differences are included in the test the H_0 that rk (Π) = 0 is rejected in favor of H_1 that rk (Π) = 1, only in the case when intercept is included with the value of test statistic 20.34 being significant at 1 percent l.s., and in the case when intercept plus trend are included with the value of test statistic 14.12 being significant at 10 percent l.s. Furthermore, when one lagged difference is included H_0 that rk (Π) = 0 is again rejected in the case when only intercept is included with the value of test statistic 57.11 being significant at 1 percent l.s., as well as in the case when intercept plus trend are included with the value of test statistics of 37.65 also being significant at 1 percent l.s. On the other hand, when orthogonal trend is included in the testing procedure of tests with two or one lagged differences, the H_0 that rk (Π) = 0 cannot be rejected in neither case. Finally, on the basis of overall results produced by cointegration tests it can be argued that there is sufficient evidence to proceed subsequent analysis with one cointegration relation included in the VECM model, i.e. rk (Π) = 1.

Table 6.1. *Tests for the rank of cointegration*

Test	**Ld**	**Intercept** ($\mu_0 \neq 0$ $\mu_1 = 0$)		**Intercept + trend** ($\mu_0 \neq 0$ $\mu_1 \neq 0$)		**Orthogonal trend**
	rk (Π)	rk (Π) = 0	rk (Π) = 1	rk (Π) = 0	rk (Π) = 1	rk (Π) = 0
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Johansen	2	***48.36	2.65	19.52	4.50	8.68
		(0.00)	(0.65)	(0.26)	(0.67)	(0.40)
	1	***82.18	3.64	***40.61	3.32	9.35
		(0.00)	(0.48)	(0.00)	(0.83)	(0.34)
Saikkonnen & Lutkhepol	2	***20.34	2.59	*14.12	0.51	3.54
		(0.00)	(0.13)	(0.09)	(0.92)	(0.54)
	1	***57.11	2.29	***37.65	0.47	6.57
		(0.00)	(0.15)	(0.00)	(0.93)	(0.19)

Note 1: H_0: rk (Π) = 0 *vs*. H_1: rk (Π) = 1, and H_1: rk (Π) = 1 *vs*. H_2: rk (Π) = 2.

Note 2: *** - significant at 1 %; ** - significant at 5 %; * - significant at 10 %. Numbers in brackets represent p-values. *ld* – lagged differences.

Note 3: Types of cointegration tests: **a)** $\boldsymbol{\mu_0 \neq 0, \mu_1 = 0}$: Johansen - $\Delta y_t = \Pi(y_{t-1} - \mu_0) + \sum_{j=1}^{p-1} \Gamma_j \Delta y_{t-j} + u_t$; S&L - $\Delta y_t = \Pi^* \begin{bmatrix} y_{t-1} \\ 1 \end{bmatrix} + \sum_{j=1}^{p-1} \Gamma_j \Delta y_{t-j} + u_t$; **b)** $\boldsymbol{\mu_0 \neq 0, \mu_1 = 0}$**:** Johansen - $\Delta y_t - \mu_1 = \Pi(y_{t-1} - \mu_0 - \mu 1(t-1)+j=1p-1\Gamma j\Delta yt-j-\mu 1+ut$; S&L - $\Delta yt=v+\Pi+yt-1t-1+j=1p-1\Gamma j\Delta yt-j+ut$; **c) orthogonal Trend**: Johansen - $\Delta y_t - \mu_1 = \Pi(y_{t-1} - \mu_0) + \sum_{j=1}^{p-1} \Gamma_j \left(\Delta y_{t-j} - \mu_1\right) + u_t$; S&L $\Delta y_t = v_0 + \Pi y_{t-1} + \sum_{j=1}^{p-1} \Gamma_j \Delta y_{t-j} + u_t$, (Lütkhepohl and Krätzig, 2004).

Number of lagged differences (ld) – prior to running the VECM regression it is necessary to determine the number of *ld* by utilizing relevant information criteria. The test results on the suggested number of *ld* have been presented in Table 6.2, and on the basis of obtained evidence it can be argued that the suggested number of *ld* for unrestricted model ($VECM^U$) does not differ from the one suggested for restricted model ($VECM^R$). In

principle, whereas AIC overestimates the number of lagged differences the SC provides the most consistent estimates. In both cases AIC, FPE and HQC suggest 10 lagged differences whereas SC suggests zero lagged differences. Nonetheless, for the purpose of avoiding potential under-fitting of the VECM model one lagged difference has been fitted for exogenous and endogenous variables. This is so, as in some cases despite the fact that information criteria may suggest fitting zero lagged differences one or more coefficients of lagged variables may still indicate that there is a statistically significant effect after the regression has been run. In this model LWUK and LPUK have been set as endogenous variables, whereas LQUK has been set as an exogenous variable. Quarterly seasonal dummies (S1, S2, and S3) and trend (t) have been fitted in the model. Intercept is included only in the $VECM^U$ and it is excluded from the $VECM^R$. As a matter of fact, it is worth mentioning that intercept term is explicitly absent in the mathematical model, hence the $VECM^R$ may also be a practical tool to test the validity of hypothesis on whether the intercept term is present or not in the wage-price relationship.

Table 6.2. *Determination of optimal number of lagged differences for VECM models*

Model	AIC	FPE	HQC	SC
(1)	(2)	(3)	(4)	(5)
$VECM^U$	10	10	10	0
$VECM^R$	10	10	10	0

Interpretation of estimated coefficients β of cointegration matrix - It has to be noted that the first coefficient in the cointegrating relation β_1 has been normalized to 1 by JMulTi software, i.e. $\beta_1 = 1$. With this normalization, one should also verify whether the estimated cointegrating relation β_2 is close to what one would expect on the basis of prior considerations. In general, without normalizing the coefficient associated with the first variable, $LWUK_{t-1}$ in this case, such a result is unlikely because the Reduced Rank (RR) estimation procedure imposes statistical uniqueness constraints on the estimated cointegration parameters, which do not take any prior economic considerations into account. Taking into account the fact that the first coefficient of cointegration vector is normalized, one can then use the asymptotic distribution of the second coefficient to test whether the expected value of the cointegration relation β_2 is as expected.

In general, the *loading coefficients α* are also to some extent arbitrary because they are determined by normalization of cointegrating vectors, however their t-ratios can be interpreted in the usual way as being "conditional on the estimated cointegration coefficients." In other words, they can be used for assessing whether the cointegration relations resulting from our normalization enter a specific equation significantly. Because they are in fact asymptotically normal, using them with critical values from a standard normal distribution can be justified in the usual way. Hence, the systems are evaluated on whether the cointegration relation is an important variable in both equations, (i.e. whether the estimated loading coefficients have absolute t-ratios greater than 2). The estimators of the parameters associated with lagged differences of the variables (short-run parameters) may be interpreted in the usual way. Their t-ratios are asymptotically normal under our assumptions. The same is not necessarily true for the parameters associated with deterministic terms. Their t-ratios are just given for completeness (Lütkhepohl and Krätzig, 2004, 2005).

Table 6.3. *VECM Coefficients with Simple Two Step (S2S) Procedure*

Model	**VECM^U**		**VECM^R**	
(1)	(2)		(3)	
α_1	***-0.75		***-0.19	
	[-3.48]		[-5.32]	
α_2	-0.05		***-0.04	
	[-1.24]		[-5.50]	
β_1	1.00		1.00	
	[0.00]		[0.00]	
β_2	*0.522		***-1.002	
	[1.64]		[-315.92]	
(1)	(2a)	(2a)	(3a)	(3b)
	DLWUK	**DLPUK**	**DLWUK**	**DLPUK**
DLWUK$_{t-1}$	-0.23	-0.01	***-0.55	-
	[-1.46]	[-0.18]	[-5.27]	
DLPUK$_{t-1}$	0.36	-0.23	-	-
	[0.43]	[-1.57]		
LQUK	0.17	*-0.04	-	-
	[1.31]	[-1.67]		
Constant (μ_0)	***4.28	*0.49	n/a	n/a
	[2.97]	[1.94]		
S_1	-0.01	***-0.01	-	***-0.007
	[-0.80]	[-5.04]		[-8.02]
S_2	-0.01	***0.00	-	***0.004
	[-0.97]	[4.35]		[5.36]
S_3	0.00	0.00	-	***-0.005
	[-0.40]	[-1.61]		[-5.83]
Trend (t)	***0.01	*0.00	***0.001	***0.000
	[3.26]	[1.70]	[7.59]	[8.09]

Note 1: *** - significant at 1 %; ** - significant at 5 %; * - significant at 10 %. Numbers in brackets show t ratios.

Even though the sample includes data from 1996:Q1 to 2007:Q4, i.e. T = 48, only T = 46 observations have been used in the VECM models, as one lagged difference has been fitted in the models and also one observation has been lost due to first difference transformation. Full results of estimated VECM models have been presented in Table 6.3, respectively VECM^U in column (2), and VECM^R in column (3), both using the Two Stage (S2S) estimation procedure, i.e. Johansen procedure in the first stage and Feasible Generalized Least Squares (FGLS) procedure in the second stage. However, it is worth emphasizing that Sequential Elimination of Regressors (SER) procedure using SC has been employed in the restricted model in order to eliminate those regressors that lead to the largest reduction of the respective information criteria, (Lütkhepohl and Krätzig, 2004, 2005). Hence, all the coefficients with t ratios lower than two have been eliminated or restricted to zero in the second stage.

VECM^U complete results have been presented in column (2) of Table 6.3. On the basis of estimated loading coefficients from this model it can be argued that cointegration relation resulting from normalization of cointegration vector enters significantly only in the first equation, i.e. wage equation, with estimated coefficient $\alpha_1 = -0.75$ and test statistic of -3.48 being significant at 1 percent l.s. In contrast, it does not enter in statistically

significant way in the second equation with α_1 = -0.05 and test statistic of 1.24 is statistically insignificant. Now by selecting $LWUK_t$ as the first variable in the model means that the coefficient of this variable in the cointegration relation, i.e. β_1, will be normalized to 1 in the maximum likelihood estimation procedure. This normalization is tricky if LWUK is not actually present in the cointegration relation. The value of the second cointegration coefficient β_2 is 0.52, however the low value of the test statistic indicates that there is weak evidence of cointegration relationship between $LWUK_t$ and $LPUK_t$. Consequently, the model can be presented in the simple form as,

$$LWUKt = -\underset{[1.64]}{0.52}\ LPUK_t + ec_t^{FGLS} \qquad (6.1)$$

where numbers in brackets represent *t* ratios. Considering that logs of variables have been used, the relation in (6.1) expresses the elasticity of wages on prices, i.e. the coefficient of 0.52 is estimated wage elasticity. Accordingly, if the log prices increases by 1%, it is expected that the log of wages would decrease by 0.52 percent, which is in contradiction with *a priori* theoretical expectations. In other words, a 1 percent increase in the log prices would induce a 0.52 percent decrease in the log of wages. This coefficient is statistically significant only at 10 percent l.s.

On the other side, none of the coefficients associated with lagged variables are statistically significant at any reasonable l.s. Furthermore, the estimated productivity coefficient LQUK has no statistically significant impact on wages, i.e. LWUK, whereas it indicates a small though negative effect on prices, specifically its impact on LPUK is 0.04 and it is significant at 10 percent l.s. From deterministic terms, coefficients of seasonal dummies for DLWUK are statistically not significant, whereas coefficient of trend is significant at 1 percent l.s. On the other side, the first two coefficients of seasonal dummies for DLPUK are significant at 1 percent and the third is not significant, whereas coefficient of trend is significant at 10 percent l.s. Constant term is statistically significant at 1 percent in the first equation, whereas it is 10 percent in the second equation. Nonetheless, one has to bear in mind that constant term is not present in the mathematical relationship between wages, prices and productivity. Thus, the restricted model will impose zero restriction on the constant as well as all other coefficients with low value of test statistic in order to design a more parsimonious model.

$VECM^R$ full results have been presented in column (3) of Table 6.3. One the basis of estimated loading coefficients from this model it can be argued that cointegration relation resulting from normalization of cointegration vector enters significantly in both equations. The loading coefficient α_1 = -0.19 for the wage equation has a test statistic of -5.32, and the other coefficient α_2 = -0.04 for the price equation has a test statistic of -5.50. Thus unlike $VECM^U$, both loading coefficients in this model are significant at 1 percent l.s. Again by selecting $LWUK_t$ as first variable in the model, it means that the coefficient of this variable in the cointegration relation will be normalized to 1 in the maximum likelihood estimation procedure. The high value of test statistic of the second coefficient, β_2, indicates that there is sufficient evidence of a strong cointegration relationship

between $LWUK_t$ and $LPUK_t$. Consequently, the model can be presented in the simple form as,

$$LWUKt = 1.002\ LPUK_t + ec_t^{FGLS} \qquad (6.2)$$

[-315.92]

where the numbers in brackets represent t ratios. Taking into account that logs of variables have been used, the relation in (6.3) expresses the elasticity of wages on prices, hence the coefficient of 1.00 is the estimated wage elasticity. Accordingly, if the log of prices increases by 1 percent it is expected that the log of wages would increase by 1 percent. In other words, a 1 percent increase in the log of prices would induce a 1 percent increase in the log of wages. Importantly, this coefficient is statistically significant at 1 percent l.s.

When the coefficients associated with lagged variables are analyzed, it results that only the coefficient which estimates impact of $DLWUK_{(t-1)}$ on DLWUK, is statistically significant at 1 percent l.s. In contrast, all other coefficients have been restricted to zero given that their t-ratios had low values, hence through the use of SER procedure have been eliminated in the second stage of VECM estimation when FGLS procedure was used. Furthermore, the estimated productivity coefficient of LQUK indicates no statistically significant impact, neither on LWUK nor on LPUK. From coefficients of deterministic terms, those of seasonal dummies for LWUK are statistically insignificant, whereas trend coefficient is significant at 1 percent l.s. At the same time, all coefficients of seasonal dummies for LPUK as well as trend coefficient are significant at 1 percent l.s. As previously explained, the constant term has been excluded from the model.

Diagnostic tests - full details have been presented in appendix in Figure A6.1 and column (4) of Table A5.1 for $VECM^U$, respectively in Figure A6.2 and column (5) of Table A5.1 for $VECM^R$. In summary, the visual inspection of the plots of residuals, standardized residuals, correlation, autocorrelation and cross-correlation of residuals raises no concerns on the statistical adequacy of either model. Additionally, the formal diagnostic tests only reaffirm the previous assertion, thus on the basis of evidence from diagnostic tests it can be argued that these results are statistically robust. Specifically, Breusch-Godfrey test (see Breusch, 1978; Godfrey, 1978) with 5 lags suggests no potential problems with residual autocorrelation, with test statistic being 16.71 and p-value being 0.67 for $VECM^U$, and respectively 18.93 and 0.53 for $VECM^R$. Furthermore, all the tests for non-normality (Doornik and Hansen, 1994; Lütkepohl, 1993; Jarque-Bera, 1987), as well as ARCH-LM tests with 16 lags and Multivariate ARCH-LM tests with 5 lags raise no concerns regarding potential statistical issues in these models. Respective test statistics are low and their p-values are sufficiently higher than the critical level of 0.10.

Comparing $VECM^U$ and $VECM^R$ - Important information in evaluating the robustness of this model is VECM model statistics, (see Lütkhepohl and Krätzig 2004). The value of LR-test is 3.57 and p-value is 0.89, hence on the basis of this statistic it can be argued that no information is lost if restrictions are imposed on the VECM model by SER procedure, or one may not reject the hypothesis that the restricted model (H_0) is a better representation of DGP than the unrestricted model (H_1). Next the values of cointegration

coefficients of each model are compared with the value that one would expect on the basis of prior theoretical considerations. In a simple theoretical model, the rational expectations approach assumes that people use all relevant information in forming expectations of economic variables. For example changes in the price level as a result of increase in money stock, leave output and employment unchanged. Money and wages will rise, but since the real wage is unchanged, neither the quantity of labor supply nor that demand will change, (see for example Muth, 1961; Sargent and Wallace, 1976). Hence, provided that assumption on rational expectations holds true, it is expected that the wage elasticity is going to have the value of one.

Next, one can use the asymptotic distribution of cointegration coefficients, β_2, of each model to test the hypotheses (H_0) that the values of estimated elasticity coefficients from equations (6.1) and (6.2) are -1, as theoretically expected, or that they are statistically different from -1. Hence, a t test can be conducted as follows:

$$H_0: \beta_2 = -1, \text{ versus } H_A: \beta_2 \neq -1 \qquad (6.3)$$

Specifically, test statistic is calculated using formula $t = (\hat{\beta}_1 + 1) / (se)$. The value of test statistic for $VECM^U$ is $t = (0.522 + 1) / 0.318 = 4.79$, and for $VECM^R$ $t = (-1.002 + 1) / 0.003 = -0.67$, (see Lütkhepohl and Krätzig, 2004). In the case of $VECM^U$ not only the zero hypotheses, H_0, is rejected, but the coefficient β_2 also has incorrect sign and is in contradiction with a priori theoretical assumptions. In contrast, zero hypotheses for the cointegration coefficient β_2 of $VECM^R$ cannot be rejected at any reasonable level of significance. In the light of this, it can be argued that the simple t test indicates that the value of coefficient β_2 is not different from -1, as theoretically expected. Hence, this is an additional argument in support of hypothesis that $VECM^R$ has a better representation of DGP than $VECM^U$. In the end, not only statistically, but most importantly in terms of economic accuracy it better describes the relationship between wages and prices as well.

7. Conclusion

As it has been noted in the process of literature review on the causal relationship between wages and prices there are two opposing opinions with regards to the flow of causality. In addition to this, it is evident that various studies have used different sample ranges, various datasets, and have consequently obtained different conclusions on the nature of relationship. Considering all the facts, it can be argued that it is very difficult to reject the Hess and Schweitzer (2000) hypothesis that respective conclusions on the causal relationship ultimately depend on a number of elements such as sample length, the number of explanatory variables used (including the number of lags of each variable) and in particular the use of specific measure of prices (see also Emery and Chang, 1996). Equally, it is important to emphasize Palley (1999) argument that causal relationship may change with economics cycles.

The evidence provided by both VAR models, log-levels and first differences, suggests that in the case of UK there is unilateral causal relationship running from prices to wages, and not vice versa. Regardless of the fact that diagnostic tests indicate no statistical

issues, the VAR modeling procedure is inadequate in that it is incapable in explicitly estimating cointegrating relationships. Clearly, the cointegration tests, Johansen Trace Test as well as Saikkonen and Lütkepohl test, have suggested that there is sufficient evidence in favor of analyzing the wage and price relationship with one cointegration relation included in the VECM model. The VECM models have been estimated using the S2S procedure, with *Johansen procedure* used in the first stage and FGLS in the second stage, while SER has been utilized only in the restricted model. Although the cointegration relationship enters significantly only in the wage equation in the unrestricted model, it enters significantly in both wage and price equations in the restricted VECM model. Furthermore, VECM model statistics suggests that no information is lost when restrictions are imposed on the VECM model. The strongest evidence against the unrestricted model is the fact that the estimated cointegration coefficient is not only significantly different from its expected value but it has incorrect sign too. In contrast, it is very obvious on the basis of prior theoretical expectations that the value of the estimated cointegration coefficient of restricted model is almost identical to the expected value.

References

Andersson, J. (2005). Testing for Granger Causality in the presence of measurement errors. *Economics Bulletin.* Vol. 3. No. 47. pp. 1-13.

Ashley, R., Granger, C.W.J. and Schmalensee, (1980). Advertising and Aggregate Consumption: An Analysis of Causality. *Econometrica.* Vol. 48. No. 5. July. pp. 1149-1167.

Breusch, T.S. (1978). Testing for Autocorrelation in Dynamic Linear Models. *Australian Economic Papers.* 17. pp. 334-355.

Davidson, R. and MacKinnon, J. (1993). *Estimation and Inference in Econometrics.* Oxford University Press. London.

DeGrauwe, P. (2003). *Economics of Monetary Union.* Fifth edition. Oxford University Press.

Dickey, D.A. and Fuller, W.A. (1979). Estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association.* 74. pp. 427-431.

Doornik, J.A. and Hansen, H. (1994). A practical test of multivariate normality. Unpublished paper. Nuffield College.

Doraszelski, U. and Jaumandreu, J. (2013). R&D and Productivity: Estimating Endogenous Productivity. *Review of Economic Studies.* 80. pp. 1338-1383.

Emery, K.M. and Chang, C.P. (1996). Do Wages Help Predict Inflation?. Federal Reserve Bank of Dallas. Economic Review of the First Quarter 1996.

Fuller, W.A. (1976). *Introduction to Statistical Time Series.* John Wiley & Sons. New York.

Garcia, C.J. and Restrepo, J.G. (2001). Price and wage inflation in Chile. *BIS Papers*. No. 8 (part 5). November 2001.

Gilbert, C.L. (2004). Economic Causality. Paper prepared for the 2004 Annual Causality. Metaphysics and Methods Conference. LSE. London. 15-17 June.

Goretti, M. (2008). Wage-Price Setting in New EU Member States. *IMF Working Paper*. WP/08/243.

Godfrey, L.G. (1978). Testing Against General Autoregressive and Moving Average Error Models when the Regressors Include Lagged Dependent Variables. *Econometrica.* 46. pp. 1293-1301.

Granger, C.W.J. (1969). Investigating Causal Relations by Econometric Models and Cross-spectral Methods. *Econometrica.* Vol. 37. No. 3. August. pp. 424-438.

Haavlemo, T. (1994). The probability Approach in Econometrics. *Econometrica.* 12. Issue Supplement. July. iii-vi. pp. 1-115.

Hess, G.D. and Schweitzer, M.E. (2000). Does Wage inflation cause price Inflation?. Federal Reserve Bank of Cleveland. *Policy Discussion Paper*. No. 10. April.

Hume, D. (1739). *A Treatise of Human Nature.* Reprinted from the Original Edition in three volumes and edited. With an analytical index, By L.A. Selby-Bigge. M.A. Oxford. Clarendon Press.

Jarque, C.M. and Berra, A.K. (1987). A test for normality of observation and regression residuals. *International Statistical Review.* 55. pp. 163-172.

Jonsson, M. and Palmqwist, S. (2004). Do Higher Wages Cause Inflation?. Sveriges Riskbank. *Working Paper Series.* April.

Jung, C. and Seldon, B. (1995). The Macroeconomic Relation between Advertising and Consumption. *Southern Economic Journal.* Vol. 61.

Lemos, S. (2004). The Effect of the Minimum Wage on Prices. University of Leicester. *Working Paper*. No. 04/7. March.

LeRoy, S.F. (2004). Causality in Economics, Centre for Philosophy of Natural and Social Science Causality: Metaphysics and Methods. Technical Report 20/04.

Lütkepohl, H. (1993). Testing for causation between two variables in higher dimensional VAR models. In H. Schneeweiss and K.F. Zimmermann (eds.). *Studies in Applied Econometrics.* Physica-Verlag. Heidelberg. p. 7591.

Lütkhepohl, H. and Krätzig, M. (2004). *Applied Time Series Econometrics.* Cambridge University Press. October.

Lütkhepohl, H. and Krätzig, M. (2005). VECM Analysis in JMulTi. www.jmulti.de

Lütkhepohl, H., Krätzig, M. and Boreiko, D. (2006). VAR Analysis in JMulTi, www.jmulti.de

Lütkhepohl, H. and Krätzig, M. (2006). Initial Analysis in JMulTi. www.jmulti.de

Moschos D. (1983). Aggregate Price Responses to Wage and Productivity Changes: Evidence from the US. *Empirical Economics.* Vol. 8. pp. 169-75.

Muth, J. (1961). Rational Expectations and the Theory of Price Movements. *Econometrica.* Vol. 29. No. 3. July.

Ng, S. and Perron, P. (1995). Unit root tests in ARMA models with data-dependent methods for the selection of the truncation lag. *Journal of the American Statistical Association.* 90. pp. 268-281.

Palley, T.I. (1999). The U.S. Inflation Process: Does Nominal Wage Inflation cause Price Inflation, Vice-versa, or Neither?. Presented at the annual ASSA/URPE Conference held in New York. NY. 2-3 January.

Pu, C., Flaschel, P. and Chihying, H. (2006). A Causal Analysis of the Wage-Price Spiral. *Working Paper*. March 14.

Sargent, T.J. and Wallace, N. (1976). Rational Expectations and Theory of Economic Policy. *Journal of Monetary Economics.* 2. pp. 169-183. North-Holland Publishing Company.

Sims, C. (1972). Money, Income and Causality. *The American Economic Review.* Vol. 62. No. 4. September. pp. 540-552.

Sims, C. (1999). Granger Causality. Econ. 513. *Time Series Econometrics.* Fall.

Smolny, W. (2000). Sources of productivity growth: an empirical analysis with German sectoral data. *Applied Economics.* 32. pp. 305-314.

Solow, Robert M. (1959). A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics.* Vol. 70. No. 1. February. pp. 65-94.

Stiroh, K.J. (2001). What Drives Productivity Growth?. FRBNY Economic Policy Review. March. pp. 37-59.

Strauss, J. and Wohar, M.E. (2004). The Linkage between prices, wages and productivity: a panel study of manufacturing industries. *Southern Economic Journal.* April.

Appendix

Table A4.1. *Description of the price, wage and productivity variables*

Variable	Description of variables
(1)	(2)
c *or* μ_0	Constant / Intercept
t *or* μ_1	Trend
s_0, s_1, s_2, s_3,	Seasonal dummy variables for quarters (I,II, III, IV)
WUK	Wages
LWUK	Log of WUK
DLWUK	First Difference of the log of WUK
PUK	Price Index
LPUK	Log of PUK
DLPUK	First Difference of the log of PUK
QUK	Productivity
LQUK	Log of QUK
DLQUK	First Difference of the log of QUK

Table A4.2. *Augmented Dickey-Fuller (ADF) unit root test – number of lagged differences suggested by a) AIK, b) FPE, c) HQC, and SC, (Lütkhepohl and Krätzig, 2004).*

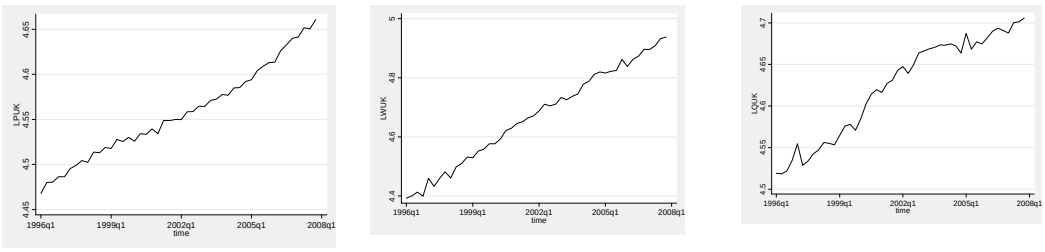
Variable	μ_0				$\mu_0 + \mu_1$				μ_0 + sd				$\mu_0 + \mu_1$ + sd			
(1)	(2)				(3)				(4)				(5)			
	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
LPUK	4	4	4	4	4	4	4	4	1	1	0	0	1	1	0	0
LWUK	6	6	1	1	0	0	0	0	6	6	1	1	1	1	0	0
LQUK	8	8	1	0	10	10	10	0	8	8	1	0	10	10	10	0
DLPUK	3	3	3	3	3	3	3	3	5	5	0	0	0	0	0	0
DLWUK	0	0	0	0	5	5	0	0	0	0	0	0	5	5	0	0
DLQUK	7	0	0	0	2	2	0	0	7	7	0	0	7	7	0	0

***Note 1*:** *column (2)* $\mu_0 \neq 0$: $\Delta y_t = \phi y_{t-1} + \Sigma^{p-1}_{j-1} \alpha^*_j \Delta y_{t-j} + \mu_0 + u_t$; *column (3)* $\mu_0 \neq 0$, $\mu_1 \neq 0$: $\Delta y_t = \phi y_{t-1} + \Sigma^{p-1}_{j-1} \alpha^*_j \Delta y_{t-j} + \mu_0 + \mu_1 t + u_t$; *column (3)* $\mu_0 \neq 0$, sd $\neq 0$: $\Delta y_t = \phi y_{t-1} + \Sigma^{p-1}_{j-1} \alpha^*_j \Delta y_{t-j} + \mu_0 + \pi_j s_i + u_t$; column (5) $\mu_0 \neq 0$, $\mu_1 \neq 0$, sd $\neq 0$: $\Delta y_t = \phi y_{t-1} + \Sigma^{p-1}_{j-1} \alpha^*_j \Delta y_{t-j} + \mu_0 + \mu_1 t + \pi_j s_i + u_t$.

Figure A4.1. *Plots of wage, price and productivity variables: a) log-levels and b) first difference of log-level.*

Price Wage Productivity

(a)



(b)

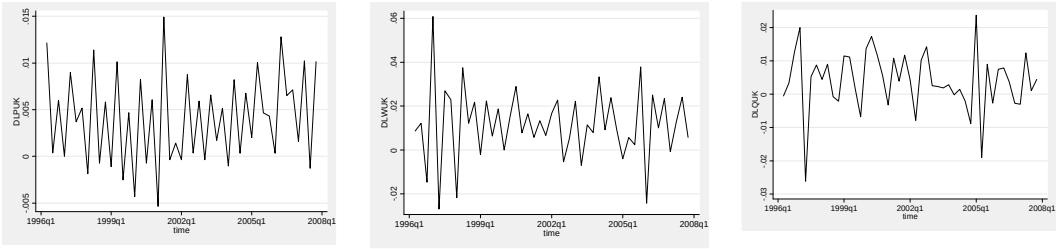
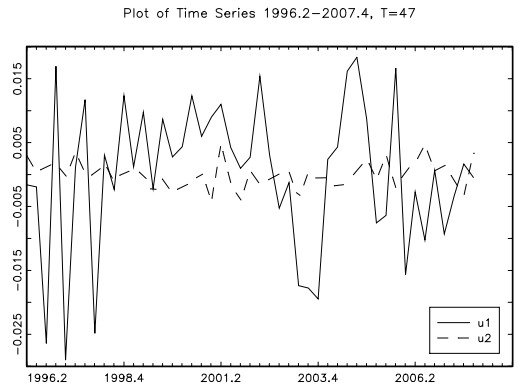
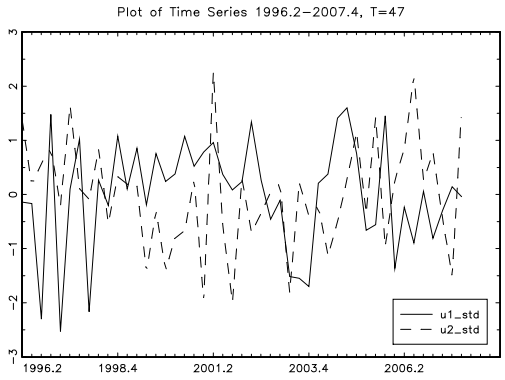


Figure A5.1. *VAR Levels Model (VAR^L) - Graphical Diagnostic Checks*

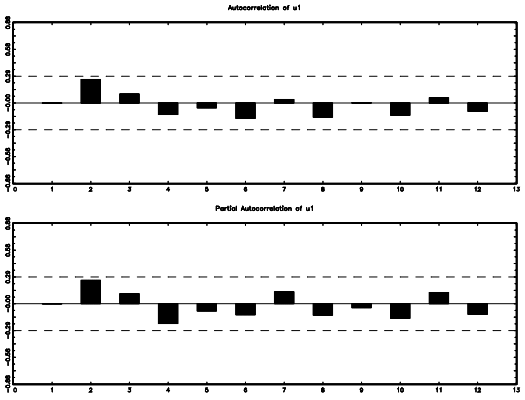
Residuals u_{1t} and u_{2t}



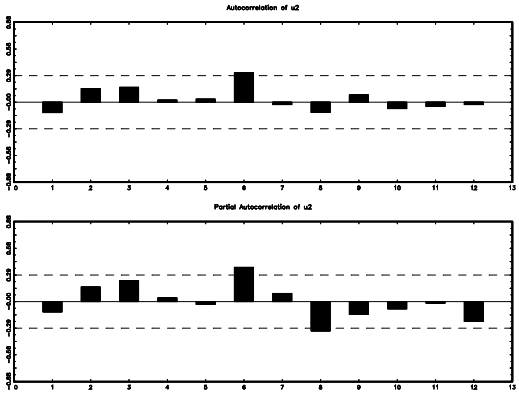
Standardized residuals u_{1t} and u_{2t}



AC and PAC of u_{1t}



AC and PAC of u_{2t}



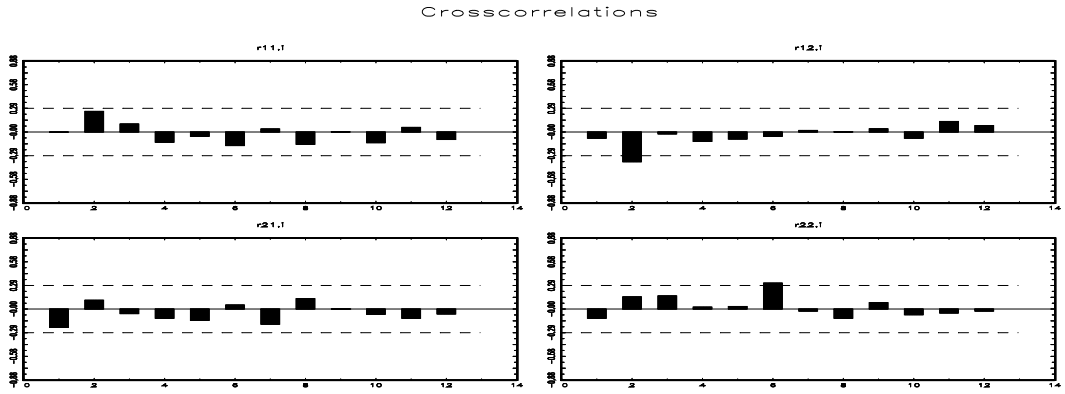
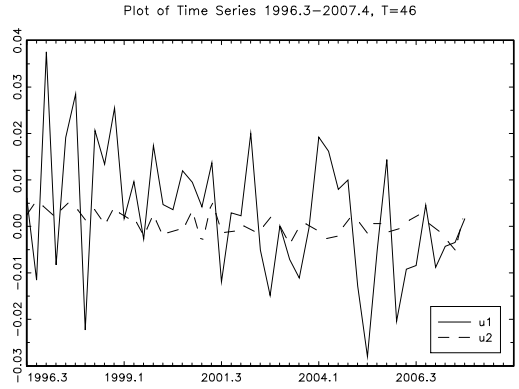
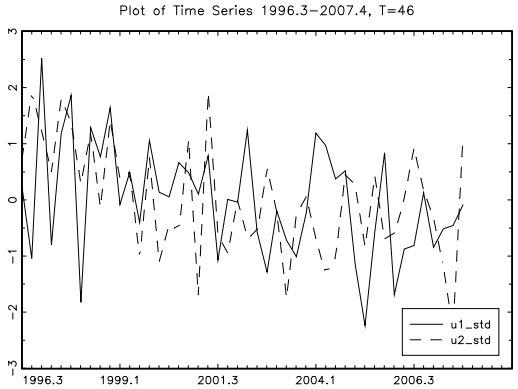


Figure A5.2. *VAR First Differences Model (VAR^D) - Graphical Diagnostic Checks*

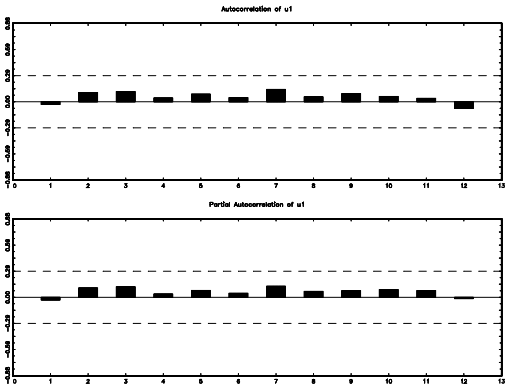
Residuals u_{1t} and u_{2t}



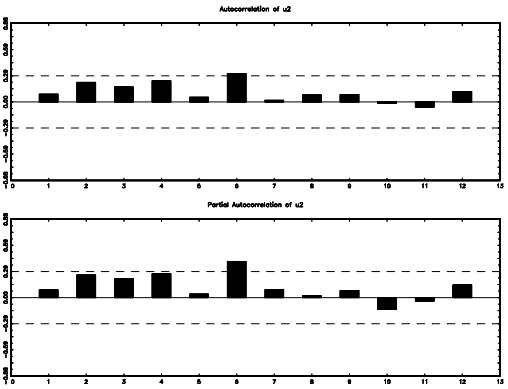
Standardized residuals u_{1t} and u_{2t}



AC and PAC of u_{1t}



AC and PAC of u_{2t}



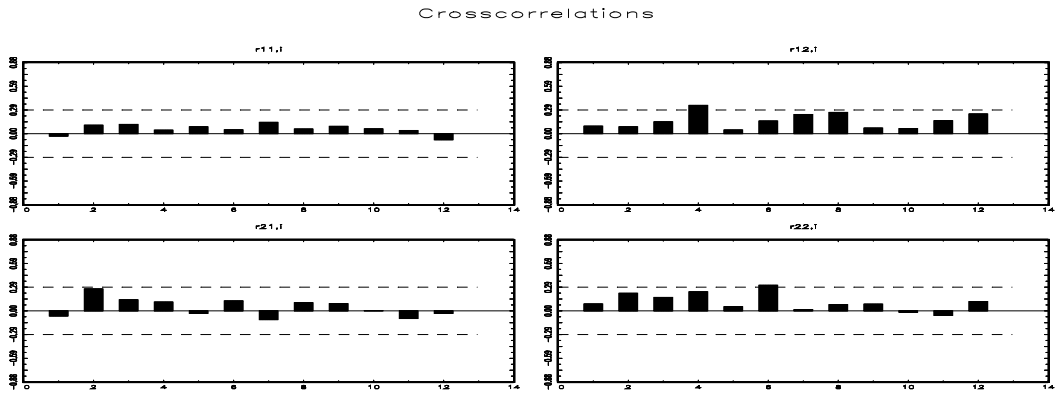


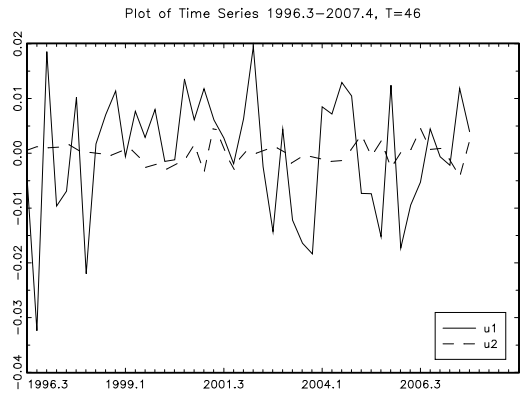
Table A5.1. *Diagnostic Tests for the VAR and VECM models*

Model	**VAR^{L}**	**VAR^{D}**	**VECM^{U}**	**VECM^{R}**
(1)	**(2)**	**(3)**	**(4)**	**(5)**
LM-Type Test for autocorrelation with 5 lags	23.09	20.65	16.71	18.93
	(0.28)	(0.42)	(0.67)	(0.53)
TESTS FOR NONNORMALITY				
Doornik & Hansen (1994)	3.99	0.78	4.60	1.66
	(0.41)	(0.94)	(0.33)	(0.80)
Skewness	3.93	0.16	4.00	0.56
	(0.14)	(0.92)	(0.14)	(0.76)
Kurtosis	0.06	0.61	0.60	1.10
	(0.97)	(0.74)	(0.74)	(0.58)
Lütkepohl (1993)	3.97	0.79	4.57	1.06
	(0.41)	(0.94)	(0.33)	(0.90)
Skewness	3.91	0.25	3.99	0.43
	(0.14)	(0.88)	(0.14)	(0.80)
Kurtosis	0.06	0.53	0.58	0.63
	(0.97)	(0.77)	(0.75)	(0.73)
Jarque-Berra Test				
u_1	3.82	0.24	3.16	0.86
	(0.15)	(0.89)	(0.21)	(0.65)
u_2	0.16	0.65	0.69	0.24
	(0.92)	(0.72)	(0.71)	(0.89)
ARCH-LM TEST with 16 lags				
u_1	16.42	10.83	9.38	8.62
	(0.42)	(0.82)	(0.90)	(0.93)
u_2	12.35	8.43	8.51)	16.42
	(0.72)	(0.94)	(0.93)	(0.42)
MULTIVARIATE ARCH-LM TEST with 5 lags				
VARCH LM test statistic	37.50	46.67	43.64	47.06
	(0.78)	(0.40)	(0.53)	(0.39)

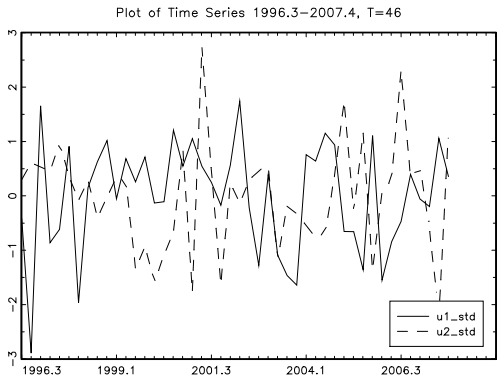
Note 1: The numbers in brackets represent p-values.

Figure A6.1. *VECM Unrestricted Model (VECM^{U}) - Graphical Diagnostic Checks*

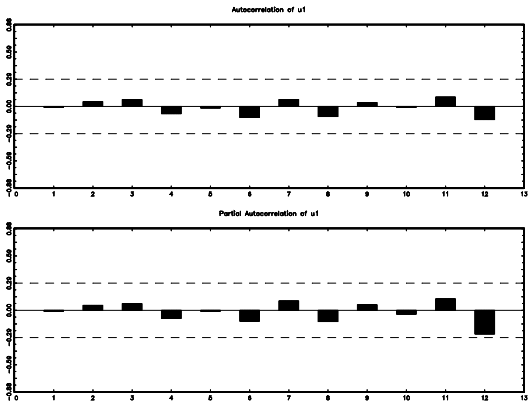
Residuals u_{1t} and u_{2t}



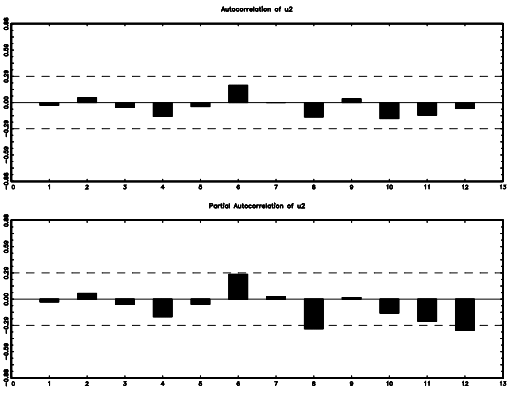
Standardized residuals u_{1t} and u_{2t}



AC and PAC of u_{1t}



AC and PAC of u_{2t}



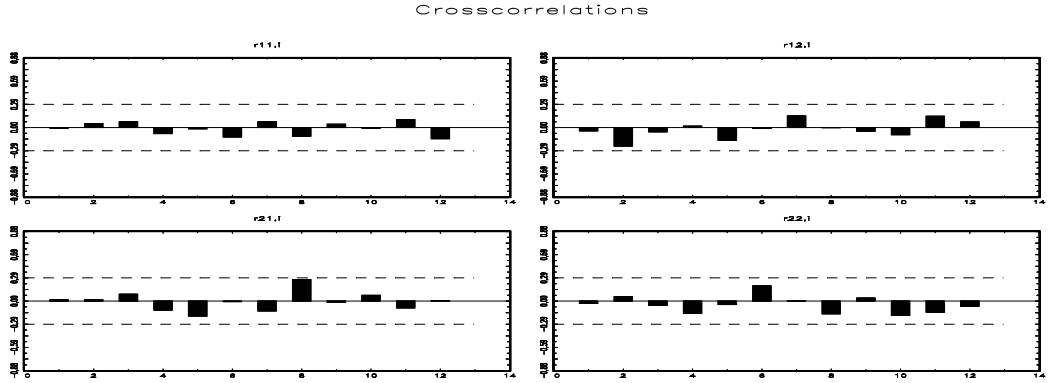
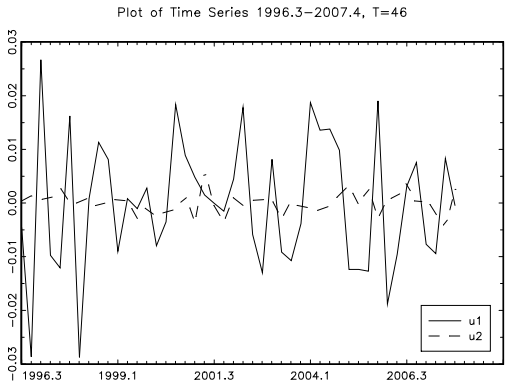
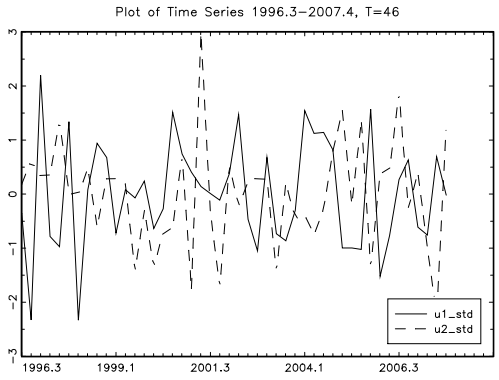


Figure A6.2. *VECM Restricted Model (VECM^R) - Graphical Diagnostic Checks*

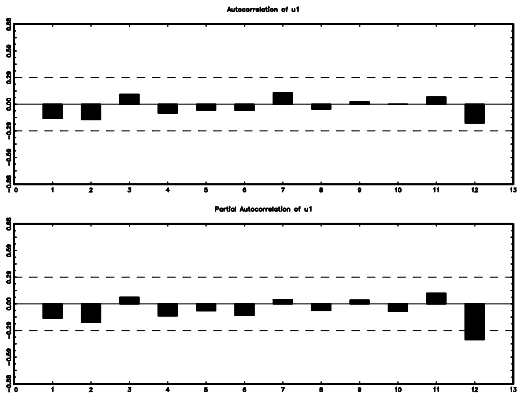
Residuals u_{1t} and u_{2t}



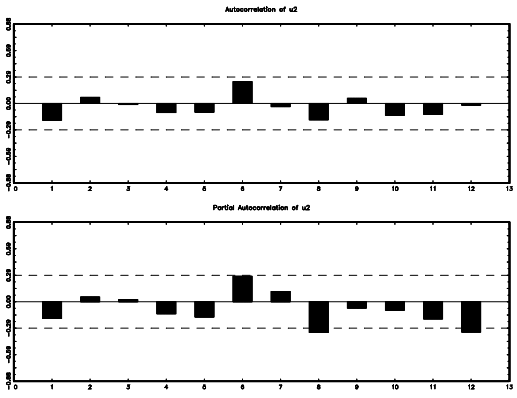
Standardized residuals u_{1t} and u_{2t}

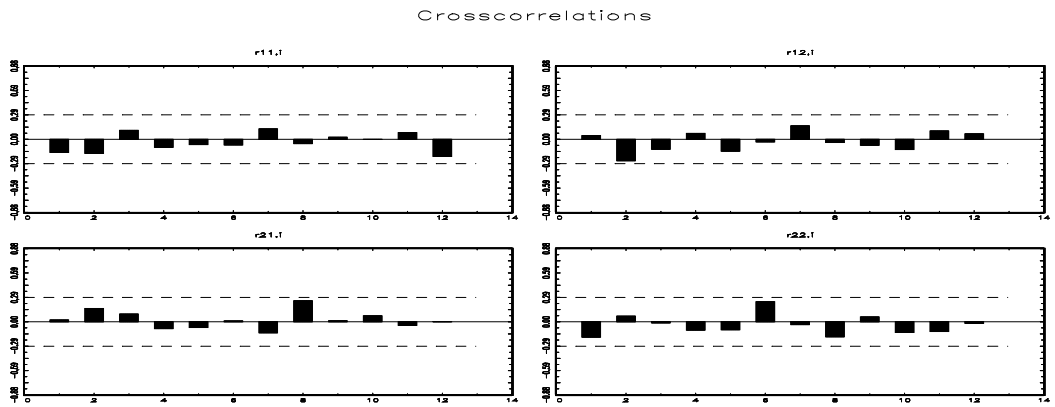


AC and PAC of u_{1t}



AC and PAC of u_{2t}





Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 41-56

Assessing the regional development degree – step one: Calibrating the polar diagram

Cătălin Daniel DUMITRICĂ (1)
National School of Political Science and Public Administration, Bucharest, Romania
catalin_dumitrica@snspa.ro
Teodora I. BIŢOIU (2)
National School of Political Science and Public Administration, Bucharest, Romania
tdinu@snspa.ro
Dragoş DINCĂ (3)
National School of Political Science and Public Administration, Bucharest, Romania
dragosdinca2000@yahoo.com

Abstract. *The issue of regional development is widely debated, regulated and analyzed in official EU documents, as well as in specialized literature. The theme of the research is extensive and it includes the analysis of economic, legal and administrative dimensions that contribute to the development of a strong interdisciplinary research. The traditional objective of regional development policies is to reduce regional disparities, intra and inter-regional, achieving a relative balance between economic and social development levels of various areas of a national territory.*
To achieve this goal, it is necessary to develop management tools capable of providing an objective scientific analysis developing reliable data to contribute to the shaping in an essential manner the main directions of regional development.
The article is the first part of the "Polar diagram – Tool for periodic assessment of the degree of regional development" and it aims to achieve a brief description of regional development areas that are the subject of analysis of the project, as well as highlighting the main indicators that will be used in the research, in order to contribute to the development of a regional polar diagram.

Keywords: regional development, polar diagram, economic development, indicators.

JEL Classification: H5, H7, R5.

Introduction

The regional economy has as a main reason for its existence, the need to provide a theoretical and methodological rational basis, scientific for the strategies and regional policies, i.e. to establish a coherent set of objectives and ways to mitigate regional disparities in terms of aggregate economic-social dynamics, as well as identifying measures and appropriate tools for achieving these objectives.

The issue *raised* in the research project aims to develop an instrument able to provide registration information on the fluctuations recorded in the regional development process and hence on the process of how is the regional economy developing.

Given the complexity of the regional development process, this research aims to analyze the evolution of a set of indicators, deemed relevant by the authors in the context of regional development, set of indicators that will contribute to the development of a monitoring process for the status of regional development in Romania. The set of indicators will be developed in relation to eight areas of development such as: social development, economy and market, governance and regulations, science and research, environmental protection (sustainable development), public health, education and training. For each of these areas, a number of five unitary indicators, considered by the research team as relevant in terms of applicability in the eight regions, will be identified through the research conducted within the project.

The research objective will aim the development of a *polar diagram* of regional development in Romania. The set of used indicators, based on a periodic analysis will contribute to the monitoring of regional development status in the eight development regions in Romania, which will contribute to the development of the regional development polar diagram in Romania

1. Calibrating the polar diagram - Setting the indicators

1.1. The Social Development and the Economy & Market Dashboards

The research project draws the attention upon the real danger of an unrighteous use of the indicators periodically assessing the regional development degree, the jeopardy of an ill assessment that can sometimes prove worse than the lack of an assessment.

This part of the project also underlines the need to emphasize that the Millennium Development Goals (MDGs) set by the United Nations for 2000-2015 timeframe should have been almost accomplished but find it seems that the Global Financial Crisis has already and will still create problems for most of the goals. The world leaders express their concern about meeting the MDGs and "the UN is also working with governments, civil society and other partners to build on the momentum generated by the MDGs and carry on with an ambitious post-2015 development agenda". (www.un.org/millenniumgoals/)

Nevertheless, all the efforts are concentrated in the direction of reaching the goals. The European Commission declared this year the "European Year for Development", as an incentive for everyone to contribute to the international development policy.

1.1.2. The Social Development Dashboard

The social development had become an issue impossible to be treated collaterally and gained its top single position on most of the private, public or non-profit entities missions. In the literature, academics have intensified their analysis upon the crisis effects that are registered on the level of population and labour market, local economies, quality of life, local governance and economic and social increasing disparities (Matei and Matei, 2010; Kotler and Caslione, 2009; Lustig and Walton, 2009; Siddique, 2010; Ciutacu, 2010).

The Social Development Dashboard shall seek to calibrate **five indicators** that will later be integrated in the broad analysis on the periodical assessment of the regional development degree:

1. **Price of the in-work poverty (PIWP)** defined by the minimum *wage and guaranteed minimum income*. The in-work poverty refers to the "individuals who are classified as 'employed' (distinguishing between 'wage and salary employment plus self-employment' and 'wage and salary employment' only) and who are *at risk of poverty*. This is a relative concept referring to those living in households whose total equivalised income is below 60 per cent of the median national equivalised household income (Eurostat Statistical books, 2010, p. 104). This indicator needs to be analyzed according to personal, job and household characteristics. It should also be analyzed in comparison with the poverty risk faced by the unemployed and the inactive." (Eurostat Methodologies and Working Papers, 2010, p. 7).
2. **Price of the out-of-work poverty (POWP)** refers to the *unemployment benefits and social aids*. Out-of-work poverty involves both the unemployed who are at risk of poverty, and to the unpaid family workers – who are not receiving unemployment aids. This category pertains to the agricultural workers and it can be often seen in Romania. It is defined by the Romanian National Institute for Statistics as "The unpaid family worker who works in a household managed by a member of the family or relative and receives no remuneration either in the form of a wage or in kind. The farm household (agricultural) is considered such a unit. If several people in a household work on the family farm, one of them – most often the head of the household – is considered to be self-employed, while the rest are unpaid family workers".
3. **Price of the out-of-the-labour-force poverty (POLFP)** means the *minimum welfare pension, children allowance* (e.g. child poverty, retiree poverty). This category (out-of-labour-force poverty) comprises the elderly persons at risk of poverty and the children facing the same risk (usually those coming from large families, young people, the Roma community, unemployed households, and families comprising rural workers).
4. **Distribution of poverty (DP)** through different channels. Lustig and Walton (2009) provide a broad view upon the transmission mechanisms that is of great use for grasping the whole range of poverty distribution channels pertaining to the measures taken during crisis:

- **Labor market** – loss of jobs who leads to the loss of income is a direct channel through which poverty immediately increases in the household.
- **Prices** – inflation, raise of taxes and other charges – this channel has an impact upon the global market demand for commodities, leading to reduced companies' profits; on the consumers' side, *persistently high inflation, in particular on food prices, will challenge food security and reduce the resources poor consumers can spend on non-food items, such as education and investment.* (ODI Briefing Paper, 2009, p. 2)
- **Reduced access to public and private assistance** – state support and bank loans – this channel takes into account the decreasing public budget that is unable to cover the increasing demand for social protection, and the limited access to bank loans due the both the dropping private income of the population and the more restrictive requirements of the banks (e.g. debt to income ratio).
- **The provision of goods and services** – the poverty is transmitted to this channel no matter who the transmitter is (state, private companies or tertiary sector) as all are facing the same problem of the falling revenue.

5. **Promotion of Poverty (PP)** There are many actors who strive for raising awareness on the poverty issue. For this paper's argument, we shall be taking into account as the most active in this regard the World Bank and the International Bank for Reconstruction and Development, the International Monetary Fund, the United Nations, and the European institutions, due to both their high profile in social marketing campaigns and their financial assistance for the current crises, with special focus of their involvement in Romania.

1.1.3. The Economy and Market Dashboard

The economy and market indicators are probably the most often used statistics in the decision-making process of the government, public administration, non-profit organisations, or even private entities. The most common indicators refer to the real Gross Domestic Product, Consumer Price Index, Employment rate or Money supply. These can be easily accessed on a national level but do not necessarily provide useful information on the degree or regional development.

Therefore, our project chose to develop certain indicators that, even if they can sometimes hide subjective data, they can provide us, in the end, with a solid image upon the degree of regional development.

Taking into account the trend of focusing on public "industry" results and efficiency, it becomes natural to develop **five indicators** that can be calibrated on regional data and that can result in knowing whether the region is efficient, market oriented and consumer oriented:

1. **The Three-fold Efficiency (TFE)**. The Economists have developed three methods for measuring the efficiency. Firstly, the efficiency of production or technical efficiency relates to the efficient use of resources in a technical manner. In other words, the technical efficiency involves obtaining a maximum output with a given set of inputs. In terms of cost, it means that an organization must produce a certain quantity in the cheapest way possible. Secondly, the allocative efficiency refers to the distribution of

resources between alternative uses so as to obtain an optimal mix of production. In other words, allocative efficiency considers choosing between different technical effective combinations. Taken together, the technical and allocative efficiency determine the degree of economic efficiency. Thus, if an institution uses its resources perfectly efficient both allocatively and technically, then we can say that it is economically efficient. Otherwise, if there is allocative or technical inefficiency the organization operates less efficient from an economic standpoint. Thirdly, opposite to the technical and allocative efficiencies, the dynamic efficiency is a less precise concept. In general, the dynamic efficiency refers to the efficient use of resources insufficient in time, thus combining both the efficiencies in an inter-temporal dimension.

2. **The threat of alternatives (TAs)** can be considered rather low, not from the viewpoint of a monopolistic thinking, but by realistically assessing the situation enforced by the public goods. A privately owned company envisions the decision making system based on CSR – Corporate Social Responsibility – as the ultimate goal on the evolution scale, a development target. For this company, the financial profit comes first, and the social one can appear only as a result of a sustained real growth. The goods that the company deals with are divisible, which means that once consumed nobody can benefit from it any longer, so the quantity available to others has decreased. There are many alternatives to this issue. The threat of alternatives is absolutely vital in this case, and this powerful fight for profit created more and more rivalry. However, the public sector is considering goods that are not divisible. The most known example, of a pure public good that is both non-rival and non-excludable, is that of "defence". The available quantity of "defence" is not divisible, meaning that the security that I feel does not diminish the "quantity" available to the others, and, more importantly, the consumers cannot be excluded from use.
3. The problem that arises is that, because it can be consumed without modifying the remained quantity available to others, it becomes a stimulus for not paying what you consumed – **citizen's power (CP)**. The reference point becomes the consumer's willingness to pay, according to the "consumer sovereignty" principle. The market mechanisms would never provide a social project. The markets certainly functions in terms of demand and supply, and those trying to satisfy the demand are looking to maximise their profit. Such a market, being of course a normal one, based on competition, would never succeed in providing Pareto type solution, meaning covering the demand of some without affecting anybody else – being it a "Pareto improvement", *i.e.* the change makes at least one person better off, without leaving anybody worse off, or a "Pareto optimal situation", when the systems reaches a certain level where it is impossible to make anybody better off, without leaving somebody worse off.
4. Even like that, there is the **power of supplier (PS)**, that lies in the fact that the good is still an economic one, scarce and desirable, and these features assures it the power of attracting payment in return for its use or consumption. In this regard, the supplier's behaviour facing a decision should be emphasized. **Three broad categories of**

behaviour paradigms may be distinguish for public decision making: "optimizing" behaviour, "satisficing" behaviour and "justifying" behaviour (Munda et al., 1993, p. 43). Though most of the decision making techniques are part of the first category, less of the second, in practice, they are often used as a mean to justify public decisions, even if these decisions are not in accordance with the *optimizing and satisficing principles.*

5. The **barriers to entry (BsE)** actually hide the decision making system or, more precisely, the centralisation or decentralisation of the decision making systems. A decentralised decision making system relies on cooperation. If this cooperation is not stimulated, the decision making system can be damaged. Giving all these, the decentralised decision making system still has its advantages, due to the fact that it does not depend on the existence of a central decision making core that would be in charge of collecting and analyzing the data. This type of operations becomes difficult on the account of proper technology deficiency which would allow an efficient allocation of available resources. A decentralized decision making system would appear as the ideal solution, but the government could find itself in a situation of decision making impossibility when these sub systems fail to cooperate.

A modern public administration must be focused on meeting the citizens' needs, better informing the citizens, cooperating with those to whom it is addressing and strengthening public control over government. It aims to strengthen and broaden the framework for civil society participation in decision making. (Profiroiu, 2002, p. 16)

The problem of measuring the citizen's power and willingness to pay perpetually revives, the result being a Pareto efficient allocation of public goods – that makes at least one person better off, without leaving anyone worse off.

As a result of these forces action, the **rivalry** comes into sight. The rivalry refers to the problems that need to be solved, to the issue of ranking them and, more importantly, to issue of choosing the right allocation of resources, keeping in mind the public interest, *i.e.* social benefit. Putting it simply, it is all about covering the *distance from the present state to de desired one*. (Fiala, 1997) This is the moment when those having the mission of managing public resources – public managers – must prove responsible (administrative structures of collective decisions, not individual, their cohesion is underpinned by the principle of collective responsibility – for example, if the Prime Minister of Great Britain (Androniceanu, 2007) and fair when assessing the actual level of public demand for the provided goods and services. This rivalry creates many biases, the reason being the crucial parameters like decision maker competence, the constraint complexity, or the considered evaluation criteria. The mechanisms employed by the analysts in order to solve these issues – mechanisms that have become necessary as a result of the innovation mentioned above, and the lack of innovation would mean no real growth – are numerous, the basic condition being that they must be logically built, and accurately reflect the modelled reality. Their place in the decision making cycle has a special meaning, as it is the key moment of outrunning, or not, a *bottleneck.*

1.2. Governance and regulation, science and research

1.2.1. Governance and regulation

The development process is governed at all levels, both through international organizations such as the United Nations or the European Union and the national authorities at central and local level.

To cope with all the global challenges and problems, states have created supranational institutions such as the United Nations, World Trade Organization, UNESCO, the World Health Organization, and the International Labour Organization. In parallel with this process there is an increase in the influence of nongovernmental international organizations, acting globally in a wide range of domains, from Green Peace (environmental organization), Amnesty International (an organization that monitors human rights) or organizations that promote animal rights. All these nongovernmental international organizations received official recognition from the UN in the meeting of the Heads of State and Governments held in 1992 in Rio de Janeiro, Brazil organized by UN and it was devoted to environmental issues. The United Nations is neither a government nor legislative, but it offers means to resolve international conflicts.

Also at European level, the European Union is involved in various fields such as business, social, research, culture, trade, education and training, human rights, environment, justice, public health, foreign policy etc.

At national level the government and the ministries play important roles in formulating local development policies and strategies. At this level are devised the directions and ways in which to perform the development process, each ministry having one area of development, thus for the economy Ministry of Economy; education and research Ministry of Education, Youth and Sports; social: Ministry of Labour, Family and Social Protection; environment: Ministry of Environment etc.

Authorities at central level issue rules and regulations which can facilitate development in all existing areas but can equally complicate the process, through legislation less accessible and heavy bureaucracy that not only delays but also even prevents any type of local development.

The following level is the local one, where stakeholders, county and local councils as well as mayors take over government policies and apply them in the field, each using its own measures at their disposal. By county or local council decisions and provisions of the mayor local development programs in the cities, communes and villages of administrative-territorial units can be adopted.

Local authorities can improve the living standards of citizens through improvements in public services subordinated to them. “Local public services, according to Romanian legislation in the field may be subordinated to the local council (organized by the local council, as self-managed public companies, public companies or other public or private types). Local public services are seen *m* public utility services, considered industrial and commercial public services, in sanitation, water distribution, sewage, gas distribution

domains etc. or public administrative services purely administrative (civil protection, guardianship authority, marital status etc.), education services etc." (Matei, 2004)

Apart from state structures, citizen participation plays an important role in involving all stakeholders in urban development. Educating citizens in the spirit of participation in administrative decision is a critical component in development. Information and access to public information facilitates citizens' involvement, in order to identify social requirements and their actual needs.

From the perspective of regional development, establishing a set of indicators on governance and regulation can consider:

Selected indicator	Utility	Application
No. of public authorities within the development region	Process of analysis on the distribution of authority sources in the regions	Regional/local administration level
Number of civil servants/local elected officials	Analysis of administrative capacity in quantitative terms - human resources at local level	Local public administration/Human resources
Categories of decentralized functions from the state level towards local authorities	The analysis of different categories of responsibilities evolution and their division between the state and local level	Local public administration
Number of normative acts issued by the county	Analysis of the regulatory capacity of local public authorities	The degree of autonomy/local decentralization
Financial resources transferred from the state budget to local authorities	Analyzes the dependence/ autonomy degree of local authorities from the state level.	The degree of autonomy/local decentralization

1.2.2. Science and Research

Science and research must be the starting point for any development process. This means harnessing the human potential at local level and the knowledge and existing information. Within each area of development research is needed to substantiate development programs promoted by each actor. (Dincă and Dumitrică, 2010)

Given the continuing transformation and society's continually progress it is absolutely necessary to identify new methods of production and development that enable the growth of the living standard and also to ensure environmental protection and the right to a healthy environment recognized by the Constitution to all citizens.

One can talk about research in the domains of health, information technologies, transport, economy, national security, environmental protection, education and governance. Research is the way to improve activities in all sectors of social life. Man is constantly evolving, and its needs are diversified and therefore he will always seek to find the most efficient ways to meet his/her needs and at the same time to protect the natural environment thus achieving sustainable development.

Local development depends to a great extent on progress in science and research. Thus any strategy, plan or local development project is based on extensive research, research that aims to identify the best actions that authorities can undertake as well as the effects they will have on people's lives and on environment.

Research is the one that increases the quality of administrative measures and of the various activities undertaken by the authorities. Advances in science facilitate the easier fulfillment of the fundamental objective of public administration namely general well-being. Also research in information technology makes it easier for public authorities to communicate with the citizens; it improves citizens' access to public information.

The generation and exploitation of knowledge have become vital resources of global welfare growth. Knowledge is also central to determining competitiveness and as such states of the world, especially the developed ones, have engaged in a systematic generation, developing sophisticated national systems and international interactions. In the knowledge triangle, education-research-innovation, the last item is most closely related to the impact on welfare and the most problematic in terms of the related policies. Innovation, a process with many variables, has in its center the cooperation between research and industry. In the last decade, developed countries have proposed intermediary entities or forms of interaction and collaboration through which bridges between the two sectors are created, allocating these entities increased public financial resources.

Even if the system of research, development and innovation has failed so far to generate impressive success examples in transferring results in the socio-economic development, it has managed to maintain or to develop actors (including universities, institutes, research teams) having a certain international visibility and who can be or already are poles of excellence.

Science and technology development aims to increase the competitiveness of the economy, improve social quality and to increase knowledge of potential capitalization and expansion of the horizon of action. To fulfill this role several strategic objectives can be shaped:

- creation of knowledge i.e. the achievement of scientific and technological results, competitive worldwide, aiming to increase the contribution of the Romanian system to the global knowledge stock, increase international visibility and transfer results into the economy and society;
- increasing the competitiveness of the Romanian economy through innovation with an impact upon the economic actors and transferring knowledge in the economy;
- Increase social quality through the development of solutions, including technological ones that generate direct benefits to the society.

The priority areas considered in the development field of research and innovation aims: information society technologies, energy, environment, health, agriculture, food security and safety; biotechnology; materials, processes and innovative products; space and security; socio-economic and humanities research.

Thus taking into account the specifics of the analyzed field, in order to develop a set of indicators to monitor regional development process, we consider as being interesting to monitor a set of indicators that can provide information on:

Selected indicator	Utility	Application
No. of research entities existing in the region	Decentralized local research capacity	Local public administration
No. of research institutions, including universities in the state system existing in the region	Analysis of regional research capacity	Local/regional level
No. of researchers existing at the region level.	Regional research capacity in terms of human resources	Local public administration/Human resources
No. of research projects aimed at local development	Preoccupation of local authorities for research	Local/regional/national level
No. of partnerships between research institutions and public authorities	The degree of cooperation and integration of research results in the development processes.	The development of associative structures.

1.3. Environment (Sustainable Development), Public Health, Education and Training

1.3.1. Sustainable Development

The economic development process inevitably involves changing the natural environment both by using environmental factors as renewable resources, but also because the nuisance affects to a greater or lesser extent, sometimes irreversible the ecological balance.

Economic development involves an external cost borne by the environment, whose dimensions, increasingly evident in recent years, if not properly evaluated, question the long-term viability of the very process itself. Economic development theories have approached from the early stages of their shaping the natural resource issues and their limited nature. Starting from the need that the objectives and echelons of environmental protection measures are connected to the transition path to a market economy in order to ensure sustainable development, it is clear that macroeconomic adjustments must take account energy and environmental restrictions.

As a manifestation of macroeconomic dynamics, sustainable economic development requires a set of quantitative, structural and qualitative transformations, both in economy and in scientific research and manufacturing technology, in the mechanisms and organizational structures of functioning of the economy, the fundamental principle of this development will be PPP, i.e. “polluter pays principle”.

In this context, the sustainable development concept appears, representing that form of economic development in which it is intended that the satisfaction of the present consumption demands does not compromise or prejudice those of future generations.

The concept of sustainable development expresses the process of broadening the opportunities through which present and future generations can fully manifest options in every area: economic, social, cultural or political, man being placed in the center of action

for development. If from the historical perspective, the economic conditions have had a dominant role in the evolution of humanity, the other conditions cannot be ignored today any longer, the economic component being the essential component of development.

The core concept of sustainable development is the interaction between population, economic progress and potential of natural resources, highlighting the key issues arising from: optimizing the needs-resources ratio, goals to be achieved, the necessary means, based on mutual compatibility over time and space.

The overall objective of sustainable development is to find an optimal of interaction and compatibility of four systems: *economic, human, environmental and technological*, in a dynamic and flexible functioning process. The optimum level corresponds to that long-term development that can be sustained by the four systems. For the system to be operational, it is necessary that such support or viability to be amplified in all the subsystems forming the four dimensions of sustainable development - starting from the energy, agriculture, industry to investments, human settlements and biodiversity.

We talk therefore of human resources capacity to support the development of human society for an indefinite period i.e. sustainable use of natural resources (Allaby, 1998) within the carrying capacity limit. In this context we talk about development to ensure development of human socioeconomic system on a continuous path without affecting the existence of future generations within the carrying capacity limits. The practical application of this perception of sustainable development has triggered a pragmatic definition of it that involves integrating environmental policies in economic and social development policies at all levels in a holistic manner through economic, political and technological strategies. (Barbier, 1987, pp. 101-111)

Thus the concept of sustainable development assumes the balance of the four key dimensions, which are really the pillars of sustainable development that may be retained under the name of the four 'D's of sustainable development, namely sustainable human, social sustainability, economic sustainability, environmental sustainability.

The set of indicators used in this research will attempt to answer these four dimensions of sustainable development, thus being selected some profound interdisciplinary indicators as follows:

Selected indicator	Utility	Application
Number of active entrepreneurs	Allows the dynamics analysis of the private sector and its development trends.	Local/regional level
Area of artificial regeneration	Analysis of the measures taken for environmental conservation and development.	Local authorities' policies regarding environmental protection.
Municipal waste recycling rate collected	Analysis of local public services in terms of waste collection	Local/regional level
The coverage degree of population to garbage collection services	Easiness of access to sanitation services	The development level of local public sanitation services
Population connected to wastewater treatment system	Facilitating access to wastewater treatment mechanisms.	The degree of local/regional development

3.2. Public Health, Education and Training

The development is based on human resources, so that locally there should be responsibilities regarding qualification of the workforce and increasing the capacity to adapt to environmental changes. In education and training, local development processes must take into account seven items (Morin, 1999): The need of introduction and development of applied studies; Promoting a knowledge able to grasp global issues, fundamental, to be able to incorporate local knowledge; The human condition should be the center of learning processes; Knowing the identity and human development; Education should eliminate uncertainties; Education should develop understanding; Education should contribute to the link between individual and society.

Romania passed after 1989 to a system of democratic education – in the sense that it serves to maintain and develop the identity of those educated/trained, national, social, cultural, religious values of the person and the people they belong to, of the society, culture, religion, geographical space, which takes place in the context of education and teaching, with ample openings to the values of humanity.

The educational ideal of Romanian school is the free, integral and harmonious human individuality development, in the formation of autonomous and creative personality. Education aims at the formation of human personality through: acquiring scientific knowledge, the values of national and universal culture; formation of intellectual capacities, affective availabilities and practical skills through assimilation of humanistic, scientific, technical and aesthetic knowledge; assimilation of intellectual work techniques necessary for instruction and lifelong self-instruction; a culture of respect for human rights and fundamental freedoms, dignity and tolerance and free exchange of views; sensitivity towards human problems, moral and civic values against, respect for nature and the environment; the harmonious development of the individual through physical education, hygienic-sanitary education and sports; professionalization of the young generation through useful activities that produce material and spiritual goods.

Thus to ensure a sustainable development, central and local authorities should focus primarily on two fundamental areas such as **Education and Training and Public Health.**

The development of integrated measures which have as their main effect local/regional development will have to start from the peculiarities of the two main areas of development, bearing in mind their development tendencies.

The proposed set of indicators for consideration in the two areas of development is aiming:

3.2.1. Public Health

Selected indicator	Utility	Application
Mortality rate	Demographic evolution	Developing of certain local/regional public policies.
Infant death rate	Demographic evolution	Developing of certain local/regional public policies.
Natural population growth	Demographic evolution	The development of measures to support the birth rate
Number of hospitals beds per 1000 inhabitants	Health system capacity to provide specialized assistance	The functioning of public health services
Number of doctors per 1000 inhabitants	The capacity of the system to provide specialized assistance	The functioning of public health services

3.2.2. Education and Training

Selected indicator	Utility	Application
Economically active population	The capacity to implement development trends	Local/regional level
Employment rate	Monitoring the employment rate	Developing regional local measures that contribute to increasing the employment rate
The education level of adults 25-64 years	Identification of possible development directions	Developing training programs at the local/regional
Individuals level of computers skills	Computer using degree at local / regional level	Developing training programs at the local/regional
The total school population on macro regions, regions of development and counties	Demographic evolution	Preparing local/regional educational system depending on the fluctuations in the level of school population.

Conclusions

This research aims to draw the attention *to the need of developing a unitary tool for constant monitoring of fluctuations in the process of regional development, called polar diagram*, tool that can then be the basis for the implementation of sectoral policies designed to contribute to the elimination of inter and intra-regional disparities.

Thus building on the results achieved by applying the *polar diagram* we can identify underdeveloped areas within a certain development region relative to other developing regions. Measures can be implemented to contribute to ensuring a balanced development process in the eight development regions.

The aimed *impact* is that through the polar diagram to create a documentary that would be the basis of an objective mean of information for academia and the public/private sector on fluctuations recorded in the regional development process in Romania.

Notes

(1) Project Manager – Exploratory Research Project Director "Polar diagram – Tool of regular assessment of the degree of regional development" – Project financed by the National School of Political Science and Public Administration, Faculty of Public Administration.

(2) Research assistant in the project "Polar diagram – Tool of regular assessment of the degree of regional development" – Project financed by the National School of Political Science and Public Administration, Faculty of Public Administration.

(3) Expert consultant in the project "Polar diagram – Tool of regular assessment of the degree of regional development" – Project financed by the National School of Political Science and Public Administration, Faculty of Public Administration.

References

Androniceanu, A. (2007). *Sisteme administrative în statele din Uniunea Europeană. Studii comparative.* Ed. Universitară. Bucharest. Romania.

Anghelache, C., Isaic-Maniu, A., Mitrut, C. and Voineagu, V. (2006). Sistemul de indicatori utilizați în măsurarea sărăciei. *Economie teoretică şi aplicată.* No. 8(503). Bucharest, Romania, retrieved on January 27, 2011 from http://www.ectap.ro/articol.php?id=135&rid=8

Ciutacu, C. (2010). Working poor in Europe – Romania. Institute of National Economy, Romanian Academy, Romania, retrieved on January 26, 2011 from http://www.eurofound.europa.eu/ewco/ studies/tn0910026s/ro0910029q.htm

Dincă, D. and Dumitrică, C. (2010). *Dezvoltare şi planificare urbană.* Ed. Pro Universitaria. Bucharest.

Dinu, T. (2009). Marketingul social – o viziune 3D. The Annals of the Eftimie Murgu University Reşiţa. Faculty of Economic and Administrative Sciences. Eftimie Murgu Publishing House. Reşiţa.

Dinu, T. (2010). Public pricing decision on covering social costs. Proceedings of the 9th International Congress of IAPNM. Bucharest. Retrieved on February 21. 2011 from http://www.admpubl.snspa.ro/iapnm_congress/diverse/Proceedings_Regulation%20and%20Best%20Practices.pdf

Fiala, P. (1997). *Models of Cooperative Decision Making* – Multiple Criteria Decision Making – Proceedings of the Twelfth International Conference. Haegen (Germany) Gunter Fandel, Tomas Gal (Eds.) in collaboration with Thomas Hanne. Lecture Notes in Economics and Mathematical Systems 448. Springer

FOA R (2011). Indices of Social Development. Handbook. ISS The Hague. Retrieved on 24 June. 2015 from http://www.academia.edu/1850055/Indices_of_Social_Development_Handbook

Holden, A.C. (2002). IMF Initiative to Reduce Poverty: Social Marketing to Make Globalization Work Better for All. A paper presented at the CJBE 5th Annual Conference (July 19-20, 2002) at Saint Joseph's University. Philadelphia. Retrieved on January 26. 2011 from http://www.iajbs.org/resources/187.pdf

Kotler, P. and Caslione, J.A. (2009). *Chaotics – Management şi marketing în era turbulenţelor.* Publica Publishing House. Romania.

Kotler, P. and Lee, N.R. (2009). Up and Out of Poverty. The Social Marketing Solution. Wharton School Publishing. Pearson Education. USA.

Kotler, P. and Zaltman, G. (1971). Social Marketing: An approach to Planned Social Change. *Journal of Marketing*, Vol. 35 (July, 1971). pp. 3-12. Retrieved on January 28. 2011 from http://www.sfu.ca/cmns/faculty/laba_m/425/07-fall/documents/Kotler-Zaltman.PDF

Lustig, N. and Walton, M. (2009). Crises and The Poor: A template for Action. The World Bank. Washington DC. Inter-American Development Bank. Retrieved on January 27. 2011 from http://siteresources.worldbank.org/INTPOVERTY/Resources/WDR/malaysia/lustigwalton.pdf

Matei, L. (2004). *Servicii publice.* Ed. Economică. Bucureşti.

Matei, L. and Matei, A. (2010). Local employment policies in the context of the economic crisis. Influences of the European Community structural instruments. *Journal of Economic Policy and Research.* Vol. 6. No. 1. pp. 48-73. October 2010-March 2011. Retrieved on February 5. 2011 from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1619964

Morin, E. (1999). Les sept saviors nécessaires à l'éducation du future. ONU for education. Science and culture.

Munda, G., Nijkamp, P. and Rietveld, P. (1993). Information Precision and Multicriteria Evaluation Methods. In Williams, A. and Giardina, E. *Efficiency in the Public Sector – The Theory and Practice of Cost-Benefit Analysis.* Ed. Edward Elgar. Anglia. Marea Britanie. University Press. Cambridge.

Profiroiu, M. (2002). Accelerarea reformei administraţiei publice. *Revista Transilvană de Ştiinţe Administrative*. VIII.

Siddique, M.H. (2010). NGOs and poverty issues in peri-urban areas. *Economia. Management Series.* Vol. 13. Nr. 1. Retrieved on January 27. 2011 from http://www.management.ase.ro/reveconomia/2010-1/8.pdf

Eurostat Methodologies and Working Papers (2010). In-work poverty in the EU. European Commission. Retrieved on February 11. 2011 from http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-10-015/EN/KS-RA-10-015-EN.PDF

Eurostat Statistical books (2010). Income and living conditions in Europe. Edited by Atkinson, A. and Marlier, E. European Commission, retrieved on February 11. 2011 from http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-31-10-555/EN/KS-31-10-555-EN.PDF

Global Monitoring Report (2009). A Development Emergency. The International Bank for Reconstruction and Development/The World Bank and the International Monetary Fund. Retrieved on January 26. 2011 from http://siteresources.worldbank.org/INTGLOMONREP2009/Resources/5924349-1239742507025/GMR09_book.pdf

Ministry of Labor, Romania (2009). Social Inclusion Programs Direction, retrieved on February 24. 2011 from http://www.mmuncii.ro/pub/imagemanager/images/file/Domenii/Incluziune%20si%20asistenta%20sociala/Raportari%20si%20indicatori/100809Analiza_indemn_ cr_%20 copil_martie%202009.pdf

ODI Briefing Paper (2009). The global financial crisis: Poverty and social protection. Evidence from 10 country case studies. Overseas Development Institute. Retrieved on June 18. 2015 from http://www.unicef.org/eapro/The_global_financial_crisis_-_poverty_and_social_protection_evidence_from_10_country_case_studies.pdf

Report No. 48665 – RO (2009). Country Partnership Strategy for Romania for the period July 2009-June 2013. The International Bank for Reconstruction and Development/The World Bank and The International Finance Corporation, retrieved on January 26, 2011 from http://siteresources.worldbank.org/ROMANIAEXTN/Resources/275153-1253883114942/ CPS0913_Full.pdf

Unicef, World Bank (2009). România – O evaluare rapidă a impactului crizei economice asupra sărăciei. Retrieved on March 16. 2011 from http://www.unicef.org/romania/ro/Impactul_ crizei_2009.pdf

http://epp.eurostat.ec.europa.eu, accessed on January 26, 2011

http://www.fmi.ro/index.php?lg=en&programs, accessed on February 26, 2011

http://www.insse.ro, accessed on January 26, 2011

http://www.povertynet.org/, accessed on January 27, 2011

http://www.unfpa.ro/?limba=En, accessed on February 26, 2011

http://www.un.org/millenniumgoals/, accessed on June 18, 2015

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 57-76

The relationship between output and asset prices: A time – and frequency – varying approach

Chi-Wei SU
Ocean University of China, Qingdao, China
cwsu7137@gmail.com
Zong-Liang YAO
Ocean University of China, Qingdao, China
Hsu-Ling CHANG
Ling Tung University, Taichung, Taiwan

Abstract. *This paper employs wavelet analysis to examine the relationship between the U.S. output and asset prices. We use the theory of the monetary transmission mechanism to explain the relationship between them. Wavelet analysis takes the simultaneous examination of co-movement and causality into account in both the time and frequency domains. We do find the positive correlation between each two series in the time domain. More specifically, the output and asset prices including oil, stock and house prices exhibit positive co-movement in the most of the sample period. However, the relationship between output and gold prices is a positive correlation for only a few years. From the frequency domain, output and stock, house prices correlate with each other across different frequencies. In addition, output and oil prices correlate at middle (medium run) and higher (short run) frequencies and output and gold prices correlate at higher (short run) frequencies. These findings offer important implications analysing how to apply assets prices to forecast output and analysing periodic variation of economic growth and economical sustainability for policymakers and practitioners.*

Keywords: Gold Prices, Oil Prices, House Prices, Stock Prices, Output; Wavelet Analysis, Frequency Domain, Time Domain.

JEL Classification: C22, F36.

1. Introduction

This paper aims to provide some innovative insights on the relationship between the output and asset prices including gold, oil, house and stock prices in U.S. We use the theory of the monetary transmission mechanism to explain the relationship between them. In the U.S. economy, gold, oil, real estate and stock holdings comprise the principal components of wealth. Movements in their market values can dramatically affect the economic condition of families and business and, hence, affect the overall sustainable growth of the U.S. economy. In addition, as one of the important policy goal variables, output has been paid great attention by scholars and policymakers and is helpful for analyzing economic sustainability. For example, potential output is fundamental to the Phillips curve, which indicates the inverse relationship between unemployment and inflation. When real output rises above its equilibrium level, the economy is overheated and inflationary pressures amplify; when real output falls below it, the economy confronts the risk of disinflation. According to output and asset prices, forward-looking, useful information such as the trend of future economic activity, especially the future changes in output and/or inflation can be provided by asset prices (Stock and Watson, 2001; Gupta and Hartley, 2013). Furthermore, in order to achieving sustainable economic growth, it is bound to be analyzed the relationship between output and these asset prices. In the past decades, papers which analyze the relationship between output and these asset prices have emerged largely (Raja and Saumitra, 2009; Miller et al., 2011; Apergis et al., 2013; Kakali and Sajal, 2014, etc.). This paper employs wavelet analysis to identify co-movements and causality in the time and frequency domains between them in the U.S., deriving new insights and implications for investment strategies and market forecasts.

Oil is arguably an influential commodity with extraordinary ramifications for the real economy and financial markets and oil market is certainly the most influential commodity market. Furthermore, the U.S. acts as the biggest oil consumer and importer in the world and its oil industry is the pillar of the sustainable economy. So oil prices volatility in the U.S. are always an indispensable factor of studying economic development in the context of sustained economic growth and have a close relationship with output. In addition, oil acts as a non-renewable resource and is an important factor in achieving sustainable economic growth, so it is essential to analyse the relationship between output and oil prices. Forward-looking, Mork (1989) finds that the negative correlation between output and oil prices is in fact not statistically significant when the sample size of Hamilton's model is extended to include the oil collapse in 1986. However, the collapse of oil prices around the mid-1980s does not lead to an expansion in economic activity, and this triggers a new debate on the existence of an asymmetric relationship between output and oil prices. The asymmetric relationship suggests that oil prices shocks would have a larger negative impact on output than oil prices decline. Mork et al. (1994) have confirmed the validity of a similar type of asymmetric behavior for the OECD countries. Their results have revealed that increasing in oil prices seems to have a negative impact on economic growth in the U.S. to a larger extent, although the U.S. does not depend on imported oil compared to other developed countries, such as Germany, France, and Japan. In addition, Alessandro and Matteo (2009) find that the asymmetric effects of oil shocks on output growth do exist for the G-7 countries. Nazif and Ozelm (2013) suggest

relationship between oil prices and macroeconomic activity is nonlinear and exhibits an asymmetric pattern, that is, oil price changes have a significant effect on inflation and output when the change exceeds a certain threshold level.

As for stocks, they own two main features, that is low transaction cost and high liquidity, and thus act as one of the most convenient investment vehicles. Sustainable capital markets are also critical of the economic sustainability. Recently, the financial crisis and Great Recession see a remarkable stock market crash, causing the U.S. and the world economy to suffer huge financial losses. So stocks prices in the U.S. are always an indispensable factor of achieving economic sustainable development and have a close relationship with output. Ram and Spencer (1983) think there is a negative relationship between real output and real stock prices. On the contrary, Fama (1981) and Raja and Saumitra (2009) obtain that there is a positive relationship between real output and real stock prices. In addition, the correlation between real economic activity and lagged real stock prices in the U.S. is positive and both statistically and economically significant by Barro (1990) and Schwert (1990). A similar relationship holds in Canada (Barro, 1990) and the G-7 (Choi et al., 1999).

Real estate has an important role for promoting the development of steel, home appliances, household goods and other industries and real estate is closely related to the stability of financial sector and the upgrading of consumption structure. In addition, housing market situation could have impact on the regional demographic changes, such as household formation, age group structure and household size structure. The demographic structure and trend are important features of social sustainability. In the U.S., housing assets is a widely held assets, housing wealth (non-housing wealth) is 37.78 percent (41.04 percent) of the U.S. household's total assets, and 47.93 percent (52.07 percent) of the U.S. household's total net worth. However, we know that the U.S. subprime mortgage crisis is a nationwide banking emergency that coincides with the U.S. recession of 2007:12-2009:06[(1)]. It is triggered by a large decline in home prices, which spark a price bubble and collapse in the housing market and then lend fiasco and the financial crisis and destroy the economic sustainability. Many scholars argue that these events cause the dramatic changes in the behavior of financial and economic markets, even extending to global financial markets and economies. In addition, many studies have demonstrated the impacts of house market on economic through the investment effect, and that increase in house price will attract investment, as a result of capital gain expectation, and hence economic sustainable development. So policy makers generally agree that house prices play an important role in stimulating the growth or declining of an economy. For example, Miller et al. (2011) suggest that the strong housing market during the 2001 stock market crash may have increased the output and saved the U.S. economy from a severe recession and that the recent collapse of the housing market initiated the Great Recession. In recent years, a growing literature obtains the importance of the relationship between the housing market and the macro economy, suggesting that the interaction between house prices and economic growth imbeds important policy implications (Andrea and Claudio, 2010; Wendy et al., 2013). To identify whether house prices and output are integrated or segmented, a number of studies examine the spillover

effects of the real house prices on consumption in the U.S. (Carroll, 2004; Campbell and Cocco, 2007; Mian and Sufi, 2011; Guerrieri and Iacoviello, 2013; etc.). Beltratti and Morana (2010) find that the US is an important source of global fluctuations for real housing prices. They think global supply-side shocks are an important determinant of G-7 house prices fluctuations. The linkage between real housing prices and macroeconomic developments is bidirectional, with investment showing in general a stronger reaction than consumption and output to housing prices shock. Moreover, Demary (2010) investigates the link between the real house prices and key macroeconomic variables, including output, and concludes that the real house prices significantly affect output. Miller et al., (2011) conclude that changes of house prices significantly affect Gross Metropolitan Product (GMP) growth, and the effect of predictable changes (the collateral effect) generate about three times the effect of unpredictable changes (the wealth effect). More recently, Apergis et al. (2013) find two-way causality between output and house prices across the U.S. metropolitan areas, but they require pre-testing for cointegration and stationarity. Besides, Wendy et al. (2013) find that while the real house prices leads real GDP per capita, in general (both during expansions and recessions), significant feedbacks also exist from real GDP per capita to the real house prices.

Besides, gold is thought as one of the most attractive investment options, although as a commodity it does not add much values to the productive capacity of the economy. Whereas currency depends on the strength of the economy, during times of financial crisis, such as a stock market crash, high inflation, recession, depreciating exchange rates, or other financial insecurity, gold is seen as a safe way to hold the value of one's worth or to preserve the value of one's assets and promote socio-economic development and stability in sovereign reserve portfolios. So the characteristic of gold lets many researchers to focus on the gold market and its influences on the economy. To analysis the distribution characteristics and nonlinear structure of gold prices, we can initially obtain the relationship between output and gold prices. For example, Manu and Rajnish (2012) find that when individual GDPs are regressed with gold prices, the gold prices are least correlated with Italy's GDP but highly correlated with Brazil's GDP. The gold prices are only moderately correlated with the U.S. GDP even though the U.S. has the world's highest gold holdings. However, Kakali and Sajal (2014) investigate cointegrating relationship between gold import demand, gold prices and GDP for Indian economy, they also estimate short-run and long-run elasticities of gold import demand with respect to gold prices and GDP and find that they have cointegrating relationship.

As for methodology, wavelet analysis possesses significant advantages over conventional time-domain methods. It expands the underlying time series into a time-frequency space where researches can visualize both time- and frequency-varying information of the series in a highly intuitive way. Moreover, wavelet coherency and phase differences simultaneously assess how the correlation and causalities between the U.S. output and gold prices, oil prices, house prices, stock prices vary across frequencies and change over time in a time-frequency window. In this way, we can observe higher frequency (short run), middle frequency (medium run) and lower frequency (long run) relationships between each two series as well as possible structural changes and time-variations in such relationship. This method has been widely used in aspect of economic. For example,

Goffe (1994) and Ramsey and Lampart (1998; 1998) have presented applications of wavelet analysis in economics and finance. More recent study, however, focuses on the correlation between stock markets as well as between energy commodities and macroeconomy (Rua and Nunes, 2009; Graham and Nikkinen, 2011; Aguiar-Conraria and Soares, 2011; McCarthy and Orlov, 2012; Loh, 2013; etc.). To the best of our knowledge, limited work so far simultaneously applies wavelet analysis to the relationship among output and these asset prices.

On one hand, the time- and frequency-varying features in such relationships can provide important practical implications for analysing the phenomenon of macroeconomic and achieving the economic sustainability. Time-varying co-movement means that the trends of variety and diversification benefits of macroeconomic evolve over time and, thus, economist should incorporate such effects when evaluating the trends, risk and returns of these macroeconomics. On the other hand, frequency-varying co-movement implies that economic analysts with different economical horizons should consider the co-movement at corresponding frequencies representing short, medium or long run so as to allocating economic phenomenon more effectively. What's more, the time- and frequency-varying features in the causality can also significantly affect the accuracy of market performance prediction and, hence, affect the regulatory benefits to policymakers and the comprehensive of analysing the phenomenon of economy and achieving the economic sustainability. For example, a recent study by Zhou (2010) stresses the importance of the time- and frequency-variation in the assessment of the relationship between the U.S. real estate and stocks markets.

Compared with papers in literature review, we conclude that there almost have no the research and related literatures that simultaneously analyze relationship between these four asset prices and output, and that simultaneously analyze dynamic correlation and causalities between them. In addition, methods[(2)] that most of previous studies use almost are, however, the conventional time-domain methods, they do not explore the frequency-variation in such relationships by these time-domain approaches while the time- and frequency-varying features in such relationships can provide important practical implications for portfolio management. Aiming at these problems, our paper utilizes a novel wavelet analysis to explore the relationship between output and asset prices in the U.S. in both the time and frequency domains with the help of the U.S. monthly data ranging from 1986:01 to 2015:03. Subsequently, we execute a simultaneous assessment of the co-movement and causal relationships between the U.S. output and these four asset prices.

This empirical study does find the positive co-movement between output and asset prices including oil prices, stock prices, house prices and gold prices indicated by the phase difference. This result is consistent with the results of theoretical derivation of the monetary transmission mechanism. More specifically, from the time domain, the output and asset prices including oil prices, stock prices and house prices exhibit positive co-movement in the most of the sample period. However, the relationship between output and gold prices is a positive correlation for only a few years. From the frequency domain, the output and stock prices, house prices correlate with each other at the short, medium

and long run horizon. In addition, the results implies that combining output and oil prices achieves diversification generally at the short and medium run horizon, output and gold prices at the short run horizon.

This study proceeds as follows. Section 2 briefly introduces the theory of monetary transmission mechanism. Section 3 explains the methods about wavelet. Section 4 describes the corresponding data. Section 5 presents the empirical results. Section 6 concludes and policy implications.

2. The Theory of Monetary Transmission Mechanism & Wavelet Theory and Methods

Tobin's q-theory (Tobin, 1969) offers an important mechanism for how movements in asset prices could affect the economy. Tobin's q is defined as the market value of firms divided by the replacement cost of capital. Q is high, that is, the market price of firms is high relative to the replacement cost of capital, and new plant and equipment capital is cheap relative to the market value of firms. Companies can then issue asset and get a high price for it relative to the cost of the facilities and equipment they are buying. Investment spending will rise because firms can now buy a lot of new investment goods with only a small issue of asset.

The key of the Tobin q-model is that a link exists between stock prices and investment spending. Higher stock prices will lead to higher investment spending, leads to the following transmission mechanism which can be described by the following schematic:

$$P_s \uparrow \Rightarrow q \uparrow \Rightarrow I \uparrow \Rightarrow Y \uparrow ,$$

where a rise in stock prices($P_s \uparrow$) can increase company's profit, that is, raises q ($q \uparrow$) and then raises investment ($I \uparrow$), thereby leading to an increase in aggregate demand and a rise in output($Y \uparrow$).

McCarthy and Pench (2001) suggest that the model of housing expenditure is really a variant of Tobin's q-theory in which q for housing investment is the price of housing relative to its replacement cost. With a higher price of housing ($P_h \uparrow$) relative to its construction cost, construction firms find it more profitable to build housing, and thus housing expenditure will rise ($H \uparrow$) and so aggregate demand will rise ($Y \uparrow$).This transmission mechanism is then described by the following schematic.

$$P_h \uparrow \Rightarrow H \uparrow \Rightarrow Y \uparrow .$$

Analysis of the monetary transmission mechanism of fluctuations in oil prices on the impact of output is that raise of oil prices (denoted by $P_o \uparrow$) can stimulate surging in inflation ($P \uparrow$) and then we infer interest rate will fall ($r \downarrow$) according to Fisher equation (The Fisher Equation is used in economic theory to explain the relationship between interest rates and inflation. The theories behind it were introduced by American economist Irving Fisher.), leading to a drop in the exchange rate ($E \downarrow$), the lower value of the domestic currency makes domestic goods cheaper than foreign goods, thereby causing a rise in net exports ($NX \uparrow$) and hence in aggregate spending ($Y \uparrow$). That is,

$P_o \uparrow \Rightarrow P \uparrow \Rightarrow r \downarrow \Rightarrow E \downarrow \Rightarrow EX \uparrow \Rightarrow Y \uparrow$.

Gold prices rise (denoted by $G \uparrow$), which lowers interest rates ($r \downarrow$), which raises investment ($I \uparrow$), thereby leading to an increase in aggregate demand and a rise in output ($Y \uparrow$).This transmission mechanism is then described by the following schematic.

$G \uparrow \Rightarrow r \downarrow \Rightarrow I \uparrow \Rightarrow Y \uparrow$.

Wavelet analysis which is an alternative to the well-known Fourier analysis has stemmed from in the mid-1980s. In terms of methods, wavelet analysis that takes the simultaneous examination of co-movement and causality into account in both the time and frequency domains owns significant advantages over conventional time-domain methods. In spite of Fourier analysis can discover how relations vary across frequencies using spectral techniques, the time-localized information is discarded by the Fourier-transform analysis. In addition, Fourier analysis is no longer in force for non-stationary series. In contrast, wavelet analysis conducts the estimation of spectral characteristics of a time series as a function of time [38]. Moreover, it exhibits a significant advantage compared with Fourier analysis for non-stationary or locally stationary series (Roueff and Sachs, 2011).

2.1. Continuous wavelet transform

Using the wavelet transform, a time series is decomposed into some basis wavelets, which are stretched and translated versions of a given mother wavelet localized in both the time and frequency domains. In this way, the time series expands into a time-frequency space where its oscillations appear in a highly intuitive way. At this point, two kinds of wavelet transforms, discrete wavelet transforms (DWT) and continuous wavelet transforms (CWT), usually exist. The DWT can reduce noise and decomposes data whereas the CWT extracts information and detects data self-similarities (Grinsted et al., 2004; Loh, 2013)(3). In this paper, we choose the CWT to decompose the concerned series into wavelets. The CWT of a given time series $x(t)$ is defined as a convolution type:

$$W_x(u,s) = \int_{-\infty}^{+\infty} x(t)\psi_{u,s}^*(t)dt \tag{1}$$

where $\psi_{\tau,s}^*(t)$ is the complex conjugate function of $\psi_{\tau,s}(t)$ which is called the basis wavelet function. As has been noted, the basis wavelet comes from a given mother wavelet, represented by $\psi(t)$, that is:

$$\psi_{u,s}(t) = \frac{1}{\sqrt{s}}\psi\left(\frac{t-u}{s}\right) \tag{2}$$

where S is the wavelet scale that controls how the mother wavelet is stretched or dilated, and u is the location parameter that determines the exact position of the wavelet. By changing the scale parameter (S) and translating along the localized time index (u). In addition, we define $x(t)$ as:

$$x(t) = C_\psi^{-1}\int_0^{+\infty}\left[\int_{-\infty}^{+\infty} W_x(u,s)\psi_{u,s}(t)du\right]\frac{ds}{s^2}, \quad s>0 \tag{3}$$

Torrence and Compo (1998) suggest one can construct a photo representing how the amplitudes of $x(t)$ vary across scale and over time.

Three conditions must be fulfilled in a mother wavelet of the CWT: First, $\int_{-\infty}^{+\infty}\psi(t)dt=0$, that is, the mean of $\psi(t)$ must equal zero, which makes sure that it oscillates across positive and negative values near zero and, thus, is nonzero locally; Second, $\int_{-\infty}^{+\infty}\psi^2(t)dt=1$, that is, its quadratic sum must equal one, which suggests a limitation to an interval of time; Third, it must satisfy the admissibility condition, that is:

$$0<C_\varphi=\int_0^{+\infty}\frac{\left|\tilde{f}(\omega)\right|}{\omega}d\omega<+\infty \tag{4}$$

where $\tilde{f}(\omega)$ is the Fourier transform of the mother wavelet $\psi(t)$.

In wavelet theory, the most popular and applicable mother wavelet for feature extraction is the Morlet wavelet[(4)] which is introduced by Grossman and Morlet (1984), that is:

$$\psi^M(t)=\pi^{-1/4}e^{i\omega_0 t}e^{-t^2/2} \tag{5}$$

where $\pi^{-1/4}$ ensures the second condition is satisfied and $e^{-t^2/2}$ ensures the third condition is satisfied. According to Aguiar-Conraria and Soares (2013), the Fourier frequency $f(s)$ is given by $f(s)=\omega_0/2\pi s$ [43]. In particular, when the dimensionless frequency satisfies $\omega_0=6$, the Morlet wavelet attains optimal trade-off between time and frequency localization. Therefore, this paper supposes $\omega_0=6$, we obtain the relationship between the wavelet scale S and the Fourier frequency f through derivation:

$$f=6/2\pi s\approx 1/s \tag{6}$$

As a result, equation (6) implies that $x(t)$ decomposes into a joint time-frequency plane where the shorter wavelet scale corresponds to the higher frequency and the longer wavelet scale corresponds to the lower frequency. Moreover, since the Morlet wavelet is a complex wavelet, the CWT is split into real and imaginary parts, we can calculate the amplitudes and phases of the CWT for further estimations of wavelet power spectrum, wavelet coherency and phase difference.

2.2. Wavelet power spectrum

In wavelet theory and practice, the wavelet power spectrum of one series $x(t)$, namely the auto-wavelet power spectrum, is defined as equation (3). For simplicity, we simply defined $x(t)$ as $\left|W_x(u,s)\right|^2$. It introduces a measure of the localized volatility of $x(t)$ at each scale or frequency. Furthermore, since Hudgins et al. (1993) first define $W_x(u,s)$

and $W_x(u,s)$ which are the continuous wavelet transforms of $x(t)$ and $y(t)$ as $W_{xy}(u,s) = W_x(u,s)W_y^*(u,s)$, where the symbol * denotes a complex conjugate. So the cross-wavelet power spectrum is accordingly written as:

$$\left|W_{xy}(u,s)\right|^2 = \left|W_x(u,s)\right|^2 \left|W_y^*(u,s)\right|^2 \quad (7)$$

The function of cross-wavelet power spectrum is give a measure of the localized covariance between $x(t)$ and $y(t)$ for the specified frequency.

In this paper, the wavelet power spectrum depicts the localized volatility of the U.S. output and these four asset prices as well as estimates the wavelet coherency between each two. Note that, in wavelet power spectrum plots, the wavelet power of these economic variables is marked by color bars between 0 and 1 on the right side, where red colors correspond to high power while blue colors correspond to low power. That is, the color bars also correspond to the localized volatility of the underlying series.

2.3. Wavelet coherency

Wavelet coherency allows for a three-dimensional analysis, which simultaneously thinks about the time and frequency components and the strength of correlation between the time-series components. In this way, we can observe both the time- and frequency-variations of the correlation between series in a time-frequency space. Consequently, the wavelet coherency gets a more accurate results of co-movement between the U.S. output and asset prices in comparison to the conventional correlation analysis as well as the dynamic conditional correlation analysis (Zhou, 2010; Liow, 2012; Loh, 2013). Following the approach of Torrence and Webster (1999), we define wavelet coherency by using the cross-wavelet and auto-wavelet power spectrums as follows:

$$R^2(u,s) = \frac{\left|S\left(s^{-1}W_{xy}(u,s)\right)\right|^2}{S\left(s^{-1}\left|W_x(u,s)\right|^2\right)S\left(s^{-1}\left|W_y(u,s)\right|^2\right)} \quad (8)$$

Here, we calculate wavelet coherency with the above squared type and the smoothing operator S [(5)]. It, by this way, gives a quantity between 0 and 1 in a time-frequency window. Zero coherency implies no co-movement between the U.S. output and asset prices while the highest coherency indicates the strongest correlation among them. In the empirical section, we also clearly mark the squared wavelet coherency with color bars on the right side of the wavelet coherency plots, where red colors correspond to a strong co-movement whereas blue colors correspond to a weak co-movement.

2.4. Phase difference

Because the wavelet coherency is squared, that is, we can only compute positive number, we can't distinguish between positive and negative correlation. Therefore, we subsequently use the phase difference to judge positive or negative correlation as well as

the lead-lag relationships among them. According to Bloomfield et al. (2004), the phase difference characterizes phase relationship between $x(t)$ and $y(t)$ as follows:

$$\phi_{xy}(u,s) = \tan^{-1}\left(\frac{\Gamma\left\{S\left(s^{-1}W_{xy}(u,s)\right)\right\}}{\mathrm{N}\left\{S\left(s^{-1}W_{xy}(u,s)\right)\right\}}\right), with\ \ \phi_{xy} \in [-\pi,\pi] \tag{9}$$

where Γ and N are the imaginary and real parts of the smoothed cross-wavelet transform, respectively.

A phase difference of zero implies that the two underlying series move together whereas a phase difference of $\pi\ (-\pi)$ indicates that they move in the opposite direction. On one hand, if $\phi_{xy}(u,s) \in (-\pi/2, \pi/2)$, it suggests that the series move in phase (positively co-movement). On the country, if $\phi_{xy}(u,s) \in (\pi/2, \pi)$ or $\phi_{xy}(u,s) \in (-\pi, -\pi/2)$, indicating that the series move out of phase (negatively co-movement). On the other hand, if $\phi_{xy}(u,s) \in (0, \pi/2)$ or $\phi_{xy}(u,s) \in (-\pi, -\pi/2)$, it suggests that the series $x(t)$ leads the series $y(t)$. While, if $\phi_{xy}(u,s) \in (-\pi/2, 0)$ or $\phi_{xy}(u,s) \in (\pi/2, \pi)$, then the series $y(t)$ leads the series $x(t)$. In addition, the phase difference can also indicate causality between $x(t)$ and $y(t)$ in both the time and frequency domains. As a consequence, it dominates the conventional Granger causality test, which assumes that a single causal link holds for the whole sample period as well as at each frequency (Grinsted et al., 2004; Tiwari et al., 2013). For example, if $x(t)$ leads $y(t)$, then it suggests a causal relationship running from $x(t)$ to $y(t)$ at a particular time and frequency.

3. Data and Empirical Results

The aim of this paper is to examine the relationship between output and asset prices including gold prices, oil prices, house prices and stock prices in the U.S. and employs the U.S. monthly data ranging from 1986:01 to 2015:03. This sample period covers a series of different market booms and busts in the U.S, as well as different economic recessions and expansions, creating substantial volatility that may provide different outcomes from other less-volatile periods. We use the monthly industrial production index to measure the U.S. output[(6)] and use the prices of WTI[(7)] to get the oil prices. We obtain the Consumer Price Index (CPI), stock prices and Industrial Production Index (INDPRO) from the online data segment of Robert J. Shiller's website[(8)]. In addition, we get the monthly gold prices series from The London Gold Market Fixing Limited (TLGMFL), the monthly house prices[(9)] series and the monthly oil prices from Federal Reserve Bank of St. Louis. To get the data of real industrial production index, the real oil prices, the real stock prices, real house prices and real gold prices, we make the corresponding and original time series to divide the U.S. consumer price index. In order

to obtain more accurate results, all the original data is processed by taking natural logarithms and taking first-differences of the concerned variables, to correct for potential heteroscedasticity and dimensional difference between series and to get month-on-month growth rates of real stock prices, real house prices, real gold prices, real oil prices and real output (using industrial production index).

An "island" which is surrounded by a black coil on the left-hand side of part (a.1) in figures 1-4, shows the significant correlation between each two series at a particular time-frequency (this paper hypothesizes the significant level equals to 5%). The cone-shaped zone at the below of two symmetrical black lines points out the correlation between output and asset prices is easily affected by the edge effect in this region. Color bars on the right-hand side of the wavelet coherency plots display the extent of the correlation between them. In addition, the plot (a.2) shows phase difference between them in the 1 to 4 years' time-frequency and the plot (a.3) states the phase difference between them in the 4 to 8 years' time-frequency. In order to observing relationship between them better, this paper defines the 1 to 2 years' time-frequency as short run, the 2 to 4 years' time-frequency as medium run and the 4 to 8 years' time-frequency as long run.

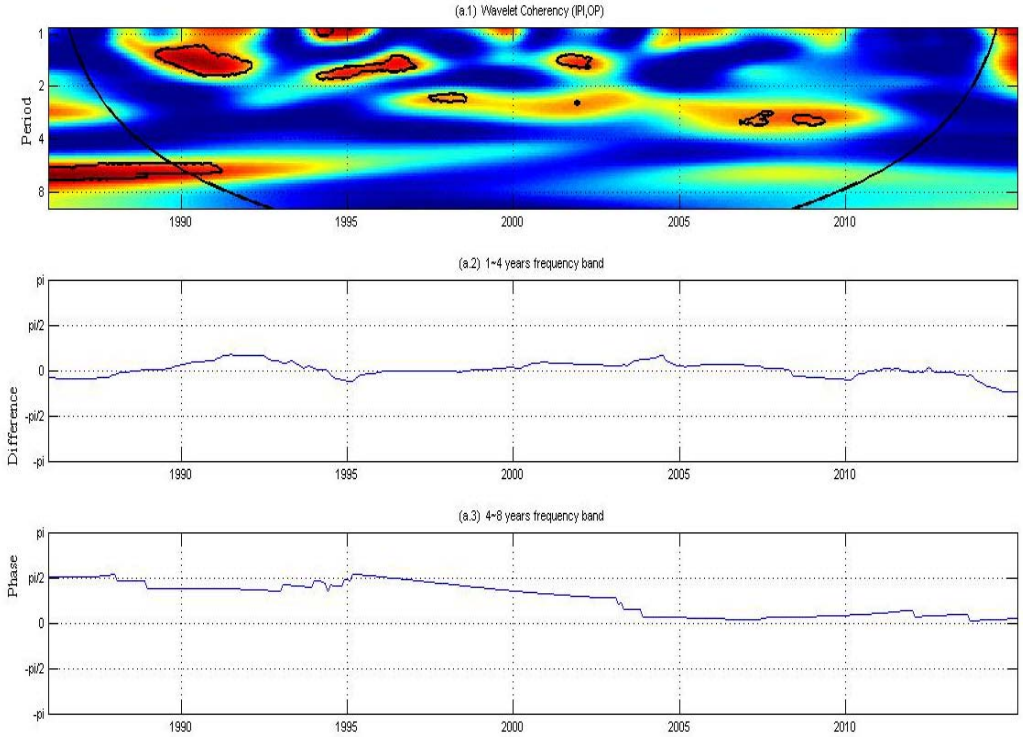
3.1. The relationship between U.S. output and oil prices

Figure 1 shows positive and strong correlation between the U.S. output and oil price. The co-movement, however, does depend on the frequency and is unstable over the period 1986 to 2015, which largely unanimous with Mork (1990) who suggests a negative co-movement between output and oil prices. More specifically, from 1989-1992, the U.S. output and oil prices show an average coherency of 0.9 across the 1-2 year frequency band with an in-phase relation indicated by the phase difference between 0 and $\pi/2$, implying a high degree of co-movement, it, meantime, means that the U.S. output leads oil prices in the short run. In other words, the change of the U.S. output is an important factor which impacts the oil prices. Investigating its reason, we find most of the 1990s in the U.S. as a strong sustained economic growth period and bring with it the oil prices rise from 1989-1992. The result from 1994-1996 is just opposite, that is, the change of oil prices is an important factor which impacts the U.S. output. Then, there is an average coherency of 0.6 with an in-phase relation indicated by the phase difference between 0 and $\pi/2$ across the 2-4 year frequency band during 2002-2004, it shows that the change of the U.S. output, in the context of sustained economic growth, is an important factor which impacts oil prices in the medium run. In this sense, the wave of output has been lagging effected by the earlier period of oil prices in 2002-2004. It is in line with the U.S. situation. For example, the sustained real economic growth continued in 2002 and 2004, when, due to a hike in total factor productivity and industrial capacity utilization, increasing external competitiveness and decreasing unemployment, the output gap closed and the economy subsequently overheated, growing much faster than implied by its potential rate of growth and expediting the oil prices. Furthermore, the output and oil prices show an average coherency of 0.8 across the 1-10 year frequency band during 2006-2015, more specifically, between $-\pi/2$ and 0 from 2008-2011 in 1-4 years frequency band and from 2006-2014 in 4-8 years frequency band. It suggests, in this

period, oil prices mostly lead the U.S. output not only in the short run, but also in medium run, the most important is in the long run. That is, the wave of oil prices is an important reason which impacts the U.S. output in the short run, in the medium run and in the long run. However, we find that the output leads oil prices in the medium run indicated during 2006-2008, it is helpful to explain the realistic economic phenomena that the outlook for the U.S. output increases from 1994-2000, a large portion of capital goes to the crude oil markets and pushes up oil prices from 2006-2008. These results are consistent with the results of theoretical derivation of the monetary transmission mechanism, that is, when oil prices rise, the output will rise and vice versa.

Figure 1. *The wavelet coherency and phase difference between the U.S. output and oil price*

The y-axis refers to the frequencies (measured in mouths); the x-axis refers to the time period over the period 1986:1-2015:3. The color bar on the right side corresponds to the strength of correlation at each frequency.



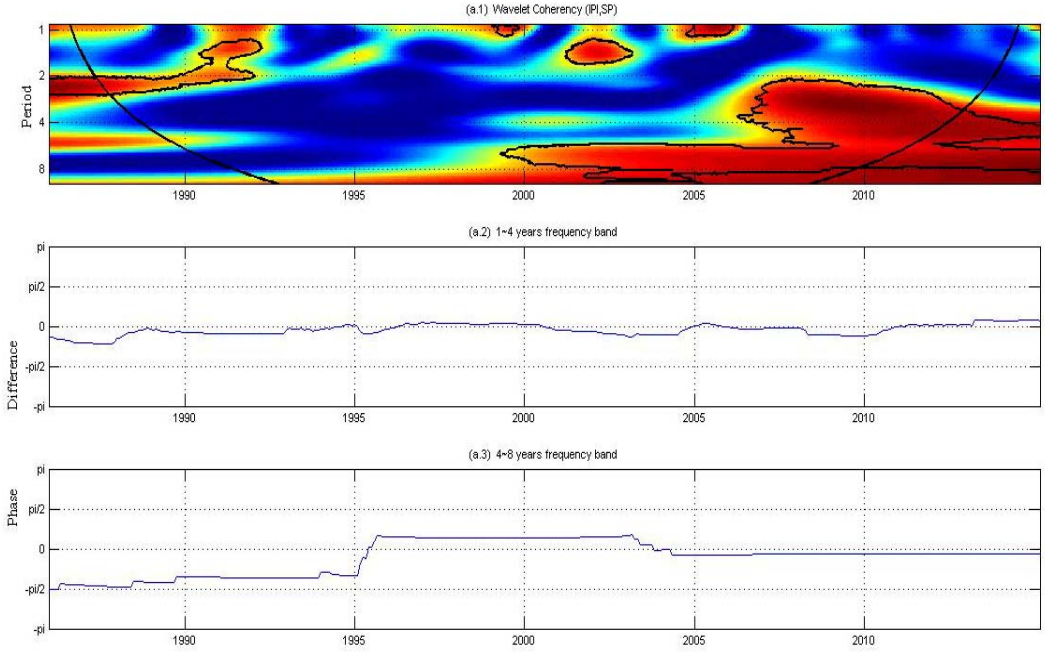
3.2. The relationship between U.S. output and stock prices

Figure 2 shows positive and strong correlation between the U.S. output and stock prices. This finding is according with Carlstrom et al. (2002), which document a two-way causality between stock market and output. When stock prices are climbing, it is often easier for companies and business to obtain financing. In the meanwhile, companies are more likely to expand and hire more employees and thus national output will raise. From 1987-1992, we find that they show an average coherency of 0.8 across the 1-4 year frequency band and they have a high degree of positive co-movement, which largely

unanimous with Barro (1990) as well as Schwert (1990) who suggest a positive co-movement between output and stock prices, and the output will vary with our changes in the stock prices in the short run and in the medium. At the same time, this phase difference is suggest that stock prices affect the U.S. output. Then, we discover that output and stock prices show an average coherency of 0.8 in the period 1995-2003. During this time we can obviously see that they show stock prices will vary with the changes in output in the long run. It is in line with the U.S. situation that most of the 1990s in the U.S. as a strong sustained economic growth period. During 1993-2000, the U.S. exhibited the best economic performance of the past decades. From 1995-2000, stock prices have been rising owing to the lagging influence of output. Furthermore, the U.S. output will vary with the changes in stock prices for the short, medium and long run during 2003-2013. Furkan et al. (2014) explain that economic expansion may signal appropriate time for stock investment, resulting in an increase in stock prices. It well reflects in the real world. For example, when the Dow Jones index rises from 6600 of 2009 to 16000 of 2013, the growth of GDP is 4.1% at the first three quarters of 2013 and then reaches new height since two and a half years. These results are consistent with the results of theoretical derivation of the monetary transmission mechanism, that is, the rise in stock prices will boost output.

Figure 2. *The wavelet coherency and phase difference between the U.S. output and stock prices*

The y-axis refers to the frequencies (measured in mouths); the x-axis refers to the time period over the period 1986:1-2015:3. The color bar on the right side corresponds to the strength of correlation at each frequency.

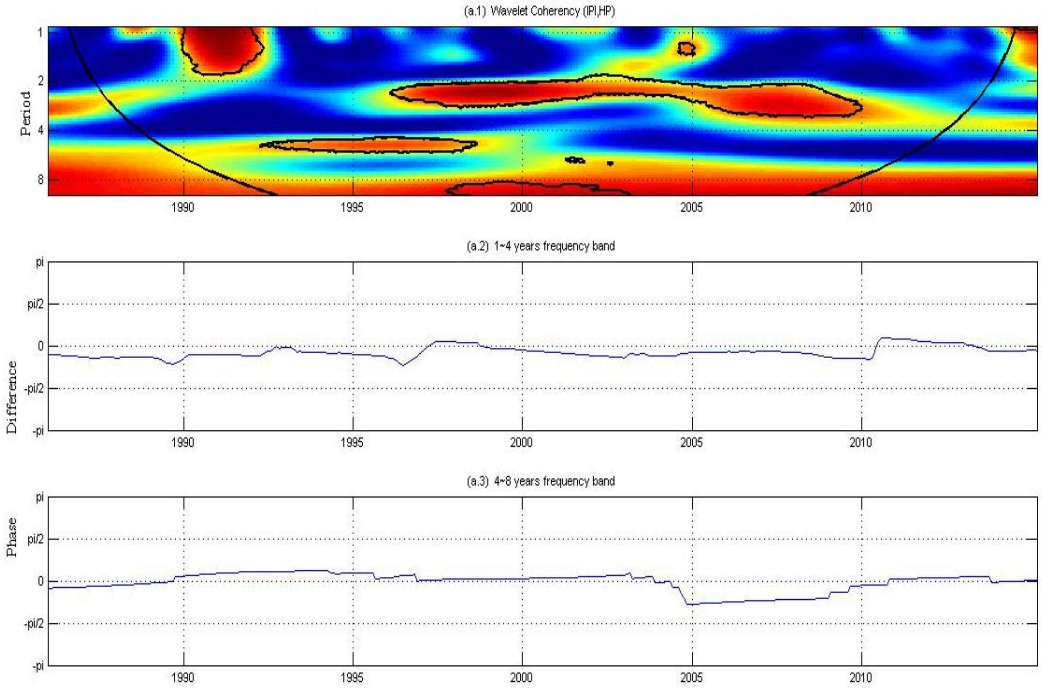


3.3. The relationship between U.S. output and house prices

Figure 3 shows that the relationship between the U.S. output and house prices is nonlinear and exhibits positive correlation. In the period 1990-1992, we first find that they show a obvious coherency of closes to 1 across the 1-2 year frequency band, implying a high degree of positive co-movement and the series of output will vary with our changes in house prices in the short time, which largely contradicts with Demary (2010) and Wendy et al. (2013), who suggest the real house prices affect output. This result is realistic that after a period of economic expansion in the 1980s, the Gulf War and the 1990 oil prices increase weakened the estate economy, leading to a period of brief slowdown in economic growth. Furthermore, we will read that house prices effect output in the short run during 1994-2010. Because the increase of house prices simultaneously increases the value of wealth of home owners. The increase of housing wealth can promote household consumption, which also contributes to economic growth. We also see that output effects house prices in the long run in the period 1994-2004. Furkan et al. (2014) present a reason to explain this relationship, that is, when the economy is in upswing, firms which have a job qualifies for cheap mortgage loan need more office space. This will trigger the demand for housing and then will translate into an increase in house prices. From 2004-2010, we, however, obtain that house prices lead output in the long run, that is, the experience of the financial crisis and Great Recession pushes the real house prices down and then provides the most vigorous response of the long-term variety of output in this period. The real house prices lead output for an extended period prior to the Great Recession. In addition, the cumulative effect of the real house prices on output proves positive and of long duration. Generally speaking, this results show that significant causality from the house prices to real GDP occurs more frequently than significant causality from real GDP to the real house prices. These results show that while the real house prices generally leads real output, both during expansions and recessions, significant feedback effects from the real output onto the real house prices. These findings occur especially during periods of volatility such as the brief recession in the 1990s, as well as, the recent financial crisis and Great Recession. These results are consistent with the results of theoretical derivation of the monetary transmission mechanism, higher house prices will lead to higher output.

Figure 3. *The wavelet coherency and phase difference between the U.S. output and house prices*

The y-axis refers to the frequencies (measured in mouths); the x-axis refers to the time period over the period 1986:1-2015:3. The color bar on the right side corresponds to the strength of correlation at each frequency.

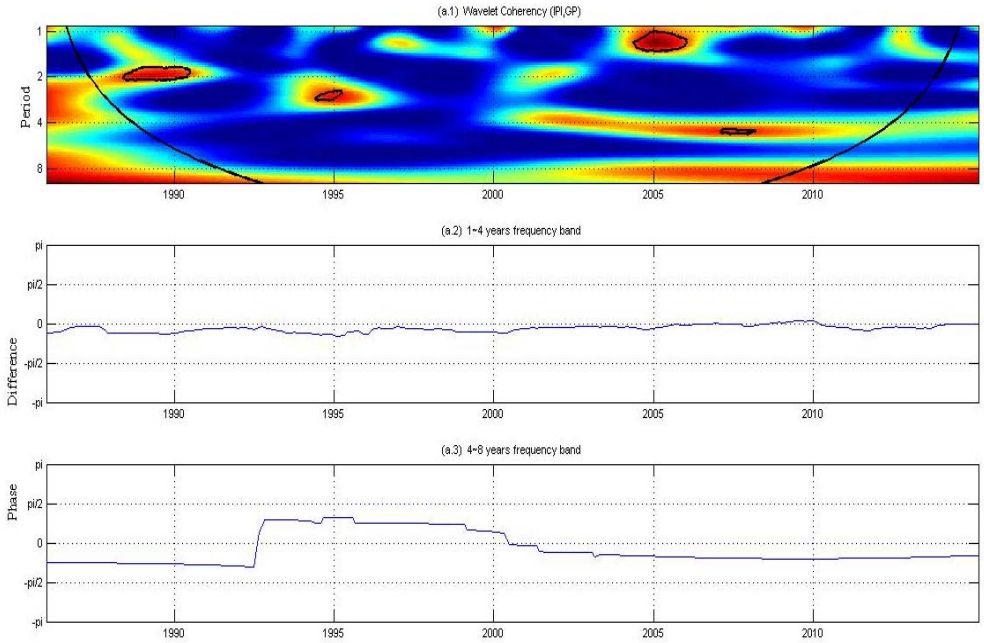


3.4. The relationship between U.S. output and gold prices

Figure 4 shows positive correlation and strong co-movement between the U.S. output and gold prices. More specifically, from 1987-1990,2004-2006,2007-2008 and 2013-2014, the two economic variables show an average coherency of 0.9 across the 1-2 year frequency band and indicated by the phase difference between $-\pi/2$ and 0 , implying gold prices affects the U.S. output in the short run. This result is consistent with the results of theoretical derivation of the monetary transmission mechanism, that is, higher gold prices will cause gold output. In addition, Manu and Rajnish (2012) obtain a similar conclusion, that is, the gold price is only moderately correlated with the U.S. GDP.

Figure 4. *The wavelet coherency and phase difference between the U.S. output and gold price*

The y-axis refers to the frequencies (measured in mouths); the x-axis refers to the time period over the period 1986:1-2015:3. The color bar on the right side corresponds to the strength of correlation at each frequency.



4. Conclusion

This paper employs wavelet analysis to research the relationship between the U.S. output and asset prices including gold prices, oil prices, house prices and stock prices using the U.S. monthly data ranging from 1986:01 to 2015:03. Wavelet analysis allows a simultaneous assessment of co-movement and causality between the every two series in both the time and frequency domains. More specifically, from the time domain, the output and asset prices including oil prices, stock prices and house prices exhibit positive co-movement in the most of the sample period. However, the relationship between output and gold prices is a positive correlation for only a few years. From the frequency domain, the output and stock prices, house prices correlate with each other at the short, medium and long run horizon. In addition, the results implies that combining output and oil prices achieves diversification generally at the short and medium run horizon, output and gold prices at the short run horizon.

These findings provide a more complete picture of the relationship between the U.S. output and asset prices over time and frequency domain, offering important implication to achieving economic growth and economic sustainability for policymakers and practitioners. That is, on one hand, development of the oil, stock, estate and gold market might be an efficient tool to stimulate economic growth and economic sustainability. On the other hand, it is necessary to avoid the over-heating of the economy in response to any positive asset prices shock that may raise the volatility of future GDP growth. More

specifically, when there is a long-term relationship between assets prices and output, and we analyse the change of output in some years, we don't ignore the lag effect and structural changes between the relevant variables in earlier years and policymakers have to distinguish any asset bubble in earlier years to avoid much larger bubble burst in the future. In addition, a sustainable price can be the long-run equilibrium price. An equilibrium price is determined by macro fundamentals. The fundamentals of these assets prices include economic output. If there is a relationship in the short run between variables, implying that we should focus on a short time horizon so as to effectively judge main economic variables that affect the output in this period, and then we can more effectively interpret the change of output and fiscal policy might be more effective in formulating measures about output and it is helpful for economic sustainability.

Notes

(1) We know it from US Business Cycle Expansions and Contractions, NBER, accessed August 9, 2012.

(2) Such as Threshold VAR (TVAR), factor vector autoregressive models and threshold cointegration tests, etc. (Andrea and Claudio, 2010; Nazif and Ozelm, 2013; Kakali and Sajal, 2014).

(3) Feature extraction simplifies the resources required to describe a large set of data accurately. The self-similarity of a time series means the series exhibits long-term dependence (i.e., the whole series possesses the same shape, such as wave and cycle, as one or more of its parts). Taking advantage of feature extraction and self-similarity detection, the CWT extracts the local amplitudes of a time series in time and frequency domains. Then, the ensuing wavelet coherency and phase difference tools measure whether and how the local amplitudes of two time series correlate, and which one leads.

(4) In wavelet theory and practice, various types of mother wavelets exist for various purposes, such as the Haar, Morlet, Daubechies, Mexican hat and so on wavelets.

(5) Without smoothing, the squared wavelet coherence would always equal 1 at any frequency and time. Smoothing is achieved by convolution in time and frequency; see Torrence and Compo (1998) for details.

(6) As a measure of economic activity we use the lag of Gross Domestic Product. Since GDP figures are not available on a monthly basis, the monthly GDP is interpolated through the monthly industrial production index. In addition, the interpolation of GDP into monthly frequency using industrial production index may lead to exclusion of valuable information and measurement errors in the estimates. In order to check the robustness of the results obtained with interpolated GDP, the model is re-estimated with total industrial production index.

(7) Following the Bredin et al. (2010) and we use crude oil prices of West Texas Intermediate (WTI) - Cushing, Oklahoma as the initial data(expressed in U.S. dollars per barrel) we want to analysis. Because Oklahoma is the main crude storage place of United States. We obtain this data from http://research.stlouisfed.org/fred2/ series/DCOILWTICO/downloaddata.

(8) This gateway address is http://www.econ.yale.edu/~shiller/data.htm.

(9) We use Median Sales Price for New Houses Sold (expressed in U.S. dollars) in the United States.

References

Aguiar-Conraria, L., Azevedo, N. and Soares, M.J. (2008). Using wavelets to decompose the time-frequency effects of monetary policy. *Physical A: Statistical Mechanics and its Applications.* 387. pp. 2863-2878.

Aguiar-Conraria, L. and Soares, M.J. (2011). Oil and the macroeconomy: using wavelets to analyze old issues. *Empirical Economics*. 40. pp. 645-655.

Aguiar-Conraria, L. and Soares, M.J. (2013). The continuous wavelet transform: moving beyond uni- and bivariate analysis. *Journal of Economic Surveys*. 00 (0). pp. 1-32.

Alessandro, C. and Matteo, M. (2009). The asymmetric effects of oil shocks on output growth: A Markov-Switching analysis for the G-7 countries. *Economic Modelling*. 26. pp. 1-29.

Apergis, N., Simo-Kengne, B.D., Gupta, R. and Chang, T. (2013). The dynamic relationship between house prices and output: Evidence from US metropolitan areas. Department of Economics. *Working Papers.* No. 2013-49. University of Pretoria, South Africa.

Barro, Robert J. (1990). The Stock Market and Investment. *The Review of Financial Studies.* 1. pp. 115-131.

Bloomfield, D., McAteer, R., Lites, B., Judge, P., Mathioudakis, M. and Keena, F. (2004). Wavelet phase coherence analysis: application to a quiet-sun magnetic element. *The Astrophysical Journal*. 617. pp. 623-632.

Bredin, D., Elder, J. and Fountas, S. (2011). Oil volatility and the option value of waiting: an analysis of the G-7. *Journal of Futures Markets.* 31. pp. 679-702.

Campbell, J. and Cocco, J. (2007). How do house prices affect consumption? Evidence from micro data. *Journal of Monetary Economics*. 54. pp. 591-621.

Carlstrom, T.C., Fuerst, S.F. and Vasso, P.I. (2002). Stock prices and output growth: An examination of the credit channel. *Working Papers*, Federal Reserve Bank of Cleveland.

Carroll, C.D. (2004). Housing wealth and consumption expenditure. *Working Papers*. Department of Economics. Johns Hopkins University.

Chang, T., Li, X.L., Miller, S.M., Balcilar, M. and Gupta, R. (2013). The Co-Movement and Causality between the U.S. Real Estate and Stock Markets in the Time and Frequency Domains. *Working Papers.* Department of Economics. University of Pretoria.

Choi, Jongmoo, J., Shmuel, H. and Kenneth J. (1999). Does the Stock Market Predict Real Activity? Time Series Evidence from the G-7 Countries. *Journal of Banking and Finance.* 23. pp. 1771-1792.

Demary, M. (2010). The interplay between output, inflation, interest rates and house prices: International Evidence. *Journal of Property Research.* 27(1). pp. 1-17.

Fama, E.F. (1981). Stock returns, real activity, inflation and money. *American Economic Review.* 71. pp. 545-564.

Frederic, S.M. (2001). The transmission mechanism and the role of asset prices in monetary policy. *Working Paper.* National Bureau of Economic Research. Cambridge.

Friedman, M. (1962). The interpolation of time series by related series. *Journal of the American Statistical Association.* 57. pp. 729-757.

Furkan, E., Nicholas, A., Beatrice, D.S., Chang, T. and Gupta, R. (2014). Causal relationship between asset prices and output in the US: Evidence from state-level panel Granger causality test. *Working Papers.* IPAG Business School. France.

Goffe, W. (1994). Wavelets in macroeconomics: an introduction. In D. Belsley (Ed.), Computational Techniques for Econometrics and Economic Analysis. *Kluwer Academic.* pp. 137-149.

Grinsted, A., Moore, J.C. and Jevrejeva S. (2004). Application of the cross wavelet transform and wavelet coherence to geophysical time series. *Nonlinear Process Geophysics*. 11. pp. 561-566.

Grossman, A. and Morlet, J. (1984). Decomposition of Hardy functions into square integral wavelets of constant shape. *SIAM J. Math. Anal.* 15 (4). pp. 723-736.

Graham, M. and Nikkinen, J. (2011). Co-movement of Finnish and international stock markets: a wavelet analysis. *European Journal of Finance*. 17. pp. 409-25.

Guerrieri, L. and Iacoviello, M. (2013). Collateral constraints and macroeconomic asymmetries. *International Finance Discussion Papers 2013:6.* Board of Governors of the Federal Reserve System.

Gupta, R. and Hartley, F. (2014). The role of asset prices in forecasting inflation and output in South Africa. *Public Finance Review.* 42. pp. 511-531.

Hudgins, L., Friehe C. and Mayer, M. (1993). Wavelet transforms and atmospheric turbulence. *Physical Review Letters.* 71 (20). pp. 3279-3282.

Iacoviello, M. and Neri, S. (2010). Housing market spillovers: Evidence from an estimated DSGE model. *American Economic Journal: Macroeconomics* 2. pp. 125-164.

Kakali, K. and Sajal, G. (2014). Income and price elasticity of gold import demand in India: Empirical evidence from threshold and ARDL bounds test cointegration. *Resources Policy.* 41. pp. 135-142.

Liow, H.K. (2012). Co-movements and correlations across Asian securitized real estate and stock markets. *Real Estate Economics.* 40(1). pp. 97-129.

Loh, L. (2013). Co-movement of Asia-Pacific with European and US stock market returns: a cross-time-frequency analysis. *Research in International Business and Finance.* 29. pp. 1-13.

Manu, S. and Rajnish, A. (2012). Gold price and GDP analysis of the world's top economies. *The Journal of Index Investing.* 3. pp. 83-87.

McCarthy, J. and Orlov, A.G. (2012). Time-frequency analysis of crude oil and S&P500 futures contracts. *Quantitative Finance.* 12(12). pp. 1893-1908.

McCarthy, J. and Peach, R.W. (2001). Monetary Policy Transmission to Residential Investment, forthcoming in Federal Reserve Bank of New York, *Economic Policy Review*, Conference on Financial Innovation and Monetary Transmission.

Mian, A. and Sufi, A. (2011). House prices, home equity-based borrowing, and the US household leverage crisis. *American Economic Review*. 101. pp. 2132-2156.

Miller, N., Peng L. and Sklarz, M. (2011). House prices and economic growth. *Journal of Real Estate Finance and Economics.* 42(4). pp. 522-541.

Mork, K.A. (1989). Oil and the macroeconomy when prices go up and down: an extension of Hamilton's results. *Journal of Political Economy*. 97. pp. 740-744.

Mork, K.A., Olsen, O. and Mysen, H.T. (1994). Macroeconomic responses to oil price increases and decreases in seven DECD countries. *Energy Journal.* 15. pp. 19-35.

Nazif, A.C. and Ozlem, A.O. (2013). An asymmetric analysis of the relationship between oil prices and output: The case of Turkey. *Economic Modelling.* 33. pp. 884-892.

Raja, S.S. and Saumitra, N.B. (2009). Stock prices, inflation and output: Evidence from wavelet analysis. *Economic Modelling.* 26. pp. 1089-1092.

Ram, R. and Spencer, D.E. (1983). Stock returns, real activity, inflation and money: a comment. *American Economic Review*. 73. pp. 463-470.

Ramsey, J. and Lampart, C. (1998a). Decomposition of economic relationships by time scale using wavelets: money and income. *Macroeconomic Dynamics.* 2. pp. 49-71.

Ramsey, J. amd Lampart, C. (1998b). The decomposition of economic relationships by time scale using wavelets: expenditure and income. *Studies in Nonlinear Dynamics and Econometrics.* 3. pp. 23-42.

Rua, A. and Nunes, L.C. (2009). International co-movement of stock market returns: a wavelet analysis. *Journal of Empirical Finance.* 16. pp. 632-639.

Roueff, F. and Sachs, R. (2011). Locally stationary long memory estimation. *Stochastic Processes and their Applications.* 121(4). pp. 813-844.

Schwert, G. (1990). Stock Returns and Real Activity: A Century of Evidence. *The journal of Finance.* 4. pp. 1237-1257.

Stock, J.H. and Atson, M.W. (2001). Forecasting output and inflation: The role of asset prices. *NBER Working Paper 8180.* Cambridge.

Tiwari, A.K., Mutascu, M. and Andries, A.M. (2013). Decomposing time-frequency relationship between producer price and consumer price indices in Romania through wavelet analysis. *Economic Modelling.* 31. pp. 151-159.

Torrence, C. and Compo, G. (1998). A practical guide to wavelet analysis. *Bulletin of the American Meteorological Society.* 79. pp. 61-78.

Torrence, C. and Webster, P. J. (1999). Inter decadal changes in the ENSO-monsoon system. *Journal of Climate*. 12(8). pp. 2679-2690.

Wendy, N., Miller, S.M., Mehmet, B., Sonali, D. and Gupta, R. (2013). Temporal Causality between House Prices and Output in the US: A Bootstrap Rolling-Window Approach. *Working papers 2013:6.* Department of Economics. University of Connecticut.

Zhou, J. (2010). Co-movement of international real estate securities returns: a wavelet analysis. *Journal of Property Research.* 27(4). pp. 357-373.

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 77-88

Territorial patterns of development in the European Union

Mădălina AVRAM
Bucharest University of Economic Studies, Romania
avram.madalinaa@yahoo.ro
Constantin POSTOIU
Bucharest University of Economic Studies, Romania
postoiu.constantin@gmail.com

Abstract. *Although the European Union is considered the largest integration project, disparities at national and regional level existed since the advent of the European model and grew with the new waves of enlargement of the countries from Central and Eastern Europe in 2004 and 2007. This paper is aimed at studying the problematic disparities between NUTS 2 regions of the EU. These imbalances are highlighted through a cluster analysis which aims to identify clusters of regions with similar characteristics in terms of various socio-economic indicators. Results are illustrated using GIS software.*

Keywords: regional development, cluster analysis, convergence, regional inequalities, spatial growth patterns.

JEL Classification: R11, C49.

The dichotomy between rich and poor economies represents the source of economic research that analyzes the capacity of emerging countries to intensify the catching-up process. Given that economic reality has always highlighted the existence of developed and emerging countries on the world map, reducing disparities among member states represent an essential goal for the European Union. Therefore, it aims to reduce disparities among regions and social categories.

Although the development exercise makes its presence felt in the European model, both in developed countries, and especially in the emerging ones, a large segment of population is still characterized by poverty and unmet basic needs.

Stiglitz (2012) draws attention to the perpetuation of inequalities and its increased value. If the cake would be apportioned equally, everyone would get a slice of the same size, so the top 1% of people would receive a percentage of the cake. In reality, the upper 1 percent takes a slice much bigger, about a fifth of the whole cake, which means that the rest of the population has to be "satisfied" with an insignificant slice.

In his last book "Capital in the Twenty-First Century", Thomas Piketty has made a detailed analysis of inequalities since the eighteenth century. The French author highlighted that the main mechanism for convergence between countries / regions is dissemination of knowledge, both internationally and internally. In other words, the poorest countries will catch up the rich ones if they will achieve the same level of technological knowledge, qualifications and education. This pleading for education is reinforced by Jean-Claude Berthelemy (2006), who mentioned the importance of a quality education system, described as a key factor for growth in the case of developing countries.

However, in 2011, only 29 of the 272 European regions have reached or exceeded the level of 3% of GDP for research and development, threshold set by Europe 2020 Strategy. Statistics show that regions which invest 3% or more of their GDP in R&D are the most developed regions in the EU, in particular regions from Germany, United Kingdom, Sweden, Finland, Austria and Belgium(1). Some of these regions are positively impacted by capital cities such as Brussels, Vienna, Helsinki, Stockholm and London. At the opposite pole are regions of Central and Eastern Europe, especially in Romania and Bulgaria which invest below 1% (exception: Bucharest – Ilfov region -1.05%) in research and development.

According to Piketty, another conclusion is looming already as clearly as possible: the economists would be naive to believe that in the structure of modern economic growth or in the market economy laws there are strong convergence influences that naturally lead to a reduction of inequalities or to a harmonious stabilization. Thus, complex analysis on the distribution of wealth and the gaps between countries/regions return in the spotlight of researchers (Morris, 2012, Stiglitz, 2012, Landes, 2013, Piketty, 2014).

The European economic model aims to solve difficulties in the development process by eliminating the compromise between equity and efficiency. The European model proposes a win-win game between economic and social side, in order to ensure the stability of the construction (Dinu et al., 2005).

To give the European model the chance to generate smart, sustainable and inclusive growth, the European Union should disseminate prosperity from its hard core - Western Europe - to emerging areas which will exceed the peripheral condition. This requires maintaining an extensive process of convergence, including allocation of non-refundable European funds that generate economic, social and territorial cohesion.

Borsi and Metiu (2013) have demonstrated that there is no overall real income per capita convergence in the European Union, however they have identified groups of countries that converge to different steady states. The authors accentuate the importance of regional linkages in determining these clusters.

The issue of discrepancies between the member regions existed since the advent of the European model and grew with the new waves of enlargement of the countries from Central and Eastern Europe in 2004 and 2007 (Marinas, 2008). These two waves have added new countries considered peripheral. With the increasing number of Member States the convergence and the cohesion process based on common policies have become decisive. Therefore, the main purpose for the new countries is to adapt to the model performing core standards.

Cohesion, sustained by convergence is a process of European construction to approach the nations and regions in terms of welfare and living conditions. These processes sustain the European project stake: development felt at the individual level, society, region.

The current economic situation of the European Union can be described by multiple equilibria theory sketched by Young's contributions (1928) and Rosenstein-Rodan (1943). Subsequently, Abramovitz (1986) and Baumol (1986) associated the idea of multiple equilibria with the notion of “convergence club”. Baumol split the states according to the political regime and he identified three clusters: developed market economies – OECD members, planned economies and middle income countries, a group imprecisely defined.

The analysis of convergence clubs is very important for the European Union taking into consideration the attention given to the objective of reducing regional disparities at NUTS2 level. For this purpose, EU allocates for the period 2014-2020 a percentage of 32.5%(2) of total cohesion policy budget. Jean Claude Barthelemy (2006) draw special attention to the importance of policies adopted. Regarding the efficiency of these policies, Azomahou et al. (2011) highlight that in the period 1950-1990, the European Union has been characterized by an economic convergence process. In general, regions with low initial level of income per capita experienced a higher growth rate than developed regions. However, in the past two decades researchers talk about divergence for poor regions and convergence for middle-income regions.

Bartkowska and Riedl (2009) tested the convergence of per capita income at regional level in 17 countries of Western Europe between 1992 and 2002. The authors identified six separate groups and showed that initial conditions play a crucial role in determining clusters (initial level of human capital, initial level of income per capita, etc.), while the structural characteristics of the economy have only a minor role. However, the regions belonging to the same state tend to be part of the same cluster - country effect (see Quah,

1996). In addition, it is emphasized that the capital regions generally belong to a club more developed compared with neighboring regions.

According to Quah (1995), the welfare of a region depends on the level of development of neighboring regions and the performance of the entire state. Based on this assumption, the regions of Europe are not isolated islands. Thus, independent regions cannot be studied in isolation. The author highlights the importance of geographic position and spillovers in understanding income distribution. Quah gives great importance to geographical factors, but does not deny any impact of national factors.

Baldwin and Wyplosz (2006) point out that technological progress - regarded as the accumulation of knowledge (knowledge capital) - is essential to generate and sustain economic growth in the long term because it may move production function in maintaining the capital stock.

Drawing inspiration from the literature and studies carried out by the European Regional Development Fund, we can talk about the existence of regional patterns of development in the European Union. There is a clear distinction between the regions of Western and Eastern Europe in terms of economic performance. As exceptions to this rule are the poorest regions of Spain, southern Italy and Portugal. In Eastern Europe, positive exceptions are capital regions (Bratislava, Central Hungary and Bucharest-Ilfov). However, this territorial pattern is less pronounced compared to a decade ago, when 12 states joined the European Union(3). This can be explained by two scenarios:

- Beta Convergence: poor regions tend to grow faster than rich ones
- The economic and financial crisis had an increased impact on the economic performance of many developed European regions.

Even if the effects of the two scenarios made their presence felt in reducing regional disparities, in 2013, all nineteen European regions with a GDP per capita level lower than 50% of UE28 average were located in Eastern Europe. Therefore, about a quarter (19) of the 80 low-income regions(4) fails to reach even half of the average GDP per inhabitant in the European Union. These regions were spread across five Eastern Europe countries: five regions in Bulgaria, Poland and Romania and 4 regions in Hungary. The most difficult situation is in Bulgaria, which reported a per capita GDP equivalent to one third of the European average for the regions Severozapaden, Severen tsentralen and Yuzhen tsentralen. Also in Greece, Slovenia and Croatia all regions have a GDP below the European average.

According to Eurostat statistics, in 2013 GDP per capita in Inner London (325% of the UE28 average) was at least 11 times higher than the level recorded in the region Severozapaden (Bulgaria)(5) and 10 times compared to the Nord-Est region of Romania(6). Although the ratio between the richest European region (Inner London) and the poorest (Severozapaden) seems exaggerated, it has declined in recent years (in 2008 the London region was 13 times richer). It should be specified, however, that flows of cross-border workers in regions such as Inner London, Vienna or Ile de France boosts economic activity well above potential level of the resident population.

Another territorial pattern splits Europe into two parts. The northern European regions are characterized by higher economic performance compared with southern ones. Positive exceptions in this case are the regions of the Alps in southern Germany and from Western Europe.

It is also important to note that the capital regions recorded higher economic performance compared to other regions within the same state. In 2013, the Bucharest - Ilfov region had a GDP per capita of 34,900 euros compared to 9,000 euros in the North East (yielding a ratio of 3.9). Large gaps exist also in Slovakia (a ratio of 3.6 between capital region and the eastern regions of the country – Východné Slovensko), France (a ratio of 3.3 between Ile de France and Guyane region) and the UK where GDP per capita in Inner London was almost five times higher than in the West Wales and The Valleys region.

Reviewing patterns of territorial development in the European economic model, we intend to highlight imbalances in European construction through a cluster analysis in SPSS which aims to identify clubs regions with similar characteristics based on five socio-economic indicators.

The methodology and data used

The research aims to identify regions with similar characteristics, grouping them into clusters based on several economic and social indicators. Withal, we are trying to identify the evolution of regions by analyzing the changes in the structure of clusters between 2007 and 2012. Cluster analysis is a tool that allows grouping of cases or variables based on several criteria. This analysis seeks to identify a number of homogeneous groups in order to minimize the variation within a group and maximize the variation between groups.

There are two types of cluster analysis: hierarchical and non-hierarchical. The first type involves setting up clusters by successive mergers of closest regions and/or clusters (agglomerative clustering), or by dividing all regions (divisive algorithm – opposite of agglomerative). The second type (k means clustering) starts from an ex-ante choice concerning the number of clusters. The algorithm estimates the cluster means and assigns each region to the group for which its distance to the cluster mean is the smallest (iterative action).

SPSS enables the use of a different type of cluster analysis, a combination between hierarchical methods and non-hierarchical. This method was preferred for various associated tools: the assessment of the quality of formed clusters, the importance of each indicator for the clustering operation, comparative illustration of the clusters characteristics.

We opted to group the European regions into four or five clusters. Three or less clusters could not reflect the high heterogeneity of the indicators included in the analysis. In the opposite case, a bigger number of clusters would represent a too high reduction of the variance between groups. If the number of clusters increases, the variation within groups decreases, but decreases also the variation among groups. Between these two

possibilities, we consider that the option with five clusters is more opportune because, even if the groups are quite similar in the two divisions, the option with four clusters has a higher variability within clusters.

By using this technique of multivariate analysis, we intend to group the 272 European regions such that the similarities between the regions that are part of the same cluster have to be as large as possible, but between the members of two distinct clusters, the similarities have to be insignificant.

In performing the analysis five economic indicators at regional level were used. Data source is Eurostat:

1. GDP per capita (in PPS per inhabitant),
2. GDP growth rate (this indicator illustrates the economic growth),
3. Population aged 25-64 with tertiary educational attainment (Bachelor degree or equivalent),
4. Employment rates (men and women) of the population aged 15-64 years,
5. Total research and development expenditure (% of GDP or percentage of people employed in R&D in the total active population).

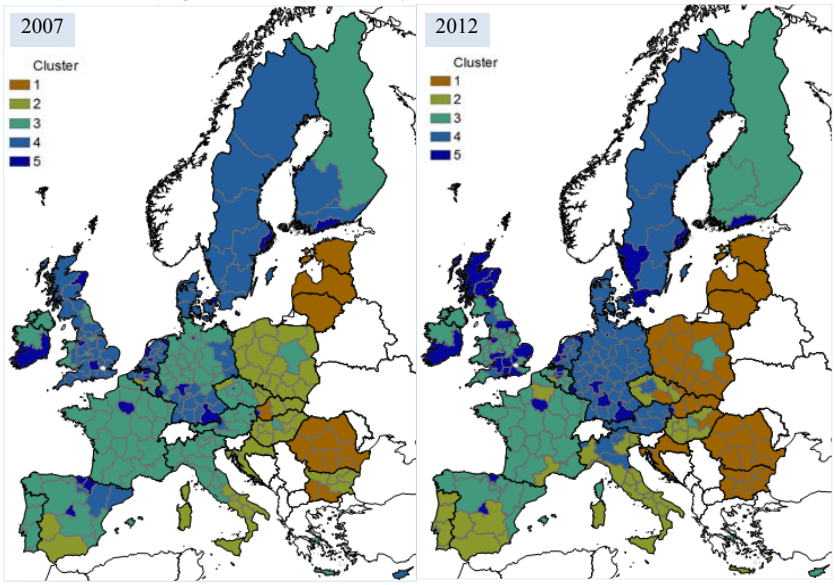
GDP is the most widely used indicator for measuring macroeconomic activity. This indicator gives an overview regarding the competitiveness and productivity of a region and becomes an indirect indicator of social development and progress in general. The population with tertiary education reflects the level of professional attainment of human capital and R&D sector size is an indicator of innovation. Knowledge and innovation are considered to be the engine of progress by several authors.

We opted for clustering based on data from 2007 and 2012. The main criterion was the availability of data: the year 2007 was chosen because it is the first year with complete data, and 2012 is the last year with complete data concerning GDP per capita at regional level.

Results

Figure 1 illustrates the NUTS 2 regions of the European Union divided in 5 clusters according to values from 2007 and 2012 of GDP per capita level and growth rate, employment rate, the percentage of people with tertiary education.

Figure 1. *Clusters of NUTS2 regions in the European Union grouped according to the employment rate, GDP (PPS / loc.), growth rate and tertiary education*



Cluster analysis in 2007

Cluster 1 contains only 14 regions, including all Romania, the Baltic countries and some of Bulgaria and Slovakia. Here are the regions with the lowest level of GDP per capita and tertiary education. The major difference in contrast with the other clusters is the very high GDP growth rate.

The second cluster includes regions with higher values of GDP per capita and tertiary education. The growth rate is higher than the following three clusters but significantly less than the cluster 1. Another important characteristic for these regions is the lowest employment rate of all EU regions. As illustrated above, clusters 1 and 2 gather regions of eastern and southern Europe. These regions have the lowest values of per capita GDP, tertiary education and employment rate.

Cluster 3 is composed of regions characterized by average performances in terms of employment rate, GDP per capita and tertiary education. These regions are situated in particular in Latin speaking countries (France, Italy, Spain and Portugal) plus Austria, Czech Republic and Germany. The economic growth rate has the lowest value because this cluster contains regions that have had the worst economic evolution between 2000 and 2007 (located especially in Italy and France).

Cluster 4 includes regions with the highest employment rate and with a level of GDP / capita and rate of tertiary education above European average. Most of these regions are located in the United Kingdom, Netherlands, Sweden, Denmark, Belgium and in the south of Germany.

The most developed regions are grouped in cluster 5. They have a significantly higher GDP per capita than the other clusters and the highest percentage of tertiary education. These include the European capitals: London, Paris, Brussels, Stockholm, Helsinki, Madrid, Amsterdam, Prague, Vienna and Bratislava.

Cluster analysis in 2012

Cluster analysis based on data from 2012 shows that the cluster 1 summarized all the poorest regions in Europe but with the highest rates of economic growth. The number of members of the group has expanded from 14 to 40 regions, now including all Bulgaria, Croatia and a big part of Poland and Slovakia. Both in 2007 and 2012 capital regions of Poland, Hungary, Slovakia and the Czech Republic are part of a cluster more developed (4 or 5). Despite the fact that the development gap between the capital region Bucharest-Ilfov and others Romanian regions is significantly higher than in other countries, the capital region belongs to the same cluster with all the Romanian regions.

This enlargement of cluster 1 reduced the growth rate and increased median proportion of people with tertiary education (Chart 1). The explanation is that new entrant regions have a lower growth rate and more people with higher education.

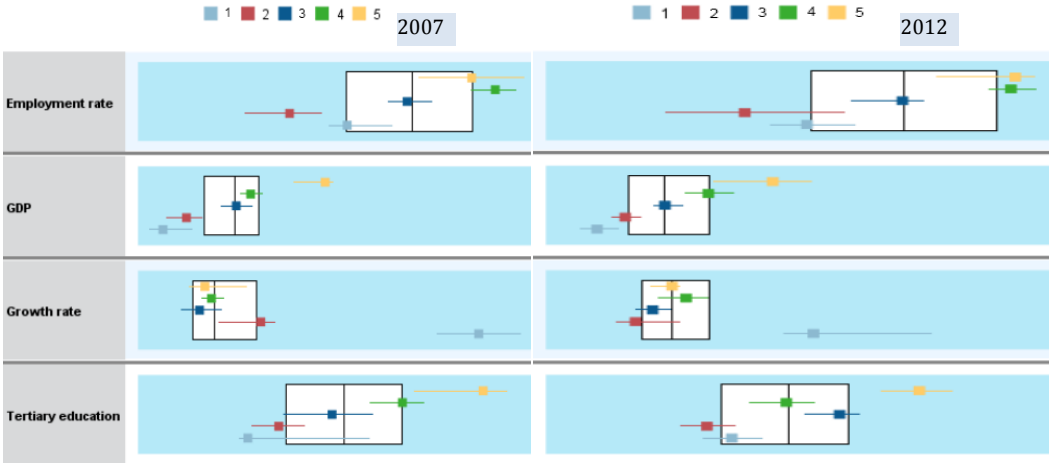
The second cluster has the same number of regions as in 2007 because the number of regions laving cluster 1 was covered by the regions that have migrated from cluster 3 in 2. Most of them are from Italy, Greece and Portugal, but also some regions from Spain, Czech Republic and even France. Note that in 2007 the cluster 2 has the second highest growth rate, while in 2012 has the worst performance in this regard. This fact is due to the inclusion of Greek and Italian regions, which had the lowest economic growth rates of the whole European Union.

Cluster 3 is significantly reduced in size, from 104 in 2007 to 66 in 2012 as a result of the moving of aforementioned regions or the fact that the regions of Germany and Austria moved into cluster 4. These changes have increased the percentage of people with tertiary studies in cluster number 3, inasmuch as regions in Italy, Portugal and Spain who have left the group have the lowest scores on this indicator.

Important changes occur also inside the forth cluster who gains four regions in Germany and Austria, but loses parts of Spain and United Kingdom. In fact, the British areas represent an interesting case. In 2007 the majority of them were part of cluster 4. Meanwhile some of them have reduced the economic performance, migrating in cluster 3, while others have migrated to cluster 5. These developments highlight a significant increase of disparities among the UK regions. Overall, cluster 5 gathers many members mostly from the United Kingdom, Germany, Sweden, Finland and the Netherlands.

Figure 2 shows a comparative analysis of characteristics of each cluster for 2007 and 2012. The situation in the two years is quite similar except for the changes described above.

Figure 2. *The median values and quartiles of indicators for each of five clusters (squares and lines of different colors) and for all 272 regions (white rectangles)*



Note: *Different colors are used for each cluster: the small colored square illustrates the median value, while the horizontal line of the same color connects the 25% and 75% quantiles. The big, white rectangles show the median value (middle vertical line), the 25% and 75% quartiles (left and right side of the rectangle) for all the 272 regions.*
For example, regarding the tertiary education, the median for the cluster 4 (green small square) in 2007 is equal to the 75% quartile of the whole population (all EU28 NUTS 2 regions) (right side of the white rectangle). In 2012 the two medians coincide.

Chart 1 gives an overview on the relative position concerning the performance of each group in 2007 and 2012. Table 1 points out the performance in absolute terms. It is preferable to use the median instead of the arithmetic mean because the last one has a major disadvantage: it is notably influenced by outliers (an observation point that is distant from other observations; a value that is notably smaller or larger than the rest of the values). Outliers are found in the data for GDP, population with tertiary educational attainment and growth rate. Thus, because the median is less affected by outliers, it is preferable to use it in our analysis.

Table 1. *Clusters performance in 2007 and 2012 (median values)*

	Cluster 1		Cluster 2		Cluster 3		Cluster 4		Cluster 5	
	2007	2012	2007	2012	2007	2012	2007	2012	2007	2012
Regions	14	40	58	59	104	66	70	65	26	42
Employment	61,8%	58,9%	55,2%	54,4%	65,7%	64,2%	73,1%	72,7%	70,5%	71,2%
GDP	12471	14655	14926	19025	24338	24045	26986	29592	41464	38812
Growth rate	105%	107%	40%	26%	28%	31%	30%	40%	33%	37%
Tertiary	17,5%	21%	14,7%	17,3%	20,9%	31,3%	28,5%	25,5%	36%	40,2%

The enlargement of cluster 1 and 5 highlights an increase regional cohesion in the European Union. The analysis of 2007 draws attention to the extreme values and socio-economic disparities inside the EU. A cluster included the 14 most underdeveloped regions situated far away from the European average, and another cluster comprised the 26 highly developed regions.

In 2012 clusters have a more balanced structure in terms of number of regions. Cluster 1 has increased at 40 regions and cluster 5 at 42. This is a positive thing given that these two clusters approached to the European average in terms of GDP / capita. The median rates of growth in cluster 1 were, in both 2007 and 2012, three times higher than the median of all European regions. Thus, we can notice a catching-up process in terms of GDP per capita (from 52% in 2007 to 62% in 2012) but also a slowdown of economic growth inside cluster number 5 (from 113% in 2007 to 103% in 2012).

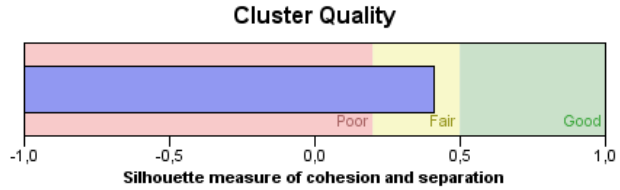
Disparities among regions have increased in terms of employment rate because the values recorded for this indicator have decreased in underdeveloped regions and increased within the cluster 5. This evolution is highlighted in Table 2 which illustrates the position of clusters compared to the EU median.

Table 2. *Relative performance of clusters in 2007 and 2012*

	Cluster 1		Cluster 2		Cluster 3		Cluster 4		Cluster 5	
	2007	2012	2007	2012	2007	2012	2007	2012	2007	2012
Regions	14	40	58	59	104	66	70	65	26	42
Employment	93%	90%	83%	83%	99%	98%	110%	111%	106%	109%
GDP	52%	62%	62%	81%	102%	102%	113%	125%	173%	164%
Growth rate	355%	297%	135%	73%	95%	86%	101%	112%	113%	103%
Tertiary	77%	80%	65%	66%	93%	119%	126%	96%	159%	152%

Note: *The table shows the median of each cluster divided by the median of all EU regions*

SPSS has a specific tool that allows assessing the quality of a cluster analysis solution. A common measure is the **silhouette coefficient**, a measure of both cohesion and separation. In a fair cluster solution there is less variability within the group, but high variability among groups. The result shows that the rule is respected at a reasonable level for both clusters analysis (2007 and 2012).



In case of introducing the R&D personnel indicator in our analysis, the results are quite similar, for both 2007 and 2012. Due to the fact that the data for R&D sector is missing for more regions, we gave less attention to this indicator.

Concluding remarks

The research aims to identify regions with similar characteristics, grouping them into clusters based on several economic and social indicators: GDP per capita, GDP growth rate, population aged 25-64 with tertiary educational attainment, employment rates (men and women) of the population aged 15-64 years and total R&D expenditure.

Our main findings can be summarized as follow. Firstly, the results show that the regions with low economic performance for all indicators used in analysis (except for GDP growth rate) were all located in Eastern Europe, in former communist countries.

Secondly, the third cluster consists of regions from France, Spain, United Kingdom and Finland. The last two clusters contain the most developed regions in the European Union, covering all Germany, Austria, Netherlands and Sweden, a part of UK and several capital regions. Research results outline an array of socio-economic development in which the most powerful regions are located in Central and Northern Europe and, at the opposite side, the underdeveloped at periphery, particularly in the Eastern and Southern Europe.

Last but not least, the changes in the structure of clusters draw attention to an increased cohesion between European regions. Except for employment rate, the economic characteristics of both performing regions and less performing region converge to European average. A phenomenon of relatively rapid growth among less developed regions while the developed ones slowdown their grow rate is normally. Regarding the evolution of employment rate, it is notable an increase of disparities among regions (the best performance was recorded in Germany). The Greek regions were strongly affected by the financial and economic crisis and these regions recorded the worst performances of the whole European Union. This situation is also applicable for some Spanish regions.

Notes

(1) Eleven regions of Germany exceeded the threshold of 3% of GDP (Braunschweig, Stuttgart, Tübingen, Upper Bavaria, Karlsruhe, Dresden, Franconia, Darmstadt, Berlin, Rheinhessen-Pfalz, Cologne), followed by Sweden and the United Kingdom with four regions:
- UK (Cheshire, East Anglia, Kent and Berkshire region, Buckinghamshire and Oxfordshire).
- Sweden (Stockholm, Sydsverige, Östra Mellansverige and Västsverige).

Finland has three regions that exceed this percentage (Helsinki-Uusimaa, Itä-Suomi ja Pohjois-, launched Suomi), followed by Belgium and Austria with two regions.

(2) For the 2014-2020 period 351.8 billion euros of the total EU budget are allocated for the cohesion policy. This provides the framework and the necessary investment for the fulfillment of five specific objectives contained in the Europe 2020 Strategy.

(3) The wave of accession from 2004 included: Cyprus, Estonia, Latvia, Lithuania, Malta, Poland, Czech Republic, Slovakia, Slovenia and Hungary. In 2007, Romania and Bulgaria joined the European construction (action considered an extension of the wave from 2004).

(4) To define the development degree of regions we took into consideration the methodology provided by the European Commission. Therefore:
- Regions with low incomes (GDP <75% of the European average)
- transition regions (GDP ranging between 75% -90% of the European average)
- developed regions (GDP> 90% of the European average).

(5) Severozapaden Region (Bulgaria) is the region with the lowest GDP per capita of the whole European Union (only 30% of the average UE28).

(6) GDP per capita in North East region was 9,000 euro compared to 86.400 euro in Inner London region

References

Abramovitz, M. (1986). Catching up, forging ahead, and falling behind. *The Journal of Economic History*. Vol. 47. No. 2. pp. 385-406.

Artelaris, P., Kallioras, D. and Petrakos, G. (2010). Regional inequalities and convergence in the European Union new-members states. *Eastern Journal of European Studies*. Vol. 1. Issue 1.

Azomahou, T., El Ouardighi, J., Nguyen-Van, J. and Pham, T., (2011). Testing convergence of European regions: A semiparametric approach. *Elsevier – Economic Modelling* (28). pp. 1202-1210.

Baldwin, R. and Wyplosz, C. (2006). *The economics of European integration.* McGraw Hill Education, second edition.

Barro, R. and Sala-i-Martin, X. (1991). Convergence across States and Regions. *Brooking Paper on Economic Activity.* pp. 107-182.

Barthelemy, J.-C. (2006).Clubs de convergence et equilibres multiples: comment les economies emergentes ont-elles reussi a echapper au piege du sous-developpement. Revue d`economie du developpement, 14(1), pp. 5-44.

Bartkowska, M. and Riedl, A. (2009). Regional convergence clubs in Europe. Identification and conditioning factors. *Elsevier – Economic Modelling*. 29. pp. 22-31.

Baumol, W. (1986). Productivity growth, convergence and welfare: what the long – run data show. The American Economic Review, Vol. 76, No. 5, pp. 1072-1085.

Borsi, M. and Metiu, N. (2013). The evolution of economic convergence in the European Union. *Discussion Paper – Deutsche Bundesbank.* No. 28/2013.

Canova, F. (2001). Testing for Convergence Clubs in Income per-capita: A predictive Density Approach. *Hambourg Institute of International Economics.*

Dinu, M., Socol, C. and Marinaș, M. (2005). *Mecanisme de convergenţă şi coeziune.* Ed. Economică.

Fischer, M. and LeSage, J. (2014). A Bayesian space-time approach to identifying and interpreting regional convergence clubs in Europe.

Fuss, C. (1999). Mesures et tests de la covergence: une revu de la literature. *Revue de l`OFCE*, No. 69. pp. 221-249.

Kolasa, M. (2014). Real convergece and its ilusion. *Elsevier – Economic Modelling*. 37. pp. 79-88.

Landes, D. (2013). *Avuția și sărăcia națiunilor. De ce unele țări sunt atât de bogate și altele atât de sărace*. Ed. Polirom.

Marinaș, M. (2008). *Convergența economică*. Ed. Economică.

Monfort, M. (2008). Convergence of EU regions. Measures and evolution. *Working papers – Directorate General for Regional Policy*. No. 01.

Monfort, M., Custeas, J. and Ordonez, J. (2013). Real convergence in Europe: A cluster analysis. *Elsevier –Economic Modelling*. 33. pp. 689-694.

Morris, I. (2012). *De ce vestul deține încă supremația și ce ne spune istoria despre viitor*. Ed. Polirom.

Piketty, T. (2014). Capital in the Twenty-First Century. Harvard University Press.

Quah, D. (1995). Empirics for Economic Growth and Convergence. *Centre for economic performance discussion paper.* No. 253.

Quah, D. (1996). Twin peaks: Growth and Convergence in Models of Distribution Dynamics. *The Economic Journal*, Vol. 106, No. 437, pp. 1045-1055.

Rosenstein, R. (1943). Problems of industrialisation of Eastern and South-Eastern Europe. *The Economic Journal*, Vol. 53, Issue 210/211, pp. 202-211.

Simuț, R. (2015). Real Convergence in EU countries. A cluster analysis. *Management Intercultural.* Vol. XVII. No. 1 (33).

Stiglitz, J. (2012). *Prețul inegalității*. Ed. Publica.

Young, A. (1928). Increasing returns and the big push. *Economic Journal.* 38. pp. 527-542.

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 89-102

Nexus between defense expenditure and economic growth in BRIC economies: An empirical investigation

Devi Prasad DASH
Indian Institute of Technology, Ropar, Punjab, India
devi100.dash@gmail.com
Debi Prasad BAL
Xavier Institute of Management, Bhubaneswar, Odisha, India
debiprasad.bal@gmail.com
Manoranjan SAHOO
Indian Institute of Technology, Madras, Tamil Nadu, India
msahoo100@gmail.com

Abstract. *This paper considers the defense expenditure and economic growth nexus based on the cross-border problems and increasing geo-political presence for BRIC blocs over the period 1993-2014. Our approach is more methodological in terms of employing Panel cointegration and causality to highlight the fundamental relation between the defense expenditure and economic growth. Here we emphasize various economic considerations in terms of pre and post war, strategic and spatial phenomenon to capture the magnitude of gains from the increased defense spending in the region. We are using panel unit-root; panel cointegration and panel-Granger causality to highlight the fundamental relationship between the variables. We conclude by discussing the issues as well as quantifying the consequences of present geostrategic conditions associated with these economies.*

Keywords: Defense Expenditure, BRIC, Panel cointegration.

JEL Classification: O39, O50, C22.

1. Introduction

The policy analysts put startlingly different opinions regarding the effect of defense expenditure upon the economic growth. Similarly the economists have been estimating and putting the analyses regarding efficiency and trade-off of defense expenditure and growth differently. One of the key barriers to the mainstream approach in this field is the prevalence of misconception regarding its stand from geo-political fronts. Historically, the trends of war, defense mechanism, controlling extremism and restoring peace have been defined as the geo-political phenomenon. Being characterized as an economic approach, the defense and peace mechanisms have come up with certain pioneering contributions - Peck and Scherer (1962), Brito (1972), Benoit (1973), Intriligator (1975). Some of the papers as cited above have provided the strategic significance to the new economic field. Further the applications of asymmetric information and game theory in defense economics have made the analysis quite robust (See *Handbook of Defense Economics Vol-1*, *Ch-1*). Though the attempt has been made to justify the theoretical foundation, still it is increasingly complex to satisfy the proposition because of the multifarious approaches in terms of strategic, political, domestic, spatial and international factors.

As far as the practical prospects of the existing literature are concerned, the analysis has invoked the series of time series, panel studies by focusing on individual economies and the regions as the whole. The result derived from this paper suggested that there are long relation between defense expenditure and economic growth in the case of BRIC countries. Here we confine our analysis to the most important block- BRIC.(1) Except growth standpoint, their defense expenditures have been rising over the years due to the looming cross-border problems and increasing geo-political presence. 2014 BRIC Summit has advocated the needs to propel the defense industries to pursue certain common security interests and handle other domestic spheres.

The post-cold war scenario brought some significant momentum in terms of the formation of new blocs based on some common parameters like economic development, security interests and strategic affairs. BRIC literally fulfills most of the common parameters laid down by Jim O Neill. BRIC economy as a whole shares 11% of global GDP in 1990, which further rose to 25% in 2011 and is forecasted to post 40% by 2050.(2) The defense component always plays key role in BRIC(3) policy paradigm due to the various internal and external factors associated with it. Some factors are Chechnya, Ukraine problems of Russia, Naxalism and Kashmir problem of India, Drug war in Brazil, Xinjiang problem and ethnic conflicts with China. Further, some conflicting interests like Russia-China border crisis, China-India border problems, Silk Route, Geo strategic influence in South-East Asia have fueled tensions among the BRIC nations. The defense expenditure has been increasing leading to three major reasons - 1) internal security 2) border crisis and external issues 3) geo-strategic competition.(4) Among the BRIC nations, Russia is the primarily the biggest arm exporter to the rest of the world with the larger consumers being from China and India. As per SIPRI report, India is the largest importer of arms and ammunitions in the world.(5) With the latest agreements with France and American companies regarding the purchase of defense weapons and fighter

jets, India's defense import bill has been swelled to more than $20 billion. China is the 2nd largest spender in defense sectors behind USA, with a budget tantamount to $ 188 billion in 2013. It constitutes 1.4% of Chinese GDP.(6)

Our aim is to undertake the detailed investigation regarding the effect of defense expenditure upon the economic growth in BRIC nations. Though previous studies have concentrated on analyzing the relation between defense expenditure and growth in a considerably bigger panels (Chen et al., 2014; Topcu and Aras, 2015), a very few number of studies like (Zhong et al., 2014) have concentrated in terms of smaller panels with the notable omissions like BRIC, N-11 nations etc. Here we focus our analysis on a relatively shorter and important panel of economies like BRIC. More prominently, with the rising income, each of the economies in this bloc has invested heavily in their concerned defense sector and also involved heavily in arms, ammunition trading among each other as well as with other economies. In 2014-15, India's defense deals with France, USA and Russia are the significant events. Similarly, China has doubled its defense spending in last couple of years. Brazilian government is in the process of reviving its defense industry in terms of modernization, investments in arms and ammunitions and recruiting more defense personnel. Russia has been traditionally largest arms exporter in the world. Further, Russia has shaped its defense and other strategic avenues due to the increasing threat of proxy war with NATO and to tackle ongoing Ukraine crisis.(7) Here we need to see, whether the spectacular growth of 1990s and early 2000s have ascribed to a rising defense expenditure in these economies.

Our paper goes further compared to the other conventional papers of the recent times in terms of econometric investigations. We use the BRIC panel data for defense expenditures, *per capita* GDP and Real GDP growth for the estimation. The logic behind taking GDP parameters in two forms is to capture the effect of defense expenses on the economy as a whole and on the income of the individuals. Further, the notion behind adding the per-capita income part is to capture whether increasing per-capita defense expenditure has the impact upon the per-capita growth or not.

The modern literature's focus on the defense-growth nexus contrasts sharply with the traditional theory since Benoit (1973). Recent empirical framework has not found any convincing evidences in terms of defense-growth relations across the world. Motivated by a wealth of evidences from several studies, we undertake study with respect to BRIC nations due to some underlined reasons. **First**, BRIC region has gained importance economically, spatially and strategically due to their roles in world economy. Such a defense- growth theory in case of BRIC revolves around two key questions. (a) Why do these economies find it optimal to spend more on arms and ammunitions despite their persistent failures in achieving their social sectors initiatives? (b) What prompts those economies to push for more arms import despite the looming of higher deficit pictures (exception in case of Russia being the arms exporter)? **Second**, this region, to the best of our knowledge, has not been studied with respect to defense- growth relation. In the light of several issues like Xinjiang problem, Ukraine crisis, South China Sea, India's border issues and other defense deals, it is quite imperative to assess the trend and pattern of defense sector's performance of these economies. **Third**, rising defense trade and defense

deals among BRIC economies in recent BRIC meetings at Fortaleza, 2014 have revived the interests of focusing on such mechanism. **Fourth**, given the importance of the study, our empirical findings will give an insight to the issue, which can open up the channels for further research on this region irrespective of our results. This study though not a very different study, still acts as a building block approach to capture the relative volatility in defense spending and capture the stylized trends of unbalanced domestic development in these developing economies (Hassan et al., 2003; Yildirim and Öcal, 2006; Narayan and Singh, 2007; Hirnissa et al., 2009; Muhanji and Ojah, 2014).

We consider our paper to complement the existing line of research that relies heavily on the long run relationship. The rest of the paper has been organized as follows. Section-2 summarizes the literatures on effects of defense expenditures on growth of the developed and developing economies. Section-3 describes the data and methodology of the study. Section-4 discusses the econometric procedures and empirical results. Section-5 concludes the analysis.

2. Literature review

Using Benoit (1973) as a starting point, here we have collected a large set of previous theoretical and empirical literatures to corroborate in the existing framework. This section considers the evidences presented below as the meaningful supplements to our present analysis. From this standpoint, establishing the correlation among defense expenditure, economic growth and spatial development stand inevitable as far as our analysis is concerned.

Benoit (1978) was one of the pioneering papers in this field, where 44 less developed countries were taken into the analysis. The analysis reported the positive relationship between defense expenditure and economic growth. Though being a starting point, still later analyses are not consistent with the Benoit's paper. Factors like strategic features, geographical constraints, cross-border conditions, extremisms seem to have put comparable effects in the financing of defense sectors across the economies. Some non-traditional determinants like defense cluster, modern artillery exercise turn out to be the important factors in popping up the increasing defense expenses. In another seminal paper, Deger (1986) found out the negative relation between economic growth and defense expenditure in less developed economies. The paper cited the reason that rising defense expenditure was the concomitant result of the non-developmental expenditure of the economy, which further was unable to channelize it into the productive sources. Post-cold war literatures notably Ram (1995), Dunne (1996) have augmented the analyses by stating negative and no correlation between defense expenditure and growth patterns in less developed economies. However, still some studies have reported positive relationship (Yildirim and Öcal, 2006; Pradhan, 2010; Shahbaz et al., 2013). Here we have further typified the literatures into certain types.

In this section of literature review, we outline the effect of defense expenditure on economic growth by citing some time series specific analysis- mostly individual economy based study. This type of study rationalizes and captures the economic specific

externalities from defense expenditure, domestic defense spheres, and geo-strategic relation with neighbors and internal interactions of social sector parameters. Yildirim and Öcal (2006) analyzed the arms race strategies between India and Pakistan. The causality approach pinpointed the causal relation between the defense expenditures of India and Pakistan, because of arms race and nuclearization of the region. Further, the causal relation stated that defense expenditure did granger cause economic growth in India, not in Pakistan. A VAR analysis framework emphasized that defense expenditure might have certain short run impact on growth but not in long run in case of India. Shahbaz et al. (2013) provides a tractable platform of the Portuguese economy by taking trend of defense expenditure and economic growth from 1980 to 2010. His framework applied ARDL model through which, they found a significant relation between defense expenditure and growth rate. In addition, they found the unidirectional causality from defense expenditure to growth in Portugal. Ali and Dimtriakis (2014) have studied the impact of defense expenditure on economic growth in case of China by undertaking two state Markov switching model analysis. Their results pinpointed the fact that defense expenditure generally exerted two way effects upon growth rate- positively during boom and negatively during slowdown.

The last ten years have seen an exponential rise in the panel studies of defense- growth-inequality mechanism. Demonstration of such panel studies are strived to fulfill one such objective- to establish the strategic and geo-political importance in the world. Hirnissa et al. (2009) empirically examined the relation between defense spending and economic growth in ASEAN-5 nations. In case of Singapore, they got bi-directional causality, while uni-directional causality was obtained in case of Thailand and Indonesia. No meaningful relation was found in context of Malaysia and Philippines. Dunne (2010) has focused such an analysis with respect to the Sub-Saharan African nations. His analysis hardly found any positive relation between defense spending and economic growth despite being those economies frequently involved in war. Pradhan (2010) analyzed the nexus between defense expenditure and economic growth in the European Union economies from 1973 to 2010. The results were showing the strong nexus between defense spending and economic growth in the European Union economies. Other promising works with respect to the European Union are Kollias et al. (2007). Muhanji and Ojah (2014) have studied the panel of highly indebted war-prone African economies. Their analysis has shown the positive relation between defense spending and external debt across the nations and also during pre-war, war time, and post war periods. Further Topcu and Aras (2015) have extended their analysis of previous work on EU nations by adding some new members of European Union. Their analysis however refuted the previous results by stating no uniform approach in this context. Their analysis discovered the fact that during Post-Cold War, defense expenditure had exerted negative impact upon the economic growth in some East European economies.

3. Empirical Model and Data

In this study, we used two common proxy for "increasing state expenditure" i.e. government defense expenditure and government *per capita* defense expenditure (Narayan et al. (2008). Our panel data model is in the following form:

$$\ln X_{it} = \alpha_{1i} + \alpha_{2i} Y_{it} + \varepsilon_{it} \quad (1)$$

Where, X represents the defense expenditure and *per capita* defense expenditure; Y represents the proxy for economic growth (real GDP and real *per capita* GDP). ln denotes the natural logarithm form of the variables; and subscript i and t represent the cross-section countries and time period respectively.

This study covers 4 emerging countries of the World, i.e. Brazil, Russia, China and India. Our study has used annual data covering the period from 1993-2014. We have taken data solely from World Development Indicators (WDI) database. The time period taken here has been favored by 3 reasonable facts. Firstly, we have taken the full sample of data depending upon the availability, and more prominently, the era of globalization has brought some spectacular growth in those economies. Secondly, division of Soviet Republics has changed the regime from Communism to Capitalism in Russia. As our bloc takes into account Russia only, we prefer not to place the defense scenario of Soviet Republic prior to 1990. Thirdly, these emerging economies after 1990s have been inflicted by several terrorism and separatism movements. Fourthly, in our analysis we have deliberately excluded South Africa from the analysis due to certain reasons. A) South Africa has comparatively less *per capita* defense spending compared to its BRIC counterparts. B) There are no such cross-border and strategic issues revolved near its geographic boundaries. C) More prominently, there is severe discontinuity in South Africa's defense spending data for which we seek to exclude it from our analysis.

4. Methodology and Results

Panel unit root test

In this section, this study trace the panel stationary property of the data in order to avoid any kind of spurious relation among the variables used in the model. Our dataset includes 4 variables namely real GDP, real *per capita* GDP, real defense expenditure and real *per capita* defense expenditure. We used Levin et al. (2002) unit root test and the result is presented in Table 1. It is derived from the unit root test is that we are not able to reject the null hypothesis of unit root test at the level series of the variables. In other words, all the variables are stationary at first difference. The main implication from the finding of I(1) of all the variables implies existence of long run relation among these variables. So, this study shows the long run relationship between expenditure and economic growth of BRIC countries in the next step.

Table 1. *Result of Unit Root Test*

Variable	Intercept	Intercept and Trend
lnGDP	0.50 (0.69)	-0.53 (0.29)
ΔlnGDP	-2.91 (0.00)	-2.23 (0.01)
lnPGDP	0.56 (0.71)	-0.57 (0.28)
ΔlnPGDP	-2.67 (0.00)	-2.18 (0.01)
lnMXP	0.68 (0.75)	0.67 (0.74)
ΔlnMXP	-1.50 (0.06)	-1.25 (0.09)
lnPMXP	0.89 (0.82)	0.62 (0.73)
ΔlnPMXP	-1.47 (0.07)	-1.23 (0.09)

Note: All variables are transformed logarithmically. PGDP and PMXP represent *per capita* GDP and *per capita* defense expenditure respectively. Δ indicates the first difference of the series concerned. Probability values are reported in the parenthesis.

Panel cointegration test

Once it is observed panel unit root, then in the next step this study performs a panel cointegration test proposed by Pedroni (2004). This test allows for heterogeneity in the intercept and slopes of the cointegration equation. In the Pedroni (2004) test conduct seven test statistics such as panel v-statistics, panel rho-statistics, panel pp-statistics, panel ADF-statistics, group rho-statistics, group PP-statistics and group ADF-statistics. So, the panel cointegration regression is as follows:

$$\ln X_{it} = \alpha_{1i} + \alpha_{2i} Y_{it} + \varepsilon_{it} \qquad (2)$$

More specifically, Pedroni (2004) seven test statistics are based on estimated residual i.e. $\varepsilon_{it} = \eta_i \varepsilon_{i(t-1)} + \mu_{it}$. Hence, when the calculated values of these seven test statistics are greater than the Pedroni (2004) critical value indicates rejection of null hypothesis. This implies existence of long run relation between expenditure and economic growth.

We report Pedroni (2004) panel cointegration result in Table 2. The result shows, a long run relation is captured or not between defense expenditure and economic growth in the case of BRIC countries. We frame our model into two parts. Model 1 represents the relation between real GDP with real defense expenditure and Model 2 represents the relation between real *per capita* GDP with real *per capita* defense expenditure of BRIC countries. The need for the inclusion of *per capita* defense expenditure and *per capita* growth are quite imminent because of their relative impact on the economic welfare and wellbeing of the individuals. Many earlier literatures (Pan et al., 2014) have identified the fundamental consequences of inequality arising out of excessive defense spending. Though we have not solely taken the inequality aspect here, still the inclusion of *per capita* aspects with reference to defense expenditure and growth have been considered here to make our analysis more robust and significant. The first column of the Table 2 presents the relation between the real defense expenditure as well as real *per capita* defense expenditure and real GDP and real *per capita* GDP of BRIC countries. The second column of the Table 2 present the seven test statistics proposed by Pedroni (2004) and the third column present the calculated test statistics.

Table 2. *Result of Cointegration Test*

Model 1	Test Statistics	Calculated Statistics
lnMXP-lnGDP	Panel v-statistics	3.20 (0.00)
	Panel rho-statistics	-5.03 (0.00)
	Panel pp-statistics	-7.54 (0.00)
	Panel ADF-statistics	-2.64 (0.00)
	Group rho-statistics	-3.15 (0.00)
	Group pp-statistics	-6.27 (0.00)
	Group ADF-statistics	-2.87 (0.00)
Model 2	Test Statistics	Calculated Statistics
lnPMXP-lnPGDP	Panel v-statistics	-3.19 (0.05)
	Panel rho-statistics	-4.98 (0.00)
	Panel pp-statistics	-7.39 (0.00)
	Panel ADF-statistics	-2.53 (0.00)
	Group rho-statistics	-3.07 (0.00)
	Group pp-statistics	-6.09 (0.00)
	Group ADF-statistics	-2.72 (0.00)

Note: Figure in parenthesis shows the p-value, MXP = real defense expenditure, PMXP = *per capita* defense expenditure, GDP= real economic growth, PGDP = real *per capita* economic growth.

The result derived from the Table 2 clearly show that the null hypothesis of no cointegration between real defense expenditure and real economic growth as well as real *per capita* defense expenditure and real *per capita* economic growth reject in all of the Pedroni (2004) test statistics. In Brazil, the *per capita* GDP (7.923) from 1993 has risen to (9.35) in 2014. Similarly the *per capita* defense spending (3.80) from 1993 has increased to 5.04 in 2014 due to the drug war as well as some defense deal with some developed economies (all values in brackets are logarithmically transferred). Russia in the similar fashion has improved its defense position by reflecting its geo-strategic significance and initiative to counter to NATO. India with a rising growth prospective (5.72 in 1993 to 7.37 in 2014) has also been facing the internal threats as well as spatial induced terrorism (separatist problems) and maritime piracy problems.[8] China has uniquely established its identity by employing geo-strategic influence over South China Sea and imminent problems with Japan, Taiwan and other southern neighbors. China's *per capita* defense spending has been increasing exponentially from 2.37 in 1993 to 5.06 in 2014.

Panel long run test

Once we find a long run relation between defense expenditure with economic growth, in the next step, this study shows the long run effect of real economic growth with real defense expenditure. This study used dynamic ordinary least square (DOLS) proposed by Kao and Chiang (2000), which includes leads and lags of the 'independent' variables to show the long run effect among them. The merit of DOLS over ordinary least square (OLS) and fully modified ordinary least square (FMOLS) explained by Kao and Chiang (2000) that OLS and FMOLS are biased up to N = 60 and T = 60 and hence DOLS is superior to OLS and FMOLS in all the case. We report the result of DOLS in Table 3. We

present the result of DOLS in the case of two models. Model 1 shows the long run effect of real economic growth on real defense expenditure and the model 2 shows the long run effect of real *per capita* economic growth on real *per capita* defense expenditure.

Table 3. *Result of DOLS Test*
Dependent variables are lnMXP and lnPMXP for Model 1 and Model 2 respectively

	Model 1		Model 2	
	Constant	lnGDP	Constant	lnPGDP
Coefficient	-0.60	0.86	-3.22	0.54
Std. Error	1.09	0.002	0.25	0.001
Prob.	0.58	0.00	0.00	0.00

Note: All variables are transferred into the logarithmic terms.

The result derived from Table 3 finds that real GDP positively affects to the real defense expenditure. More specifically, 1% change in real GDP, *ceteris paribus,* leads to raise 0.86% in real defense expenditure. Similarly, this study finds a positive relation between real *per capita* GDP to real *per capita* defense expenditure- 1% rise in real *per capita* GDP leads to raise 0.54% in real *per capita* defense expenditure. If we look at 20 year time span, except China, rest of the economies have experienced minor decrease in the real defense expenditure, although their *per capita* defense spending has increased significantly. Similarly, real GDP over 20 years for BRIC economies have also increased significantly.

Table 4. *Average trend of total defense expenditure as percent to GDP*

Country	1992-1996	1997-2001	2002-2006	2007-2011	2012-2013
Brazil	1.779	1.709	1.572	1.481	1.394
Russia	4.442	3.589	3.72	3.698	4.124
India	2.649	2.842	2.724	2.624	2.488
China	1.972	1.846	2.09	2.053	2.01

Source: World Development Indicators (WDI) of World Bank.

Table 5. *Growth rate of real GDP for the BRIC countries*

Country	1992-1996	1997-2001	2002-2006	2007-2011	2012-2013
Brazil	-0.317	-0.12	0.073	0.136	-0.096
Russia	-0.375	-0.214	0.13	0.062	-0.013
India	-0.012	-0.018	0.093	0.051	-0.085
China	0.038	0.089	0.138	0.182	0.097

Source: World Development Indicators (WDI) of World Bank.

Further, this study conducted a panel Granger Causality test to observe the direction of causality between the real defense expenditure and real GDP; real *per capita* defense expenditure and real *per capita* GDP. As panel Granger Causality test shows the short run relation between the variables, therefore, this study capture the speed of adjustment or ECM_{t-1} term through Arellano-Bond (1991) dynamic panel generalized method of moment (GMM) (Narayan et al., 2012; Narayan et al., 2008). We report the result in Table 6.

Table 6. *Panel Granger Causality Result*

	Model 1			Model 2		
	dlnMXP	**dlnGDP**	**ECM_{t-1}**	**dlnPMXP**	**dlnPGDP**	**ECM_{t-1}**
dlnMXP	------	3.90 (0.23)	-0.78 (0.00)	------	-------	-------
dlnGDP	5.88 (0.00)	------	-0.76 (0.00)			
dlnPMXP	-------	-------	-------	------	3.99 (0.00)	-0.80 (0.00)
dlnPGDP				5.92 (0.00)		-0.77 (0.00)

Note: Figure in parenthesis shows the p-value, MXP = real defense expenditure, PMXP = *per capita* defense expenditure, GDP= real economic growth, PGDP = real *per capita* economic growth.

The result of short run Granger causality is derived from the difference of the variables and the long run causality between the variables is observed from one period lag of error correction term (Narayan et al., 2012 and Bal and Rath, 2015). From the Table 6, it finds that there is unidirectional short run relation between real GDP to real defense expenditure for the BRIC countries. In addition to short run relation, we find significant ECM_{t-1} term which indicates existence of bidirectional relation between them in the long run. However, this study finds bidirectional causality between real *per capita* GDP and real *per capita* defense expenditure in the short run as well as in the long run in the case of BRIC countries.

Summary of the results

We set out another illustration of our notion of defense-growth nexus through the channel of a detailed empirical framework. Our main finding is quite interesting in terms of providing a strong and significant correlation among the variables of defense expenditure and growth rate.

In our analysis, initially we test the Pedroni cointegration, where almost all the 7 statistics have rejected the null hypothesis of no cointegration among the variables. The economies in the bloc have profoundly favored this aspect, if we study their distinctive geo-strategic, defense and security initiatives over the period from 1990s to till date. Incidents like maritime piracy, continuous terrorist threats, separatists' movements, extremist activities, border disputes and other random factors like territorial disputes have infused these economies to strengthen their defense mechanisms. Further, our panel DOLS analysis reflects the positive associations among the variables in the region. Every 1% rise in the economic growth has contributed nearly 0.54% rise in real defense expenditure, with the highest rise in case of China (0.60%). Despite the persistence of certain degree of skewedness in Brazilian defense spending, still a high correlation persists among the rest 3 superpowers (India, China, Russia) in terms of defense spending and economic growth. Russia is the leading arms exporter in the region, from which India and China are purchasing weapons over the years. Recent BRIC summit 2014 at Fortaleza has called for a BRIC defensive wall against the imminent external threat in the region. In addition to this, our Panel Granger result has reflected the bidirectional short run and long run causality among the variables. The causality test formally attributes to the fact that these variables are not only causally related in the long run, but also in short run. Many insignificant events in the short run like territorial disputes, defense deals have led to the significant rise in defense spending in these economies. Many prominent and unsolved

incidents like fundamentalism, terrorism have prompted these economies to adopt a collective long term strategy in the region, ultimately resulting in huge defense spending. Though this analysis has altogether got a significant relation among defense spending and growth rate, still it questions the ethos of such mechanism regarding which we are silent. We even baffle by such mechanism, whether a particular uniform threshold exists for defense spending or not in case of emerging economies.

5. Conclusion and future implication

Many interesting features of defense and economic growth are dynamic in nature because of present day's changing dynamics. In recent years, a large number of literatures have come up with different dimensions of economic growth by correlating with the defense mechanism. Using the empirical framework, we investigate the effect of defense spending upon the economic growth in so called BRIC bloc from 1993-2014. We primarily argue the essence of our study by using cointegration and causality tests. Cointegration tests show that there is a long run relation between defense expenditure and economic growth. We further apply Panel DOLS to show the long run effect of economic growth with defense expenditure. 1% change in real growth rate has attributed to 0.86% change in real defense expenditure in the region. Similarly the study finds the 0.54% change in *per capita* defense expenditure due to 1% change in economic growth. Further the application of Panel Granger causality test shows the short run relation among the variables and application of error correction mechanism reflects the long run bidirectional causality between the variables.

Through more sophisticated tools and highly detailed datasets, defense economists already reach a consensus that expansion of defense sector and economic growth are causally related with each other. Here our analysis shows a positive and significant relation among the variables, as found in many earlier literatures. The strategies used in this analysis leave open some innate possibility of researching further in this type of emerging bloc. A new insight may be gained in this BRIC region by exploring more options in the field of defense economics. Indeed, there is a more fundamental normative question persisting in case of emerging blocs after 1990s- should the emerging economies assign a tradeoff between social sector and defense sector spending in the name of growth. It is still highly controversial, how optimally the developing economies should spend and maintain their payoffs irrespective of their domestic and external scenarios. By looking at BRIC, each economy has been highly susceptible both domestic and external threats mostly in forms of separatism and terrorism. Furthermore, it is suggested here that given the financial backup of the respective government, defense spending can either be good or bad depending upon the time and spatial specific conditions.

Notes

(1) Here we exclude South Africa from our analysis due to the fact that South Africa's defense expenses are far lesser than the rest four economies in this bloc. It's defense expenditure to GDP ratio is lesser than that of BRIC Economies.

(2) Please See, "BRICS and the Global Economy" by B.R. Prasad - ORF Online Paper.

(3) South Africa has been excluded due to its relatively less share of defense expenses to that of world's defense expenditure. Its share is comparatively lesser than those of other BRICS members.

(4) Please refer to-www.novinite.com/articles/162111/Are+the+BRICS+Putting+Up+a+Defensive+Wall%3F

(5) For more, see SIPRI Report 2014.

(6) See Military Balance Press Report, 2014 by IISS.

(7) Please See Cooper, 2013 report on "Russian Military Expenditure- Data and Facts".

(8) Maritime piracy is an act of criminal violence at sea. This problem is more prominent in the Indian Ocean, Bay of Bengal and some parts of Caribbean Sea. A joint military effort is needed by these 4 BRIC economies to combat such crisis because these are the important international waterways for trade. For more, Please refer to UNODC Report, 2014 on Maritime Crime.

References

Ali, H.E. and Abdellatif, O.A. (2014). Defense expenditures and Natural Resources : Evidence from Rentier States in the Middle East and North Africa. *Defense and Peace Economics,* 26(1). pp. 4-13.

Arellano, M. and Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies.* 58(2). pp. 277-297.

Bal, D.P. and Rath, B.N. (2015). Nonlinear Causality between Crude Oil Price and Exchange Rate: A Comparative Study of China and India. *Energy Economics.* 51. pp. 149-156.

Benoit, E. (1973). Defense and Economic Growth in Developing Countries. Boston MA: Health. Lexington Books.

Benoit, E. (1978). Growth and Defense in Developing Countries. *Economic Development and Cultural Change.* 26(2). pp. 271-280.

Brito, D.L. (1972). A Dynamic Model of an Armaments Race. *International Economic Review.* 13(2). pp. 359-375.

Chen, P.F., Lee, C.C. and Chiu, Y.B. (2014). The Nexus between Defense Expenditure and Economic Growth: New Global Evidence. *Economic Modelling.* 36. pp. 474-483.

Deger, S. (1986). Economic Development and Defense Expenditure. *Economic Development and Cultural Change.* 35(1). pp. 179-196.

Dunne, J. (1996). Economic Effects of Military Expenditure in Developing Countries. *The Peace Dividend.* pp. 439-64.

Dunne, J.P. (2000). The Economic Effects of Military Expenditure in Developing Countries. Economics Group. Middlesex University Business School, the Burroughs, Hendon. London, NW4 4BT.

Dunne, J.P. and Smith, R.P. (2010). Military expenditure and Granger Causality: A Critical Review. *Defense and Peace Economics.* 21(5-6). pp. 427-441.

Hassan, M.K., Waheed Uzzaman, M. and Rahman. A. (2003). Defense Expenditure and Economic Growth in The SAARC countries. *The Journal of Political, Social and Economic Studies.* 28(3). pp. 275-293.

Hartley, K. and Sandler, T. (1995). Introductory Chapter (pp. 2-11). *Handbook of Defence, Economics.* Vol. 1. Elsevier.

Hirnissa, M.T., Habibullah, M.S. and Baharom, A.H. (2009). Military Expenditure and Economic Growth in ASEAN-5 Countries. *Journal of Sustainable Development.* 2(2). p. 192.

Intriligator, M.D. (1975). Strategic Considerations in the Richardson Model of Arms Races. *The Journal of Political Economy.* 83(2). pp. 339-354.

Kao, C. and Chiang, M.H. (1999). On the Estimation and Inference of a Cointegrated Regression in Panel Data. *Advances in Econometrics.* 15. pp. 179-222.

Kollias C., Mylonidis, N. and Paleologou, S.M. (2007). A Panel Data Analysis of the Nexus between Defense Spending and Growth in the European Union. *Defense and Peace Economics.* 18(1). pp. 75-85.

Lai, C.N., Hung, B.N., Yang, C.Y. (2005). Defense Spending and Economic Growth across the Taiwan Straits: A Threshold Regression Model. *Defense and Peace Economics.* 16(1). pp. 45-57.

Levin, A., Lin, C.F. and Chu, C. (2002). Unit Root Test in Panel Data: Asymptotic and Finite Sample Properties. *Journal of Econometrics.* 108 (1). pp. 1-24.

Lin, E.S. and Ali, H.E. (2009). Military Spending and Inequality: Panel Granger Causality Test. *Journal of Peace Research.* 46(5). pp. 671-685.

Malizard, J. (2014). Defense Spending and Unemployment in France. *Defense and Peace Economics.* 25(6). pp. 635-642.

Muhanji, S. and Ojah, K. (2014). External Debt and Military Spending: The Case of Africa's Conflict Countries. (No. 56077). University Library of Munich. Germany.

Narayan, P.K., Nielsen, I. and Smyth, R. (2008). Panel data, Cointegration, Causality and Wagner's Law: Empirical Evidence from Chinese Provinces. *China Economic Review.* 19(2). pp. 297-307.

Narayan, S., Rath, B.N. and Narayan, P.K. (2012). Evidence of Wagner's Law from Indian States. *Economic Modelling.* 29(5). pp. 1548-1557.

Narayan, P.K. and Singh, B. (2007). Modelling the Relationship between Defense Spending and Economic Growth for the Fiji Islands. *Defense and Peace Economics*. 18(4). pp. 391-401.

Pan, C.I., Chang, T. and Wolde-Rufael, Y. (2014). Military Spending and Economic Growth in the Middle East Countries: Bootstrap Panel Causality Test. *Defense and Peace Economics.* pp. 1-14.

Peck, M.J. and Scherer F.M. (1962). The Weapon Acquisition Process: An Economic Analysis. Boston: Harvard University.

Pedroni, P. (2004). Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis. *Econometric Theory.* 20(03). pp. 597-625.

Pedroni, P. (2007). Social Capital, Barriers to Production and Capital Shares: Implications for the Importance of Parameter Heterogeneity from a Nonstationary Panel Approach. *Journal of Applied Econometrics.* 22(2). pp. 429-451.

Pradhan, R.P. (2010). Defense Spending and Economic Growth in China, India, Nepal and Pakistan: Evidence from Cointegrated Panel Analysis. *International Journal of Economics and Finance.* 2(4). pp. 65-74.

Ram, R. (1995). Defense Expenditure and Economic Growth. *Handbook of Defense Economics.* 1. pp. 251-274.

Shahbaz, M., Leitão, N.C., Uddin, G.S., Arouri, M. and Teulon, F. (2013). Should Portuguese Economy Invest in Defense Spending? A Revisit. *Economic Modelling.* 35. pp. 805-815.

Topcu, M. and Aras, I. (2015). Defense Spending and Economic Growth: Extended Empirical Analysis for the European Union. *Defense and Peace Economics.* 26(2). pp. 233-246.

Yildirim, J. and Öcal, N. (2006). Arms Race and Economic Growth: The Case of India and Pakistan. *Defense and Peace Economics.* 17(1). pp. 37-45.

Yildirim, J. and Sezgin, S. (2002). Defense, Education and Health Expenditures in Turkey, 1924-1996. *Journal of Peace Research.* 39(5). pp. 569-580.

Zhong, M., Chang, T., Tang, D.P. and Wolde-Rufael, Y. (2014). The Causal Nexus between Military Spending and Unemployment in The G7: a Bootstrap Panel Causality Test. *Defense and Peace Economics.* 26(6). pp. 609-622.

Important Reports' studies being cited

1. SIPRI Report, 2014 on "Trends in World Military Expenditure, 2014" edited by Sam Perlo-Freeman, Aude Fleurant, Pieter D. Wezeman and Siemon T. Wezeman.
2. Observer Research Foundation Draft, 2013 on "BRICS and the Global Economy" by Bandi Ram Prasad.
3. International Institute of Strategic Studies Report, 2014 on "The Military Balance 2014" by John Chipman.
4. Swedish Defence Research Agency Report, 2013 on "Russian Military Expenditure: Data, Issues and Facts" by Julian Cooper (Paper No- FOI-R--3688—SE, September, 2013).
5. UNODC Annual Report, 2014 on Maritime Crime Programme.

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 103-118

Efficiency, non-linearity and chaos: evidences from BRICS foreign exchange markets

Anoop S. KUMAR
BITS Pilani KK Birla Goa Campus, Goa, India
anoopk@goa.bits-pilani.ac.in
Bandi KAMAIAH
University of Hyderabad, Hyderabad, India

Abstract. *This study examines the presence of possible weak form of market efficiency, non-linearity and chaotic behaviour in the foreign exchange markets of Brazil, Russia, India, China and South Africa(commonly known together as BRICS) using various tests. Monthly Nominal Effective Exchange Rate (NEER) data for the said countries, ranging from April 1994 to September 2014 were examined. The analysis was carried out using variance ratio (VR) tests, BDS test, Hinich Bispectrum test, Teräsvirta Neural Network test and estimation of Largest Lyapunov exponents (LLE's). The first stage consisted of testing for weak-form market efficiency using VR tests, which rejected the Weak-form Efficient Market Hypothesis for all the five series. The next step was to analyze the possible presence of non-linearity, and this was carried out using BDS test, Hinich Bispectrum test, and Teräsvirta Neural Network test. All the tests confirmed the presence of non-linearity in the five series under study. The last step of the study was to analyze the structure of non-linearity. LLE's were estimated for all series in order to examine the possible presence of chaos. LLE's for all the 5 series returned positive values, and thus confirmed the presence of an underlying chaotic structure for all markets.*

Keywords: Forex Market, BRICS, India, Chaos, Efficiency.

JEL Classification: G14, G15, F31.

Introduction

Behaviour of financial markets is an area of interest to researchers, investors and policy makers alike. Among the hypotheses proposed to explain market behaviour, efficient market hypothesis is the most discussed one.

The efficient market hypothesis in its weak form (Fama, 1965) states that a security price fully reflects all available information. The market is weak-form efficient if the current price of a security fully reflects all its information contained in its past prices, which means that studying the behaviours of historical prices cannot help in earning abnormal returns. The implication of weak-form efficiency is the random walk hypothesis (RWH), which indicates that successive price changes are random and serially independent. Stated differently, it is not possible to gain extra-normal profits from a market.

Weak form market efficiency implies that the markets are informationally efficient and there are no chances for extreme events such as a financial crisis. Any deviation will be temporary in such a set up. However, past evidences show that this is not the case. Financial markets are seen to be prone to extreme events, the latest being financial crisis of 2008. In such a situation, it will be of interest to study the behaviour of financial markets.

There are many methods to test weak form of market efficiency. Among them, variance ratio tests are considered powerful tools. Lo and MacKinlay (1988) were the first to construct the conventional variance ratio test. There were many improvements upon the Lo and MacKinlay (1988) test, and there were new tests constructed to address the potential shortcomings associated with the test. Chow and Denning (1993) modified Lo-MacKinlay's (1988) test to form a simple multiple variance ratio test. Choi (1999) put forward a data-driven automatic Variance Ratio test. Chen and Deo (2006) proposed a test to take care of the small sample distribution problem associated with Variance ratio (VR) statistic.

The efficient market hypothesis in the weak from is essentially deals with a linear dependency between current prices and past prices, while is perfectly possible that there could exist non-linear relationship between the variables under consideration. To analyse non-linear dependence in a time series, various tests are implemented. Some of the tools are BDS test (1987), Hinich Bispectrum test (1982) and neural network test by Teräsvirta (1993).

However, it is to be noted that none of the above mentioned test proposes a definite alternative hypothesis regarding the structure of the non-linearity. Non-linear systems could be stochastic or deterministic. Chaotic system is a type of non-linear deterministic system, with certain properties. Of the methods used in detection of chaos, Lyapunov exponents (LE) are powerful tools. It measures the rate of divergence between two near-by trajectories. If the value of LE for a system is positive, the system is said to be chaotic and vice versa.

Among financial markets of a country, forex markets hold great importance. A stable currency is a pre-requisite to economic growth and trade relations. Hence, it would be of

great interest, especially from an economic policy view point, study the forex market behaviour. In an efficient market, there need not be any intervention by the monetary authority, as it will self correct. If the market is not efficient, the monetary authority could take necessary steps, as per the prevailing exchange rate management regime, if needed.

About BRICS

Jim O'Neill (2001) of Goldman Sachs coined the acronym 'BRIC'. The acronym has come into widespread use as a symbol of shift in global economic power towards the developing nations. Meetings between BRIC countries began in New York in September 2006, with a meeting of the BRIC foreign ministers. The BRIC countries met for their first official summit on 16 June 2009, in Yekaterinburg, Russia, with leaders of Brazil, Russia, India and China attending.

The core focus of the summit was the improvement of the current global economic situation and discussing how the four countries can better work together in the future, as well as a more general push to reformation in financial institutions. There were also discussions regarding how emerging markets, such as those members of BRIC, could be better involved in global affairs in the future.

South Africa sought membership during 2010, and was admitted as a member nation on December 24, 2010 after being formally invited by BRIC countries to join the group. The group was renamed BRICS to reflect the five-nation membership, with an "S" for South Africa appended to the acronym.

As BRICS aims at economic co-operation, and considering the fact that all of the member nations are developing countries, it will be of importance to see whether their respective economies follow any common traits. This study concentrates on the foreign exchange markets of BRICS countries, and seeks to analyze certain behaviours of the same. All of the forex markets follow managed float regimes with various degrees of intervention.

The reminder of this study is organized as follows. First, a brief review of the literature is presented. The analysis consists of three stages. In the first stage, the presence of weak form of market efficiency in the BRICS foreign exchange markets is analyzed using a family of Variance ratio tests. As the next stage, possible presence of non-linearity is analysed by employing BDS test (for raw series and residuals extracted from fitted GARCH models), Hinich Bispectrum test and Teräsvirta's Neural network test. The last stage of the analysis includes test to find a structure of non-linearity, if present. Estimation of Largest Lyapunov Exponent (LLE) was carried out for this purpose.

Literature Review

Tabak and Lim (2003) analyzed the random walk hypothesis on emerging markets exchange rates by employing Lo and McKinley (1989) variance ratio test on a daily and weekly frequency using a bootstrap technique, which is robust to heteroskedasticity. They

examined some Asian and Latin American countries and Russia. Empirical evidence supports the random walk hypothesis on both daily and weekly frequencies for the recent period.

Das et al. (2007) has analyzed the presence of chaos in the foreign exchange markets of India and china by analyzing the bilateral daily exchange rates against US dollar. The methodology implemented was that of Largest Lyapunov Exponents. They estimated LLE's for the original exchange rate series as well as surrogate data series created from the original, and found the evidence of deterministic chaos in both the currencies.

Noman and Ahmed (2008) investigated the weak-form efficiency for foreign exchange markets in seven SAARC countries for the period from 1985 to 2005. They employed variance ratio test of Lo and MacKinlay (1988) and Chow-Denning joint variance ratio test (1993). Their study failed to reject the null hypothesis of random walk for all the seven currencies and the conclusion was that foreign exchange markets in South Asian region follow random walk process and, therefore, are weak-form efficient.

Asad (2009) tested the random walk and efficiency hypothesis for 12 Asia-Pacific foreign exchange markets using individual as well as panel unit root tests and variance ratio test of Lo and MacKinlay (1988) and the non-parametric-based variance ratio test of Wright (2000). The study used both daily and weekly spot exchange rate data from January 1998 to July 2007. While the daily data accepted the null hypothesis of weak form efficiency, it was rejected for the majority of the exchange rates while using weekly data.

Sasikumar (2011) analyzed the validity of weak form efficient market hypothesis in Indian foreign exchange market using 3 individual (Lo and McKinley, Wright, Choi) as well as 3 joint variance ratio(Chow-Denning, Chen-Deo and Wald) tests. All tests conclusively rejected the hypothesis of weak-form market efficiency.

Ibrahim et al. (2011) test for the weak form of market efficiency for the OECD countries efficiency using the Augmented Dickey-Fuller (ADF) and Phillip-Peron(PP)tests. The results indicate that the exchange rates studied follow random walks. The study used bilateral exchange rates to carry out the analysis.

Many of the above-mentioned studies were carried out using bilateral exchange rates and the analysis shows the evidence of weak-form market efficiency, except in the case of India and China. And regarding analysis of non-linearity and chaos for the exchange markets of said countries, there is a serious dearth of material, as per the best knowledge of the author, and it is the main motivation to carry out the present study. It could be said that bilateral exchange rates may not fully represent the dynamics of the foreign exchange market. Here, it is proposed to use Nominal Effective Exchange Rate (NEER) instead.

Data and Methodology

Monthly NEER data from April 1994-September 2014 is used for the analysis, taken from the Bank of International Settlement (BIS) website. To analyze the presence of weak-form market efficiency, 4 types of variance ratio tests (two individual, two joint)

were employed. To test for non-linearity, BDS test, Hinich bispectrum test, and Teräsvirta neural network test were used. Largest Lyapunov exponent (LLE) were calculated for each series to test the presence of chaos. Detailed description of the tests is given in Appendix I.

Analysis

Tables 1 and 2 display the result of individual and joint variance ratio tests respectively. Tables 3, 4, 5 and 6 show the results of the tests for non-linearity. Table 7 displays the result of LLE estimation.

Table 1. *Result of individual variance ratio tests*

Test	Statistic	Holding Periods	Brazil	India	Russia	China	South Africa
Lo-Mac	Z_1	2	13. 3766 (0. 0000)	13. 55999 (0. 0000)	13. 34135 (0. 0000)	13. 65202 (0. 0000)	13. 73550 (0. 0000)
		5	23. 96705 (0. 0000)	22. 95078 (0. 0000)	22. 14875 (0. 0000)	23. 41138 (0. 0000)	23. 5504 (0. 0000)
		10	32. 19612 (0. 0000)	29. 67557 (0. 0000)	29. 32821 (0. 0000)	30. 25523 (0. 0000)	31. 1298 (0. 0000)
	Z_2	2	9. 33872 (0. 0000)	9. 276806 (0. 0000)	7. 468472 (0. 0000)	8. 073136 (0. 0000)	8. 59914 (0. 0000)
		5	16. 39696 (0. 0000)	16. 01941 (0. 0000)	12. 94002 (0. 0000)	14. 06835 (0. 0000)	15. 01571 (0. 0000)
		10	22. 6260 (0. 0000)	29. 67557 (0. 0000)	18. 18043 (0. 0000)	18. 70377 (0. 0000)	20. 52205 (0. 0000)
Choi	AV(K)		88. 95893 (0. 0000)	71. 3408 (0. 0000)	65. 30769 (0. 0000)	61. 57797 (0. 0000)	95. 0317 (0. 0000)

Note: for all the tables* indicates Significance at 1% level, P-values in the Parenthesis.

Table 2. *Result of joint variance ratio tests*

Test	Statistic	Holding Periods	Brazil	India	Russia	China	South Africa
Chen-Deo	QP_K	2, 5, 10	80. 24667*	76. 21783*	55. 59929*	58. 88748*	67. 35016*
Chow-Denning	CD_1	2, 5, 10	32. 1961*	29. 6755*	29. 3282*	30. 2552*	31. 1298*
	CD_2	2, 5, 10	22. 6260*	21. 4765*	18. 1804*	18. 7038*	20. 5220*

Table 3. *BDS test results (for the raw series)*

Currency/M&E	M=2, E=0. 5	M=4, E=1	M=8=E, 1. 5	M=10, E=2
Brazil	93. 0228 (0. 000)	76. 3654 (0. 000)	115. 4003 (0. 000)	70. 88 (0. 000)*
Russia	28. 3814 (0. 000)	39. 2551 (0. 000)	98. 3718 (0. 000)	132. 9022 (0. 000)
India	132. 1733 (0. 000)	85. 4309 (0. 000)	79. 4735 (0. 000)	46. 977 (0. 000)
China	60. 2393 (0. 000)	63. 1154 (0. 000)	59. 8894 (0. 000)	39. 566 (0. 000)
South Africa	95. 7388 (0. 000)	80. 2871 (0. 000)	77. 8248 (0. 000)	50. 456 (0. 000)

Table 4. *BDS test results (Residuals of the fitted GARCH Models)*

Fitted Models	M & E→	M=2, E=0. 5	M=4, E=1	M=8=E, 1. 5	M=10, E=2
Brazil (AR(1, 0) -EGARCH(1, 1))		5. 4751 (0. 000)	8. 0755 (0. 000)*	7. 9874 (0. 000)	5. 6085 (0. 000)
Russia (ARMA(1, 1)-EGARCH(1, 1))		13. 4818 (0. 000)	9. 7733 (0. 000)	7. 9728 (0. 000)	7. 9724 (0. 000)
India (AR(1, 0)-EGARCH(1, 1))		0. 3752 (0. 7075)	0. 1402 (0. 0883)	1. 9128 (0. 000)	2. 5535 (0. 010)
China (AR(0, 0) –APARCH(1, 1))		60. 0217 (0. 000)	62. 9749 (0. 000)	58. 83 (0. 000)	39. 04 (0. 000)
South Africa (AR(1, 0)-APARCH(1, 1))		3. 3537(0. 000)	1. 7831(0. 0743)	2. 2749(0. 0331)	0. 8709(0. 3814)

Table 5. *Teräsvirta Neural Network test result*

Currency\lag	2	3	4	5	6
Brazil	24. 09 (0. 000)	39. 267 (0. 001)	60. 15 (0. 000)	123. 03 (0. 001)	211. 75 (0. 000)
Russia	155. 42 (0. 000)	359. 24 (0. 000)	419. 37 (0. 000)	523. 75 (0. 000)	523. 75 (0. 000)
India	3. 06 (0. 86)	16. 44 (0. 442)	40. 28 (0. 009)	77. 71 (0. 007)	168. 70 (0. 003)
China	7. 74 (0. 378)	33. 67 (0. 006)	40. 20 (0. 09)	75. 96 (0. 010)	140. 92 (0. 000)
South Africa	12. 09 (0. 090)	17. 030 (0. 366)	37. 50 (0. 160)	61. 96 (0. 119)	110. 38 (0. 000)

Table 6. *Hinich Bispectrum test results*

Currency	H-statistics
Brazil	30. 53(0. 000)*
Russia	77. 54(0. 000)
India	53. 45(0. 000)
China	58. 74(0. 000)
South Africa	56. 49(0. 000)

Table 7. *Largest Lyapunov Exponent*

Currency	Largest Lyapunov exponent
Brazil	0. 2458
Russia	0. 1011
India	0. 0567
China	0. 0803
South Africa	0. 0605

The holding periods (k) for VR tests considered are (2, 5, 10) as advocated by Deo and Richardson (2003). After examining the Individual VR test results, we can see convergence among the various individual variance ratio tests. Here all the individual test statistics are significant at 1% level, and therefore the null hypotheses of weak-form market efficiency are rejected by all the tests.

After examining the joint VR test results, a similar conclusion is reached. Here too, a convergence among the test results is observed. All the test statistics are showing significance at 1% level. Hence, the null hypothesis is rejected with the joint tests also.

From the above results, it could be concluded that foreign exchange markets of the BRICS countries are not weak form efficient.

In the second stage, the presence of non-linearity was analyzed using various tests. The BDS test was applied in successive increasing embedding dimensions and increasing values of epsilon, for raw series, as well as residual extracted from fitted GARCH models. The GARCH models were fitted in order to see whether the non-linearity present could be explained by a GARCH process. While BDS test was applied to the raw dataset, the null hypothesis of i. i. d. was rejected for all values of m and epsilon for all series.

While the BDS test was applied to the extracted residuals from the GARCH models, the null of linear independence were rejected at all levels of m and epsilon for NEER series of Brazil, Russia and China. For India, the presence of non-linearity were confirmed for the values m = 8, epsilon = 1.5, and m = 10, epsilon = 2, and for South Africa, it was confirmed for m = 2, 4, 8 and corresponding epsilon = 0.5, 1, 1.5. This indicates that a GARCH process cannot satisfactorily explain the non-linearity present in these series, and further analysis is required.

The Teräsvirta Neural network test confirmed the presence of non-linearity for NEER of Brazil and Russia at all lags, while for the other three countries, the presence of non-linearity was detected in higher lags. The results from the Hinich bispectrum test also confirmed the presence of non-linearity in all of the five series. Thus it was confirmed non-linearity is present in all the five series under analysis after examining various test results.

To examine the nature of the non-linearity, LLE was calculated for each dataset. A positive value of Lyapunov exponent signifies chaotic behaviour. Here, the estimation returned positive values for all the five series. The value of Lyapunov exponent was highest for Brazil, indicating that the Brazilian forex market is most chaotic among the group. Indian forex market had the least value of Lyapunov exponent. Hence, it could be said that chaotic behaviour is present in the foreign exchange markets of "BRICS" countries in various degrees.

Conclusion

This study examined the possible presence of weak form of market efficiency, non-linearity and chaotic behaviour in the foreign exchange markets of Brazil, Russia, India, China and South Africa using a three-step-analysis. The first stage of analysis consisted of using variance ratio (VR) tests for checking weak form market efficiency. Presence of non-linearity was tested using BDS test, Hinich Bispectrum test and Teräsvirta Neural Network test. In the third stage, estimation of Largest Lyapunov exponents (LLE's) was carried out to detect the possible presence of chaos. The first stage rejected the Weak-form Efficient Market Hypothesis for all the five series. The next step was to analyze the possible presence of non-linearity. Here too, all tests confirmed the presence of non-linearity in the five series under study. The third step of the study, which was to analyze the structure of non-linearity, was carried out by estimating LLE for all five series. LLE's

for all the 5 series returned positive values, and thus confirmed the presence of an underlying chaotic structure for all markets.

Here, we could assume that these markets may share some common characteristics, which resulted in them being not weak-form efficient, non-linear and chaotic. However, further study is required to identify the possible presence of such factors in order to reach at a strong conclusion.

References

Andrews, D.W.K. (1991). Heteroskedasticity and autocorrelation consistent covariance matrix estimation. *Econometrica.* Vol. 58. No. 3. pp. 817-858.

Asad, A.S.M.S. (2009). Random walk and efficiency tests in the Asia-Pacific foreign exchange markets: Evidence from the post-Asian currency crisis data. *Research in International Business and Finance.* Vol. 23. No. 3. pp. 322-338.

Brock, W.A., Dechert, W. and Scheinkman, J. (1987). A test for independence based on the correlation dimension, *Working paper*. University of Wisconsin at Madison. University of Houston, and University of Chicago.

Brillinger, D.R. (1965). An introduction to the polyspectrum. *Annals of Mathematical Statistics*, Vol. 36. pp. 1351-1374.

Chen, W.W. and Deo, R.S. (2006). The variance ratio statistic at large horizons. *Econometric Theory.* Vol. 22. No. 2. pp. 206-234.

Chiang, S.M., Lee, Y.H., Su, H.M. and Tzou, Y.P. (2010). Efficiency tests of foreign exchange markets for four Asian Countries. *Research in International Business and Finance.* Vol. 24. No. 3. pp. 284-294.

Choi, I. (1999). Testing the random walk hypothesis for real exchange rates. *Journal of Applied Econometrics.* Vol. 14. No. 3. pp. 293-308.

Chow, K.V. and Denning, K.C. (1993). A simple multiple variance ratio test. *Journal of Econometrics.* Vol. 58. No. 3. pp. 385-401.

Cochrane, J.H. (1988). How big is the random walk in GNP?. *Journal of Political Economy.* Vol. 96. No. 5. pp. 893-920.

Das, A. and Das, P. (2006). Chaotic analysis of the foreign exchange rates. *Applied Mathematics and Computation.* Vol. 185. pp. 388-396.

Deo, R.S. and Richardson, M. (2003). On the asymptotic power of the variance ratio test. *Econometric Theory.* Vol. 19. No. 2. pp. 231-239.

Fama, E.F. (1965). The behavior of stock market prices. *The Journal of Business.* Vol. 38. No. 1. pp. 34-105.

Ibrahim, J., Long, Y., Ghani, H. (2011). Weak-Form Efficiency of Foreign Exchange Market in the Organization for Economic Cooperation and Development Countries: Unit Root Test. *International Journal of Business and Management*. Vol. 6. No. 6. pp. 55-65.

Kantz, H. (1994). A robust method to estimate the maximal Lyapunov exponent of a time series. Phys. Lett. A. Vol. 185. pp. 77-87.

Lo, A.W. and MacKinlay, A.C. (1988). Stock market prices do not follow random walk: evidence from a simple specification test. *Review of Financial Studies.* Vol. 1. No. 1. pp. 41-66.

Lo, A.W. and MacKinlay, A.C. (1989). The size and power of the variance ratio test in finite samples. *Journal of Econometrics.* Vol. 40. No. 2. pp. 203-238.

Noman, A.M. and Ahmed, M.U. (2008). Efficiency of the foreign exchange markets in South Asian Countries. *AIUB Bus Econ Working Paper Series*. No. 2008-18.

O'Neill, J. (2001). Building Better Global Economic BRICs. *Global Economics Paper*. No. 66.

Richardson, M. and Smith, T. (1991). Tests of financial models in the presence of overlapping observations. *Review of Financial Studies.* Vol. 4. No. 2. pp. 227-254.

Sasikumar, A. (2011). Testing for Weak Form of Market Efficiency in Indian Foreign Exchange Market. *The IUP Journal of Monetary Economics.* Vol. 9. No. 2. pp. 7-19.

Tabak, B.M. and Lima, E.J.A. (2003). Testing the random walk hypothesis for emerging markets exchange rates. *Central Bank of Brazil working papers*.

Teräsvirta, T., Lin, C.F. and Granger, C.W.J. (1993). Power of the Neural Network Linearity Test. *Journal of Time Series Analysis.* Vol. 14. pp. 209-220.

Wolf, A., Swift, J.B., Swinney, H.L., Vastano, J.A. (1985). Determining Lyapunov exponents from a time series. *Physica 16 D.* Vol. 16. pp. 285-317.

Wright, J.H. (2000). Alternative variance-ratio tests using ranks and signs. *Journal of Business and Economic Statistics.* Vol. 18. No. 1. pp. 1-9.

Appendix-I. Description of the tests

A. TESTS FOR WEK-FORM MARKET EFFICIENCY

1. Lo and MacKinlay (1988, 1989) Variance Ratio test

RWH for a time series X_t can be given by the following equation:

$$X_t = \mu + X_{t-1} + \varepsilon_t \tag{1}$$

μ is an arbitrary drift parameter and ε_t is the random disturbance term.

The underlying assumption is that the disturbance terms ε_t are independently and identically distributed normal variables with variance σ_o^2 . This is the assumption according to the traditional RWH.

Thus,

$$H : \varepsilon_t \text{ i. i. d. } N(0, \sigma_o^2) \tag{2}$$

According to the null hypothesis that the variance ratio should be unity for all levels of aggregation, it can be described as follows;

$$VR(q) = \frac{1}{q}\frac{\sigma_q^2(q)}{\sigma_1^2(q)} = 1 \tag{3}$$

The test statistic that is developed by Lo and MacKinlay for the variance ratio is as follows;

$$Z_1(q) = \sqrt{nq}\,\overline{M}_r(q)(2(2q-1)(q-1)/3q)^{-1/2} \overset{a}{\approx} N(0,1) \tag{4}$$

Where the variance ratio is,

$$\overline{M}_r(q) \equiv \frac{\overline{\sigma}_c^2(q)}{\overline{\sigma}_a^2} - 1 \tag{5}$$

And where the variance estimators are;

$$\overline{\sigma}_a^2 = \frac{1}{nq-1}\sum_{k-1}^{nq}(X_k - X_{k-1} - \hat{\mu})^2 \tag{6}$$

And,

$$\overline{\sigma}_c^2(q) = \frac{1}{m}\sum_{k=q}^{nq}(X_k - X_{k-q} - q\hat{\mu})^2 \tag{7}$$

Where,

$$m = q(nq - q + 1)(1 - \frac{q}{nq}) \tag{8}$$

The tests are based on different aggregation levels, signaled by q.

Next to the homoskedastic test statistic, Lo and MacKinlay (1989) also developed a test statistic that is robust to heteroskedasticity. They developed this test statistic with the knowledge that volatilities change over time, and that the error terms of financial time series are often not normally distributed.

Since $\overline{M}_r(q)$ still approaches zero, therefore we only have to calculate its asymptotic variance, which is defined as θ_q.

The variance ratio estimate as defined before, is asymptotically equivalent to a weighted sum of serial autocorrelation coefficient estimates, such that;

$$\overline{M}_r(q) = \sum_{j-1}^{q-1} \frac{2(q-j)}{q} \hat{\rho}(j) \tag{9}$$

Where $\hat{\rho}(j)$ is the estimator of the j^{th} autocorrelation factor.

Here, the asymptotic distribution of $\overline{M}_r(q)$ under the null hypothesisis defined as follows;

$$\sqrt{nq}\,\overline{M}_r(q) \overset{a}{\approx} N(0, V(q)), \tag{10}$$

Where $V(q)$ is the asymptotic variance of $\overline{M}_r(q)$ and can be calculated as

$$V(q) = \sum_{j=1}^{q-1} (2(q-j)/q)^2\, \overline{\delta}(j), \tag{11}$$

Where

$$\overline{\delta}(j) = \frac{(nq)\sum_{k=j+1}^{nq} (X_k - X_{k-1} - \overline{X})^2 (X_{k-j} - X_{k-j-1} - \overline{X})^2}{\left[\sum_{k=1}^{nq} (X_k - X_{k-1} - \overline{X})^2\right]^2} \tag{12}$$

And $\overline{\delta}(j)$ is the estimator for the weighted sum of the variances of $\hat{\rho}(j)$.

The standard normal Z-statistic under heteroscedasticity is computed as:

$$Z_2(q) = \sqrt{nq}\,\overline{M}_r(q)\left[V(q)\right]^{-1/2} \overset{a}{\approx} N(0,1). \tag{13}$$

2. Automatic variance ratio test under conditional heteroskedasticity of Choi (1999)

While implementing the VR tests, the choice of holding period *k* is important. However, this choice is usually rather arbitrary and *ad hoc*. To overcome this issue, Choi (1999)

proposed a data-dependent procedure to determine the optimal value of *k*. Choi (1999) suggested a VR test based on frequency domain since Cochrane (1988) showed that the estimator of *V*(*k*), which uses the usual consistent estimators of variance, is asymptotically equivalent to 2π times the normalized spectral density estimator at the zero frequency, which uses the Bartlett kernel.

However, Choi (1999) employed instead the quadratic spectral (QS) kernel because this kernel is optimal in estimating the spectral density at the zero frequency (Andrews, 1991). The VR estimator is defined as

$$VR(k) = 1 + 2\sum_{i=1}^{T-1} h(i/k)\,\hat{\rho}(i) \tag{14}$$

Where R(i) is the autocorrelation function, and *h*(*x*) is the QS window defined as

$$h(x) = \frac{25}{12\pi^2 x^2}\left[\frac{\sin\left(\frac{6\pi x}{5}\right)}{6\pi x/5} - \cos\left(\frac{6\pi x}{5}\right)\right] \tag{15}$$

The standardized statistic is

$$VR_f = \frac{VR(k)-1}{(2)^{\frac{1}{2}}(T/k)^{-1/2}} \tag{16}$$

Under the null hypothesis the test statistic VR_f follows the standard normal distribution asymptotically. Note that it is assumed that $T \to \infty$, $k \to \infty$ and $T/k \to \infty$. Choi (1999) employed the Andrews (1991) methods to select the truncation point optimally and compute the VR test. Note that the small sample properties of this automatic VR test under heteroskedasticity are unknown and have not been investigated properly.

Joint variance ratio tests

1. Chow and Denning (1993) multiple variance ratio test

The test developed by Lo and MacKinlay (1988) uses the property of the RWH to test individual variance ratios for different values of the aggregation factor q. Chow and Denning (1993) recognized that the test lacks the ability to test whether all the variance ratios of the different observation intervals are equal to 1 simultaneously. This is a requirement of the RWH, and since Lo and MacKinlay (1988) overlooked this requirement, they used the standard normal tables to test the variance ratios on significance. Failing to control for the overall test size, leads to a large probability of a Type 1 error.

To circumvent this problem, Chow and Denning developed a test that controls for the joint test size, and also provides a multiple comparison of variance ratios. They used the Studentized Maximum Modulus (SMM) critical values to control for the overall test size and to create a confidence interval for the Variance Ratio estimates. They used the same test statistic of the Lo and MacKinlay (1988) Variance Ratio test. Only now they are simply compared to the SMM critical values, instead of the standard normal critical values to look for significance.

Since Chow and Denning (1993) consider multiple comparisons of the variance ratio estimates, and all variance ratio estimates should be above the SMM critical value, they

use the following largest absolute value of the two test statistics as defined before in the Lo and MacKinlay (1988) procedure

$Z_1^*(K) = \text{Max}_{1\le i\le K}|Z_1(q_i)|$ (17)

$Z_1^*(K) = \text{Max}_{1\le i\le K}|Z_1(q_i)|$ (18)

$Z_1(q)$ and $Z_2(q)$ is calculated same as above

In which (q_i) are the different aggregation intervals for $\{q_i | i = 1,2,...,m\}$. The decision about whether to reject the null hypothesis or not can be based on the maximum absolute value of individual variance ratio test statistics.

2. Joint Variance Ratio Test of Chen and Deo(2006)

Chen and Deo (2006) suggested a simple power transformation of the VR statistic that, when *k* is not too large, provides a better approximation to the normal distribution in finite samples and is able to solve the well-known right-skewness problem. They showed that the transformed VR statistic leads to significant gains in power against mean reverting alternatives. Furthermore, the distribution of the transformed VR statistic is shown, both theoretically and through simulations, to be robust to conditional heteroscedasticity.

They defined the VR statistic based on the periodogram as

$$VR_p(k) = \frac{1}{1-k/T}\frac{4\pi}{T\hat{\sigma}^2}\sum_{j=1}^{(0.5(T-1))} W_k(\lambda_j) I_y(\lambda_j) \quad (19)$$

Where,

$$I_y(\lambda_j) = (2\pi T)^{-1}\left|\sum_{t=1}^{T}(Y_t - \hat{\mu})\exp(-i\lambda_j t)\right|^2 \quad (20)$$

$$\hat{\sigma}^2 = (T-1)^{-1}\sum_{t=1}^{T}(Y_t - \hat{\mu})^2 \quad (21)$$

And $\lambda_j = 2\pi j/T$; while $W_k(\lambda) = k^{-1}\{\sin(0.5k\lambda)/\sin(0.5\lambda)\}^2$ is a weighting function. Chen and Deo (2006) found that the power-transformed statistic $VR_p^{\beta_K}$ (k) gives a better approximation to a normal distribution than $VR_p(k)$, where

$$\beta_k = 1 - \frac{2}{3}\frac{\left(\sum_{j=1}^{(0.5(T-1))} W_k(\lambda_j)\right)\left(\sum_{j=1}^{(0.5(T-1))} W_k^3(\lambda_j)\right)}{\left(\sum_{j=1}^{(0.5(T-1))} W_k^2(\lambda_j)\right)^2} \quad (22)$$

Let (k_1, …, k_l) be a vector of holding periods satisfying the conditions given in Theorem 5 of Chen and Deo (2006). Conditions (A1) to (A6) in Chen and Deo (2006) allow the innovations ε_t to be a martingale difference sequence with conditional heteroskedasticity. They are explained below.

A1)$\{\varepsilon_t\}$ is ergodic and $E(\varepsilon_t/\vartheta_{t-1}) = 0$ for all t, where ϑ_t is a sigma field, ε_t is ϑ_t measurable

And$\vartheta_{t-1} \subset \vartheta_t$ for all t.

(A2) $E(\varepsilon_t^2) = \sigma^2 < \infty$

(A3) For any integer q, $2 \leq q \leq 8$ and for q non negative integers s_i, $E(\prod_{i=1}^{q} \varepsilon_{t_i}^{s_i})=0$ when at least one s_i is exactly one and $\sum_{i=1}^{q} s_i \leq 8$

(A4) For any integer r, $2 \leq r \leq 4$ and for r non negative integers s_i, $E(\prod_{i=1}^{q} \varepsilon_{t_i}^{s_i}/\vartheta_t)=0$

when at least one s_i is exactly one and $\sum_{i=1}^{r} s_i \leq 4$

(A5)$\lim_{n\to\infty} \mathrm{Var}(E(\varepsilon_{t+n}^2 \varepsilon_{t+n+j}^2|\vartheta_t)) = 0$ uniformly in j for every j>0

(A6) $\lim_{n\to\infty} E\left(\varepsilon_t^2 \varepsilon_{t-n}^2\right) = \sigma^4$

Under the assumption that given time series Y_t follows a conditionally heteroskedastic martingale difference sequence Chen and Deo Showed that

$$V_{p,\beta} \equiv (VR_p^{\beta_1}(k_1), \ldots\ldots, VR_p^{\beta_l}(k_l))' \quad (23)$$

approximately follows $N(\mu_\beta, \Sigma_\beta)$. The details of μ_β and Σ_β are given in Chen and Deo (2006). Based on this, Chen and Deo (2006) proposed a joint test statistic of the form

$$QP = (V_{p,\beta} - \mu_\beta)' \sum_\beta^{-1} (V_{p,\beta} - \mu_\beta) \quad (24)$$

It approximately follows a chi-squared distribution with l degrees of freedom under H_0: $V(k_1) = \ldots = V(k_l) = 1$ against H_1: $V(k_i) \neq 1$ for some i.

B. TESTS FOR NON-LINEARITY

1. BDS (1987)Test

W.A. Brock, W. Dechert and J. Scheinkman proposed BDS test in 1987 (Brock et al., 1987). BDS test is a powerful method for detecting serial dependence in time series. It tests the null hypothesis of independent and identically distributed (I. I. D.) against an unspecified alternative.

The BDS test is based the correlation integral concept. Consider a time series $\{x_t: t = 1, 2, \ldots., N\}$, which is a random sample of independent and identically distributed (i. i. d.) observations. The correlation integral $C_m(\varepsilon)$ measures the probability that any two of the points $\{X_i\}$ meet within distance ε from each other in m dimensional phase space, and must equal to the product of the individual probabilities, provided that pairs of points are independent:

$$C_m(\varepsilon) = \prod_{i,j(i\neq j)} p(||X_i - X_j|| < \varepsilon) \; for \; N \to \infty \quad (25)$$

if all observations are also identically distributed, then

$$C_m(\varepsilon)=(C_1(\varepsilon))^m \text{ for } N\to\infty. \quad (26)$$

The statistic: $B(m, \varepsilon, N)=N^{0.5}(C_m(\varepsilon)-C_1(\varepsilon))$ (27)

would converge to a normal distribution with zero mean and a variance $V(m, \varepsilon, N)$ which could be consistently estimated from the sample data. The BDS statistic is defined as

$$W(m,\varepsilon,N) = \frac{B(m,\varepsilon,N)}{(V(m,\varepsilon,N))^{1/2}} \quad for \; N \to \infty \quad (28)$$

The BDS statistic, W, will follow a standard normal distribution. The null hypothesis of BDS test is the testing series is of i. i. d. observations. If the W estimator is larger than the

level of significance, we can reject the null hypothesis, that is, the nonlinearity exists in the testing series.

2. Hinich (1982)Bispectrum test:

The Hinich (1982) bispectrum test is a frequency domain test. It estimates bispectrum of stationary time series and provides a direct test for non-linearity in the given series. The flat skewness indicates that the return generating process is linear. In other words, the test checks for third order non-linear dependence.

For frequencies ω_1 and ω_2 in the principal domain given by

$$\Omega = \{(\omega_1, \omega_2): 0 < \omega_1 < 0.5, \omega_2 < \omega_1, 2\omega_1 + \omega_2 < 1\}, \quad (29)$$

the bispectrum $B_{xxx}(\omega_1, \omega_2)$ is defined by

$$B_{xxx}(\omega_1, \omega_2) = \sum_{r,s=-\infty}^{\infty}(C_{xxx}(r,s)\exp(-i2\pi(\omega_1 r + \omega_2 s)) \quad (30)$$

The bispectrum is the double Fourier transformation of the third-order moments function and is the third-order polyspectrum. The regular power spectrum is the second-order polyspectrum and is a function of only one frequency.

The skewness function $\Gamma(\omega_1, \omega_2)$ is defined in terms of the bispectrum as follows:

$$\Gamma^2(\omega_1, \omega_2) = \frac{|B_{xxx}(\omega_1,\omega_2)|^2}{S_{xx}(\omega_1)S_{xx}(\omega_2 S_{xx}(\omega_1+\omega_2)} \quad (31)$$

where $S_{xx}(\omega)$ is the (ordinary power) spectrum of $x(t)$ at frequency ω. Since the bispectrum is complex valued, the absolute value in Equation 31 shows modulus. Brillinger (1965) proved that the skewness function $\Gamma(\omega_1, \omega_2)$ is constant over all frequencies $(\omega_1, \omega_2)\epsilon\Omega$ if $\{x(t)\}$ is linear; while $\Gamma(\omega_1, \omega_2)$ is flat at zero over all frequencies if $\{x(t)\}$ is Gaussian. Linearity and Gaussianity can be tested using a sample estimator of the skewness function.

3. Teräsvirta (1993) neural network test

In Teräsvirta (1993) neural network test, the time series is fitted with a single hidden-layer feed-forward neural network, which is used to determine whether any nonlinear structure remains in the residuals of an autoregressive (AR) process fitted to the same time series. The null hypothesis for the test is 'linearity in the mean' relative to an information set. A process that is linear in the mean has a conditional mean function that is a linear function of the elements of the information set, which usually contains lagged observations on the process.

The intuition behind Teräsvirta test can be summed as follows: under the null hypothesis of linearity in the mean, the residuals obtained by applying a linear filter to the process should not be correlated with any measurable function of the history of the process. Teräsvirta test uses a fitted neural net to produce the measurable function of the process's history and an AR process as the linear filter. It then tests the hypothesis that the fitted function does not correlate with the residuals of the AR process. The resulting test statistic has an asymptotic χ^2 distribution under the null of linearity in the mean.

C. Test for CHAOS

1. Largest Lyapunov Exponent (LLE)

Analysis of the chaotic behavior depends on the concept of sensitive dependence to initial conditions (SDIC) and the opinion that chaos will exist if nearby trajectories diverge exponentially. One of the implications the existence of SDIC is the systematic loss of predictability of the system over time. The notion of Lyapunov spectrum is often used to quantify and detect this phenomenon.

Lyapunov exponents are calculated as follows:

$$\lambda = \lim_{n\to\infty} \ln\left(||Df^n(x)\vec{v}||\right)/n \quad (32)$$

where D signifies the derivative, $//\,//$ is the Euclidian norm, f^n is the nth iteration of dynamical system f with initial conditions in point x and $\vec{v}$ is a direction vector. If the largest real part of these exponents is positive then the system exhibits sensitivity to initial conditions. In such a case, a larger magnitude means faster decay in the predictability.

This method requires knowledge of the analytical structure of the underlying dynamics. In cases where the true dynamics are not known, the alternative is to devise methods for extracting information about the rates of divergence between nearby orbits from a sequence of observed data. An algorithm suggested by Wolf et al. (1985) has been used for this purpose. Here, a slightly modified version of Wolf's algorithm suggested by Kantz (1994) is used for the analytical purpose.

The procedure could be explained by defining a line S, as a function of the number of time steps, number of observations, the embedding dimension and radius of the ball B (which is an indicator for the size of the neighborhood):

$$S(\Delta n, N, m, \varepsilon) = \frac{1}{N-m+1}\sum_{i_0=1}^{N-m+1} ln\left(\frac{1}{|B(X_{i0})|}\sum_{X_j \epsilon B(X_{i0})} ||x_{(i_0+\Delta n,1)} - x_{(j+\Delta n,1)}||\right) \quad (33)$$

Where, $|B(\cdot)|$ is the total number of neighbors in the neighborhood B (a ball with diameter ε) of the reference vector X_{i0}. $x_{(i0,\,1)}$ is the most recent, element in the reference vector, X_{i0} and $x_{(i0+\Delta n,\,1)}$ is the first observation outside the time span covered by the reference vector.

The basic idea is to trace the distance in between a reference point X_0 and its neighbor, X_j, after n time steps. Set $d_j(X_0, X_j, n)$ to be this distance in the reconstructed phase space and let $\varepsilon(X_0, X_j)$ denote the initial distance between X_0 and X_j. In this case, $d_j(X_0, X_j, n)$ should grow exponentially by the largest Lyapunov exponent $\lambda_{\max}(X_0)$, or as it might be expressed in logarithm scale

$$ln\, d_j(X_0, X_j, n) \approx \lambda_{max}(X_0)n + ln\varepsilon(X_0, X_j) \quad (34)$$

It is proposed that, if this linear pattern is persistent for a number of time steps n, the estimated slope is an estimate for the largest Lyapunov exponent. Kantz procedure keeps track of all neighbors within a neighborhood ball $B(X_0)$. By taking an average of all neighbors within the neighborhood, this method seems more robust against noisy elements.

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 119-128

A theoretical examination of tax evasion among the self-employed

Dennis BARBER III
Armstrong State University, Savannah, GA USA
dennis.barber@armstrong.edu

Abstract. *Informal activities are looked upon by most governments as a loss in potential revenue. An extension of the Ramsey model is presented that includes an income tax and a parameter that allows for the evasion of part or all of those taxes. The model shows the decrease in government revenue and long term levels of consumption and capital. However, the growth rate of capital and consumption remains unaffected by informal activities. The model does not include any assumptions about how individuals will choose to spend the money they save by evading taxes.*

Keywords: Tax Evasion, Self-Employment, Long-run growth, Ramsey-Cass-Koopman, Optimal Growth, Entrepreneurship

JEL Classification: L26, H26, E26.

Introduction

Self-employed individuals have many difficult decisions to make as they decide to start their own venture and the decision making continues as they begin operating the firm. This paper focuses on one of those decisions, which is, do I participate in the formal or the informal sector of the economy? A self-employed person can participate in informal activities in a variety of manners, for example, hiring informal labor, buying informal inputs, selling in informal markets and evading taxes. Governments have tried over time to discourage these types of activities, even though there may be a degree of informal activity that contributes significantly to economic growth.

Take the model presented here as a marginal addition to the theoretical investigation of tax evasion, specifically as it relates to the self-employed, and how the effects are felt throughout the economy. This model employs the basic Ramsey-Cass-Koopman optimal growth model with government involvement as presented in Blanchard and Fischer (1989). The government involvement in this model is modeled by an income tax and the difference in the model presented in this paper is the addition of a parameter which allows self-employed individuals to evade any percentage of the income tax. The model shows that tax evasion among the self-employed decreases government revenue, levels of capital and consumption but does not affect the long term growth rate in the economy.

A major argument as to why individuals decide to become self-employed is because of the ease at which they can avoid paying taxes. Falsifying income and botching deductions are just a couple of the ways in which it may be easier to evade taxes as a self-employed individual. Often times, small businesses may receive payments in cash and this income is difficult to trace, therefore it is difficult to prove that tax evasion is taking place.

One possible motivation for choosing entrepreneurship, or self-employment, over wage-earning employment is the ease of evading taxes, as noted by Andreoni et al. (1998). A self-employed, sole proprietor can underreport income and overstate deductions more easily than someone employed as a wage-earner. If the perceived probability of being caught is low and the penalty for underreporting is low then the self-employed may choose to risk underreporting if they can avoid paying the taxes on the income. If the self-employed behaved in this manner then one would believe that lower taxes could increase self-employment levels. Fölster utilized data from OECD countries and found that national tax burden and self-employment as a percentage of GDP were negatively related. It is difficult to determine if this actually supports the case where entrepreneurs choose to become so to avoid taxes.

Parker and Robson (2004) also examined OECD data, specifically from 1972 to 1996, to determine what explains international differences in rates of self-employments. The cross country analysis provided an interesting comparison between countries and the panel dataset allowed the researchers to examine the countries over time. The authors showed how multiple explanatory variables cointegrated with the self-employment variable. The results suggested that average income tax rates and self-employment rates are positively and significantly related. These findings supported an earlier study by Robson and Wren (1999). Taken at face value, the implications of such studies are that as individuals face

higher tax rates they are more likely to enter into self-employment. This study offers more specifics about which taxes may be related to self-employment when compare to Fölster's study. However, the cross country macro level data sets, such as the OECD have many weaknesses. For example, reporting methods are not standardized throughout the member countries. Therefore, an individual that is categorized as self-employed in one country may not be categorized as such in another. Torrini (2005) also used OECD data to take a closer look at the relationship between public policy and self-employment. One of the results is that unemployment benefits are negatively related to self-employment, which suggests that unemployed workers with high benefit rates have little incentive to start their own business. However, these results were sensitive to model specifications.

Donald Bruce (2000) investigated the dynamics of the U.S. tax system and individuals' choice of self-employment. The Panel Study of Income Dynamics provided a good panel of U.S. data and his data set covered 1970 through 1991. The author was interested in determining the benefit that a self-employed person gains from being non-compliant. Differential taxes, specifically between wage-earning and the self-employed, were a focus of the study. Bruce computed the tax differentials for the transition from wage-earning into self-employment. The findings suggest that higher tax differentials led to a reduction in entry into self-employment. However, Bruce does not suggest that entrepreneurs choose to do so to avoid paying higher taxes. One implication of the study is that higher marginal tax rates for the self-employed could be associated with more deductions for filing as a business. Therefore, the higher marginal tax rates increase the benefits for the self-employed.

A further step in being able to tailor policies which create disincentives for tax evasion by the self-employed is to understand which of the self-employed are more likely to evade taxes. This information gives policymakers power to create specific policies that will focus on the sector of the population that are intended to be affected by the policy. Schuetze (2002) conducted a study that mainly focused on the demographic differences among the self-employed and which were more likely to be non-compliant. The data was collected from the Canadian Family Expenditure Surveys and covered the time span of 1969 to 1992. One major finding of the study is that those who were self-employed in the construction industry were more likely to be non-compliant, which may be due to the ease of underreporting in such industries. The construction industry was followed closely by service industries. Another interesting finding is that the level of non-compliance decreases with age. Also households that were headed by two self-employed individuals (as opposed to one) concealed less income.

Model

The model below is an extension of the Ramsey-Cass-Koopman optimal growth model by including an income tax and the ability for the self-employed to evade this tax. The ability to more easily evade taxes is an often cited reason that individuals choose to become self-employed. Also, with regards to access to certain markets, the self-employed are treated differently than small business owners. For our discussion and for the

implications of this model, we are only referring to the self-employed and not those who own small businesses. Therefore, the self-employed are agents in this model and not firms. This model specifically focuses how an income and tax evasion is felt throughout the economy. The model includes the self-employed and firms interacting in a marketplace.

First, the self-employed maximize the constant relative risk aversion utility function below. For simplicity, utility is only a function of consumption. c_t is total consumption by a representative agent at time *t*.

$$u(c_t) = \frac{{c_t}^{1-\theta}-1}{1-\theta} \quad (1)$$

To maximize utility, a self-employed individual solves the maximization problem below.

$$\max_{c_t} \int_0^{\infty} \frac{{c_t}^{1-\theta}-1}{1-\theta} e^{-(\rho-n)t} dt \quad (2)$$

Subject to the following constraints

$$\dot{a}_t = (1-\phi\tau)[w_t + r_t a_t] - c_t - n a_t$$

$$a_0 = a_0$$

$$a_t \geq -B \; \forall t$$

$$c_t \geq 0 \; \forall t$$

The first constraint shows how the self-employed's assets, a_t, accumulate over time. ρ is the discount rate w_t is the wages the self-employed earns from labor. r_t is the interest earned on assets. na_t is the dilution of assets due to population growth. Therefore, $[w_t + r_t a_t]$ is the income of a representative self-employed agent. τ is the income tax rate faced by all of the self-employed in the model. ϕ is the amount of taxes which they evade, $0 > \phi > 1$. A lower value for this parameter represents a higher level of tax evasion. As ϕ approaches one, the self-employed is paying more of the tax rate and as it approaches zero the self-employed agent is paying less. This shows that a high level of tax evasion leads to more income for the agent. ϕ can be directly affected by government policy. For example, as penalties for being caught evading taxes increases an agent is more likely to evade a lower amount of taxes. If the probability of being caught increases then the self-employed agent is again more likely to evade a lower amount of taxes.

The second constraint shows that the self-employed agent starts with a given asset level at time zero. The third condition constrains the self-employed agent from running a Ponzi scheme. This condition maintains that at a given point in time an agent can no longer borrow. The final constraint restricts consumption levels to be positive at all times. To solve the maximization problem, the Hamiltonian equation below is used.

$$H_t = \frac{{c_t}^{1-\theta}-1}{1-\theta} e^{-\rho t} + \mu_t[(1-\phi\tau)[w_t + r_t a_t] - c_t - n a_t] \quad (3)$$

μ_t is the marginal value of an agent's assets at time *t*. An agent's utility would increase by μ_t if they had one more unit of assets. The Hamiltonian, H_t, is the utility level, received from income, of a given agent at time *t*. The agent receives utility from their consumption in the present and receives future utility from their current savings. After first differentiating the Hamiltonian, the first order conditions (FOCs) below become evident.

$$\partial H_t/\partial c_t = 0 = {c_t}^{-\theta} e^{-\rho t} - \mu_t \Rightarrow \mu_t = {c_t}^{-\theta} e^{-(\rho - n)t} \quad (4)$$

$$\partial H_t/\partial a_t = -\dot{\mu}_t = \mu_t[(1 - \phi\tau)r_t] - n) \quad (5)$$

$$\partial H_t/\partial \mu_t = \dot{a}_t = (1 - \phi\tau)[w_t + r_t a_t] - c_t - n a_t \quad (6)$$

$$TVC\colon \lim_{t\to\infty} \mu_t a_t = 0 \quad (7)$$

The transversality condition (*TVC)* keeps the system stable and forces that as times approaches infinity either the marginal value of assets or the level assets (or both) must be equal to zero. Now, equations (4) and (5) can be used to derive the "Euler Equation." After logging and differentiating (4), equation (8) is the result.

$$\theta \frac{\dot{c}_t}{c_t} + \rho - n = -\frac{\dot{\mu}_t}{\mu_t} \quad (8)$$

And by rearranging (5), a different representation of $-\frac{\dot{\mu}_t}{\mu_t}$ is found and represented in equation (9).

$$\frac{\dot{\mu}_t}{\mu_t} = r_t - n \quad (9)$$

Setting (8) and (9) equal gives the "Euler Equation" seen in equation (10).

$$\frac{\dot{c}_t}{c_t} = \frac{1}{\theta}[(1 - \phi\tau)r_t - \rho] \quad (10)$$

There are two opposing forces on consumption for this self-employed agent. The agent is impatient and would rather consume today than save, however, the positive interest rate incentivizes the agent to save (invest) now to be able to consume even more in the future. Also, notice that if the interest rate exactly equals the discount rate then the agent will save just enough to keep consumption levels constant over time. If the interest rate is greater than the discount rate then the agent receives a higher reward for saving and therefore the agent consumes less today so they can consume more tomorrow. On the other hand, if the reward to saving is less then the agent will consume more today and consumption will decrease over time. The agent also has to choose whether to participate in informal activities by choosing how much tax to evade.

With equation (10) and our restraint on asset accumulation, there are two differential equations for consumption and assets, show in equations (11) and (12).

$$\dot{c}_t = \frac{c_t}{\theta}[(1-\phi\tau)r_t - \rho] \quad (11)$$

$$\dot{a}_t = (1-\phi\tau)[w_t + r_t a_t] - c_t - na_t. \quad (12)$$

However, the phase diagrams cannot be drawn because wages and returns to investing in assets are determined in the marketplace and therefore the behavior of firms needs to be examined. Notice that when adding income tax rate and the ability to evade taxes to the model the agent now does not care about the interest rate on investments; he or she is more interested in the "after-tax" interest rate, which is the rate they will actually receive on their investments. This after-tax rate is dependent not only on the tax rate but also on the level of tax evasion.

The firms' solutions (equations (13) and (14)) and most of the market clearing conditions (equations (15) – (17)) are the same as in the original version of this model.

$$F_K(k_t, A_t) = R_t \quad (13)$$

$$F(k_t, A_t) - k_t F_K(k_t, A_t) = w_t \quad (14)$$

$$N_t = L_t \quad (15)$$

$$a_t = k_t \quad (16)$$

$$R_t = 1 - \phi\tau r_t + \delta \quad (17)$$

$$\phi\tau[w_t + r_t a_t] = \varphi_t. \quad (18)$$

Equation (15) restricts the labor market to equal population in the model. Equation (16) shows that the banks hold all of the agents' assets and rents the capital to entrepreneurs. δ is the depreciation rate of capital. Therefore, equation (17) shows that a competitive bank makes zero profits, assuming constant returns to scale. Equation (18) is the government's budget constraint and includes the parameter for tax evasion. It holds by definition. It just says that φ_t is the revenue the government will collect given this income tax rate. Notice that it is dependent on the level of tax evasion. If a representative agent evades a high level of taxes then the government has lower income. Therefore, the government, in this model, should work to deter agents from evading taxes. This could be done by higher penalties or a ensuring a higher probability of being caught.

Combining equations these equations gives us a price free representation of the steady-state levels of consumption and capital as seen in equations (19) and (20) respectively.

$$\dot{c}_t = \frac{c_t}{\theta}[(1-\phi\tau)(F_K(k_t, A_t) - \delta) - \rho] \quad (19)$$

$$\dot{k}_t = (1-\phi\tau)[F(k_t, A_t) - \delta k_t] - c_t. \quad (20)$$

Now that prices are gone, the equations are one step closer to being able to be displayed in a phase diagram. The only part of the equations that keep this from happening is the growth in productivity. This variable is changing over time; therefore the two sets of equations are not yet autonomous. To derive the necessary equations, new variables are defined below.

$$\dot{\hat{c}}_t = \frac{\dot{c}_t}{A_t} - g\hat{c}_t \quad (21)$$

$$\dot{\hat{k}}_t = \frac{\dot{k}_t}{A_t} - g\hat{k}_t \quad (22)$$

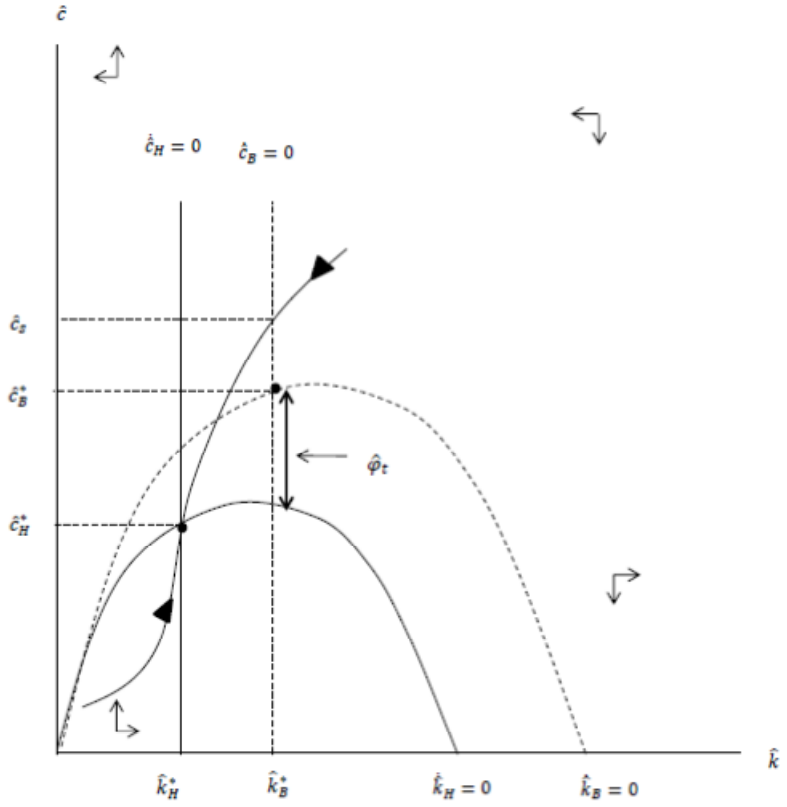
$g = \frac{\dot{A}_t}{A_t}$. Therefore, the system of differential equations can be seen in equations (23) and (24).

$$\dot{\hat{c}}_t = \frac{\hat{c}_t}{\theta}\left[(1-\phi\tau)(f'(\hat{k}_t) - \delta - \rho - \theta g\right] \quad (23)$$

$$\dot{\hat{k}}_t = (1-\phi\tau)\left[f(\hat{k}_t) - \delta\hat{k}_t\right] - \hat{c}_t - g\hat{k}_t. \quad (24)$$

The phase diagram for these two equations is show in 1.

Figure 1. *Phase Diagram*



The interesting implications for this model is the level of tax evasion and its effects throughout the economy. For comparative purposes, a baseline, indexed with a *B* on the graph, level of tax evasion is assumed and then this level is increased. The increased level of evasion is indexed with an *H.* This allows for the model to show how an increase in the level of evasion affects the economy. The tax rate faced by agents in this model is assumed to be constant throughout the analysis. The isocline for the increased level of

evasion is rotated downward when compared to the isocline of the baseline level of tax evasion. Due to this difference between the isoclines, the higher level of tax evasion leads to lower steady-state levels of capital and consumption.

To see the effects of an increase in tax evasion on capital and consumption levels over time it is useful to take a look at the time paths for these two variables. At the baseline level of tax evasion, the economy is in a steady state. There are two effects at play here, the substitution and income effects. The substitution effect is evident when a lower level of tax evasion leads to a decrease in an agent's return on savings, therefore it is more worthwhile to consume today. But the income effect is leading to a different outcome, where the lower level of evasion leads to the agent becoming poorer therefore they are forced to consume less today. To be able to draw the time paths, one of the effects has to dominate. Moving forward, the substitution effect overrides the income effect, therefore, $\hat{c}_s > \hat{c}_B^*$. Before the time paths for capital and consumption can be drawn, one final illustration must be made. Remember $\hat{k} = \frac{k}{A}$, therefore $k = \hat{k}A$ and after logging and differentiating this representation of capital it can be seen that Equation (25) shows that

$$\frac{\dot{k}}{k} = \frac{\dot{\hat{k}}}{\hat{k}} + \frac{\dot{A}}{A} \Longrightarrow \gamma_k = \gamma_{\hat{k}} + g \tag{25}$$

when $\hat{k}$ is at its steady-state level, when $\hat{k} = \hat{k}^*$, the economy never stops accumulating capital. And this growth in capital is exactly equal to productivity growth. The same analysis can be done for consumption and the results tell the same story, $\gamma_c = \gamma_{\hat{c}} + g$. See Figures 2 and 3 for the time paths of capital and consumption respectively.

Figure 2. *Time Path of Capital*

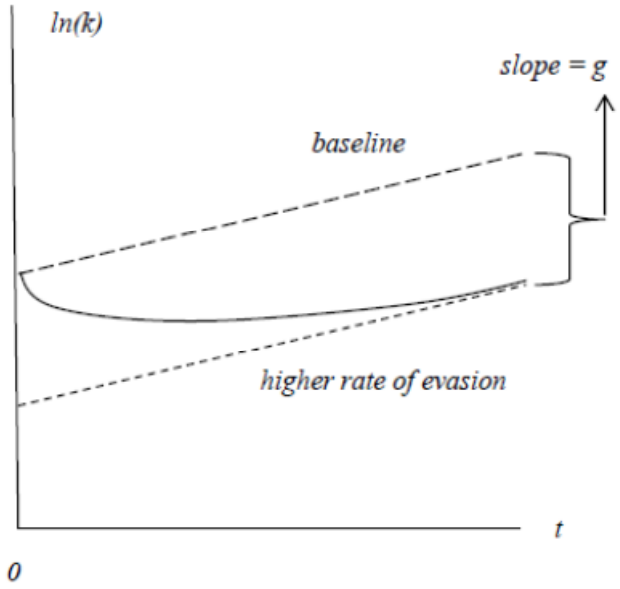
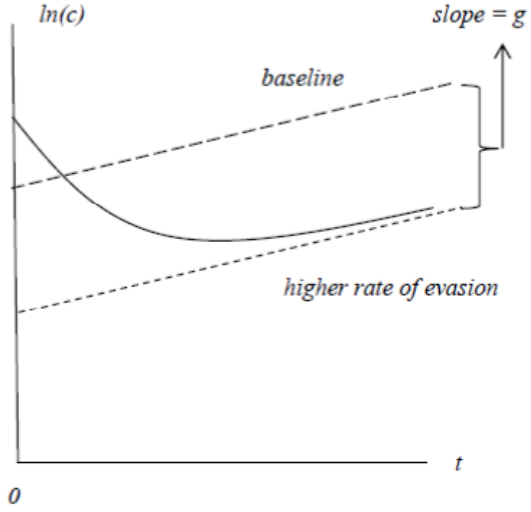


Figure 3. *Time Path of Consumption*



The results seen in the time paths show that the tax evasion activities do not affect the long term growth rate, which is only dependent on productivity growth. A higher rate of tax evasion leads to a lower level of capital per worker and, since the substitution effect outweighs the income effect, tax evasion leads to lower levels of consumption. No assumptions are made here as to what the self-employed agents will do with the income that they save from evading taxes.

How does this affect government revenue? As the level of tax evasion increases, $\phi \to 0$, the amount of government revenue decreases. Remember, $\varphi_t = \phi\tau[w_t + r_t a_t]$, and define, just as before $\hat{\varphi} = \frac{\varphi}{A}$. Now by looking at the phase diagram above it is easy to see the difference in government revenue due to tax evasion activities, $\hat{\varphi}_t$.

It is important to note that the previous model is only the beginning of the theoretical investigation of informal activities. The Ramsey model, and its possible extensions, offers a variety of ways to investigate the informal economy. For example, a functional form for the production function could be assumed. Also, the production function for formal production and informal production could be different and a producer would have to choose the output level that would maximize his or her profits. Producers in the models could also be assumed only to be entrepreneurs. Those types of extensions are future avenues of research.

Conclusion

All economies in the world face some level of informal activities, even those that have been historically considered ideal economic environments. It does not matter whether an economy is experiencing high rates of growth and is among the most developed in the world or if the economy is facing stagnant growth rates and is considered to be underdeveloped. There is no clear picture as to whether informal activities are indicators

of a flourishing entrepreneurial environment or if it is a sign of an overly bureaucratic system. More often than not governments attempt to reduce the amount of informal economic activity that is happening in their economy. However, if that is the case and at the same time self-employed choose to be so to evade taxes then the government is working against the potential entrepreneurs in the economy. It is important to know, however not included in this model, what a tax evader does with the extra income that they save from evading taxes. The model here gives a simple look at the effects of tax evasion among the self-employed throughout the economy. One of the most obvious results is that as the level of tax evasion increases, government revenue decreases. The model also shows that investment into capital and levels of consumption will decrease as more taxes are evaded. However, the long term growth rate of the economy remains unchanged as a result of tax evasion. A possible extension of the model is to include assumptions about how the self-employed use the extra income they receive from evading taxes.

References

Andreoni, J., Erard, B. and Feinstein, J. (1998). Tax Compliance. *Journal of Economic Literature.* 36(2). pp. 818-860.

Blanchard, O.J. and Fischer, S. (1989). *Lectures on Macroeconomics.* Cambridge (MA): MIT Press.

Bruce, D. (2000). Effects of the United States Tax System on Transitions into Self-Employment. *Labour Economics.* Vol. 7. pp. 545-574.

Parker, S.C. and Robson, M.T. (2004). Explaining International Variations in Self-Employment: Evidence from a Panel of OECD Countries. *Southern Economic Journal.* 71(2). pp. 287-301.

Robson, M.T. and Wren, C. (1999). Marginal and Average Tax Rates and the Incentive for Self-Employment. *Southern Economic Journal.* 65(4). pp. 757-773.

Schuetze, H.J. (2002). Profiles of Tax Non-Compliance among the Self-Employed in Canada: 1969 to 1992. *Canadian Public Policy.* 28(2). pp. 219-38.

Torrini, R. (2005). Cross-Country Differences in Self-Employment Rates: The role of institutions. *Labour Economics.* Vol. 12. pp. 661-683.

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 129-140

Long-term effects of the investments dynamics in Romania in the post-accession period – a regional approach

Anca DACHIN
Bucharest University of Economic Studies, Romania
daniela.dachin@economie.ase.ro
Georgiana MORARU
Bucharest University of Economic Studies, Romania
moraru.georgiana90@yahoo.com

Abstract. *The adhesion to the European Union has boosted investment in Romania, which contributed significantly to the economic growth in 2007-2008. The economic adjustments during the crisis period were focused mainly on reducing the public investments, while promoting procyclical policies. The economic recovery noted after 2011 was recorded amid the drop of investments, in particular due to further decrease of public investments, under the impact of the fiscal consolidation measures and the tendency to push economic growth by stimulating consumption. The private investments had an uneven territorial orientation, which contributed to an increase of regional economic disparities. The paper analyses the recent dynamics of investments in Romania and their contribution to the economic growth, seeking to determine the extent to which the investment policy will lead to a greater territorial cohesion. In this regard, we have used the econometric analysis of the relationship between investment growth and economic development at regional level, by using a set of linear regressions.*

Keywords: investments, public investments, fiscal policy, regional economic growth, regional disparities.

JEL Classification: E22, H50, H62, R11.

1. Introduction

The investments have a double role in the economy: in short-term investments are considered a component of aggregate demand, and their growth can stimulate the economy, including through the investment multiplication mechanism, while in long-term investments increase the productive potential of the national economy. In conditions of crisis, public investment may reverse the diminishing investment propensity of the private sector.

In addition to the importance of both absolute and relative level of investment as a component of GDP, also the investment efficiency is significant. The differences in efficiency can be highlighted by measuring the increase in gross investment required for a specific output's growth at the national level. Data analysis for the three most developed EU countries (France, Germany, UK) shows that this indicator was significantly higher in the period 1980-1989 (1.1 to 1.8) compared to 1990-2005 (0.7 – 0.8), so the investments efficiency increased on long-term (Griffith and Wall, 2012, p. 347). In crisis period, calculating the efficiency in this way is significantly disrupted by the impact of reduced aggregate demand, but the concern for investment efficiency continues.

In Romania there was a waste of public funds for investment and the total investments multiplier turned out to be even sub unitary in the period 2007-2012 (Dachin and Gherman, 2014). It's already outlined the idea that European funds may induce the increase of the investment efficiency and at the same time they could support the modernization of public administration (Dăianu, 2015, p. 201). Thematic concentration on the priorities of Strategy Europe 2020 influenced the approach and the construction of operational programs for 2014-2020 period. The introduction of macroeconomic conditionalities was motivated by the need to ensure the link between cohesion policy and economic governance of the European Union. The specialists say that these conditionalities have a strong coercive character (Drăgan et al., 2013, p. 199), which basically refers to the need of setting priorities in the investment process and of using European funds efficiently.

A component of private investment that supports economic growth consists of the foreign direct investments (FDI). The FDI are themselves conditioned in a certain measure by public investment and absorption of European funds, at least because of the need to have a modern infrastructure in order to be effective. Although Romania is behind many EU countries regarding the stock of FDI, empirical studies on sub-regions in Eastern Europe shows that disparities regarding the dynamics of FDI tend to decrease (the Gini coefficient tends to decrease) (Strat, 2015).

The European Commission analysed the evolution of public investment managed at subnational level, showing that during the 2009-2013 period these have declined, as well as total investment in most EU countries. The EU cohesion policy plays an important role

by providing a major funding source for public investments (European Commission, 2014, pp. 154-154).

The paper provides an empirical analysis of the investment trend in Romania in the post-accession period to the European Union in the context of the applied fiscal policy and the need for fiscal consolidation. The analysis is performed both at national level and at the level of development regions, given the regional disparities regarding the investment effort and its long-term effect. To determine the effect of the investment dynamics on economic growth and development we have used the econometric analysis by means of a set of linear regressions. The regression coefficients were calculated based on data from Eurostat and the European Commission. At national level we calculated the Pearson correlation between annual indices of real GDP/potential GDP and public investment indices, respectively separately the total investment indices (GFCF). At regional level we used for each region the same method; respectively we calculated the correlation coefficients between total investments dynamics (GFCF) and GDP dynamics, respectively GDP per capita and employment rate. Separately we determined the correlation between FDI and GDP dynamics.

2. The fiscal policy in the post-accession period and the dynamics of investments

The assessment of the general characteristics of fiscal policy in Romania in the post-accession period requires an analysis of the type of policy applied during a longer period of time, so we considered the structural budget balance evolution between 2000 and 2015. The structural budget balance was calculated by eliminating the cyclical component from the actual budget balance. For the fiscal policy to be countercyclical, it should be an expansionary policy during the recession, when the real GDP is lower than potential GDP and there is cyclical budget deficit, and respectively a restrictive policy during times of rapid expansion and cyclical budget surplus.

In Romania, the periods of expansionary policies were associated with surpluses of the cyclical budget balance (Table 1), while the deepening of the structural budget deficit could be attributed to the implementation of expansionary fiscal policy which relied on the growth of public expenditure based on temporary revenue, which had a cyclical nature. In the post-accession period the global financial crisis felt in Romania was aggravated by the existing internal imbalances, mainly by the problem of high twin deficits (the budget deficit was 5.7% of GDP and the current account deficit was 11.5% of GDP in 2008), which led to further measures of pro-cyclical nature adopted in the context of limited fiscal space.

Countercyclical policies have not followed the basic rule of the state, since fiscal adjustments were made when the economy recorded a negative output gap, contrary to the recommendation of economic theory that fiscal consolidation should be done when the economy operates above its potential.

Table 1. *The budget balance (% of GDP) and the characteristics of fiscal policy in Romania, 1999-2015*

Year	Actual budget balance (ESA deficit)	Cyclical budget balance	Struc-tural budget balance	Output-gap	Variation of the structural budget balance compared to previous year	Interpretation		
						Expansionary/ restrictive fiscal policy		Procyclical/ Counter-cyclical fiscal policies
1999	-4,4	-2,2	-2,2	-7	-			
2000	-4,7	-1,9	-2,8	-7,1	-0,6	expansionary	→	countercyclical
2001	-3,5	-1,8	-1,7	-5,2	1,1	restrictive	→	procyclical
2002	-2	-1,3	-0,7	-4	1	restrictive	→	procyclical
2003	-1,5	-0,9	-0,6	-2,7	0,1	restrictive	→	procyclical
2004	-1,2	0,4	-1,6	1,1	-1	expansionary	→	procyclical
2005	-1,2	0,3	-1,5	1	0,1	restrictive	→	countercyclical
2006	-2,2	1,6	-3,8	4,8	-2,3	expansionary	→	procyclical
2007	-2,9	2,7	-5,6	7,9	-1,8	expansionary	→	procyclical
2008	-5,6	4,5	-10,1	13,3	-4,5	expansionary	→	procyclical
2009	-8,9	0,8	-9,7	2,3	0,4	restrictive	→	countercyclical
2010	-6,6	-0,3	-6,3	-1	3,4	restrictive	→	procyclical
2011	-5,3	-0,7	-4,6	-2,2	1,7	restrictive	→	procyclical
2012	-2,9	-1,2	-1,7	-3,7	2,9	restrictive	→	procyclical
2013	-2,2	-0,9	-1,3	-2,5	0,4	restrictive	→	procyclical
2014	-1,5	-0,7	-0,8	-2	0,5	restrictive	→	procyclical
2015*	-1,6	-0,5	-1,1	-1,6	-0,3	expansionary	→	countercyclical
2016*	-3,5	-0,3	-3,2	-0,8	-2,1	expansionary	→	countercyclical

* estimations.

Source: based on European Commission data, Cyclical Adjustment of Budget Balance, Autumn 2015 (European Commission, DG ECFIN Economic Forecasts, 2015).

The structure of budgetary spending in Romania in 2009-2012 indicates the predominance of social assistance expenditures (about 32-34%) and of personnel expenditures (approximately 18-24%) in total expenditures of the Consolidated General Budget (CGB). In this period there is a gradual increase in expenditures for projects funded by external non-reimbursable funds, from 1.4% in 2009 to 6.4% in 2012 in total expenditures of CGB, however accompanied by a reduction of the share of capital expenditures covered from the national budget, from 11.3% to 9.3% over the same period. Starting with 2013 it can be observed a tendency of reducing the share of public investment expenditure: the share of capital expenditure in total expenditures of CGB decreased to 8.3% in 2013, 7.6% in 2014 and 4.7% in the first three quarters of 2015, all without a significant offset of increased actual expenditures (co-financing) for projects financed from external funds. Thus, although the Government's Fiscal Budgetary Strategy 2014-2016 included the transition to a development model focused on public investment as a driving force based on an increasing share of public investments in total expenditures of CGB (Government of Romania, 2013, p. 18), there was a contrary trend.

For the purpose of this paper, public investment expenditures include capital expenditures, expenditures for projects funded by external non-reimbursable post-accession funds received from the EU and expenditures relating to programs financed from reimbursable funds. In Figure 1a it can be seen a decrease of public capital expenditures as % of GDP, as well as a substitution process by means of transfers to projects financed from European funds since 2009. However, starting with 2012, this

process of substitution declined so that there is a decrease of total public investments relative to GDP, but also an absolute decrease of it.

Figure 1a. *Public investments as % of GDP, by components, 2008-2015*

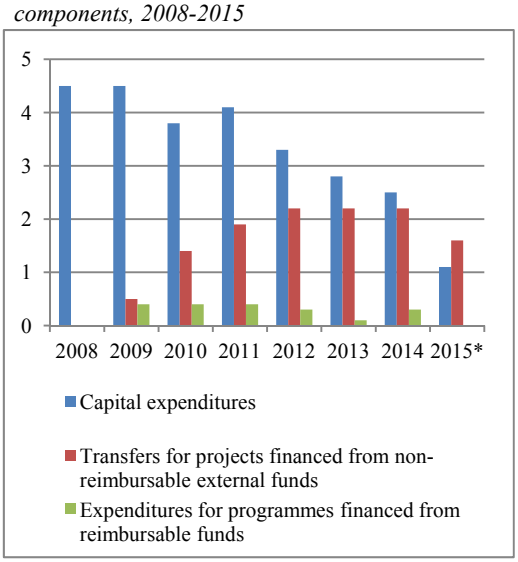
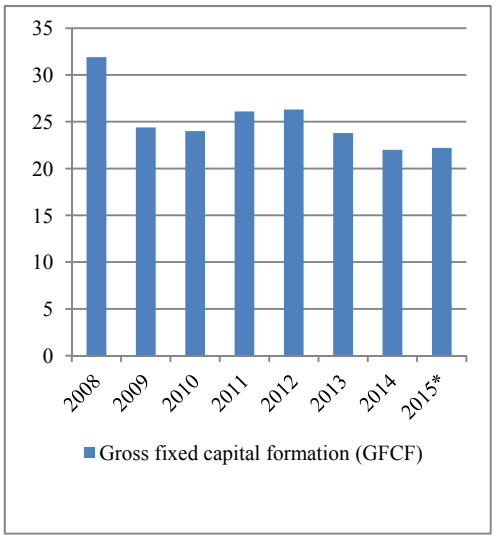


Figure 1b. *Total investment (GFCF) as % of GDP, 2008-2015*



Source: Ministry of Public Finance, Romania, The Consolidated General Budget execution – briefings, http://www.mfinante.ro/execbug.html?pagina=buletin and own calculations based on data from the National Institute of Statistics.

Public investment did not have the role to counteract the crisis after 2009, which confirms the restrictive procyclical fiscal policy. At the national economy level, the gross fixed capital formation (GFCF) (Figure 1b) has been negatively influenced by the trend in public investments in the period 2013-2015.

The gross fixed capital formation dynamics in Romania in the post-accession to the EU was strongly influenced by the crisis, which marked a decrease by 28.1% of GFCF in 2009 compared to 2008 (Table 2). Investments have not recovered significantly in 2010-2012, and then fell again. The total annual flow of investments (GFCF) recorded in 2010-2014 was significantly lower than before the crisis, period 2007-2008, so the investments have not been a priority driver of economic growth in Romania.

Table 2. *Variation of gross fixed capital formation (GFCF) in Romania, 2007-2014*

Year	2007	2008	2009	2010	2011	2012	2013	2014
% from the previous year	30.3	15.6	-28.1	-2.1	6.3	0.1	-7.9	-3.6
2007 = 100%	-	15.6	-16.9	-18.6	-13.5	-13.4	-20.2	-23.1

Source: Based on data from Romanian Statistical Yearbook 2013 and other sources National Institute of Statistics.

Economic recovery observed after 2011 was made amid the drop in investment, due in particular to lower further public investment under the impact of the fiscal consolidation measures and the tendency to spur economic growth by stimulating consumption.

GDP dynamics is strongly correlated with the dynamics of total investment (GFCF), the Pearson correlation coefficient being of 0.92 (Table 3). This correlation is much lower in the case of public expenditures, given by the coefficient of 0.57. In the long term, investment effects are reflected in the dynamic of potential GDP, the correlation is as well high, with a coefficient of 0.76, while the GFCF contributed about 58% to potential GDP growth.

Table 3. *The correlation coefficients between GDP growth and investment dynamics in the period 2004-2014*

The dependent variable - the independent variable	Correlation coefficients	R square
GDP - Capital expenditures of the national budget (GFCF from general government)	0.577537684	0.333549777
GDP - Capital transfers from the national budget	0.145930223	0.02129563
GDP - Total investments of the national economy (GFCF)	0.928475816	0.862067342
GDP/capita - Total investments of the national economy (GFCF)	0.949081242	0.862067342
Potential GDP - Total investments of the national economy (GFCF)	0.76602163	0.586789138

Source: own calculations based on Eurostat and European Commission data, Cyclical Adjustment of Budget Balance, Autumn 2015.

3. The dynamics of investments in development regions of Romania (NUTS 2)

Investments aim to respond to the challenges that are required by the new economic realities and the approach of the investment strategies should contribute to the valorisation of the existing economic potential.

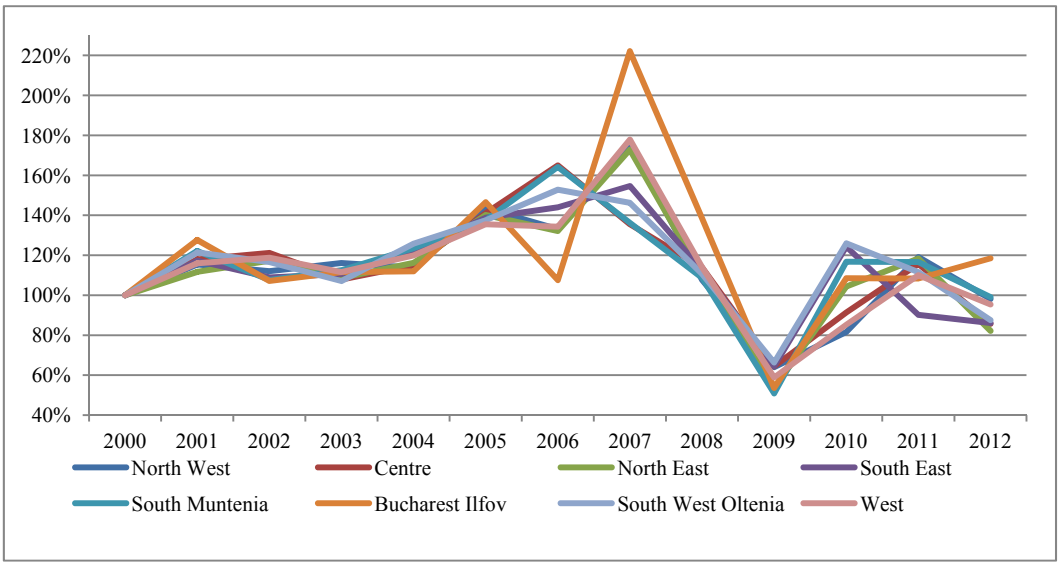
At the regional level we analysed the investments' dynamics using investment chain based index. In the Figure 2 we can see that in the year joining the European Union, due to a high confidence degree in investment environment, the investments trend has been positive.

In 2009, amid economic crisis installed, we can observe that investment activity in all regions of Romania decreased most in the South-Muntenia region (half compared to 2008). This investments dynamic has been driven by high degree of uncertainty expressed among investors, especially among foreign investors, but also due to the negative trend that public investments have recorded.

At the regional level the Eurostat available data regarding the gross fixed capital formation stop with the year 2012, when only the Bucharest-Ilfov recorded an increase of investments by 18% compared to the previous year, while the remaining regions recorded a decrease of them by 1% in the South-Muntenia region and by 18% in the North-East region.

Both at regional level and national level we can observe that the upward trend slowed in 2012, with the reduction in public investment, which targeted the budgetary balance.

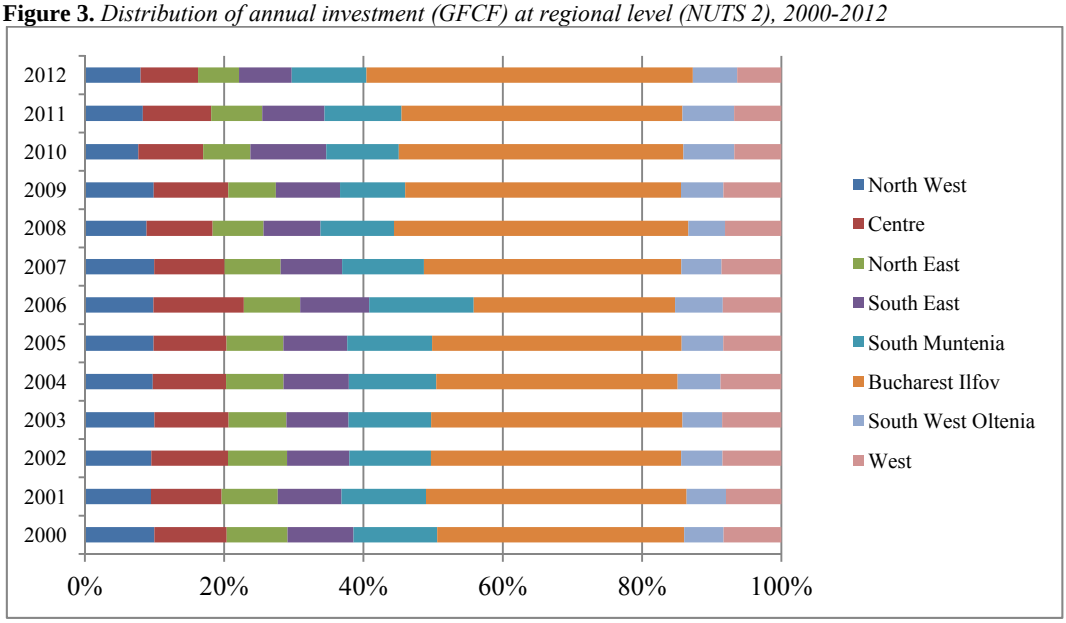
Figure 2. *The investments' indices (GFCF) at regional level, 2000-2012 (in % compared to last year)*



Source: graph based on data from Eurostat.

The regional disparities regarding both the economic environment and the development opportunities have led mainly to concentrating investments in the Bucharest-Ilfov region during the analysed period. Figure 3 highlights the distribution of investments at regional level that contribute to the persistence of development disparities between regions.

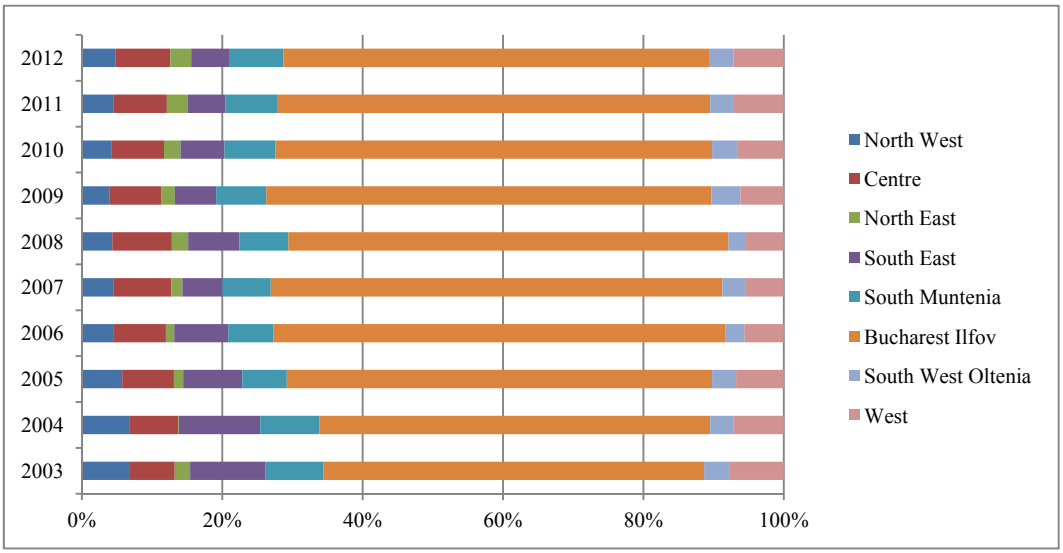
Figure 3. *Distribution of annual investment (GFCF) at regional level (NUTS 2), 2000-2012*



Source: graph based on data from Eurostat.

The distribution of foreign direct investment by regions presents a similar concentration in the Bucharest-Ilfov region, given that the FDI attracted by this region were in a percentage of 60% of the total foreign direct investments, situation which maintains the hierarchy above (Figure 4).

Figure 4. *Distribution of foreign direct investment stocks on regional level (NUTS 2), 2000-2012*



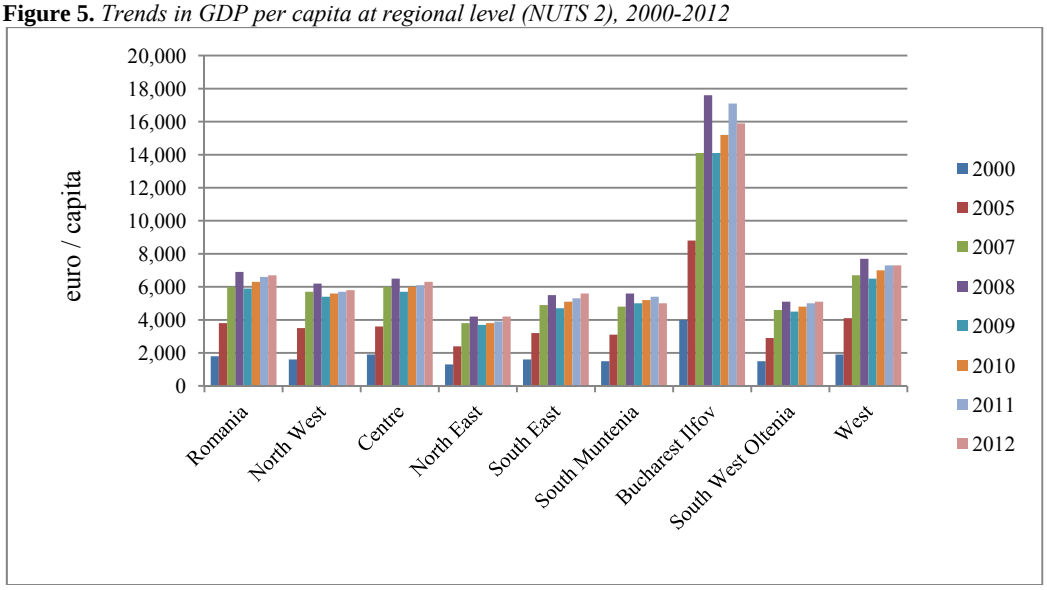
Source: graph based on data from the National Bank of Romania.

4. The effects of the dynamics of investments on economic development and employment at regional level (NUTS 2)

In Romania, regional disparities in terms of GDP per capita are persistent. There is a divergence process of economic development (GDP per capita) at regional level (Figure 5). More developed regions still attract the highest level of investments.

The Bucharest-Ilfov region recorded an upward trend of the GDP per capita in the period before the crisis, from EUR 8,800 in 2005 to EUR 17,600 in 2008, followed by a decrease in 2009 down to EUR 14.100 (Figure 5). In 2012 the recorded value was in amount of EUR 15,900. GDP per capita in Bucharest-Ilfov region constantly exceeds with minimum 50% the average GDP per capita at national level for the entire analysed period (2000-2012). Values close to the national average were registered in West and Central regions. The other five development regions have values of GDP per capita below the national average throughout the analysed period. The lowest economic performance was recorded in the North-East region with values between 2,400 EUR per inhabitant in 2005, rising to 4,200 EUR per inhabitant in 2012.

Figure 5. *Trends in GDP per capita at regional level (NUTS 2), 2000-2012*



Source: graph based on Eurostat data sources.

The statistical analysis aimed to highlight the link between investments (independent variable) and economic performance of regions (measured by GDP, respectively by GDP per capita) and the link between the investment and the employment rate. This analysis aims to show the degree of correlation between variables calculated based on regional data provided by Eurostat.

The first step of the analysis was to calculate the Pearson correlation coefficient between GDP and gross capital formation at regional level, both variables being expressed in euro. As it was expected, the coefficient is high, over 0.9 at national level, gross capital formation being the driving force of technological progress and an indicator of investment activity, representing an important factor which determines the economic growth. At regional level the correlation coefficient recorded the highest value in the South-East region, while in Bucharest-Ilfov region its value was 0.74 (Table 4). The lower intensity of the link is explained by the strength and the economic dynamics of Bucharest-Ilfov region that has a more attractive economic environment and a strong growth potential supported by many other factors including the existing institutional structure, skilled labour force, the diversity of activities developed and so on.

For a more accurate evidence, within the analysis we used the indicator GDP per capita as being representative of the development. The coefficient of correlation between investment and GDP per capita confirms the level of correlation between gross capital formation and GDP.

The link between investments and the employment rate is not straightforward in all regions. Although investments have a significant impact on growth potential, namely on

territorial cohesion by creating jobs and increasing income, employment levels depend on many other factors to be considered such as the continuing emigration of labour force and the structural change of the economic activity.

Table 4. *Pearson correlation coefficient between the investments dynamics of and GDP dynamics, respectively the employment rate, 2000-2012*

	Romania	North West	Centre	North East	South East	South Muntenia	Bucharest Ilfov	South West Oltenia	West
FBCF - PIB									
	0.93	0.90	0.91	0.91	0.92	0.85	0.74	0.87	0.87
FBCF - PIB/LOC									
	0.94	0.88	0.90	0.91	0.90	0.81	0.72	0.86	0.87
FBCF - Rata ocuparii									
	0.02	-0.18	0.26	-0.12	-0.04	0.18	-0.20	-0.12	0.27
ISD - PIB									
	0.71	0.58	0.83	0.50	0.49	0.58	0.57	0.04	0.55

Source: own computation based on data from Eurostat and National Bank of Romania.

Except the Bucharest-Ilfov region, in more developed regions (West, Central and South-Muntenia), which have a higher level of industrialization, GFCF contribute to increasing of employment, even if the strength of the correlation is weak. In the remaining regions the correlation coefficient is negative, the employment being mainly influenced by external migration and by the decline of labour force surplus employed in agriculture.

Analysing the link between GDP and foreign direct investment stock (Table 4) we can see that there is a strong positive relationship in regions such as Center where the correlation coefficient recorded a value of 0.83, or a link almost non-existent in the South-West Oltenia region. This is explained by the unequal distribution of foreign direct investment at regional level (Figure 5).

The impact of foreign direct investment on the economy is contradictory. On the one hand, FDI aim to contribute to regional economic growth and increase the standard of life by increasing labour productivity and wages through technology transfer and more intense spillover effects, complementary to the gross formation of fixed capital from internal sources. And on the other hand, the manner in which they are dispersed, the concentration in certain regions causes a negative effect as a result of widening the existing regional disparities.

5. Conclusions

In Romania, the fiscal policy in the period 2000-2015 was predominantly procyclical, so that the measures taken by the government have not contributed significantly to counteract cyclical fluctuations. In the post-accession period, which coincided largely with the economic crisis, amid a recessionary gap, the fiscal policy was restrictive. This policy is reflected in the dynamics of public investment, given that the share of capital expenditures of the budget in GDP went into sharp decline after 2011, without being

sufficiently compensated by co-financing of projects financed by external funds. The trend of reducing public investment has contributed to the overall decline in total investment (GFCF) in the period 2013-2015, which does not ensure sustainable economic growth.

The correlation coefficient of 0.94 between GFCF and GDP dynamics actually shows a strong link induced by investment, but the correlation between GFCF growth and potential GDP growth is weaker (correlation coefficient 0.76). At the same time, the correlation between public investment and GDP growth is significantly lower, which can be explained by lower relative importance of these investments, but also by their lower efficiency.

At regional level it appears that all development regions (NUTS 2) followed a similar trend of GFCF in the last decade, except the Bucharest-Ilfov region, which registered during the post-accession period an increased level of investment, above average, including foreign direct investments, which led to increase the regional disparities in levels of development measured by GDP per capita. The correlation between GFCF and GDP dynamics is very strong in each region, but it can be noted some deviations from the national average. The investments have a significant impact on growth potential, as well as on the achievement of territorial cohesion, including the creation of jobs. Except the Bucharest-Ilfov region, in more developed regions (West, Central and South-Muntenia), which have a higher level of industrialization, GFCF contribute to increasing employment, even if the strength of the correlation is weak. In other regions the correlation is negative, being mainly influenced by the external migration and by the decline of labour force surplus employed in agriculture.

Acknowledgements

This work was cofinanced from the European Social Fund through Sectoral Operational Programme Human Resources Development 2007-2013, project number POSDRU/ 187/1.5/S/155656 „Help for doctoral researchers in economic sciences in Romania”.

References

Dachin, A. and Gherman, M.G. (2014). Sustainability of Public Co-financing of Investment Projects with EU Financial Assistance in Romania. *Theoretical and Applied Economics.* Nr. 3. Vol. XXI. pp. 45-56, http://www.ectap.ro/

Dăianu, D. (2015). Marele impas în Europa. Ce poate face România?. Editura Polirom, București.

Drăgan, G., Orban, L. and Pascariu, G. (coord.) (2013). *Politica de coeziune a Uniunii Europene. Determinanți, mecanisme, instrumente*. Editura Universitară. București.

Strat, V.A. (2015). Trends in FDI among the EU member States, *Romanian Journal of Regional Science*. Vol. 9, Nr. 1 Summer, http://www.rrsa.ro/rjrs/V916.STRAT.PDF

European Commission, DG ECFIN Economic Forecasts (2015). Cyclical Adjustment of General Government Revenue, Expenditure and Budget Balances – Based on Hp Filter Method, http://ec.europa.eu/economy_finance/db_indicators/gen_gov_data/documents/2015/ccab_autumn_en.pdf

The National Bank of Romania (2015). Investițiile străine directe în România în anul 2014.

The Government of Romania (2013). Strategia fiscal-bugetară 2014-2016, http://discutii.mfinante.ro/static/10/Mfp/strategbug/Strategiafiscal_bugetara2014_2016.pdf

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 141-150

A utility based theoretical model for the income-life expectancy curve

Kaan ÖĞÜT
Bahcesehir University, Besiktas, Istanbul, Turkey
kaanogut74@gmail.com
Çağlar YURTSEVEN
Bahcesehir University, Besiktas, Istanbul, Turkey
cayurtseven@yahoo.com

Abstract. *The relationship between income and life expectancy is an established empirical fact, commonly represented by the Preston curve. Although this empirical relationship has been common knowledge for a very long time, there is no theoretical model that explicates the exact dynamic of it. The present paper fills this void by developing a utility based model which successfully estimates the Preston curve.*

Keywords: life expectancy, Preston curve, utility model, logistic function, simulation.

JEL Classification: I1, J1.

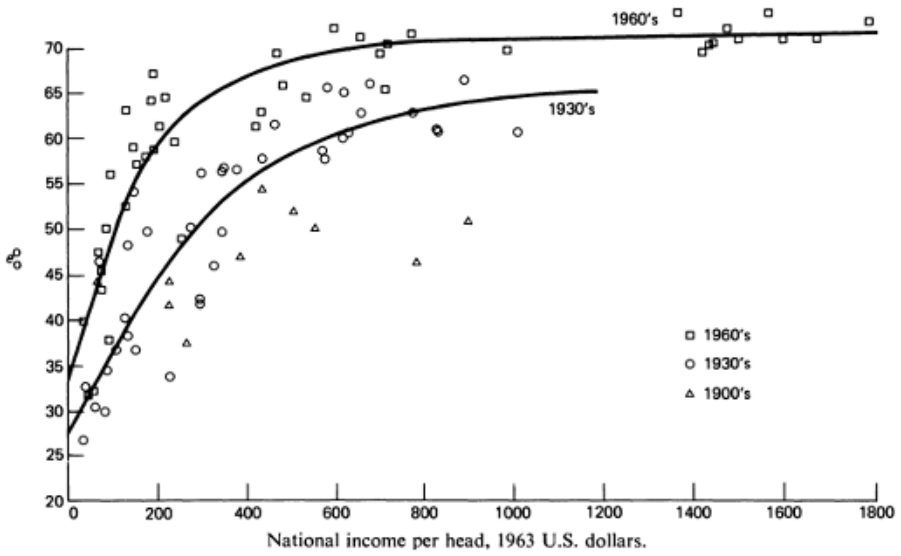
1. Introduction

In his influential paper, Preston (1975) derived an empirical income - life expectancy curve which is now known as the Preston curve. The literature is abundant with papers that study this empirical fact (e.g., Alho, 2006, pp. 41-51, Oeppen, 2006, pp. 55-82, Vallin and France, 2010, pp. 1-4). Nevertheless, it lacks a theoretical model that successfully explains the Preston curve. Without such a theoretical model, one cannot claim to fully explain the relationship between income and life expectancy. Moreover, a theoretical model would allow many interest groups (e.g., insurance companies, health ministries and social security institutions, etc.) to get accurate and convenient estimates of future life expectancy for particular countries. The present paper develops such a model.

The Preston curve (Figure 1) matches life expectancies and per capita incomes of countries. Preston claimed that fundamental improvements in medical technology and health knowledge, which are the starters of new health stages, should be considered positive shocks that shift the life expectancy-income curve up. Hence, he derived two distinct curves representing different health stages (For health stages see the appendix). Each curve has an s-shape pattern and shows life expectancy as a function of per capita national income. It grows quickly at first and then decelerates its progression with income.

Figure 1. *The original Preston Curve (1975)*

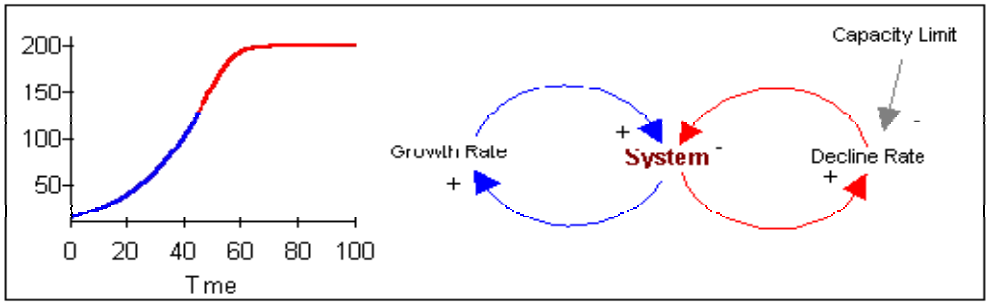
Scatter-diagram of relations between life expectancy at birth (e_0°) and national income per head for nations in the 1900s, 1930s, and 1960s.



S-shaped growth is the characteristic behavior of a system which consists of positive and negative feedback loops simultaneously (Kirkwood, 1998, p. 12). Movement is exponential at first while the positive feedback loop initially dominates the system, so the system variable increases at an increasing rate. However, the system approaches its limit or "carrying capacity" over time when the negative feedback loop becomes the dominant loop (Sterman, 2000, pp. 296-297). Logistic functions are chosen to model the S-shaped movements because the logistic law of growth assumes that systems grow exponentially

under the constraints of an upper limit (longevity in our case), producing a typical S-shaped curve (Coelho, 2007, pp. 6-7). Preston showed that 1930s and 1960s data were fitted to logistic curves. However, he did not theoretically derive the implied logistic equations.

Figure 2. *S-shaped structure and characteristic time path*



Source: http://www.systemdynamics.org/DL-IntroSysDyn/sshp.htm

Preston argued that income is the best socio-economic indicator to explain life expectancy increases. The sketch of his argument is as follows: National income consists of all the goods and services produced in a country. These include consumption items affecting health positively, such as food, housing, medical and public health services, education, leisure, health technology and health related research. Thus, there is a positive relationship between increased per capita income and life expectancy at a decreasing rate (diminishing marginal utility of consumption). Researchers, including Preston, also acknowledge that increased income could negatively influence life expectancy through pollution, animal fats, artificial nutrition and physical inertia. Actually there is a readily available tool that can be used for theoretical modeling of this relationship: Environmental Kuznets Curve (EKC). The EKC establishes that an increasing income first leads to increasing levels of pollution, artificial nutrition and physical inertia etc. However, after a threshold level, environmental bads, which affect life expectancy negatively, start to diminish (Dinda, 2004, p. 432). Thus, there is also a negative relationship between increased per capita income and life expectancy that is characterized by an inverse u-shape. We develop a solid theoretical model of income-life expectancy relationship simply by utilizing the Environmental Kuznets Curve (EKC) and using a logistic differential equation.

The plan of the paper is as follows. The second section develops the theoretical model. The third section simulates the model and checks its estimates of life expectancy against real data.

2. Theoretical Model

According to the general form of the logistic differential equation Eq. (1), the growth rate of life expectancy can be assumed to be determined by the product of longevity $\bar{L}$,[(1)] and δ which we assume to be a time-variant parameter through income.[(2)]

$$\frac{dL}{dt} = \delta \bar{L}\, L\left(1 - \frac{L}{\bar{L}}\right) \qquad (1)$$

In the derivation, we use a utility based approach. We assume that the time – variant parameter δ depends on the utility level in the relevant period. Hence, we assume that life expectancy is affected by utility levels and, following Andreoni, Levinson (2001), we set the utility to be a function of consumption C and pollution (environmental bads) P in a specific time period.

$$\delta = U(C, P) \tag{2}$$

While higher consumption affects utility in a positive way, pollution influences it negatively.

$$U = U(C, P) = C - P \qquad \frac{\partial U}{\partial C} > 0 \quad \frac{\partial U}{\partial P} < 0 \tag{3}$$

Moreover, pollution is defined as a positive function of consumption and a negative function of environmental effort.

$$P = P(C, E) = C - C^{\alpha}E^{\beta} \quad \frac{\partial P}{\partial C} > 0 \quad \frac{\partial P}{\partial E} < 0 \tag{4}$$

Therefore, utility can be expressed as a Cobb – Douglas type quasi concave function.

$$U(C, P) = C^{\alpha}E^{\beta} \tag{5}$$

People use their income for two purposes: consumption C and environmental effort E, which have unit prices P_C and P_E respectively (all in nominal terms). P_C and P_E have initial values of P_{C0} and P_{E0} and growth rates π_C and π_E.

$$P_C C + P_E E = M \tag{6}$$

When we maximize utility, given the income constraint, it is easy to obtain the dependency of the optimum value of the utility function on income, prices and input elasticities[3] (Derivation of the optimized utility is given in the appendix).

$$U^*(\alpha, \beta, P_C, P_E, M) = \left(\frac{\alpha}{P_C}\right)^{\alpha}\left(\frac{\beta}{P_E}\right)^{\beta}\left(\frac{M}{\alpha+\beta}\right)^{\alpha+\beta} \tag{7}$$

For estimation purposes, we need to define δ as a function of initial values of income and prices and their growth rates where

$$M_t = M_0 e^{\rho t}$$

$$P_{Ct} = P_{C0} e^{\pi_C t}$$

and

$$P_{Et} = P_{E0} e^{\pi_E t} \tag{8}$$

$$\delta^* = \delta^*(\alpha, \beta, P_{C0}, P_{E0}, M_0, \pi_C, \pi_E, \rho, t) = \left(\frac{\alpha}{P_{C0}e^{\pi_C t}}\right)^{\alpha}\left(\frac{\beta}{P_{E0}e^{\pi_E t}}\right)^{\beta}\left(\frac{M_0 e^{\rho t}}{\alpha+\beta}\right)^{\alpha+\beta} \tag{9}$$

Having the dynamic property of the parameter δ, we let initial income, prices and their growth rates vary across countries and get the country specific equation:

$$\delta_t^i = \delta_t^i(\alpha, \beta, P^i_{C0}, P^i_{E0}, M_0^i, \pi_C^i, \pi_E^i, \rho^i, t) = \left(\frac{\alpha}{P^i_{C0}e^{\pi_C t}}\right)^{\alpha}\left(\frac{\beta}{P^i_{E0}e^{\pi_E t}}\right)^{\beta}\left(\frac{M_0^i e^{\rho t}}{\alpha+\beta}\right)^{\alpha+\beta} \tag{10}$$

That is the change in the life expectancy of a country with respect to time can be written as:

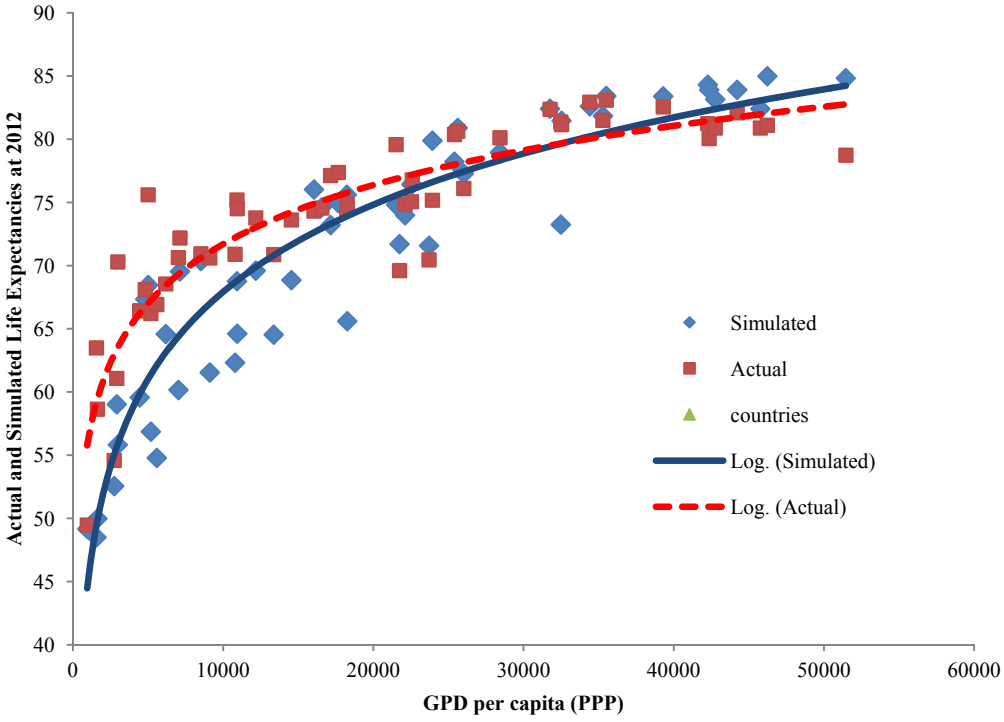
$$\frac{dL}{dt} = \left(\frac{\alpha}{P^{i}_{Co} e^{\pi_C t}}\right)^{\alpha} \left(\frac{\beta}{P^{i}_{Eo} e^{\pi_E t}}\right)^{\beta} \left(\frac{M^{i}_{0} e^{\rho t}}{\alpha+\beta}\right)^{\alpha+\beta} \bar{L}\, L \left(1 - \frac{L}{\bar{L}}\right) \qquad (11)$$

With Eq. (11), it is possible to estimate the life expectancy of a country in period t, as long as we have estimates of input elasticities, know initial values of life expectancy, income, prices and have a projection about the growth rates of income and prices.

3. Simulations

The simple correlation between life expectancy and the logarithm of income per head is 0.885 in the 1930s and 0.880 in the 1960s. Today we are still in the health era started after the 1960s, therefore, we derive a single curve for one representative year. In Figure 3, we draw an updated Preston curve which uses IMF 2012 data for "GDP per capita, PPP"[4] (World Economic Outlook Database, 2015) and "life expectancy at birth" (World Data Bank, World Development Indicators) of multiple countries around the world. The curve follows a logistic pattern with an equation of $y = 6.757 \ln(x) + 9.457$ ($R^2 = 0.82$) and the simple correlation between life expectancy and the logarithm of income per head for 2012 is 0.90.

Figure 3. *Actual and simulated life expectancies at 2012*



Then we simulate our model to see its fit with the actual Preston curve for 2012, by taking GDP per capita PPP, life expectancy in the initial year 1980, and the average growth figure for the period 1980-2012 for each country. (See appendix for a list of countries).

For the simulations, due to lack of proper data, we modified the budget constraint to have purchasing power instead of nominal income. In addition, following Andreoni, Levinson (2001, p. 272) we assume the relative prices of consumption and environmental effort to be constant and equal to one. Hence, we implicitly assume the utility of people to depend on the amounts of expenditures on consumption and environmental effort.

With input elasticities $\alpha = 0.82$ $\beta = 0.3$, which satisfy the inverse u-shape of the EKC, our model suggests life expectancy values for 2012 that fit well into the real data. The simulated curve's equation in Figure 3 is $y = 9.057 \ln(x) - 20.79$ and is not significantly different from the actual curve ($R^2 = 0.88$ and correlation between life expectancy and the logarithm of income per head is 0.92) (Letting input elasticities differ according to countries' incomes (more weight on consumption for poorer countries) actually increases the fit. See Appendix.) In addition, due to our assumption of constant relative prices, we underestimate life expectancy for poorer countries and overestimate it for richer countries. This could depend on the fact that environmental effort prices actually increase at a higher rate than consumption prices and a poorer country, the utility of which is mostly from consumption, is positively affected by the trend more than a richer country (Qiusheng and Zongchun, 2014, Kim, 2004).

4. Conclusion

This paper develops a theoretical model which explains and successfully estimates the Preston Curve. Thus, it provides a theoretical basis that will allow many interest groups to make more accurate plans for the future. A policymaker with a targeted income growth rate can use our logistic equation to find out the future life expectancy at period 't', based on initial values. Having country specific estimates of input elasticities for different countries may allow policymakers to have more accurate projections for each country as well.

The simple but powerful model developed in this paper could be further developed by letting the relative prices of consumption and environmental effort vary by country and with time. The model could also be integrated with other macroeconomic models in order to study the dynamics of economic growth.

Acknowledgements

The authors thank Professor David Bloom (Harvard University) for the invaluable guidance and comments he provided.

Notes

(1) Assumed to be 90 years.
(2) Growth rate of logistic function is defined as $r = \delta \bar{L}$.
(3) $0 \leq \alpha, \beta \leq 1$ and to satisfy the inverse u-shape of the EKC, we need $\alpha + \beta \geq 1$. (For more information, see Andreoni and Levinson, 2001, p. 23).
(4) GDP based on purchasing-power-parity.

References

Alho, J.M. (2006). Forecasting Life Expectancy: A Statistical Look at Model Choice and Use of Auxiliary Series. In: Bengtsson, T. (Ed). *Perspectives on Mortality Forecasting.* Social Insurance Studies No. 3. pp. 41-51. Swedish Social Insurance Agency.

Andreoni, J., Levinson, A. (2001). The Simple Analytics of the Environmental Kuznetz Curve. *Journal of Public Economics.* 80 (2). pp. 269-286.

Bengtsson T. (2006). Linear Increase in Life Expectancy: Past and Present. In: Bengtsson, T. (Ed). *Perspectives on Mortality Forecasting.* Social Insurance Studies. No. 3. pp. 83-99. Swedish Social Insurance Agency.

Coelho, E. (2007). Mortality and Longevity Projections for the Oldest-Old in Portugal. Conference of European Statisticians. Bucharest.

Dinda, S. (2004). Environmental Kuznets Curve Hypothesis: A Survey. *Ecological Economics.* 49(4). pp. 431-455.

Kim, J.D. (2004). A Guideline for the Measurement and Reporting of Environmental Costs. In Bennet, M., Bouma, J.J, Wolters, T. (Eds.). Environmental Management Accounting: Informational and Institutional Developments. pp. 51-65. Kluwer Academic Publishers.

Kirkwood, C.W. (1998). System Dynamics Methods. http://www.public.asu.edu/~kirkwood/ sysdyn/ SDRes.htm.

Oeppen, J. (2006). Life Expectancy Convergence among Nations since 1820: Separating the Effects of Technology and Income. In: Bengtsson, T. (Ed). Perspectives on Mortality Forecasting, *Social Insurance Studies*. No. 3. pp. 55-82. Swedish Social Insurance Agency.

Preston, S.H. (1975). The Changing Relation between Mortality and Level of Economic Development. *Population Studies.* 29(2). pp. 231-248.

Qiusheng, S., Zongchun, L. (2014). A Research on the Management of Enterprise Environmental Costs. In Ren P, Du Z., *Information Technology and Industrial Engineering*. pp. 179-184. WIT Press.

Sterman, J.D. (2000). *Business Dynamics.* McGraw-Hill.

Vallin, J., France, M. (2010). Will Life Expectancy Increase Indefinitely by Three Months Every Year. *Population and Societies.* No. 473. pp. 1-4

World Data Bank, World Development Indicators. (n.d.). Retrieved from http://databank. worldbank.org/data/views/reports/tableview.aspx#

World Economic Outlook Database 2015. Retrieved from http://www.imf.org/external/pubs/ ft/weo/2015/01/weodata/index.aspx

Appendix

A) Health Stages (Bengtsson, 2006).

1st stage 1700-1800: Reduction in volatility/epidemics

2nd stage 1800-1900: Reduction in infectious diseases (influenza, pneumonia, bronchitis, TB, and smallpox)

3rd stage 1900-1960: Reduction in other infectious diseases

4th stage 1960-…: Reduction in chronic diseases

B) Derivation of optimized utility:

$$U(C,P) = C^{\alpha}E^{\beta}$$

$$P_C C + P_E E = M$$

$$\mathcal{L} = C^{\alpha}E^{\beta} + \lambda(M - P_C C - P_E E)$$

$$\frac{\partial \mathcal{L}}{\partial C} = \alpha C^{\alpha-1}E^{\beta} - P_C\lambda = 0$$

$$\frac{\partial \mathcal{L}}{\partial E} = \beta C^{\alpha}E^{\beta-1} - P_E\lambda = 0$$

$$\lambda = \frac{\alpha}{P_C}C^{\alpha-1}E^{\beta} = \frac{\beta}{P_E}C^{\alpha}E^{\beta-1}$$

$$\frac{\alpha}{P_C}E = \frac{\beta}{P_E}C$$

$$E = \frac{P_C}{P_E}\frac{\beta}{\alpha}C$$

$$P_C C + P_E\frac{P_C}{P_E}\frac{\beta}{\alpha}C = P_C C + P_C\frac{\beta}{\alpha}C = M$$

$$P_C C\left(1 + \frac{\beta}{\alpha}\right) = M$$

$$C^{*} = \frac{M}{P_C\left(1 + \frac{\beta}{\alpha}\right)} = \frac{\alpha}{P_C(\alpha+\beta)}M$$

$$E^* = \frac{P_C}{P_E}\frac{\beta}{\alpha}C^* = \frac{P_C}{P_E}\frac{\beta}{\alpha}\frac{\alpha}{P_C(\alpha+\beta)}M = \frac{\beta}{P_E(\alpha+\beta)}M$$

$$U^*(C,P) = C^{\alpha}E^{\beta} = \left(\frac{\alpha}{P_C(\alpha+\beta)}\right)^{\alpha}\left(\frac{\beta}{P_E(\alpha+\beta)}\right)^{\beta}M^{\alpha+\beta} = \left(\frac{\alpha}{P_C}\right)^{\alpha}\left(\frac{\beta}{P_E}\right)^{\beta}\left(\frac{M}{\alpha+\beta}\right)^{\alpha+\beta}$$

$$U^*(C,P) = U^*(\alpha,\beta,P_C,P_E,M)$$

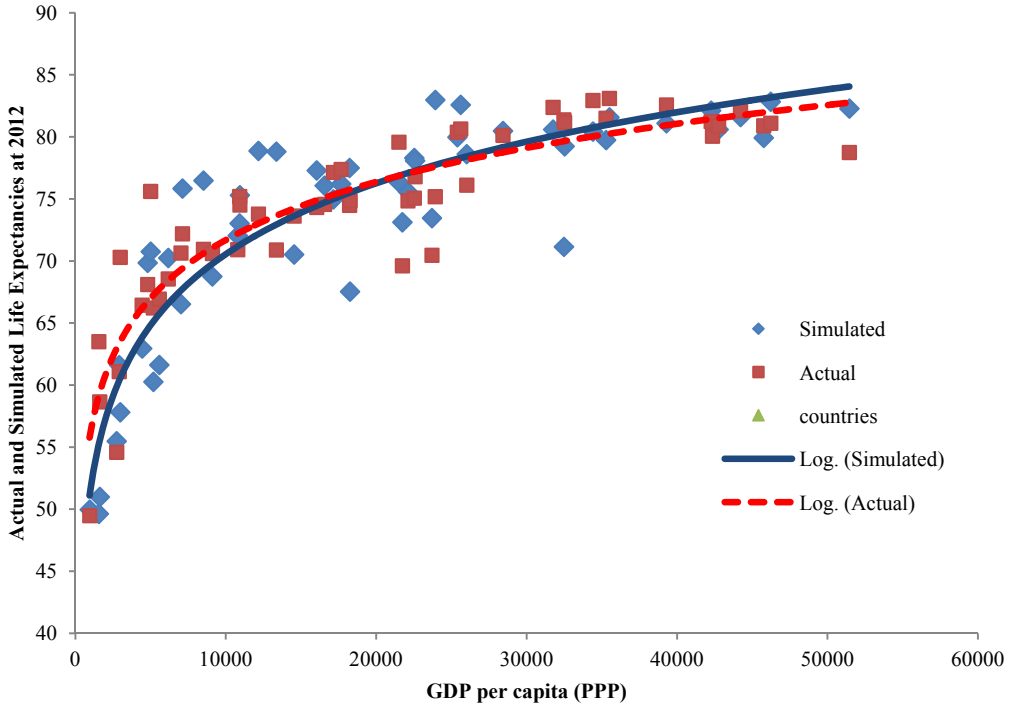
C) Countries used

Algeria	Brazil	Australia
Bangladesh	Bulgaria	Canada
Bolivia	Chile	Denmark
Cameroon	Greece	France
Central African Republic	Hungary	Germany
China	Kazakhstan	Ireland
Colombia	Libya	Italy
Egypt	Malaysia	Japan
India	Mexico	Korea
Indonesia	Panama	Netherlands
Kenya	Poland	New Zealand
Morocco	Portugal	Spain
Pakistan	Romania	United Kingdom
Paraguay	Russia	United States
Peru	Slovak Republic	
Philippines	Slovenia	
Rwanda	Turkey	
Uganda	Venezuela	
Ukraine		
Uzbekistan		
Vietnam		
Income <14000	14000< Income < 30000	30000< Income
α^l=0,98 β=0,3	α^m=0,85 β=0,3	α^h=0,78 β=0,3

D) Input elasticities based on incomes:

When $\alpha = 0.98,\ \beta = 0.3$ for income (real purchasing power) < \$14000, $\alpha = 0.85,\ \beta = 0.3$ for \$14000 < income < \$30000, and $\alpha = 0.78,\ \beta = 0.3$ for income > \$30000, the fit of our simulated curve increases ($y = 8.251\ln(x) + 5.458,\ R^2 = 0.8307$ and correlation between life expectancy and the logarithm of income per head is 0.91). It is again not significantly different from the actual curve. (See Figure 4.)

Figure 4. *Simulation with changing input elasticities*



Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 151-162

Essentials aspects on macroeconomic variables and their correlations

Constantin ANGHELACHE
Bucharest University of Economic Studies
"Artifex" University of Bucharest
actincon@yahoo.com
Alexandru MANOLE
"Artifex" University of Bucharest
alexandru.manole@gmail.com
Mădălina Gabriela ANGHEL
"Artifex" University of Bucharest
madalinagabriela_anghel@yahoo.com
Aurelian DIACONU
"Artifex" University of Bucharest
aurelian.diaconu@gmail.com

Abstract. *The measurement of the correlations between macroeconomic variables, including the cause-effect links, provide useful information for policy makers in the government and public agencies. Especially important is the system of relationships that reveals the influence of certain factors on the Gross Domestic Product. This paper outlines the influence of the unemployment, measured through the unemployment rate, the inflation. Also, the authors discuss the correlations of the economic growth.*

Keywords: correlation, inflation, gross domestic product, growth, unemployment.

JEL Classification: E00, E01.

1. General aspects

Any economic program consists in a policy measures set intended to achieve the main objectives of the macroeconomic policy, which usually means economic growing, employment, prices stability and external balance improvement.

These objectives are quantified by four main variables named macroeconomic key-variables, which measure, correlate and analyze any economy performance, namely:

- GDP growing pace;
- unemployment rate measured either as registered level at the end of each year, or as medium level per year;
- inflation rate measured either by the growing rate of the gross domestic product deflator – D , or the monthly medium growing of the consumer prices;
- current account payment balance.

The four variables make possible the evaluation of the main domestic and external macroeconomic imbalances, monitoring the changes in economy and the corresponding policy making aiming at future objective realization.

Between the four variables important macroeconomic correlations are settled as well as with strong correlations between them and other macroeconomic indicators.

Anghelache, Mitruț and Voineagu (2013) develop on the national accounts and macroeconomic indicators, describing the correlations of the high level economy, while Anghelache (2008a) is a reference work in statistics. Anghelache and Anghelache (2013) focus on the structural analysis of GDP, based on macroeconomic models. Iordache et al. (2011) have introduced an econometrical model for GDP calculation. Necșulescu and Șerbănescu (2014) characterize the correlation between main macroeconomic indicators and the final consumption. Bekerman (1968) treats some aspects regarding the analysis of the national income. Anghelache (2009) describes the macroeconomic indicators used for international comparisons. Diamond (2013) reviews some characteristics of the unemployment. Anghelache (2008b) presents the interconnections between external balance and macroeconomic outcome aggregates. Dinu (2012) describes some aspects on macroeconomics.

2. The significance of the correlation GDP growing rate and unemployment rate

Theoretically, this correlation is obvious: a recessive economy characterized by a GDP (RPIB) decreasing rate of growth, unemployment rate (RS) is growing; when the economy is increasing, the GDP (RPIB) is increasing, while the unemployment rate (RS) is decreasing. This inverted (negative) correlation is known as Okun's law. Analyzed by US economic conditions, the law has the following mathematical relation:

$$RPIB_{t/t-1} = 3\% - 2(RS_t - RS_{t-1}), \quad (1)$$

where:

$RPIB_{t/t-1}$ – GDP growth rate in t time period compared to t-1 time period;

3% – GDP growth trend (trend relative to time);

$RS_{t,t-1}$ – unemployment rate in t time period, respectively in t-1 time period.

So, if the unemployment rate does not change, the GDP will have a 3% growth. For each growth percentage point of the unemployment rate, the GDP growing rate will decrease by 3%. For example, if the RS increases from 6% to 8% in the current period, than real RPIB will be –1%.

$$RPIB = 3 - 2(8\text{-}6) = -1\%. \quad (2)$$

This relation may be written as:

$$RS_{t+1} = RS_t - 0{,}5(RPIB_{t/t-1} - 3). \quad (3)$$

It follows that the unemployment rate in the current period will increase or decrease compared to the one from the previous period, as well as RPIB will be bigger or smaller than the growth trend (3%). In other words if the decrease of unemployment rate will decrease by 1%, RPIB must reach 5%:

$$RS_{t+1} - RS_t - 0{,}5(5 - 3 = -1). \quad (4)$$

This relation is statistical, unavailable for any country, only for the USA and only for the stage which was researched by Okun. Such statistical relation may be concluded separately for each country, with regard to conditions specific to the developmental stage.

For the latter years of the Romanian economy, the statistical data analysis led us to the conclusion that Okun's law is valid but only in a specific manner.

Firstly, the economic growth trend was considered the annual medium GDP growth rate for the 1980-1989 period calculated at 1.4%.

Secondly, between 1990 and 1993, no stable statistic relation can be determined between the GDP growth rate and unemployment rate even if the inverse correlation between the two variables is obvious.

Thirdly, starting with 1994, an Okun type relation between unemployment rate change and GDP growth rate change according to the trend may be settled, precisely for a delayed relation: GDP growth in t time period, over the registered trend (1.4%) led to an unemployment decrease for the t +1 time period.

The deduced relation is:

$$RS_{t+1} = RS_t + \alpha(RPIB_{t/t-1} - 1{,}4), \quad (5)$$

where:

$$\alpha \in (-0,4;-0,45). \quad (6)$$

In other words, the 1% GDP growth rate in the t year over the trend level ensured a decrease of the unemployment rate in t +1 year with about 0.4%.

Otherwise, the GDP change only partially explains the unemployment rate evolution.

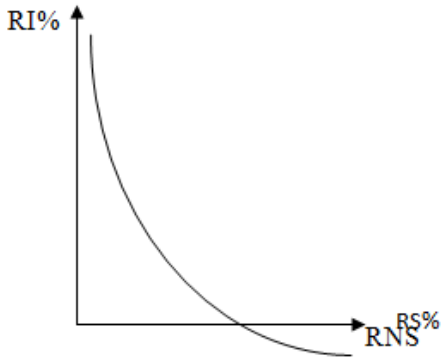
The medium credit interest rate for economic agent loans had a more important effect on the unemployment rate.

An intense direct correlation between the two variables was identified.

3. The correlation between the inflation rate and unemployment rate

The statistical data series analysis – especially the developed countries, until the "oil price shock" year, 1973 – underlined an inverse correlation, simple and stable, between inflation rate and unemployment rate. In other words, a relation of compensation between inflation and unemployment could be consisting of either a smaller unemployment obtained by a bigger inflation or the inflation may be reduced by an increased unemployment. This inverse correlation finds an expression in Philips curve.

Phillips curve on short term



The compensation relation corresponding to this graph is available only on short term is the following:

$$RI_t = RI_{t-1} + \alpha(RS_t - RNS).$$

Thus, the actual inflation rate (RI) depends on two factors:

- the inertial element, defined by the expected inflation, which can be replaced by the previous inflation (RI_{t-1});
- the cyclic element, defined by the deviation of the actual unemployment (RS_t) as to the natural rate of unemployment (RNS).

Following this formula, it is obvious that as much as unemployment is maintained at its natural level, the inflation rate does not change. Accordingly, if the unemployment rate increase over its natural level, the inflation rate will register a certain decrease depending on the α parameter (decreasing segment of Phillips curve).

After the oil price shock in the 70s, it was an awareness regarding the complexity of inflation – unemployment relation. The inflation rate is influenced by a third factor also (ε), namely the shocks of the aggregate offer (the nominal owed GDP changes, for exemple, the stressed price increases for certain products).

$$RI_t = RI_{t-1} - \alpha(RS - RNS) + \varepsilon. \tag{8}$$

It follows that there is a possibility that, on the long run, Phillips duduced inverse correlation between inflation and unemployment should not manifest. The evolution of the two variables will find an expression on a series of Phillips curves mapped on subperiods (on short term).

The medium levels registered on the inflation and unemployment rate in Romania may be analyzed by Phillips curve use.

4. Main aspects regarding the correlation between GDP growth rate and inflation rate

As GDP is calculated in current prices or in comparable prices, the nominal or real evolution of this indicator can be assumed.

The nominal evolution is indicated by the following relations:

$$IPIB_n = \frac{PIB_1^{crt}}{PIB_0^{crt}} \tag{9}$$

$$RPIB_n = IPIB_n - 1 \tag{10}$$

The real evolution refers to the fresh calculation in comparable prices (to the start period) of the GDP of the current period, by using the GDP deflator (D):

$$PIB_1^{comp} = \frac{PIB_1^{crt}}{D}, \tag{11}$$

where:
D = RI+1;
RI – inflation rate calculated based on deflator.

The real evolution is expressed by the following relations:

$$IPIB_r = \frac{PIB_1^{comp}}{PIB_0^{comp}} \frac{PIB_1^{comp}}{PIB_0^{crt}}$$
$$RPIB_r = IPIB_r - 1 \quad (13)$$

The relation between nominal GDP, real GDP and the inflation rate is:

$$IPIB_n = IPIB_r \times D \quad (14)$$

or transfer in rates:

$$RPIB_n = RPIB_r + RI + RPIB_r \times RI \ . \quad (15)$$

As the last product registers a significant value – in case of a reduced inflation rate, in many cases it is used the following relation:

$$RPIB_n = RPIB_r + RI \ . \quad (16)$$

Under the current conditions of the Romanian economy, this last relation cannot be used, as the product $RPIB_r \times RI$ has a value big enough.

5. Basic correlations of the economic increase

The total or *per capita* GDP is the synthetic indicator characterizing the economic increase expressed by increase its volume and rate. It follows that, the economic growth is based on direct production factors combination and use: fix capital, employment and the consumptions of the material circulating means.

As to the theory of economic growth, its factors, their interdependence and effectiveness and the statistic and analytic macroeconomic methods used are discussed.

A balanced development of the economy should comply with three conditions at macroeconomic and branch level:

- First of all, the GDP size is relative to the labour capacity, at national economy level through the working population $(\Sigma T)^3$, also by the quality and intensity of labour, measured by social productivity of labour $(\overline{W})$.

$PIB = \overline{W \times \Sigma T -}$ at national economy level. (17)

Based on the same indicators per branch the relation becomes:

$VAB = W \times T -$ per branch

where:
VAB = Gross Added Value

Dynamically expressed, the first relations will be:

$$IPIB = \overline{IW} \times I\Sigma T \tag{18}$$

or

$$RPIB + 1^* = \left(R\overline{W} + 1\right) \times \left(R\Sigma T + 1\right), \tag{19}$$

where:
I – increase index for each indicator;
R – increase rate for each indicator.

The last relation can be re-written as a correlation between increase rates:

$$RPIB = \underset{\substack{\text{influence}\\ \text{of intensive}\\ \text{factor}}}{R\overline{W}} + \underset{\substack{\text{influence}\\ \text{of extensive}\\ \text{factor}}}{R\Sigma T} + \underset{\substack{\text{common}\\ \text{influence}}}{R\overline{W \times R\Sigma T}}. \tag{20}$$

This relation can be used in many forms, depending on the way the common influence is approached:

- the common influence can be set aside when at least one of the increase rates registers a significant value;
- the common influence can be assigned to one factor, either quantitative or calitative;

$$RPIB = R\overline{W} + R\overline{W} \times R\Sigma T + R\Sigma T = R\overline{W}\left(1 + R\Sigma T\right) + R\Sigma T$$

$$= \underset{\substack{\text{intensive}\\ \text{factor}\\ \text{influence}}}{R\overline{W} \times I\Sigma T} + \underset{\substack{\text{extensive}\\ \text{factor}\\ \text{influence}}}{R\Sigma T}$$

or

$$RPIB = R\overline{W} + R\Sigma T + R\overline{W} \times R\Sigma T = R\overline{W} + R\Sigma T\left(1 + R\overline{W}\right) =$$

$$= \underset{\substack{\text{intensive}\\ \text{factor}\\ \text{influence}}}{R\overline{W} \times R\Sigma T} \times \underset{\substack{\text{extensive}\\ \text{factor}\\ \text{influence}}}{I\overline{W}} \tag{22}$$

- the common influence of each factor can be parted either equally or proportionally to the independent influences.

Secondly, the GDP is analyzed with regard to the main element of the national wealth – fixed funds $\left(\Sigma F\right)$ - and the average use efficiency $\left(\overline{E}\right)$.

$$PIB = \overline{E} \times \Sigma F - \text{national economy level;} \tag{23}$$

$$VAB = E \times F - \text{branch level.} \tag{24}$$

Similarly to A, increase rates correlation between GDP and influence factors is:

$$RPIB = \underset{\substack{\text{intensive}\\\text{factor}\\\text{influence}}}{R\overline{E}} + \underset{\substack{\text{extensive}\\\text{factor}\\\text{influence}}}{R\Sigma F} + \underset{\substack{\text{common}\\\text{influence}}}{R\overline{E} \times R\Sigma F} \quad (25)$$

Thirdly, GDP size depends on volume of consumed circulating material means $(\Sigma C)^4$ and their average use efficiency $(\overline{M})$

$PIB = \overline{M} \times \Sigma C -$ national economy level;

$VAB = M \times C -$ branch level.

Correlation between increase rates is:

$$RPIB = \underset{\substack{\text{intensive}\\\text{factor}\\\text{influence}}}{R\overline{M}} + \underset{\substack{\text{extensive}\\\text{factor}\\\text{influence}}}{R\Sigma C} + \underset{\substack{\text{common}\\\text{influence}}}{R\overline{M} \times R\Sigma C}. \quad (26)$$

The correlations refer to a single element of the production process: either employment or fixed capital or material consumption. Thus, GDP change is completely owed to one of these three factors. As the three resources act simultaneously in the production process, that means the GDP change to be the result of their correlated action. We cannot simply add the intensive influences from each element and then the extensive influences, because the total will be the same in size, with the relative GDP addition.

As a result, there have been a series of calculus methods which allow to settle the extent of the national economy development to be accomplished intensively or extensively, with regard to the three resources altogether.

The existent correlations between relative changes of GDP and the factor increase rates for each resource, represents the peak of these demonstration.

$$RPIB = R\Sigma T + R\overline{W} \times I\Sigma T \quad (27)$$

$$RPIB = R\Sigma F + R\overline{E} \times I\Sigma F \quad (28)$$

$$RPIB = \underset{\substack{\text{extensive}\\\text{factor}\\\text{influence}}}{R\Sigma C} + \underset{\substack{\text{intensive}\\\text{factor}\\\text{influence}}}{R\overline{M} \times I\Sigma C}$$

In order to have a displayed formula cumulating extensive and intensive influences of the three factor altogether, each influence of each element will be corrected with coefficient: GT for employment, GF for fixed capital, GC for material consumption, so as:

$$GT + GF + GC = 1(100). \quad (29)$$

These could be:

- the value definition of each factor share in the total factors cost, which can be expressed by net added value share (VAN), of economic return (A) and of materials consumption (or intermediary consumption, CI) in the gross production total (PB).

$$GT = GF = GC = 33.3\% ; \tag{30}$$

- calculated shares based on each factor elasticity (E) as to production, the elasticity expressed by the ratio between GDP relative increase and each resource relative increase:

$$ET = \frac{RPIB}{RT} \qquad EF = \frac{RPIB}{RF} \qquad EC = \frac{RPIB}{RC} \tag{31}$$

$$GT = \frac{ET}{\Sigma E} \qquad GF = \frac{EF}{\Sigma E} \qquad GC = \frac{EC}{\Sigma E},$$

where:

$\Sigma E =$ the three resources elasticity sum.

This shows the disadvantage of not being able to apply to negative elasticities.

A relation may be written with the result of the intensive and extensive contribution of the three resources to GDP increase:

$$RPIB = \underbrace{\left(R\Sigma T + R\overline{W} \times I\Sigma T\right)}_{\text{employment influence}} \times GT + \underbrace{\left(R\Sigma F + R\overline{E} \times I\Sigma F\right)}_{\text{fixed capital influence}} \times GF +$$

$$+ \underbrace{\left(R\Sigma C + R\overline{M} \times I\Sigma C\right)}_{\text{materials consumption influence}} \times GC = \tag{32}$$

$$= \underbrace{\left(R\Sigma T \times GT + R\Sigma F \times GF + R\Sigma C \times GC\right)}_{\text{total extensive influence}} +$$

$$+ \underbrace{\left(R\overline{W} \times I\Sigma T \times GT + R\overline{E} \times I\Sigma F \times GF + R\overline{M} \times I\Sigma C \times GC\right)}_{\text{total intensive influence}}.$$

The previous relations can be used to analyze the GDP dynamics starting with the the influence factors which can be viewed as medium and total indicators. The use of this version – in the first phase of the macroeconomical analyses – supposes to consider the homogeneity of the economy by the medium representativity respectively by time view quality factors at a next level. The homogeneity verification is made by analyzing the variation coefficient (v) calculated as the ratio between the average square deviation (σ) and the medium level of the respective indicator. For example, in the case of labour productivity, we use:

$$v = \frac{\sigma_w}{\overline{W}} = \frac{\sqrt{\frac{\Sigma\left(W - \overline{W}\right)^2 \times T}{\Sigma T}}}{\overline{W}} \times 100, \quad (33)$$

where:
W, T – workforce productivity and working population at branch level.

When the variation coefficient is above 35-40%, the average is not representative, and the factor contribution to GDP increase will be inaccurate as the calculated average will bring about the value equalization at branch level. Thus, in the second stage of the macroeconomic analysis, we need to determine the contribution of all factors at branch level, following that their influence on GDP growth to result from contribution aggregation at branch level.

It follows that the three basic correlations can be analyzed based on:

$$PIB = \Sigma W \times T \quad (34)$$

$$PIB = \Sigma E \times F \quad (35)$$

$$PIB = \Sigma M \times C \quad (36)$$

There are two influence factors:
- quality factor (intensive) at branch level (W, E, M);
- quantity factor (extensive) at branch level (T, F, C).

The previous relations may be studied also based on factors systems implying the influence of changes in the branch structure for each resource.

$$PIB = \overline{W} \times \Sigma T = \Sigma\left(W \times YT\right) \times \Sigma T \quad (37)$$

$$PIB = \overline{E} \times \Sigma F = \Sigma\left(E \times YF\right) \times \Sigma F \quad (38)$$

$$PIB = \overline{M} \times \Sigma C = \Sigma\left(M \times YM\right) \times \Sigma C \quad (39)$$

The three influence factors are:
- quality factor (intensive) at branch level (W, E, M);
- structural factor (YT, YF, YM);
- quantity factor (extensive) at national economy level $\left(\Sigma T, \Sigma F, \Sigma C\right)$.

We can deepen the analysis considering the correlation between work productivity and fixed capital efficiency:

$\overline{W} = \overline{E} \times \overline{Z}$ – national economy level; (40)

$W = E \times Z$ – branch level; (41)

where:
Z – fixed funds labour endowment.

Starting with these relations, GDP size can be determined by:

$$PIB = \Sigma W \times T = OE \times Z \times T ; \quad (42)$$

$$PIB = \overline{W} \times \Sigma T = \overline{E} \times \overline{Z} \times \Sigma T = \Sigma\left(E \times YF\right) \times \Sigma\left(YT \times Z\right) \times \Sigma T \quad (43)$$

Based on research objectives and the quality of the available statistic data, when analyzing GDP increase, any of these factorial relations can be used. Obviously, the most complex – by number and importance of the considered factors and as well as by the correlation between efficiency indicators – is the last relation. It is used in order to determine the contribution of each element to GDP change.

Conclusions

The correlations between macroeconomic variables, together with the equations that represent their mathematical expression, form a relevant toolbox for analysts. As it is known that data processing methodology is one of the key issues of the data analysis procedure, the presented correlations represent a solution, at least partial, to that issue.

The intensive development of an economy needs the increase of GDP by a more effective use of the existent employment, fix and material resources. Instead, the extensive development refers to an increase of the three resources.

References

Anghelache, C., Mitruţ, C. and Voineagu, V. (2013). *Statistică macroeconomică. Sistemul Conturilor Naţionale.* Ed. Economică. Bucureşti.

Anghelache, C. and Anghelache, G.V. (2013). Macroeconomic models used in the structural analysis of the gross domestic product. *Romanian Statistical Review.* Vol. 61. No. 6. pp. 15-21.

Anghelache C. (2008a). *Tratat de statistică teoretică şi economică.* Editura Economică. Bucureşti.

Anghelache C. (2008b). Interconnections between the external balance indicators and the macroeconomic outcomes aggregates. *Metalurgia International.* No. 2. pp. 168-171.

Anghelache C. (2009). Indicatori macroeconomici utilizaţi în comparabilitatea internaţională. 57th Conference „Statistica – trecut, prezent şi viitor".

Bekerman, W. (1968). *An introduction to national income analysis.* Hale Co. London.

Diamond, P.A. (2013). Cyclical unemployment, structural unemployment, Federal Reserve Bank of Boston in Working Papers

Dinu, M. (2012). Political macroeconomics. *Theoretical and Applied Economics.* Vol. XVIII. No. 8(573). pp. 1-2.

Iordache, A.M.M, Tudorache, I.C. and Iordache, M.T. (2011). An econometrical model for calculating the Romanian gross domestic product. *Journal of Information Systems and Operations Management.* Vol. 5. No. 2.1. Special Issue, pp. 492-499. available at http://www.rebe.rau.ro/RePEc/rau/jisomg/WI11-2/JISOM-WI11-2-A8.pdf

Necşulescu, C. and Şerbănescu, L. (2014). The impact of the main macroeconomic indicators on the final consumption of the population. *SEA - Practical Application of Science.* Vol. II. Issue 1 (3). pp. 388-396.

www.insse.ro

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 163-170

Determinants of the Hungarian forint/ US dollar exchange rate

Yu HSING
Southeastern Louisiana University, Hammond, USA
yhsing@selu.edu

Abstract. *Applying the EGARCH model and using demand and supply analysis, this paper finds that the HUF/USD exchange rate (units of the Hungarian forint per U.S. dollar) is positively associated with the U.S. Treasury bill rate, U.S. real GDP, the U.S. stock index, the Hungarian inflation rate and the expected exchange rate and negatively influenced by the Hungarian Treasury bill rate, Hungarian real GDP, the Hungarian stock index, and the U.S. inflation rate. The HUF/USD exchange rate has a long-term equilibrium relationship with these time series variables.*

Keywords: Exchange rates, Interest rates, Real GDP, Stock indexes, Inflation rates, EGARCH.

JEL Classification: F31, F41.

1. Introduction

The Hungary forint/U.S. dollar exchange rate has experienced fluctuations and volatile movements. The HUF/USD exchange rate was relatively stable up to the 1980s. In the 1990s, the forint continued to depreciate due to high inflation rates and difficulties in transition to a market economy. Relative political stability, low inflation rates and the joining of the EU led to a stronger forint during 2000-2007. The global financial crisis and other related factors caused the forint to depreciate as much as 58.8% from 147.0600 in 2008.M7 to 233.5400 in 2009.M3. It was settled at 275.23 on January 30, 2015.

This paper examines the HUF/USD exchange rate and has several focuses. First, a simultaneous-equation model consisting of demand and supply in the foreign exchange market is used to determine the exchange rate. This approach is justified as the central bank in Hungary had adopted a free floating exchange rate regime with the exchange rate to be determined by market forces. Second, international capital flows are considered by incorporating the interest rate and the stock market index in the U.S. in the model. Third, an advanced econometric method is applied in empirical estimation.

2. Literature review

Several recent studies have examined the determinants of exchange rates for Hungary or related countries. Frait, Komarek and Melecký (2006) study exchange rate misalignments for five central European countries. For Hungary, the EG method shows that the real exchange rate is significantly determined by the productivity differential, net foreign assets, openness and foreign direct investment. The ARDL method reveals similar outcomes except that the coefficient of net foreign direct investment is insignificant. According to the ECM, the coefficient of the error correction term is high, suggesting a fast adjustment to the equilibrium value. The forint was undervalued by about 2.5% by the end of 2004.Q1.

Ardic, Ergin and Senol (2008) compare six different exchange rate models for six CEE countries including Hungary based on three forecast error criteria. These six models are monetary models, the random walk model, uncovered interest parity, VAR(2), and ARIMA(2,1,0). They reveal that all the models have smaller forecast errors than the random walk model.

Uz and Ketenci (2010) investigate monetary models of exchange rate determination for 10 new EU countries. For Hungary, based on the OLS, DOLS, the ARDL or JOH method, the exchange rate, the relative money supply and the relatively output are cointegrated and have a long-term stable relationship, and the coefficients of the

relative money supply and relative output are significant. The hypothesis that exchange rates are unpredictable can be rejected significantly.

Giannellis and Papadopoulos (2011) consider the real, monetary and financial variables in examining exchange rate volatility for 8 EMU members and candidate nations. Monetary shocks affect exchange rate volatility in Hungary and Poland. Real shocks influence exchange rate volatility in Ireland. Both monetary and real shocks affect exchange rate volatility in France, Italy and Spain.

Kebłowski (2011) investigate exchange rate changes for the Czech Republic, Hungary, Poland and Romania. He shows that the long-term relationship between the Romanian leu and the euro can be rejected and that real exchange rates of the forint, the zloty, and the koruna versus the euro have long-term relationships and can be captured by real interest rate parities and the spreads of credit default risk premiums. Some common patterns are found among these four currencies as they were undervalued between 2003 and 2004 and overvalued between 2007 and 2009. The zloty and the forint were near their steady-state values after the global financial crisis whereas the leu and the koruna were overvalued.

Shevchuk (2014) finds that less domestic output, stronger growth abroad or more money supply leads to currency depreciation for the Czech Republic, Hungary and Poland. The money supply and the interest rate can explain 10%-14% of exchange rate changes in Hungary. The result for the interest rate differential in Poland is consistent with the monetary model.

To the author's best knowledge, few of the previous studies have applied demand and supply to analyze the determinants of the HUF/USD exchange rate. Monetary models depend on the validity of purchasing power parity, which may not hold in the short run. The assumption of the same coefficient for the interest rate, income or inflation rate differential may need to be tested.

3. The model

We can express the demand for and supply of the U.S. dollar versus the Hungarian forint in the foreign exchange market as:

$$\underset{\;-\;?\;\;\;?\;\;+\;\;+\;-}{D = X(E, Y^{HU}, R^{US}, S^{US}, E^{e}, \pi^{US})} \tag{1}$$

$$\underset{\;+\;?\;\;\;?\;\;+\;\;-}{S = Z(E, Y^{US}, R^{HU}, S^{HU}, \pi^{HU})} \tag{2}$$

where

D = demand for the U.S. dollar,

S = supply of the U.S. dollar,
E = the HUF/USD (units of the Hungarian forint per U.S. dollar) exchange rate,
Y^{US} = U.S. real GDP,
R^{US} = the interest rate in the U.S.,
S^{US} = the stock price in the U.S.,
E^{e} = the expected HUF/USD exchange rate,
π^{US} = the inflation rate in the U.S.,
Y^{HU} = real GDP in Hungary,
R^{HU} = the interest rate in Hungary,
S^{HU} = the stock price in Hungary, and
π^{HU} = the inflation rate in Hungary.

We expect that the demand for the U.S. dollar has a negative relationship with the HUF/USD exchange rate and the U.S. inflation rate and a positive relationship with the U.S. stock price and the expected HUF/USD exchange rate. The supply of the U.S. dollar is expected to be positively associated with the HUF/USD exchange rate and the stock price in Hungary and negatively affected by the Hungarian inflation rate.

A higher U.S. real GDP may increase U.S. imports from Hungary. However, if some of the increase in real GDP are due to an increase in import-substitute goods, U.S. imports from Hungary may decline. Hence, the sign of Y^{US} is unclear. A higher real GDP in Hungary is expected to increase imports from the U.S. and increase the demand for the U.S. dollar. However, if some of the increase in real GDP is due to import-substitute goods, Hungarian imports from the U.S. may decline. Hence, the sign of Y^{HU} is unclear.

According to the traditional view, a higher U.S. interest rate tends to attract Hungarian investors to purchase U.S. financial assets, resulting in an increase in the demand for the U.S. dollar and a higher HUF/USD exchange rate. On the other hand, the revisionist view maintains that a high U.S. interest rate may reduce the demand for the U.S. dollar and cause the U.S. dollar to depreciate because of a weaker economy and a higher default risk (Dekle et al., 2002; Huang et al., 2010). The analysis applies to Hungary as well.

Solving for the equilibrium values of the two endogenous variables simultaneously, we can express the equilibrium exchange rate as a function of all the exogenous variables:

$$\overline{E} = \overline{E}(R^{US}, R^{HU}, Y^{US}, Y^{HU}, S^{US}, S^{HU}, \pi^{US}, \pi^{HU}, E^{e}) \qquad (3)$$
$$\quad ? \quad ? \quad ? \quad ? \quad + \quad - \quad - \quad + \quad +$$

According to comparative static analysis, the sign beneath an exogenous variable shows the impact of a change in the exogenous variable on the equilibrium HUF/USD exchange rate.

4. Empirical results

The data were collected from the *International Financial Statistics* of the International Monetary Fund. The HUF/USD exchange rate is expressed as units of the Forint per U.S. dollar. Hence, an increase in the HUF/USD exchange rate means depreciation of the forint and appreciation of the U.S. dollar. Real GDP is measured in billions. The share price in Hungary is selected to represent the stock index in Hungary, and the Wilshire 500 index is chosen to represent the U.S. stock index. The inflation rate is derived from the percent change in the consumer price index in both countries. The expected exchange rate is derived from the weighted average exchange rate of the past four quarters. The exchange rate, Real GDP, stock indexes and the expected exchange rate are measured on the log scale in order to reduce collinearity among right-hand side variables. The sample ranges from 2000.Q1 to 2014.Q2 and has a total of 58 observations. Earlier data for the share price in Hungary are unavailable.

The ADF test on the residuals shows that the value of the test statistic is estimated to be -4.3349, which is greater than the critical value of -4.1305 in absolute values at the 1% level. Thus, these time series variables are cointegrated and have a long-term stable relationship.

Table 1 presents the estimated regression and relevant statistics. The exponential GARCH (EGARCH) model is applied in estimating the parameters. The value of R-squared is 0.8067, suggesting that 80.67% of the variation in the HUF/USD exchange rate can be explained by the nine right-hand side variables. All the coefficients are significant at the 1% level. The HUF/USD exchange rate has a positive relationship with the U.S. Treasury bill rate, U.S. real GDP, U.S. Wilshire 5000 stock index, the Hungarian inflation rate and the expected HUF/USD exchange rate and a negative relationship with the Hungarian Treasury bill rate, Hungarian real GDP, Hungarian share price and the U.S. inflation rate. Except for the stock market index, the coefficient of the U.S. Treasury bill rate, real GDP or inflation rate is greater than the coefficient of a corresponding Hungarian variable in absolute values.

Table 1. *Estimated Regression of the HUF/USD Exchange Rate*

Variable	Coefficient	z-Statistic
Constant	0.756979	9.537934
U.S. Treasury bill rate	0.033721	84.30461
Hungarian Treasury bill rate	-0.019292	-11.02706
LOG(U.S. real GDP)	0.543851	40.15660
LOG(Hungarian real GDP)	-0.136299	-6.268773
LOG(U.S. Wilshire 5000 index)	0.134486	19.04455
LOG(Hungarian stock index)	-0.316863	-39.35076
U.S. inflation rate	-0.018508	-9.016306
Hungarian inflation rate	0.007702	5.848172
LOG(expected exchange rate)	0.282907	15.55974
R-squared	0.8067	
F-statistic	17.4510	
Sample	2000.Q1-2014.Q2	
Sample size	58	
MAPE	5.1825%	

Notes: The dependent variable is the log of the HUF/USD exchange rate. All the coefficients are significant at the 1% level. MAPE is the mean absolute percent error.

Several comments can be made. The traditional view prevails as a higher Hungarian Treasury bill rate would cause the Hungarian Forint to appreciate whereas a higher U.S. Treasury bill rate would cause the U.S. dollar to appreciate. Capital flows to the country with a higher rate of return on financial assets because a higher stock market index in Hungary would cause the Hungarian forint to appreciate, and a higher stock market index in the U.S. would make the U.S. dollar stronger. Inflation plays an important role in the determination of the value of a currency since a higher inflation rate in Hungary would cause the forint to depreciate whereas a higher inflation rate in the U.S. would cause the U.S. dollar to depreciate. An investors expect the HUF/USD to increase or the U.S. dollar to appreciate, the demand for the U.S. would shift to the right, leading to a stronger U.S. dollar.

Several different versions were considered. The Wald test is applied to determine whether the differential form should be used. In all four cases, the hypothesis that the coefficients are the same with the opposite signs can be rejected at the 1% level. Hence, separating each of the variables and assuming different coefficients are the correct approach. If the discount rate in Hungary and the federal funds rate in the U.S. replace the Treasury bill rates, the coefficient of the discount rate is -0.0336 and significant at the 1% level, and the coefficient of the federal funds rate is 0.0182 and significant at the 1% level. The value of R-squared is 0.7956. Other results are similar. When the simple average exchange rate of the past four quarters is used to represent the expected exchange rate, the estimated coefficient is positive but insignificant at the 10% level, the value of R-squared is 0.7638, and other results are similar.

5. Conclusions

This paper has examined the determinants of the Hungarian forint/U.S. dollar exchange rate based on demand and supply analysis. A higher interest rate, more real GDP, a higher stock market index or a lower inflation rate in Hungary would cause the forint to appreciate. A higher interest rate, more real GDP, a higher stock price index and a lower inflation rate in the U.S. would cause the U.S. dollar to appreciate. A higher expected exchange rate would lead to a higher exchange rate.

There are several policy implications. Interest rates, real GDP, stock prices, inflation rates and the expected exchange rate play important roles in exchange rate determination. Monetary easing or tightening leading to a lower or higher interest rate would affect the HUF/USD exchange rate. A stronger economy is essential to a stronger currency. Stock market performance is expected to cause international capital flows into or out of Hungary and the U.S. and affect the exchange rate. It is desirable to maintain a low inflation rate in order to protect the value of a currency.

References

Ardic, O.P., Ergin, O. and Senol, G.B. (2008). Exchange Rate Forecasting: Evidence from the Emerging Central and Eastern European Economies. *Working paper*.

Bilson, J.F.O. (1978). Rational Expectations and the Exchange Rate. In: J.A. Frenkel and H. Johnson (Eds.). *The Economics of Exchange Rates*, Addison-Wesley Press, Reading.

Dekle, R., Hsiao, C. and Wang, S. (2002). High Interest Rates and Exchange Rate Stabilization in Korea, Malaysia, and Thailand: An Empirical Investigation of the Traditional and Revisionist Views. *Review of International Economics.* Vol. 10, pp. 64-78.

Dornbusch, R. (1976). Expectations and Exchange Rate Dynamics. *Journal of Political Economy.* Vol. 84, pp. 1161-1176.

Engel, C. (2010). Exchange Rate Policies. *A Federal Reserve Bank of Dallas Staff Paper*. DIANE Publishing.

Frait, J., Komarek, L. and Melecký, M. (2006). The Real Exchange Rate Misalignment in the Five Central European countries. No 739, Warwick Economic Research Papers, pp. 1-33.

Frankel, J.A. (1979). On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Differentials. *American Economic Review*. Vol. 69, No. 4, pp. 610-622.

Frenkel, J.A. (1976). A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence. *Scandinavian Journal of Economics*. Vol. 78, No. 2, pp. 200-224.

Giannellis, N. and Papadopoulos, A.P. (2011). What Causes Exchange Rate Volatility? Evidence from Selected EMU Members and Candidates for EMU Membership Countries. *Journal of International Money and Finance*. Vol. 30, pp. 39-61.

Huang, P., Hueng, J.C. and Yau, R. (2010). Traditional View or Revisionist View? The Effects of Monetary Policy on Exchange Rates in Asia. *Applied Financial Economics*. Vol. 20, pp. 753-760.

Kębłowski, P. (2011). The Behavior of Exchange Rates in the Central European countries and Credit Default Risk Premiums. *Central European Journal of Economic Modelling and Econometrics.* Vol. 3, pp. 221-236.

Shevchuk, V. (2014). Monetary Model of Exchange Rate Determination: Evidence from the Czech Republic, Hungary and Poland. *Journal of Modern Accounting and Auditing*. Vol. 10, pp. 97-103.

Uz, I. and Ketenci, N. (2010). Exchange Rate Determination: Monetary Approach in the New EU Members and Turkey. *Applied Economics Letters*. Vol. 17, No. 10, pp. 963-967.

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 171-182

Macroeconomic strategies for the prevention of economic and financial crisis

Cătălin-Emilian HUIDUMAC-PETRESCU
Bucharest Academy of Economic Studies, Romania
catalinhuidumac@yahoo.com
Alexandru Cătălin POPA
Bucharest Academy of Economic Studies, Romania
alexandrup86@gmail.com

Abstract. *The role of any macroeconomic policy, regardless of the economic school of thought which they are based, is to create a stable economic environment and to ensure sustainable growth in the long term. This involves the prevention of economic and financial crisis, which actually means to correct any major imbalances before they produce their destructive effects in the economy. This article is intended to be a critical analysis of fiscal and monetary policies, based on the main schools of thought, in terms of their effectiveness in preventing crises.*

Keywords: macroeconomic theories; economic model; economic crisis; anti-crisis strategies.

JEL Classification: E44, Q54, E43.

1. Introduction

The recent economic and financial crisis that humanity has crossed questioned many of the conclusions produced by theories of economics which until recently were considered by many analysts absolute truths. Controversies are related to supporter's ideological options, but generally falls within the ideological conflict between state interventionism in economies and free market. Monetary and fiscal policy errors often caused artificial growth. Balloons, no matter in which form, always burst sooner or later, and their effects reach other segments of the economy. Most often, their forming coincides with misallocation of resources in economy, later requiring measures to support the recovery which also means discretionary consumption, perpetuating inequity.

The effects of the recent crisis were among the toughest and were seen around the world in increasing unemployment following the closure of businesses, in increasing interest rates and default rates paid to banks (which sometimes even led to foreclosures) and in a general reduction of purchasing power and consumption.

Economic and financial crisis is the result of the conjugate failure of main economic actors, coming mainly from the financial environment, in building long term business models, of the authorities – regulators, legislators, central banks – in preventing the crisis through macroeconomic adequate policies and regulations and of the economic science in creating theoretically support of reliable long-term business models. For some time, economic practice has maintained an almost blind trust in the efficiency of free markets and economic theories of this type dominated other theoretical options. But every science must be able to challenge its fundamental assumptions, at least when reality no longer fully confirms them. Economics plays a crucial role in ensuring the wellbeing of individuals as it creates the framework where ideas are generated and promoted, which are then accepted by decision makers and implemented by the competent authorities.

This paper is divided into five parts. After introduction, there is a part dedicated to the overall evolution of the economic crisis both in the developed and in the developing economies around the world. The economic crisis started in 2007, first as a crisis of the US financial system has spread rapidly to all levels of the economy and in most countries. The fast extension on other continents took place on a background of old issues of world economies related to the heterogeneity in countries development or to some major worldwide trade imbalances, problems that, up until the crisis were not felt so easy. Beyond this, many investors were attracted primarily by the prospect of investing in US financial markets, but also in countries of origin. The third part of this article discusses the fiscal policies adopted by policymakers in most EU Member States before the crisis and how they have contributed to the widening of financial crisis. The fourth chapter is about the monetary policies adopted by central banks around the world before the financial crisis which were especially influenced by Milton Friedman's monetarist political vision promoted in the 1970s. The last chapter is dedicated to conclusions.

2. The economic crisis evolution

The origins of the current crisis lie in the US financial system errors before 2007 that fueled years of growth models based almost solely on consumption. The fast increase in housing prices was due mainly to credit becoming easier and based exclusively on guarantees provided by borrowers in the form of mortgages on real estate purchases (the so-called subprime loans). Creating complex derivatives allowed American credit institutions to transform these risky assets into cash, thereby avoiding the few existing prudential regulations and feeding the whole process. These assets tied to mortgages on homes and assessed by renowned rating agencies as safe, were mostly sold by various financial intermediaries with an activity different from that of credit institutions such as investment funds/banks or insurance companies, which allowed the latter to assume higher risks. As long as banks could find increasingly more customers willing to borrow, the housing price were increases, and borrowers who had difficulties to repay rates could refinance the loans by contracting other new and higher loans (the mortgages value was increasing).

This system was obviously unsustainable, worked for years under the eyes of authorities that had the task of ensuring the stability of financial systems. The effects were mainly seen in the construction sector where developers were trying to keep up with demand growth of new housing, but also in the rest of the real economy, the loans fueling, even if less, private final consumption of any kind.(1) This way there have been created major imbalances between real household purchasing power and consumption, the effects being not immediate nor any readily observable.

The main factor that fueled the scheme has been creating and developing financial derivatives markets. The maturation of this instrument market has stagnated or began to decline slightly. At this stage appeared the first default situations which have increased gradually. Practically the entire circuit was reversed; banks began to execute real estate collateral, demand has increased considerably and prices have dropped further. Under market forces, macroeconomic equilibrium started to recover, but with negative effects not only on individuals. This moment was the beginning of the crisis. The negative effects in the financial system were so strong that endangered its main function in economy, which is intermediation of financial resources. Bankruptcies of major players in the financial sector, of which the most spectacular remains that of Lehman Brothers bank in 2008, generated large liquidity problems throughout the US economy, including the real sector and a general state of panic for investors. The construction market collapsed and consumption decreased considerably being fueled no longer by subprime loans.

In Europe the crisis manifested itself in a relatively similar way although the housing market has not had a similar pattern, European banks couldn't grant loans as easily as those on the American continent. However, European banks in developed countries have been attracted by the high yields offered by financial derivatives and did not hesitate to

buy them. Also, over issues brought by the holding US toxic assets overlapped some old issues that were related to the European economic model characterized by a monetary union, a totally different state to state fiscal policy and a general heterogeneity in the degree of economic development.

Basically European countries can be divided into two categories: the developed ones that founded the European Union, with financial systems large and very large relative as reported to GDP level, able to invest significant resources externally, and developing countries which, at least before the crisis, were dependent on external resources, such as European funds and external loans.

US financial crisis has spread primarily in European countries in the first category because of significant exposures that they had against American financial institutions. In crisis situations, the first reaction of any investor is to withdraw from the market, to invest in the most liquid and safe possible assets, even if they produce lower yields. The general feeling of distrust led to the limiting of foreign financing that less developed states depended. These states underwent major adjustments of current account deficits, consumption proportionally decreasing.(2) Adjustments have assumed lower revenues to the state budget which in turn have resulted in major cuts in public spending, including pensions and wages in some countries and calling for immediate financial assistance from international institutions. However, a beneficial effect of the crisis was that of reducing the dependence of developing states for external financing, redirecting it to EU funds and increased exports. At least from this perspective, one can say that the European economic model is more sustainable post-crisis than before the crisis.

In the Asian countries the model based mainly on surplus production, fueled by excessive lending in the Western countries, also suffered major adjustments, decline in consumption in Western countries materialized in reducing exports to them. However, an economic model where someone just produce and someone else consume on credit cannot be sustainable in the long term.

The crisis is nothing but a restoration of the natural balance of economies in a relatively short period and with some negative effects on short and medium term. In the long run an economic crisis can be seen as an opportunity to streamline existing business models or even create new ones by the emergence and promotion of innovative ideas in economic science, which otherwise would have been accepted with great difficulty.

3. Fiscal policies before the crisis

Fiscal policy refers to how financial resources are drawn and used in the public interest by the authorities who represent the executive power. They cover the taxes and income collected, including the way they are collected (taxation thresholds, flat tax rate, etc.) and the use of such resources so called the state budget structure. Budget deficits are recorded

when collection is below the level of spending, and governments are forced to borrow to cover the gap, thus increasing public debt.

In the Keynesian view, governments should intervene in economy in a cyclical manner; in times of strong economic growth, the accumulation of budget deficits and public debt is not at all recommended. Under conditions of prolonged expansion governments should adopt a countercyclical behavior that would not further encourage consumption and should possibly accumulate resources for using when recessions appear.

In the classical vision, noninterventionist, governments should be restricted only to give citizens those services they need and that the private sector cannot provide, namely defense, public order, infrastructure, etc.; in terms of market intervention it is a neutral policy. Governments should not try to avoid crises, as often under these reasons, government intervention will impair proper functioning of markets, creating macroeconomic imbalances. In other words, crisis prevention is done by the authorities by non-involvement in economic activity, the solution often promoted by famous slogan enunciated since the eighteenth century by Vincent de Gournay *"Laissez faire, laissez passer, le monde va de lui même!*"

Unfortunately, reality shows that fiscal policies adopted by most governments before the crisis have not followed any of the above recommendations, operating pro-cyclical and exacerbating the negative effects of the crisis.

Cyclical fiscal policies can be easily seen in the development of budget deficits before the crisis. The table below presents the evolution of this indicator during 2005-2009, years in which the EU ought to apply fiscal policy limits laid down in the Maastricht Treaty to ensure financial sustainability (deficit up to 3% of GDP and a public debt level of under 60% of GDP). Almost all European governments have broken to a lesser or greater extent these limits, all except Denmark, Estonia, Luxembourg and Sweden. Perhaps even more serious is that these limits considered reasonable in 1993, when ratificating the Maastricht Treaty, were violated by European states even in years of economic growth (figures in Table 1 marked with *) when, at least theoretical, encouraging consumption by public authorities was not justified. The United States registered deficits also comparable with the European Union countries in the years before the crisis.

Table 1. *The budget balance in the European Union and United States (% GDP)*

	2005	2006	2007	2008	2009
United States	-2,43	-1,79	-1,11	-3,12	-4,05
European Union (EU28)	-2,6	-1,6	-0,9	-2,5	-6,7
Eurozone (E19)	-2,6	-1,5	-0,6	-2,2	-6,3
Belgium	-2,6	0,3	0,1	-1,1	-5,4
Bulgaria	1,0	1,8	1,1	1,6	-4,1
Czech Republic	-3,1*	-2,3	-0,7	-2,1	-5,5
Denmark	5,0	5,0	5,0	3,2	-2,8
Germany	-3,4*	-1,7	0,2	-0,2	-3,2
Estonia	1,1	2,9	2,7	-2,7	-2,2

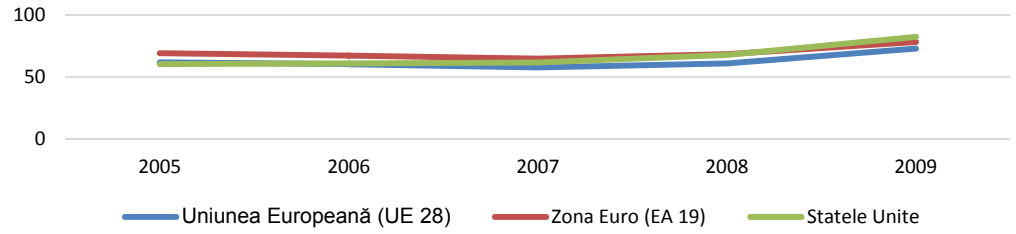
	2005	2006	2007	2008	2009
Ireland	1,3	2,8	0,3	-7,0	-13,8
Greece	-6,2*	-5,9*	-6,7*	-10,2	-15,2
Spain	1,2	2,2	2,0	-4,4*	-11,0
France	-3,2*	-2,3	-2,5	-3,2*	-7,2
Croatia	-3,7*	-3,2*	-2,4	-2,7	-5,8
Italy	-4,2*	-3,6*	-1,5	-2,7	-5,3
Cyprus	-2,2	-1,0	3,2	0,9	-5,5
Latvia	-0,4	-0,6	-0,7	-4,1	-9,1
Lithuania	-0,3	-0,3	-0,8	-3,1*	-9,1
Luxembourg	0,2	1,4	4,2	3,3	-0,5
Hungary	-7,8*	-9,3*	-5,1*	-3,6*	-4,6
Malta	-2,7	-2,6	-2,3	-4,2*	-3,3
Netherlands	-0,3	0,2	0,2	0,2	-5,4
Austria	-2,5	-2,5	-1,3	-1,4	-5,3
Poland	-4,0*	-3,6*	-1,9	-3,6*	-7,3*
Portugal	-6,2*	-4,3*	-3,0	-3,8*	-9,8
Romania	-1,2	-2,2	-2,9	-5,6*	-9,1
Slovenia	-1,3	-1,2	-0,1	-1,4	-5,9
Slovakia	-2,9	-3,6*	-1,9	-2,3	-7,9
Finland	2,6	3,9	5,1	4,2	-2,5
Sweden	1,8	2,2	3,3	2,0	-0,7
UK	-3,5*	-2,9	-3,0	-5,1	-10,8

Source: Eurostat, US Office of Management and Budget (OMB).

The natural result was that at the outbreak of crisis governments couldn't do much to limit the financial crisis effects, many entering themselves into a sovereign debt crisis amid uncertainty created by the financial markets. The best example of this is Greece, a member of the European Union and the euro area who at the onset of the US financial crisis in 2007 already had an unsustainable debt level of 103% GDP. The crisis has exacerbated the problems of tax administration in this country, the only way to avoid a complete failure of the Greek Government (the first in Eurozone) being a substantial financial aid and harsh fiscal adjustment measures. Despite all the efforts, including a major restructuring of public debt in 2012, Greece will remain in history as the first country in the Western world who failed to reimburse a loan from the International Monetary Fund in 2015. Later there were found some temporary solutions to redress the situation, an extension being considered very dangerous both for Greece and for all EU states. At the end of 2014, Greece's debt stands at 178% of GDP.

The graph below shows the development levels of government debt to GDP for the US, Eurozone 19 and the European Union, pointing out the high values for all of these economic zones in recent years preceding the financial crisis, levels considered until recently quite dangerous (over 60% of GDP).

Chart 1. *Government debt (% GDP) during 2005-2009*



Source: Eurostat, US Office of Management and Budget (OMB).

In conclusion, fiscal policies before the economic crisis have not been able to prevent the financial crisis, even acting in the sense amplifying its negative effects.

4. Monetary policy before the crisis

Monetarist school, with its main exponent Milton Friedman, was the most dominant economic vision since the 1970s. Although financial stability before the crisis was an atribution of central banks, their primary objective remained to ensure and maintain price stability (Stiglitz, 2010 p. 409). Monetary policy was about the action of the central banks' intervention in economy for correcting associated inefficiencies caused by variations in prices, even if they were modest. Monetary policy instruments available to central banks are multiple (interest rate monetary policy, open market operations, minimum required reserves and other administrative and regulation measures). Most frequently central banks resorted to actions on the monetary policy interest rate as it is considered the most effective tool available due to the speed that it acts with minimum negative externalities. Although central banks act on interest rates in the short term, it is an illusion to believe that this monetary policy instrument only, even if used in the most ingenious way possible, could ensure long-term stability in the financial markets. Financial markets means more than money markets and the consequences, losses and gains, of the first products exceed the losses of the last. However the increased attention of financial markets is justified even in the light of ensuring a low inflation rate. The recent financial crisis has highlighted the limits of using monetary policy rates, central banks being forced to resort to unconventional measures aimed at influencing long-term interest (quantitative easing measures).

Monetarism is based on the idea of the classical school that there is always a direct and natural link between money and inflation and suggests, at least in its primary forms, a fixed rate of increasing money supply, in correlation with the GDP expansion (Stiglitz, 2010, pp. 409-410). This should ensure price stability, sustainable economic growth, free of periods of economic and financial crisis. Monetarism supported the idea of strict control of money supply to ensure price stability.

Regarding the possibility of using monetary policy tools to prevent or limit the effects of a financial crisis, monetarism followers were somewhat skeptical. Monetary policy should be neutral and act solely on ensuring price stability.

Table 2 shows the evolution of these two indicators for the United States and the European Union, represented by Euro Zone 19 and the largest economy outside this zone, namely UK.

The data in this table confirms the existence of a direct relationship between money and inflation, but also shows a somewhat surprising thing, that this link is not strictly proportional, at least in the short term. Thus, during 2005-2014 prices in the Eurozone 19 rose by 17.9%, while broad money increased by 47%. Things are similar in other areas analyzed, i.e. broad money seems to grow faster than prices.

Table 2. *Inflation and money supply[3] between 2005-2014*

	Euro Area 19		Great Britain		United States	
	Harmonized Index of Consumer Prices (2005=100)	Index of M3 - broad money supply (2005=100)	Harmonized Index of Consumer Prices (2005=100)	Index of M3 - broad money supply (2005=100)	Harmonized Index of Consumer Prices (2005=100)	Index of M3 - broad money supply (2005=100)
2005	100	100,00	100	100,00	100	100,00
2006	102,22	108,62	102,3	112,63	103,17	105,29
2007	104,43	120,66	104,7	127,89	105,88	111,77
2008	107,92	133,24	108,5	145,96	110,51	119,44
2009	108,27	138,30	110,8	161,23	109,6	129,10
2010	110,01	136,80	114,5	175,44	112,26	132,28
2011	113,01	138,17	119,6	172,63	116,55	141,93
2012	115,83	141,86	123	169,65	119,01	154,10
2013	117,39	144,60	126,1	176,84	120,5	164,42
2014	117,9	147,06	128	175,96	122,08	174,60

Source: Eurostat, OECD, own calculations.

This phenomenon has many explanations. One explanation would be that any increase in the money supply causes an immediate increase in prices as new the new money are making their way into the financial system and remain there for a certain period without having an impact on the real economy. Accordingly we must admit that it is only a matter of time before a significant growth in money supply will make its presence felt in the general consumption, and therefore in inflation.

A second explanation could relate with the rotation speed of money, but it is still unlikely because according to the quantity theory of money, to act this way would mean that the rotation speed of money in the analyzed period to decrease in order for money growth to increase faster than prices. This is pretty hard to believe given the very rapid development of financial and payment instruments in the recent years. Monetarism was based on the assumption that the rotational speed of money is relatively constant, but in the last 30 years this indicator varied greatly, mostly increasing (Stiglitz, 2010, p. 410).

A third explanation of this same phenomenon is related to the calculation methodology of consumer price indices. It is known that they do not consider real estate prices, prices that had strong growth in these years amid the US subprime lending.

However, the table above shows that the monetary policies in most geographical areas considered cannot be characterized as being of anti-cyclical nature in the years before the financial crisis. At most we can say that monetary policies were neutral, given that they ensured a relatively steady growth in money supply, while maintaining a low inflation rate. However, many studies that support the monetary policies adopted by countries that have been pro-cyclical, according to a study published by OECD in 2013, the monetary policy interest rates have been below Taylor level.

The charts below show without too many doubts that central banks around the world have tried to prevent / limit the financial crisis and its effects primarily appealing to classical instrument, namely the monetary policy interest rates. The charts show the evolution of monetary policy rates in the major economic powers, namely the US, European Union, represented by the Eurozone 19 and the UK, and China. There is a consistent and significant growth in the years preceding the financial crisis and a sharp drop in the onset of the crisis, namely in 2007 in the United States and in 2008 in the rest of economic areas.

Chart 2. *Changes of the monetary policy rate in the Eurozone (%)*

Chart 3. *Changes of the monetary policy rate in US (%)*

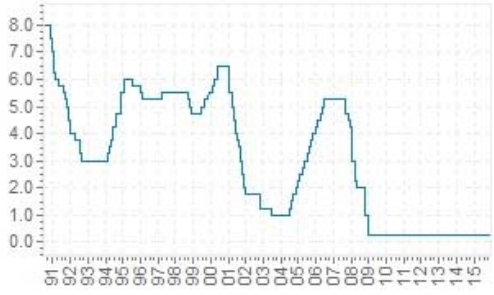


Chart 4. *Changes of the monetary policy rate in GB (%)*

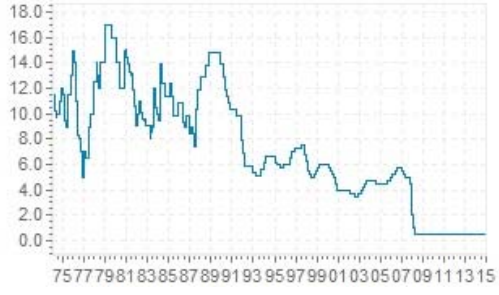
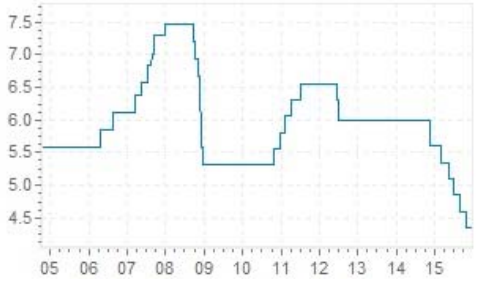


Chart 5. *Changes of the monetary policy rate in China (%)*



Source: Global-Rates.com

With the outbreak of the crisis, many countries began to use monetary policy as a tool to combat the financial crisis significantly modifying the development of monetary policy everywhere. The main tool used after exhausting the possibilities to reduce the monetary policy interest rates, quantitative easing was a contemporary solution to the liquidity trap set by J.M. Keynes in 1936.

It is obvious that the monetary policies implemented by the authorities have achieved the objective of ensuring financial stability. Interestingly, economic theories and developments in this area. If the beginning of monetarism his followers campaigned for careful control of monetary aggregates, after 1990 most central banks have adopted the strategy of inflation targeting citing a number of arguments relating both to measure precisely and in real time of monetary aggregates or the importance of achieving the ultimate objective of monetary policy, namely price stability.

Monetary policy should be limited to a single objective - that of price stability Friedman, 1982, p. 100). Faith that rooted in central bankers was that low inflation is necessary and even sufficient to ensure long-term economic growth in terms of financial stability. This proved more than once false. In addition, major central banks have contributed directly and indirectly to the subprime mortgage crisis by the failure of adopting adequate regulatory and control measures and by practicing for extended periods low rates of interest. Finally, since 2006, the US central bank has refrain from publishing data on the M3 monetary aggregate, which private analysts of informations absolutely necessary to make complete analyzes of long-term financial stability. However the OECD publishes data on M3 US using the M2 as an indicator proxy.(4)

5. Conclusions

One of the primary values of economics is to provide authorities with the tools needed to prevent economic and financial crises. Government actions, namely macroeconomic policies, are merely the product of economic science. The ideological fighting between interventionism and non-interventionism developed along modern history of humanity have led to current situations where crises are repeated, and authorities hesitate in answering important questions on the solutions of the crisis, but also to the question on why it was not possible to prevent it.

The state power is based on two main types of macroeconomic policies: monetary and fiscal policies. Inspired by the classical school, monetarism seems to greatly restrict the degree of state intervention by limiting monetary policies to a single objective of price stability and the recommendation to use monetary policy rate only for that purpose. The fight with inflation (actual or potential) became the number one concern for central banks around the world, financial stability or economic growth were put in the background.

Fiscal policies have remained up to politics and undoubtedly could have made a contribution to the prevention of financial crisis, but unfortunately in most states, they acted to the contrary. This time economics is not to blame, since all economic theories caution in encouraging consumption under high economic growth. It rather sounds like a simple matter of implementation, even malevolent, of economic theories.

Not incidentally, solutions to overcome the crisis consisted in giving up conventional monetary policies and adopting firm measures of quantitative easing nature, as well as a rethinking of policy and fiscal practices. But these solutions have involved significant costs for everyone and the crisis still continues to be felt.

It is clear that in the next period the economics theory of monetary policy must redefine, in extending the responsibilities of central banks and the instruments at their disposal. At the same time, we must not ignore the lessons of irresponsible fiscal policies in the region. One of the best ideas of monetarism was supporting the independence of central banks. Reality shows that politicians are prone to abuses and monetary policy mistakes can be extremely costly. On the other hand, the politics always express the will of the people, and economic and political power must be distributed only on this basis. It is in such context that the economic science has to offer viable solutions for crisis prevention and treatment, with minimal costs.

Notes

(1) Incidentally, one of the reasons this unsustainable growth was hardly seen in the official data on inflation is that the statistic pursued by central banks worldwide is free of prices of real estate assets.

(2) For example, in Romania, the current account deficit declined in 2009 to around 4% of GDP from 13% the previous year, a period that coincided with the most pronounced economic downturn.

(3) The M3 money supply in broad sense is presented as defined by OECD and includes passive of the following financial instruments: currency, overnight deposits, deposits with maturities up to 2 years or refund less than 3 months from the notification, REPO agreements, money market fund units and other similar debt securities with maturities of up to two years.

(4) http://www.federalreserve.gov/Releases/h6/discm3.htm
http://stats.oecd.org/mei/default.asp?lang=e&subject=14&country=USA

References

Bălţăţescu, I. (2009). Abordarea Keynesistă a Ciclului de Afaceri şi Crizelor Economice şi Critici ale acesteia. *Revista de Economie Mondială*. 1(4).

Bouis, R. et al. (2013) The Effectiveness of Monetary Policy since the Onset of the Financial Crisis. *OECD Economics Department Working Papers.* No. 1081. OECD Publishing.

Friedman, M. (1982). Monetary Policy, Theory and Practice. *Journal of Money, Credit and Banking*. Vol. 14, No. 1, pp. 98-118.

Friedman, M. and Friedman, R. (2009). *Libertatea de a alege. O declaraţie personală.* Ed. Publica. Bucureşti.

Greenspan, A. (2008). *Era turbulenţelor*. Ed. Publica. Bucureşti.

Keynes, J.M. (2009). *Teoria generală a ocupării forţei de muncă, a dobânzii şi a banilor,* Ed. Publica, Bucureşti.

Mankiw, N.G. (2015). *Principles of economics*. Seventh Edition. Cengage Learning. Stamford USA.

Stiglitz, J.E. (2010). *În cădere liberă.* Ed. Publica. Bucureşti.

Taylor, J. (1993). Discretion versus policy rules in practice. *Carnegie Rochester Conference Series on Public Policy.* 39. pp. 195-214.

http://stats.oecd.org

http://www.bankofengland.co.uk

http://www.bnr.ro

http://www.ecb.europa.eu

http://www.federalreserve.gov

https://circabc.europa.eu

https://www.whitehouse.gov/omb

www.global-rates.com

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 183-194

Does tourism affect economic growth in Indian states? Evidence from panel ARDL model

Lingaraj MALLICK
Maulana Azad National Urdu University, Hyderabad, India
lingaraj.pu@gmail.com
Ummalla MALLESH
School of Economics, University of Hyderabad, India
mallesh.ummalla@gmail.com
Jaganath BEHERA
School of Economics, University of Hyderabad, India
Jaganathbehera1988@gmail.com

Abstract. *We investigate the relationship between tourism and economic growth in 23 Indian States from 1997 to 2011. Using panel autoregressive distributed lag model based on three alternative estimators such as mean group estimator (MG), pooled mean group (PMG) and dynamic fixed effects (DFE), we found that there is a significant relationship between tourism and economic growth in the long-run but not in short-run in India.*

Keywords: Economic growth, Tourism development, Panel ARDL, India.

JEL Classification: O47, L83, C23.

1. Introduction

Tourism plays a significant role in every economy. Tourism sector represents a vital source of revenue, employment and entrepreneurial significance for a country. From the global perspective, tourism sector estimates for 5 percent of the world GDP and 30 percentages of world export services (UNWTO, 2012). In recent time tourism specialization and economic growth become a core area of research. Now researchers have great interest to support empirically the direct effect of tourism on economic growth. Nevertheless, the relationship is unpredictable with economic theories, particularly; from the theory of endogenous growth viewpoint, economic growth deals with: (a) economic sectors with a high concentration of R & D, which leads to high productivity; (b) Large Scale, in fact, this feature is not shared by intensive tourism countries (Lanza and Pigliaru, 1999; Easterly and Kraay, 2000). If we look at the literature that seeks to determine the linkages between tourism and economic growth, there would be four empirical symmetries that can be interpreted as four hypotheses (Chatziantoniou et al., 2013). When there is a unidirectional causality between tourism and economic growth, either from tourism to economic growth, it satisfies the first two hypotheses known as Tourism-Led Economic Growth Hypothesis-TLEG and Economic Driven Tourism Growth Hypothesis-EDTG. Whereas, if there is a bidirectional relationship between tourism and economic growth, it fulfils Bidirectional Causality Hypothesis-BCH or if there is no relationship between the said variables it is called Neutral Causality Hypothesis-NCH, respectively. Tourism-led economic growth hypothesis promotes benefits from tourism to economic growth, which spread through many ways (Schubert et al., 2011). Moreover, Tourism promotes economic growth in the following process e.g.; tourism inspires investment and helps local firms to be more efficient through increasing competition (Balaguer and Contavella-Jorda, 2002); tourism assists in reduction of unemployment, in the meantime tourism accomplishments are heavily based on human capital (Brida and Pulina, 2010); tourism leads to increasing in foreign exchange earnings, which in turn can be utilized to finance imports (Mckinnan, 1964), and finally, tourism leads to positive economies of scale. As a result, it reduces production cost for local business entrepreneurs (Andrioties, 2002; Croes, 2006).

Over the years extensive empirical research work has been conducted on the relationship between tourism and economic growth in developed and developing countries (Ghali, 1976 for Hawaii; Balaguer and Cantavella-Jorda, 2002, for Spain; Durbarry, 2004; for Mauritius and Gunduz and Hatemi, 2005; for Turkey, Eugenio-Martin and Morales, 2004; for Latin American Countries).The researchers have documented healthy literature in favour of tourism-led economic growth hypothesis (see, Sugiyarto et al., 2003; Durbarry, 2004; Parrilla et al., 2007; Croes and Vanegus, 2008; Proenca and Soukiazis, 2008; Fayissa et al., 2011; Dritsakis, 2012; Eeckels et al., 2012; Ivanov and Webster, 2013; Surugiu and Surugiu, 2013). There are some studies which support bidirectional

causality between tourism and economic growth (Lee and Chang, 2008; Chen and Chiou-Wei, 2009; Seetanah, 2011; Ridderstaat et al., 2013). However, other studies do not support the tourism-led economic growth and economic growth-led tourism hypothesis (See, Katircioglu, 2009; Po and Huang, 2008; Tang and Jang, 2009). Since numerous studies have been conducted to examine the relationship between tourism and growth, but the area still remains controversial. On this line, recent studies (Lean and Tang, 2010; Arslanturk et al. 2011) suggest that, the stability of tourism and economic growth relationship changes over time.

The tourism industry in India is one of the important industries which contributes to economic growth and also brings various employment opportunities. Since last decade, the tourism sector is growing significantly in different parts of the States in India. As per the World Travel and Tourism Council, tourism comprises 6.6% of GDP in 2012 and helps 39.5 million people for direct employment. There was a positive growth of 5.9% in foreign tourist arrivals in 2013. Hence, about 8.8% compound annual growth rate (CAGR) of foreign was tourists registered during 2001 to 2013. At the same time, employment in the tourism based industries increased along with foreign exchange in the country significantly. Hence, tourism among others has been the largest net earner among of various foreign exchanges to India. If we compare India with USA in terms foreign exchange earnings, India hold US $18.445 billion than USA's $17.737 billion in 2012 with a growth rate of 4.0%. The overall tourism receipts of India were 1.59% in 2013(Indian Tourism Statistics, 2013). The tourism industry has directly and indirectly contributed employment to 38.8 million and 8.3% of people in India. Out of overall share of total GDP, 5% of GDP was directly coming from the tourism sector in India (the Tourism Satellite Accounts for India compiled by NCAER for the year 2002-2003). Generally, Indian tourism industry attract various tourism from various countries (Africa, Australia, Latin America, Europe; South East Asia, etc.). The overall share of tourism to GDP increased from 6.78% in 2011-12 to 6.88% in 2012-13. This illustrates that the tourism industry has a potential contribution towards the economic growth in India. On this backdrop, it is essential to investigate the impact of tourism on economic growth in India.

Although some studies have been examined the tourism-led growth hypothesis in various countries, to the best of our knowledge, no single study has been conducted for the Indian States in a panel data framework. The present study can fill up this research gap. The rest of the paper is organised as follows: Section 2 focuses on the review of the literature. Data source and methodology are briefly explained in Section 3. The empirical results and discussions are reported in Section 4, and finally, conclusion and policy implications are given in Section 5.

2. Review of Literature

In a study, Ghali (1976) supported the tourism-led growth hypothesis in Hawaii by applying OLS from 1950 to 1970. Besides, to this Gunduz and Hatemi (2005) found the existence of tourism-led growth hypothesis in Turkey by employing bootstrap Granger causality with leveraged adjustment. However, Balaguer and Cantavella-Jorda (2002) found a unidirectional causality that runs from tourism to economic growth in Spanish economy from 1975 to 1997. Kim et al. (2006) found that tourism expansion led economic growth bi-directionally in Taiwan from 1971 to 2003. Akinboade and Braimoh (2010) made use of multivariate VAR model and Sims Granger causality in investigating the tourism-led economic growth in South Africa and concluded the existence of tourism-led economic growth in the concerned country. Similarly, Lanza et al. (2003) investigated the positive impact of tourism specialization on economic growth for 13 OECD countries for the period 1977 to 1992. By employing advanced Almost Ideal Demand System (AIDS), they found that tourism significantly causes economic growth. In contrary to the bidirectional causal relationship between tourism and economic growth, Narayan (2004) argued for unidirectional causality from economic growth to tourism with the application of more advanced computable general equilibrium model rather than traditional cointegration and Granger causality for Fiji's economy from 1970 to 2000. Employing Panel Generalized Least Square (PGLS) method, Eugenio-Martin and Morales (2004) revealed unidirectional causality between tourism and economic growth in Latin American countries from 1980 to 1997. However, Eugenio-Martin and Morales (2004) suggested that tourism leads to economic growth in low and middle countries but not in high-income countries. Using threshold autoregression model, Po and Huang (2008) clarified that tourism has a positive impact at certain threshold level of 4 percent and no impact on growth beyond the threshold level in 88 countries. Jackman and Greenidge (2012) argued in strong favour of the tourism-led growth hypothesis in Barbados economy. However, they concluded that tourism has significant impact in both short-run and long-run on economic growth. Employing bootstrap panel causality, Chou (2013) concluded for tourism-led growth hypothesis in Cyprus, Latvia and Slovakia where as a reverse relationship found for the Czech Republic and Poland. He also suggested a feedback hypothesis for Estonia out of 10 transition economies for the period 1988 to 2011.Tang and Tan (2013) found tourism and economic growth have a stable relationship for Malaysia. To the contrary, using VAR based spillover approach Antonakakis et al. (2014) suggested that tourism and economic growth are not stable over 1995- 2012 in 10 European countries both regarding magnitude and direction. Finally, they confirmed that tourism- led economic growth and growth led tourism hypothesis are highly time and economic dependent. A Recent study by Tang and Tan (2015) examined the tourism-led growth hypothesis in Malaysia within the Solow growth model. The results based on Granger causality test confirmed that tourism has a positive impact on economic growth both in short and long-run in Malaysia.

3. Data Source and Methodology

3.1. Data

The present study has collected annual data covering the period 1997-2011 for 23 Indian States from Indiasat.com and Handbook of Statistics on Indian Economy, Reserve Bank of India. Based on the availability of data, we have taken into consideration 23 Indian States (namely Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Haryana, Himachal- Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Odisha, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal) for our analysis. Economic growth is measured by per capita Gross State Domestic Product (PGSDP) and per capita tourism arrivals (PTA) measures tourism development. All the variables are transformed into natural logarithm.

3.2. Testing Pesaran Cross Section Dependence Test

The first empirical work of the present study is to check the cross-sectional dependence between economic growth and tourism. Pesaran (2004) proposed CD test which can be applied when N is larger than T. Since our study includes 23 cross-sectional data (N) and 15 years' time period (T). The CD test is based on the average of the pair correction coefficients (ρ_{ij}) of OLS residuals regressions. Pesaran (2004) considered the following model.

$$y_{i,t} = \mu_i + \beta_i x_{i,t} + u_{i,t} \quad (1)$$

Where:

$\mu_i =$ intercept of individual state i;

$\beta_i =$ slope coefficient of individual state i;

$t = 1,2,3 \ldots\ldots, T$ is the total time period;

$i = 1,2,3 \ldots\ldots 23$ Corresponding 23 states;

$x_{i,t}$ is vector of observing time varying regressors;

$y_{i,t}$ follows $iid(0, \sigma_i^2)$ for all $i \; and \; t$.

Pesaran (2004) proposed following CD Statistic

$$\mathrm{CD_P} = \sqrt{\frac{2\mathrm{T}}{\mathrm{N}(\mathrm{N}-1)}} \sum_{\mathrm{i}=1}^{\mathrm{N}-1} \sum_{\mathrm{j}=\mathrm{i}+1}^{\mathrm{N}} \hat{\mathrm{p}}_{\mathrm{i,j}} \quad (2)$$

Where: $e_{i,t}$ the OLS are estimates of $u_{i,t}$and $\hat{\rho}_{i,j}$ is the sample estimate of the pair-wise correlation of residuals.

$$\hat{\rho}_{i,j} = \hat{\rho}_{j,i} = \frac{\sum_{t=1}^{T} e_{i,t}\, e_{j,t}}{(\sum_{t=1}^{T} e_{i,t}^2)^{1/2}(\sum_{t=1}^{T} e_{j,t}^2)^{1/2}}$$

3.3. Pesaran's Cross-Sectional Augmented Dickey-Fuller (CADF) Test

After confirming cross-sectional dependence, in order to understand the stationary properties of the variables we have applied Pesaran CADF test (Pesaran, 2007). The presence of cross sectional dependence among the variables can be solved by augmenting the standard Dickey-Fuller regression with cross sectional averages of lagged levels and first differences of the individual series (Pesaran, 2007). The Pesaran CADF equation follows as:

$$\Delta y_{i,t} = \alpha_i + \beta_i y_{i,t-1} + \gamma_i \bar{y}_{t-1} + \varphi_i \Delta \bar{y}_t + \varepsilon_{i,t} \tag{3}$$

where the unit root test hypothesis will be tested based on the OLS results derived from Eq. (3) with t-ratio by $t_i(N, T)$. The Pesaran CADF test is

$$\text{CADF} = t_i(N, T) = \frac{\Delta y_i' \bar{M}_w y_{i-1}}{\hat{\delta}_j \left(y_{i,-1}' \bar{M}_w y_{i-1}\right)^{1/2}} \tag{4}$$

Where:

$$\Delta y_i = (\Delta y_{i,1}, \Delta y_{i,2}, \ldots\ldots, \Delta y_{i,T})', y_{i,-1} = (y_{i,0}, y_{i,1}, \ldots\ldots, y_{i,T-1})', \tau_T = (1,1.\ldots,1)',$$

$$M_w = I_T - \bar{W}(\bar{W}'\bar{W})^{-1}\bar{W}', \quad \bar{W} = (\tau, \Delta\bar{y}, \bar{y}_{-1})$$

$$\Delta\bar{y} = (\Delta\bar{y}_1, \Delta\bar{y}_2, \ldots\ldots, \Delta\bar{y}_T)', \quad \bar{y}_{-1} = (\bar{y}_0, \bar{y}_1, \ldots\ldots \bar{y}_{T-1})'$$

$$\hat{\sigma}_i^2 = \frac{\Delta y_i' M_{i,w} \Delta y_i}{T-4} \quad M_{i,w} = I_T - (G_i (G_i' G_i)^{-1} G_i' \quad and \quad G_i = (\bar{w}, y_{i,-1})$$

3.4. Panel Autoregressive Distributed Lag Model (P-ARDL)

For estimating the long-run relationship among the variables, we have applied panel autoregressive distributed lag model based on three alternative estimators such as mean group estimator (MG), pooled mean group (PMG) and dynamic fixed effects (DFE). According to Pesaran et al. (1999), an ARDL dynamic heterogeneous panel regression can be written by using ARDL (p, q) approach where 'p' is the lags of dependent variable and 'q' is the lags of independent variable. The equation can written as

$$\text{PGSDP}_{it} = \sum_{j=1}^{p} \lambda_{ij}\, \text{PGSDP}_{i,t-j} + \sum_{j=0}^{q} \delta_{ij}'\, \text{PTA}_{i,t-j} + \mu_i + \varepsilon_{it} \tag{5}$$

Where: $i = 1, 2, 3, \ldots, N$ number of cross sectional ($Here\ i = N = 23$);

$t = 1,2,3 \ldots\ldots T$ total time period($T = 15$);

PTA_{it} is a $k \times 1$ vector of the explanatory variable;δ_{it} are the $k \times 1$ coefficient vectors; λ_{ij} are the scalars; and μ_i is the cross-section effects. If the variables in Eq. (5) are I(1) and cointegrated, then the error term should follow I(0) order in all cross-sections to have long-run equilibrium relationship between the variables. The principal feature of cointegrated variables is that their time paths are influenced by the extent of any deviation from long-run equilibrium. This explains that an error correction model in which the short-run dynamics of the variables in the system can be influenced by the deviation from equilibrium. Hence it is necessary to reparametrize Eq. (5) into an error correction equation.

$$\Delta PGSDP_{it} = \emptyset_i(PGSDP_{i,t-1} - \theta_t^{'} PTA_{it}) + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta PGSDP_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij}^{'*} \Delta PTA_{i,t-j} + \mu_i + \varepsilon_{it} \quad (6)$$

Where:

$$\emptyset_i = -\left(1 - \sum_{j=1}^{p} \lambda_{ij}\right), \theta_i = \frac{\sum_{j=0}^{q} \delta_{ij}}{(1 - \sum k\, \lambda_{i\,k})}, \lambda_{ij}^{*} = -\sum_{m=j+1}^{p} \lambda_{im},$$

$$j = 1, 2, \ldots, p-1, and\ \delta_{ij}^{*} = -\sum_{m=j+1}^{q} \delta_{im}\ \ j = 1, 2, 3, \ldots, q-1.$$

The $\emptyset_i$ is speed of adjustment parameter. The speed of adjustment parameter must be non-zero. If $\emptyset_i$=0, then there would be no long-run relationship. This parameter is expected to be negative sign with statistical significance under the assumption of bringing back the variables to the long run equilibrium. But more recently Pesaran, Shin and Smith (1997, 1999) propose a PMG estimator which combines both averaging and pooling the residuals. This test incorporates the intercept, short-run coefficients, and different error variances across the groups (like the MG estimators). However it holds the long-run coefficients to be equal across the groups (like FE estimators).

The MG estimate of the error correction coefficients, $\emptyset$, is

$$\widehat{\emptyset} = N^{-1} \sum_{i=1}^{N} \widehat{\emptyset}_i \quad (7)$$

With the variance

$$\hat{\Delta}_{\hat{\emptyset}} = \frac{1}{N(N-1)} \sum_{i=1}^{N} (\hat{\emptyset}_i - \hat{\emptyset})^2 \quad (8)$$

The Eq. (6) can be estimated by three different estimators such as mean group estimator of Pesaran and Smith (1995), pooled mean group estimator developed by Pesaran et al. (1999) and dynamic fixed effects estimator. According Pesaran and Shin (1999), panel ARDL can be applied even if the variables follow different order of integration, i.e. I (0) and I (1) or a mixture of both.

4. Empirical Analysis

The traditional panel unit root tests do not address the cross sectional dependence which might give an incorrect interpretation towards the stationary properties of large panel data. To overcome this problem, the present study has applied CD (Pesaran, 2004) test to check cross section interdependence between per capita Gross State Domestic Product (PGSDP) and Per capita tourism arrivals (PTA). The CD test is based on the average of the pair correction coefficients (ρ_{ij}) of OLS residuals regressions. The CD test results reported in Table 1 reject the null hypothesis of no cross-dependence between the variables. It means there is high dependence between per capita Gross State Domestic Product (PGSDP) and Per capita tourism arrivals (PTA) in Indian states.

Table 1. *Pesaran Cross-section dependency tests*

Test	Statistics	P-value
CD	27.177	0

After confirming cross sectional dependence between the variables, we have employed Pesaran Cross sectional Augmented Dickey-Fuller (PCADF) unit roots test to check stationary properties of variables. The PCADF test results are reported in Table 2. The result shows that PGSDP and PTA follow I (0) and I (1) orders respectively.

Table 2. *Pesaran's Cross-Sectional Augmented Dickey-Fuller (CADF) test results*

		Constant	Constant and Trend	
Variable	T bar	P-Value	T bar	P-Value
lnPGSDP	-1.427	0.890	-3.959	0.000***
lnPTA	-1.171	0.514	-1.703	0.992
ΔlnPGSDP	-4.271	0.000***	-4.711	0.000***
ΔlnPTA	-2.130	0.037**	-2.741	0.020**

Note: The critical values are -2.340, -2.170, and 2.070 at 1%, 5%, and 10% respectively with constant. -2.880, -2.690 and -2.590 at 1%, 5%, and 10% respectively with constant and trend. The ***, ** and * indicate1%, 5% and 10% level of significance.

The results of the pooled mean group (PMG), mean group (MG) and dynamic fixed effects (DFE) are reported in Table 3.

Table 3. *Panel ARDL Model Results (Pooled Mean Group and Mean Group Estimates)*

(Dependent Variable: $\Delta lnPGSDP$)

	Pooled Mean Group		Mean Group		Dynamic Fixed Effects	
Variables	Coefficients	Std. error	Coefficient	Std. error	Coefficient	Std. error
Long-run						
lnTR	0.786**	0.081	0.321	0.728	0.245***	0.555
Error Correction (Ø)	0.085	0.053	0.182**	0.062	0.792	0.238
Short-run coefficients						
ΔlnTR	0.091	0.186	0.179	0.247	0.087**	0.355
Intercept	0.222	0.109	0.442	0.287	-0.793	0.36
No. of states	23		23		23	
Observations	345		345		345	
Hausman Test			0.41		0.9955	
P-value			0.5243		0	

Note: Δ is first difference operator; *** , ** and * indicate 1%, 5% and 10% per cent level of significance; MPG means pooled mean group; MG means mean group; EC is error correction term.

According to PMG and DFE estimators, PTA has a positive and significant impact on PGSDP in the long run, whereas MG estimator suggests no significant impact of PTA on PGSDP both in the long-run and short-run. The MG and PMG estimators do not support any short run causality between variables. However, the DFE estimator shows the existence of short-run causality between the two variables at 5% level of significance.

However, in order to measure efficiency and consistency among the estimators (PMG, MG and DFE) the Hausman test has been applied. The validity of long-run homogeneity restrictions across Indian states, and hence efficiency of PMG estimator over the MG and DFE estimators, is examined by Hausman test. The Hausman test results accept the null hypothesis of homogeneity restrictions on the long-run regressors, which indicates that PMG is a more efficient estimator than MG or DFE. From the overall panel ARDL model, we found that tourism led growth hypothesis is valid in Indian States.

5. Concluding Remarks

The present study examined the relationship between tourism and economic growth in 23 Indian states during 1997-2011. The study have applied CD test (Pesaran, 2004) to check the cross section interdependence among the variables which rejects the null hypothesis of no cross section interdependence. The Pesaran (2007) cross section augmented Dickey Fuller (PCADF) test presents a different order of integration of the variables. We have applied the panel ARDL model (PMG, MG and DFE) to verify the short-run and long-run effects between per-capita tourism arrivals and per-capita gross State domestic product. Our findings confirmed that there is a significant evidence of tourism led growth in Indian States. The tourism industry depends on the arrivals of the international tourists and domestic tourist which is very negligible as compared to other developing and developed countries. The government has to put more emphasis on tourism sector by

innovating and re-innovating different States as well as a national tourism sector with a view to have a possible contribution towards economic growth in India.

References

Akinboade, O.A. and Braimoh, L. (2010). International tourism and economic development in South Africa. *International Journal of Tourism Research*. No. 12. pp. 149-163.

Andriotis, K. (2002). Scale of hospitality firms and local economic development evidence from Crete. *Tourism Management.* No. 23. pp. 333-341.

Antonakakis, N. and Badinger, H. (2014). International business cycle spillovers since the 1870s. *Applied Economics*. No. 46. pp. 3682-3694.

Balaguer, J. and Zorda, C.M. (2002). Tourism as a long-run economic growth factor: the Spanish case. *Applied Economics*. No. 34. pp. 877-884.

Balaguer, J. and Cantavella-Jorda, M. (2002). Tourism as a long-run economic growth factor: the Spanish case. *Applied Economics*. No. 34. pp. 877-884.

Brida, J. and Pulina, M. (2010). A literature review on the tourism-led-growth hypothesis. *Working Paper* CRENoS 201017. Centre for North South Economic Research, Sardinia.

Chatziantoniou, I., Filis, G., Eeckels, B. and Apostolakis, A. (2013). Oil prices, tourism income and economic growth: a structural approach for European Mediterranean countries. *Tourism Management.* No. 36. pp. 331-341.

Chen, C.-F. and Chiou-Wei, S.Z. (2009). Tourism expansion, tourism uncertainty and economic growth: new evidence from Taiwan and Korea. *Tourism Management*. No. 30. pp. 812-818.

Chou, M.C. (2013). Does tourism development promote economic growth in transition countries? A panel data analysis. *Economic Modelling*. No. 33. pp. 226-232.

Croes, R. and Vanegas, M. (2008). Cointegration and causality between tourism and poverty reduction. *Journal of Travel Research*. No. 47. pp. 94-103.

Dritsakis, N. (2012). Tourism development and economic growth in seven Mediterranean countries: a panel data approach. *Tourism Economics*. No. 18. pp. 801-816.

Durbarry, R. (2004). Tourism and economic growth: the case of Mauritius. *Tourism Economics*. No. 10. pp. 389-401.

Eeckels, B., Filis, G. and Leon, C. (2012). Tourism income and economic growth in Greece: Empirical evidence from their cyclical components. *Tourism Economics*. No. 18. pp. 817-834.

Easterly, W. and Kraay. A. (2000). Small States, Small Problems, Income, Growth and Volatility in Small states. *World Development*. No. 28. pp. 2013-27.

Eugenio-Matin, J.L. and Morales, N.M. (2004). Tourism and economic growth in Latin American countries: a panel data approach. *Social Science Research Network Electronic Paper.*

Fayissa, B., Nsiah, C. and Tadesse, B. (2011). Tourism and economic growth in Latin American countries further empirical evidence. *Annals of Tourism Research*. No. 17. pp. 1365-1373.

Ghali, A. (1976). Tourism and economic growth: an empirical study. *Economic Development and Cultural Change*. No. 24. pp. 527-538.

Gunduz, L. and Hatemi-J. (2005). Is the tourism-led growth hypothesis valid for Turkey?. *Applied Economics Letters*. No. 12. pp. 499-504.

Indian Tourism Statistics. (2013).

Ivanov, S. and Webster, C. (2013). Tourism's impact on growth: the role of globalisation. *Annals of Tourism Research.* No. 41. pp. 231-236.

Jackman, M. and Greenidge, K. (2010). Modelling and forecasting tourist flows to Barbados using structural time series models. *Tourism and Hospitality Research.* No. 10. pp .1-13.

Katircioglu, S.T. (2009). Revisiting the tourism-led-growth hypothesis for Turkey using the bounds test and Johansen approach for cointegration. *Tourism Management*. No. 30. pp. 17-20.

Kim, H.J., Chen, M.H. and Jang, S.C. (2006). Tourism expansion and economic development: the case of Taiwan. *Tourism Management*. No. 27. pp. 925-933.

Lanza, A., Temple, P. and Urga, G. (2003). The implications of tourism specialisation in the long run: an econometric analysis for 13 OECD Economies. *Tourism Management*. No. 24. pp. 315-321.

Lean, H.H. and Tang, C.F. (2010). Is the tourism-led growth hypothesis stable for Malaysia? A note. *International Journal of Tourism Research.* No. 12. pp. 375-378.

Lee, C.-C. and Chang, C.P. (2008). Tourism development and economic growth: a closer look at panels. *Tourism Management.* No. 29. pp. 180-192.

McKinnon, R.I. (1964). Foreign exchange constraint in economic development and efficient aid allocation. *Economic Journal.* No. 74. pp. 388-409.

Narayan, P.K. (2004). Economic impact of tourism on Fiji's economy: empirical evidence from the computable general equilibrium model. *Tourism Economics*. No. 10. pp. 419-433.

Parrilla, J.C., Font, A.R. and Nadal, J.R. (2007). Tourism and long-term growth a Spanish perspective. *Annals of Tourism Research.* No. 34. pp. 709-726.

Pesaran, H.M. (2004). General diagnostic tests for cross-section dependence in panels. *Working paper. University of Cambridge*. Cambridge.

Pesaran, M.H. (2007). A simple panel unit root test in the presence of cross-sectional dependence. *Journal of Applied Econometrics*. No. 22. pp. 265-312.

Po, W.-C. and Huang, B.N. (2008). Tourism development and economic growth - a nonlinear approach. *Physica A*. No. 387. pp. 5535-5542.

Pizam, A. (2009). The global financial crisis and its impact on the hospitality industry. *International Journal of Hospitality Management*. No. 28. p. 301.

Proenca, S. and Soukiazis, E. (2008). Tourism as an economic growth factor: A case study for Southern European countries. *Tourism Economics*. No. 14. pp. 791-806.

Ridderstaant, J., Croes, R. and Nijkamp, P. (2013). The force field of tourism. *Review of Economic Analysis.* No. 5. pp. 1-24.

Schubert, S.F., Brida, J.G. and Risso, W.A. (2011). The impacts of international tourism demand on economic growth of small economies dependent on tourism. *Tourism Management.* No. 32. pp. 377-385.

Seetanah, B. (2011). Assessing the dynamic economic impact of tourism for Island economies. *Annals of Tourism Research.* No. 38. pp. 291-308.

Sugiyarto, G., Blake, A. and Sinclair, M. (2003). Tourism and globalization: economic impact in Indonesia. *Annals of Tourism Research.* No. 30. pp. 683-701.

Surugiu, C. and Surugiu, M.R. (2013). Is the tourism sector supportive of economic growth? Empirical evidence on Romanian tourism. *Tourism Economics*. No. 19. pp. 115-132.

Tang, C.F. and Tan, E.C. (2015). Does tourism effectively stimulate Malaysia's economic growth?", *Tourism Management.* No. 46. pp. 158-163.

Tang, C.F. and Tan, E.C. (2013). How stable is the tourism-led growth hypothesis in Malaysia? Evidence from disaggregated tourism markets. *Tourism Management*, No. 37. pp. 52-57.

Tang, C.-H.H. and Jang, S.S. (2009). The tourism-economy causality in the United States: a sub-industry level examination. *Tourism Management.* No. 30. pp. 553-558.

Tourism Satellite Accounts of India

United Nations World Tourism Organization (UNWTO) (2012). Annual Report.

Wang, Y. and Davidson. M.C. (2010). A review of micro analysis of tourist expenditures. Current Issues in Tourism. No. 13. pp. 507-524.

WTTC (2008). Tourism Satellite Accounting. World Travel and Tourism council, London. Online http://www.wttc.org/eng/Tourism_Research/Tourism_Satellite_Accounting/, accessed on March 2015.

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 195-202

Sovereign debt crisis. From challenges to solutions

Elena Raluca MOISESCU (DUICAN)
Bucharest University of Economic Studies, Romania
raluca.duican@yahoo.com
Andrei GIURESCU
Bucharest University of Economic Studies, Romania
giurescu@gmail.com

Abstract. *Starting with 2007, the European Union felt the international financial crisis within the strong and the weak economies and finances of the member states. In 2008 and 2009 it sees the problem of sovereign debt crisis, although there is a strong link between the financial crisis and the sovereign debt crisis throughout economic history. The main objectives were the actions of central banks, particularly the European Central Bank in response to the economic and financial crisis. But, in 2010, after a slow recovery, the sovereign debt crisis installed, bringing in the weaknesses of Economic Monetary Union. This paper presents an analysis of the sovereign debt crisis in European Union, focusing on the causes of the sovereign debt crisis, ways of transmission, its evolution and not least on solutions that can be found.*

Keywords: sovereign debt, cause-effect, spillover, euro area.

JEL Classification: G01, F30.

1. Introduction

The success of European Monetary Union (EMU) was put under trial since early if it refers to the ability of euro area Member States to counteract economic shocks. In addition, it hasn't got a fiscal union or a financial one, as in the United States. Even if there were Stability and Growth Pact mechanism (limiting the budget deficit to 3% of gross domestic product (GDP) and public debt at 60% of GDP) and the "no bailout clause", the sovereign debt crisis problem occurred.

Arghyrou M. and Kontonikas A. (2011) give a detailed overview of the sovereign debt crisis, highlighting a shift in the behavior of markets from a model of trade convergence before August 2007 to a model characterized by risk after the crisis began. The idea of convergence exchange before the crisis can be explained by three factors. The first factor is the low risk and the global liquidity of the pre-crisis period, the second is the introduction of reforms that stimulate economic growth in the countries of the periphery of the euro zone, and the third, the lack of exit mechanism in the euro area. The solutions found in the study involve structural and institutional reforms in the countries of the EMU periphery and beyond.

This paper presents an analysis of the global financial crisis since 2007 that is closely linked to the sovereign debt crisis; focusing on the causes of the sovereign debt crisis, its transmission channels and its evolution.

2. The way to the sovereign debt crisis

Since 2009 the financial crisis turned into a sovereign debt crisis in the euro zone. Besides Greece, other countries that have suffered were Portugal, Ireland and Spain. Extraordinary measures were taken by policymakers to reduce and prevent the crisis spreading. In May 2009, it was ratified a package of measures to rescue Greece funded by the International Monetary Fund (IMF) and European Union (EU) worth 110 billion euro. Also it was created a segment of defense, a stabilization mechanism of 750 billion euro for the European states that might be in position of Greece. However, in November 2010, a second EMU member country received a package of 85 billion euro, demonstrating that the measures taken so far had not relieved the crisis.

Economic literature provides a number of empirical studies on the issue of the crisis. The main findings reveal that both the amount and the price of the risk perceived globally associated with investments in sovereign bonds have been growing during the recession, thus explaining the main role that had the transfer of risk from the banking sector by borrowers of sovereigns through banks rescue actions. But these studies do not provide explanations for the situation in Greece, which has seen a spillover effect more intense as the other countries at the periphery, or even raise questions about the issue of contagion.

The authors rely on the theoretical model of Arghyrou and Tsoukalas (2010), a model of the euro area debt crisis, the currency risk and the bankruptcy to be reflected in sovereign spreads. It provides explanations of the situation until the bailout of Greece in 2009. Until the credit crisis (in the 1999-2007 period) the markets sought the assumptions idea of

trade convergence, i.e. taking into account real convergence scenario for EMU member countries to the German model. Between 2007 and 2009, things have changed, markets established both international risk factors and macro-fundamentals in each country.

Also, there is provided evidence of the growing debt crisis in Greece. The Greek crisis is due to the fact that it had to transfer from a state that has assumed the commitment to comply with tax obligations, to a regime that no longer met these obligations. By 2010, countries like Portugal, Spain and Ireland were suffering from contagion from Greece.

However, they is information that not only speculation on the CDS (Credit Default Swap) market may have contributed to the sovereign debt crisis in the euro area, but also the macroeconomic imbalances and international conditions.

Both studies before the financial crisis of August 2007 and those after this time have three variables that influence bonds (Manganelli and Wolswijk, 2009): an international common risk factor, credit risk and liquidity risk. The first measures the yield spread between different categories of corporate bonds versus treasury bills of the United States. The second variable is addressed to the probability of partial or total reimbursement on behalf of a sovereign debtor, while the third variable, difficult to measure, liquidity risk refers to the size of the sovereign bond market.

The role of the three variables is not clearly defined in the studies on government bonds within EMU. Authors such as Barrios et al. (2009), Codogno et al. (2003), Longstaff et al. (2007), Manganelli and Wolswijk (2009), Sgherri and Zoli (2009) argue that the risk was representative for determining international sites Spread against Germany. There are questions regarding how the Growth and Stability Pact was a credible mechanism to implement fiscal discipline in the euro area countries. After the crisis, studies are focusing on global risk as a factor in the expansion of the EMU spreads, highlighting the role of the banking sector, which transforms the overall risk in sovereign risk in two ways. The first relates to recapitalize banks using public money in difficult times, and lack of liquidity result in restricting loans leading to economic imbalances. The second approach suggests that economic imbalances are penalized stronger than before the financial crisis.

Arghyrou and Tsoukalas (2010) present a theoretical model of the euro zone debt crisis. They say that systemic risk is underlying the current macroeconomic debt crisis, which in the absence of national currencies is diverted to the sovereign bond market, reinforced the idea of default risk. They develop a model out of EMU on the basis of the second and third generation models of currency crises, like Obstfeld (1996) and Krugman (1998), assuming a control variable for government (decision to stay or exit the euro area). The cost is a constant and can be explained as the difference between steady inflation rates with an independent monetary policy and the EMU caused by higher inflation and political costs related to withdrawal from EMU, whether forced or voluntary. The cost of remaining in the euro area is a second-degree function of the exchange rate deviation with which the country entered in the euro area, deviation that aimed at the macroeconomic shocks effect on domestic demand. The credibility of commitment to participate in EMU government is established by the private sector (as in Obstfeld, 1996), and as in Reinhart

and Rogoff (2010), all private sector determine the conception of the government's fiscal responsibilities as secured or unsecured.

Hence, one can see three regimes. The first way involves overall credibility of a State participation in EMU (i.e. everyone expects the government to take all necessary measures to correct macroeconomic imbalances, while capital losses to be zero). It also implies a mechanism in which the government receives signals from the private sector observed in the application of higher cost debt. The second scheme suggests ensuring fiscal debt in the euro area remaining period, but the credibility is not total, with a probability greater than zero as the government concerned is to choose exit from EMU. In the third scheme, government debt is no longer seen as guaranteed and the cost of remaining in the EMU is increasingly higher. As long as EMU participation cost is lower than the leaving, the state will remain in the euro area.

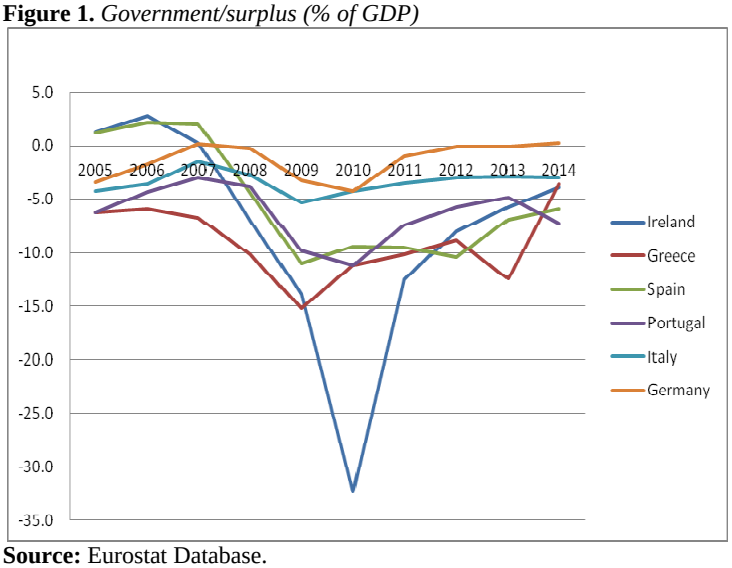
Values observed between January 1999 and July 2007 provides evidence of the credibility of full participation in EMU, tax guarantees, while real convergence of the states on the periphery decreased compared to the nucleus, not being penalized with higher interest rates for government bonds. After the outbreak of the crisis in August 2007, sovereign bond prices were set according to each country's economic performance. After this time, fiscal imbalances and competitiveness losses reflected the overvaluation of the real exchange rates. One explanation for the increase in Greek debt may be provided by changing from a standby with confidence and guarantee the tax debt from one opposite, non-credible commitment to EMU and failing debt. Changes occurred in two stages; the first was held in November 2009, when Greek spreads increased 130 basis points to 240 at the end, reinforcing the idea that Greece will be able to improve structural problems to stay in the EMU and the introduction of risk defaulted in December 2009. The second phase has meant to increase from 240 points to 700 points in April 2010.

In April 2010 Greece’s sovereign debt rating is downgraded to “junk” by the Standard and Poor’s rating agency, thus increasing the lack of trust towards sovereign debt. This downgrade makes Greek government’s debt to no longer eligible as collateral for the European Central Bank. The effect of this measure was felt in both European capital markets and the depreciation of the euro versus most currencies.

It can be summarized as follows: between 1999 and July 2007 the real exchange rate did not explain the movement spreads, which it changed after the crisis, when the appreciation rate leads to higher values of spreads, explaining contagion.

Lane (2012) describes the relationship between the euro area and the European sovereign debt crisis through three stages: the fiscal risk has increased because institutional project before the crisis, within the crisis, the fiscal impact was greater, the recovery in the post-crisis period is determined by the limitations of monetary union. It also states that there is a strong link between the banking crisis and the sovereign debt crisis in the euro zone.

Figure 1. *Government/surplus (% of GDP)*

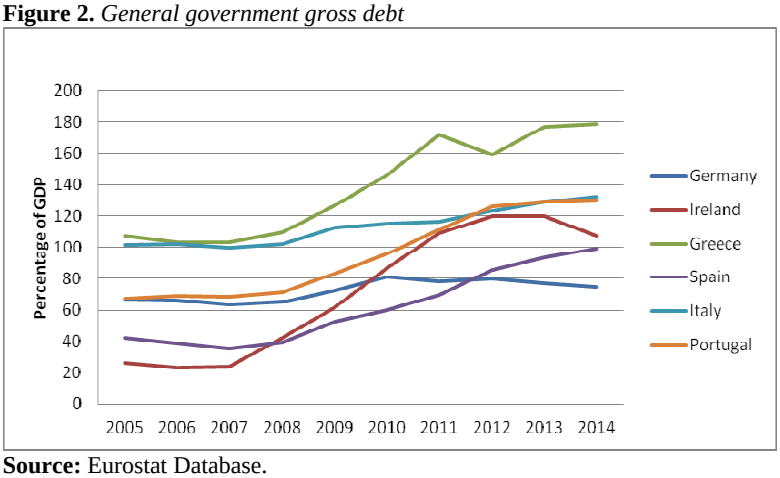


Source: Eurostat Database.

The timing of the 2007 credit crisis has affected European markets, causing budget deficits. Figure 1 and 2 show that budget balance of the euro area worsened and that it increased government debt as a percentage of GDP since 2008. These things highlight the transformation of the credit crisis in the sovereign debt crisis and the fiscal cost of financial sector aid offered. Greece reaches a budget deficit of 15.2% of GDP in 2009 to 3.6% in 2014 and public debt reached 178.6% in 2014. It may be noted that Ireland had a budget deficit of 32.3% in 2010, and in 2014 it reached 3.9%. The public debt of Ireland was 107.5% of GDP in 2014.

Regarding the period before the financial crisis in 2007, it did not seem to be a problem debt in the Union. However, at country level, things are different. Fiscal and financial vulnerabilities have gone unnoticed because of the period of economic growth.

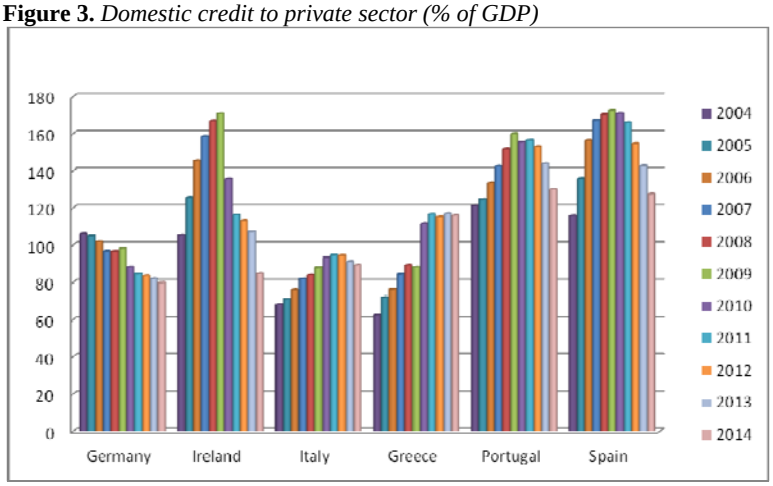
Figure 2. *General government gross debt*



Source: Eurostat Database.

Figure 3 presents the credit/GDP evolution in six EMU countries (Greece, Ireland, Portugal, Spain, Italy, Germany) and explains the credit boom that participation in the euro area allowed banks to obtain funds in euro. On the other hand, consumer loans were also fueled by low interest rates and the ease with which they could get a loan.

Figure 3. *Domestic credit to private sector (% of GDP)*



Source: World Bank Database.

During 2003-2007, the government was not a net debtor, neither in Ireland nor in Spain. In Greece and Portugal, governments had borrowed extensively. However, they failed to impose a restrictive fiscal policy. Credit expansion and construction tax receipts brought in higher income, and inflation in the expanding member states were above the inflation rate in the euro area. There was also a lack of a cautious approach regarding financial and macroeconomic risk.

Before 2009 there were not many concerns about the sovereign debt crisis, although the global financial crisis was a signal to assess the sustainability of loans. The sovereign debt crisis stemmed from the recession occurred, the plight of the banking sector and decreases in the desire of international investors to invest. Meanwhile, the European Central Bank reduced interest rate and tried to stabilize the financial and banking system.

Before the financial crisis, international risk wasn't given much importance. Since August 2007 there have been changes in the government bond market in the euro area, countries had begun to differentiate by the loss of competitiveness and liquidity risk.

Regarding Greece, it had a central role in the euro zone debt crisis. Greek spreads stresses default risk and the currency, and that the issue of the Greek state is more reliable one than economic. The Greek state should regain markets' confidence. After November 2009 a large part of the EMU member states (Spain, Portugal, Ireland) had contagion effects from Greece. Thus, in the EMU, the need for institutional reforms had been highlighted in order to prevent the crisis and the contamination from amplifying them. After 2010, the European Union and International Monetary Fund provided funding for state programs to Greece, Portugal, Cyprus, Ireland, in return for implementing fiscal austerity measures in order to improve economic growth and debt redemption of the banking

system. The macroeconomic adjustment period was three years, but in the given situation this term was not met. In June 2011, Greece needed a second loan.

The interconnectedness of the financial system caused the credit risk to be transmitted to the bank's balance sheets. The fact that the financial institutions in the euro zone had large amounts of sovereign debt from other countries (Bolton and Jeanne, 2011) led to the depreciation of bank assets, which in turn has negatively affected the central government's capacity to pay its own debt (Glover and Richards-Shubik, 2014).

On the other hand, weaknesses in the banking system could be compromised by fiscal austerity, default risk in the private sector increasing with decreasing household disposable income. When public debt and sovereign risk are affected, the plan to recapitalize banks can become an issue. Also, to avoid contagion to other EMU countries, governments should help banks that may go bankrupt.

Another important factor during the crisis was the increasing volatility in sovereign debt markets in the euro area (Lane, 2012). An increase in the interest debts rates a state has makes it vulnerable to speculative attacks if it has a high level of sovereign debt. The creation of the European Financial Stability Facility and the European Stability Mechanism can be seen as an attempt to reduce the risk of default of a country. Another option would be the European Central Bank program of purchasing sovereign bonds.

Because EMU hadn't had the tools to act promptly on the crisis, Gianviti et al. (2010) proposed the creation of a European crisis resolution mechanism which is based on the following ideas: the need for special courts to handle negotiations between creditors and debtors of unsustainable sovereign debt and the determination of rules for providing financial assistance. This mechanism should minimize moral hazard and not be too lenient with private creditors.

Corbet (2014) shows the effect of contagion among euro area countries that were downgraded by credit rating agencies, finding links between government bonds spreads response and rating announcements. Between 2005 and 2012 there were around ninety announcements rating for the European countries studied. The biggest impact rating agencies are Fitch and Standard and Poor's. For five-year CDS and ten years government bonds the highest risk was held by Greece.

3. Conclusions

The post-crisis challenge is to bring government debt up to sustainable levels. Problems may be encountered, as the slowdown in nominal GDP or the political environment. The introduction of the new European Compact Treaty aims to avoid the repeating of the economic crisis. Besides a budget deficit of 3% of GDP and a public debt level of below 60%, a structural deficit target of 0.5% of GDP has been introduced for each country.

The initial draft of EMU has several weaknesses that contributed to the spread of the sovereign debt crisis, weaknesses that can traced to the lack of a banking or a fiscal union. The globalization of the financial system also brings about new challenges in the evaluation of the contagion risk.

References

Arghyrou, M.G. and Kontonikas, A. (2011). The EMU sovereign-debt crisis: Fundamentals, expectations and contagion. European Commission. *Economic Papers.* No. 436.

Arghyrou, M.G. and Tsoukalas, J. (2010). The Greek debt crisis: Likely Causes, Mechanics and Outcomes. *The World Economy.* Issue 2.

Barrios, S., Iversen, P., Lewandowska, M. and Setzer, R. (2009). Determinants of intra-euro-area government bond spreads during the financial crisis. European Commission, Directorate General for Economic and Financial Affairs. *Economic Papers*. No. 388.

Bolton, P. and Jeanne, O. (2011). Sovereign default risk and bank fragility in financially integrated economies. *NBER Working paper*. 16899.

Codogno, L., Favero, C. and Missale, A. (2003). Yield spreads on EMU government bonds. *Economic Policy*. 18. pp. 505-532.

Corbet, S. (2014). The contagion Effects of Sovereign Downgrades: Evidence from the European Financial Crisis. *International Journal of Economics and Financial Issues.* Vol. 4. No. 1. pp. 83-92.

Gianviti, F., Krueger, Anne O., Pisani-Ferry, P., Sapir, A. and Hagen, J. von (2010). A European mechanism for sovereign debt crisis resolution: a proposal. Bruegel Institute.

Glover, B. and Richards-Shubik, S. (2014). Contagion in the European Sovereign Debt Crisis, National Bureau of Economic Research. *Working Paper.* 20567.

Krugman, P. (1998). *What Happened to Asia.* mimeo.

Lane, Ph. R. (2012). The European Sovereign Debt Crisis. *Journal of Economic Perspectives.* Vol. 26. No. 3. 49-68.

Longstaff, F., Pan, J., Pedersen, L. and Singleton, K. (2007). How sovereign is sovereign credit risk?. National Bureau of Economic Research. *Working Paper*. 13658.

Manganelli, S. and Wolswijk, G. (2009). What drives spreads in the euro-area government bond market?. *Economic Policy.* 24. pp. 191-240.

Obstfeld, M. (1996). Models of currency crises with self-fulfilling features. *European Economic Review.* 40. pp. 1037-47.

Reinhart, C.M. and Rogoff, K.S. (2010). From Financial Crash to Debt Crisis. National Bureau of Economic Research. *Working Paper*. 15795.

Sgherri, S. and Zoli, E. (2009). Euro-area sovereign risk during the crisis. *IMF Working Paper*. No. 09/222.

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 203-212

International trade and tourism for Mediterranean countries: A panel causality analysis

Ceyhun Can OZCAN
Necmettin Erbakan University, Konya, Turkey
ccozcan@konya.edu.tr

Abstract. *This paper examines the causal relationship between international trade and tourism for 16 Mediterranean countries period from 1995 to 2013. We employ the recently introduced panel Granger causality approach that is flexible enough to take account of both cross-country correlation and heterogeneity across the countries. The empirical results indicate the causality from export to tourism in four out of sixteen Mediterranean Economies.*

Keywords: Mediterranean Countries, panel causality, International Trade, Tourism.

JEL Classification: F4, L83, C23, F13.

1. Introduction

In recent years, tourism forecasting using advanced econometric techniques has dominated the tourism literature (Witt and Witt 1995; Shan and Wilson 2001). Given the importance of tourism in both economic growth and sustainable development, special attention, on the one hand, is paid to the causal dynamics between trade and tourism. Empirical studies with the aim of uncovering the causation linkage between international trade and tourism yielded conflicting results. On the other hand, many scholars have paid keen interest in the causal linkage between tourism and a variety of variables, including international trade (inter alias, Kulendran and Wilson, 2000; Khan et al., 2005; Kadir and Jusoff, 2010), regional convergence (inter alias, Cortés-Jiménez, 2010; Soukiazis and Proenca, 2008), and political (in) stability (inter alias, Algieri, 2006 and Narayan et al., 2010). One of the prominent explanations behind the conflicting results on the causality between tourism and the variety of economic aggregates is the differences in institutional structure amongst countries. According to Landes (1998), cultural norms and institutions are often believed to explain why certain countries grow rich and others remain poor.

Theoretically, international travel may "induce" more trade opportunities, and further, business travel has been an important component of international travel since the 1980 s (World Tourism Organisation, 1997; Kulendran and Wilson, 1998). Therefore, does international travel promote international trade, or does trade promote travel? This "endogeneity" issue has fundamental implications for forecasting tourist demand/flows, because failure to consider this issue will result in inadequate appraisal of determinants of the tourist demand function. Second, some scholars point out that the econometric techniques used in previous studies are generally poor and hence are subject to some debate (Lim, 1997; Song et al., 1997; Witt and Witt, 1995; Shan and Wilson, 2001). Recently, an important number of studies have applied new developments in econometric theory, such as time series concepts of cointegration and Granger-causality testing procedures, to tourism studies. Third, tourism studies on Mediterranean countries are limited; noteworthy works are presented by section 2 literature review (see Table 1). The focus of these studies, however, is not on testing the panel causality relationship between international travel and international trade (Shan and Wilson, 2001, p. 279).

As matter of fact, in trade aimed travels to a country, a product is bought from the country visited (import) or is sold to that country (export). With this regard, a successful business travel to a country leads a trade stream between countries; as a result, in the scope of new trade/business negotiations or business travels between those countries, economic relations develop. This situation is an external effect of a successful commercial business travel reveals. Thus, with externality a successful business travel creates, in the trade etc. aimed travels to that country, an increase will be under consideration. The increase of trade aimed business travels from a country to other will also certainly lead to the increase of the holiday, recreation, rest, and recreation aimed travels. However, buying goods and services from a country will indirectly pioneer to the presentation and advertisement of that country in the home country. In addition, trade between countries will cause to increase of the consumers' interest to goods and services purchased and humans to be informed about products and the country, resources of that country. Hence,

the interest and famousness that earlier begin with the commercial relationships between countries will guide to the touristic aimed travels in the next stage (Kulendran and Wilson 2000, p. 1002).

In the light of explanations, the trade contented travels are also accepted as an important component of tourism (Eilat and Einav 2004, p. 1316; Shan and Wilson 2001, p. 279; Bahar and Baldemir 2008, p. 102). Despite the all disclosure, in many scientific contented studies carried out until today, the role that the trade play, as an important component of tourism demand function, is generally ignored. At this point, present paper differs from existing literature by investigating causation linkage between international trade and tourism by employing recently developed econometric techniques in sixteen Mediterranean countries.

The paper is divided into six sections and it organized as follows: Section 2 presents recent literature, while Section 3 presents data. Section 4 discusses the relevant methodological aspects. Section 5 presents empirical findings and Section 6 concludes and policy implications.

2. Literature Review

The literature which relates international trade and tourism, has been developing simultaneously. To our knowledge, the results of the first studies to explore the causation linkage are published by Gray (1970) and Keintz (1971). Recent studies by Webber (2000), Kulendran and Wilson (2000), Turner and Witt (2001), Khan, Rex, and Chua (2005), Kadir and Jusoff (2010), Santana-Gallego, Ledesma-Rodríguez, and Pérez-Rodríguez (2011) and Lionetti and Gonzalez (2012), among others, can be pointed out other than Gray (1970) and Keintz (1971). Most of them show that a cointegration between tourism and trade exists, and an analysis of the direction of causality is made. In fact, these studies are not the objective of the present paper. Nevertheless, studies analyzing the Tourism Lead to Growth TLG hypothesis include also trade variables with the aim of taking into account the relationship between tourism and trade. The relevant studies are presented by Table 1.

Table 1. *Literature review*

Relationship between Tourism and Trade: Time Series				
Authors and Date	Country	Period	Variables	Causality
Kulendran and Wilson, 2000	Australia USA, UK, N. Zealand, Japan	1982:1 - 1997:4	Holiday, business and total tourist arrivals, real imports, real exports	T↔ trade
Shan and Wilson, 2001	China	1987:1-1998:1	GDP, total trade, living cost, exchange rate	Trade →T T→ Trade
Katircioglu, 2007	Cyprus	1960-2005	GDP, tourist arrivals, real trade volume, exports, imports	Y→ Trade /Y→T Trade →T
Obadiahb et al., 2012	Kenya	1999-2012	GDP, tourist arrivals, trade	T→Y
Massidda and Mattana, 2013	Italy	1987-2009	GDP, tourist arrivals, total trade	Trade →T↔Y→ Trade
Oludele and Braimoh, 2010	South Africa	1980-2005	GDP, tourism receipts, exchange rate and exports	T→Y

Relationship between Tourism and Trade: Time Series				
Authors and Date	Country	Period	Variables	Causality
Nowak et al., 2007	Spain	1960-2003	GDP, tourism receipts, imports of industrial goods and machinery	T→ Capital Imports →Y
Bahar and Baldemir, 2008	Turkey	1980-2005	Tourist arrivals and export	T →Exports
Kadir and Jusoff, 2010	Malaysia	1995:1-2006:4	tourism receipts, exports, imports and total trade	Exports →T Imports →T Trade →T
Cortés-Jiménez et al., 2011	Tunisia	1975-2007	GDP, tourism receipts, imports	Y→T
Relationship between Tourism and Trade: Panel Data				
Santana-Gallego et al., 2010	179 countries	1995–2006	GDP, tourist arrivals investment, growth of population, human capital, openness to trade, exchange rate, currency union	T→Y Trade →Y

3. Data

In order to undertake the statistical analysis, data are assembled from WDI (World Development Indicators) databases. For the purposes of estimation, imports, exports and tourist arrivals are used. This study uses the sample selected Mediterranean countries: Albania, Algeria, Bosnia and Herzegovina, Croatia, Egypt, Arab Rep., France, Greece, Israel, Italy, Lebanon, Malta, Morocco, Slovenia, Spain, Tunisia and Turkey. The study uses the sample period 1995 to 2013, a period for which all relevant data are available.

4. Methodology

To determine the direction of causality between the variables of interest, we employ the panel data framework, because panel methods increase the power of tests in hypothesis testing. In examining causal linkages within the panel framework, two issues play a key role for selecting the appropriate causality tool. The first issue is to control for cross-sectional dependence across the members of the panel because a shock affecting one country may also affect other countries through the high degree of globalization and also international trade and financial integration. The Monte Carlo experiment conducted by Pesaran (2006) demonstrates the importance of testing for cross-sectional dependence in a panel data study and also illustrates the substantial bias and size distortions when cross-sectional dependence is ignored in the estimates (Pesaran, 2006). The second issue is to consider whether the data can be pooled across countries or whether panel estimates account for country specific heterogeneity (Pesaran and Smith, 1995; Luintel and Khan, 2004). First of all, the assumption that the slope coefficients are homogeneous is unlikely to hold because countries differ in their stages of development (Luintel and Khan, 2009). Furthermore, in a panel causality analysis, imposing the joint restriction for the whole panel is the strong null hypothesis (Granger, 2003) and assumes that homogeneity may mask the country specific characteristics (Breitung, 2005).

Therefore, testing for cross-sectional dependence and slope homogeneity in a panel causality analysis is a crucial step. We hereby begin by investigating whether there is

cross-sectional dependence and heterogeneity across the Mediterranean economies. In what follows, we outline the preliminary tests for cross-section dependence and slope homogeneity tests, before providing the details of the panel Granger causality test.

4.1. Panel Granger causality test

Testing causality in a panel framework has attracted interest during the last decade, and different approaches have been developed to examine the direction of causality in a panel data context. One attempt is based on estimating a panel vector autoregressive or vector error correction model by means of a generalized method of moments (GMM) estimator. This approach is, however, not able to consider either cross-sectional dependence or heterogeneity. GMM estimators, furthermore, can produce inconsistent and misleading parameters unless slope coefficients are, in fact, homogeneous (Pesaran et al., 1999).

The second approach proposed by Konya (2006) is sufficient to account for cross-sectional dependency and heterogeneity across cross-sections. This approach employs the seemingly unrelated regressions (SUR) estimation method developed by Zellner (1962) to control for contemporaneous correlations (cross-sectional dependency) and produces bootstrap critical values to make results robust irrespective of unit root and co-integration properties. Although Konya's testing procedure has attracted much interest in empirical applications, this approach includes a drawback for the panel data sets if the number of cross-sections (N) is not reasonably smaller than time periods (T) because the SUR estimator is only feasible for panels with large T and small N (Pesaran et al., 1999).

The third approach proposed by Dumitrescu and Hurlin (2012) is based on averaging standard individual Wald statistics of Granger tests under the assumption of cross-section independency. This approach, thereby, controls for heterogeneity but it is not able to account for cross-sectional dependence. The individual Granger causality analysis requires estimating vector autoregressive (VAR) models with stationary variables. The presence of non-stationary variables in VAR models may cause a nonstandard asymptotic distribution of Wald statistics based on unit root and co-integration properties where these nonstandard asymptotic properties arise from the singularity of the asymptotic distributions of the estimators (Lütkepohl, 2004, p. 148). To overcome this problem, Toda and Yamamoto (1995) developed an intuitive causality approach by augmenting the VAR model with the maximum integration degree of variables, which leads to valid Wald tests with asymptotic distribution irrespective of whether variables are non-stationary or co-integrated. Emirmahmutoglu and Kose (2011) extended the Toda-Yamamoto approach to Granger causality in time series data for panel data sets in a simple way. This approach to panel causality thereby accounts for cross-country heterogeneity irrespective of whether the variables of interest are non-stationary or co-integrated. In addition to this flexibility, because the critical values for panel statistics are derived from bootstrap distributions, it also considers the cross-section dependency.

In the Emirmahmutoglu and Kose approach, the following VAR model is estimated for each cross-section:

$$y_{it} = \mu_i + A_{1i} y_{i(t-1)} + \cdots + A_{p_i} y_{i(t-p_i)} + \cdots + A_{(p+d)i} y_{i(t-p_i-d_i)} + \varepsilon_{it}. \quad (8)$$

where y_{it} is vector of endogenous variables *(TOUR, EXP, IMP)*, $\boldsymbol{\mu_i}$ denotes the p dimensional vector of fixed effects, p_i is the optimal lag(s) and d_i is the maximum integration degree of the variables. The null hypothesis of no-Granger causality against the alternative hypothesis of Granger causality is tested by imposing zero restriction on the first p parameters. The so-called modified Wald statistic has the asymptotic chi-square distribution with p degrees of freedom. To test the Granger non-causality hypothesis for the panel, the Fisher statistic is developed that defined as:

$$\lambda = -2\sum_{i=1}^{N} \ln(\pi_i) \qquad (9)$$

where π_i is the probability corresponding to the individual modified Wald statistic. The Fisher statistic has an asymptotic chi-square distribution with $2N$ degrees of freedom. However, the limit distribution of the Fisher test statistic is no longer valid in the presence of cross-section dependency. To accommodate for cross-section dependency in the panel, Emirmahmutoglu and Kose (2011) suggest obtaining an empirical distribution of the panel statistic using the bootstrap method(1).

5. Empirical results

The results for the panel causality analysis(2) between tourism and export are presented in Table 2.

Table 2. *Causality between tourism and export*

		Tourism ≠> Export		Export ≠> Tourism	
Country	Lag(s)	Statistic	p-value	Statistic	p-value
Albania	1	4.242	0.039**	0.598	0.439
Algeria	1	1.079	0.298	0.356	0.550
Bosnia and Herzegovina	1	0.582	0.445	2.529	0.111
Croatia	3	4.152	0.245	2.973	0.395
Egypt, Arab Rep.	2	1.723	0.422	8.344	0.015**
France	1	3.416	0.064**	0.214	0.643
Greece	1	0.011	0.914	4.925	0.026***
Israel	1	0.389	0.532	1.486	0.222
Italy	1	5.305	0.021**	0.114	0.734
Lebanon	2	0.468	0.791	3.267	0.195
Malta	1	2.273	0.131	0.102	0.748
Morocco	2	4.515	0.104	8.285	0.015**
Slovenia	3	26.661	6.930	0.580	0.900
Spain	1	0.367	0.544	0.368	0.543
Tunisia	3	7.778	0.050**	8.461	0.037**
Turkey	1	2.217	0.136	0.005	0.942
Panel results	Fisher stat.	p-value			
Tourism ≠> Export	73.612	4.010			
Export ≠> Tourism	49.438	0.025**			

Notes: ≠> denotes non-Granger causality hypothesis. The optimal lag(s) are selected by Schwarz information criterion by setting maximum lags to 3 in VAR model. The bootstrap critical values are based on 1000 bootstrap replications. *, **, and *** respectively denote statistical significance at 10, 5 and 1 percent.

The Table 2 presents the causation linkage between tourism and export variables. In Albania, France, Italy and Tunisia, the hypothesis implying tourism does not cause of export is rejected. It means that uni-directional causality running from tourism to export exists in these countries. The significance level is 10%. On the other hand, the hypothesis claiming export does not cause of tourism is rejected for Egypt, Greece, Morocco and Tunisia. So it is clearly accepted that export causes tourism in Egypt, Greece, Morocco and Tunisia. Moreover, results indicate that there is a bi-directional causality for Tunisia. When the group effect took into account, it is realized that export is the cause of tourism.

Table 3. *Causality between tourism and import*

		Tourism ≠> Import		Import ≠> Tourism	
Country	Lag(s)	Statistic	p-value	Statistic	p-value
Albania	1	2.841	0.091*	0.766	0.381
Algeria	2	9.203	0.010***	2.123	0.345
Bosnia and Herzegovina	1	0.565	0.452	0.029	0.863
Croatia	3	0.526	0.913	22.458	5.240
Egypt, Arab Rep.	2	0.022	0.988	6.352	0.041**
France	1	1.208	0.271	0.681	0.409
Greece	2	7.264	0.026**	1.678	0.432
Israel	1	0.912	0.339	0.632	0.426
Italy	1	0.600	0.438	1.127	0.288
Lebanon	2	1.301	0.521	2.759	0.251
Malta	1	0.175	0.675	0.022	0.881
Morocco	3	10.200	0.016**	6.852	0.076*
Slovenia	2	5.315	0.070**	0.435	0.804
Spain	1	1.218	0.269	0.493	0.482
Tunisia	3	14.354	0.002***	15.448	0.001***
Turkey	3	4.981	0.173	7.228	0.064**
Panel results	Fisher stat.	p-value			
Tourism ≠> Import	63.155	0.000***			
Import ≠> Tourism	66.619	0.000***			

Notes: ≠> denotes non-Granger causality hypothesis. The optimal lag(s) are selected by and Schwarz information criterion by setting maximum lags to 3 in VAR model. The bootstrap critical values are based on 1000 bootstrap replications. *, **, and *** respectively denote statistical significance at 10, 5 and 1 percent.

In Table 3, findings indicating causation linkage between tourism and import is represented. According to analysis results, there is a uni-directional causality running from tourism to import for Albania, Algeria, Greece Morocco, Slovenia and Tunisia. The causation linkage from import to tourism is valid for Egypt, Morocco, Tunisia and Turkey. As a result, bi-directional causality is valid for Morocco and Tunisia. The group effect indicates that bi-directional causality exists.

6. Conclusion

The paper has analyzed the possible causation linkage between international trade and tourism arrivals for 16 Mediterranean countries by employing panel-Granger-causality tests over the annual data set from 1995 to 2013. The findings of the study indicate both two-way causality and unidirectional causality running between trade and travel for different countries.

Subject to possible caveats of the study, the following are some important policy implications for Mediterranean countries in terms of tourism and trade that can be drawn from the findings. It seems that an increase in international trade even if export or import, increases will cause growth in tourism sector, which means that most of tourist arrivals are related to tourism in especially developing countries such as Morocco, Tunisia, Algeria, Albania and Turkey. Hence, economic policy should focus more on trade related tourism, in order to generate more foreign trade earning to developing Mediterranean Countries. Besides, in order to increase and sustain in the growth of tourism sector, more attention should be given to the business tourism such as meetings, incentives, academicals, conferences, workshop and exhibitions.

Notes

(1) In order to save space, the details of bootstrapping method is not outlined here. An interested reader is referred to Konya (2006) and Emirmahmutoglu and Kose (2011).

(2) The causality procedure employed here first requires determining the maximum integration degree (d) of the series. Following Emirmahmutoglu and Kose (2011), we investigate the time series properties of the variables by means of the unit root test by Dickey and Fuller (1981) and find out that d is equal to one for each country in our panel. In order to save space, we do not report the results from the unit root analysis here but are available upon request.

References

Algieri, B. (2006). International tourism specialization of small countries. *International Journal of Tourism Research*. 8. pp. 1-12.

Breitung, J. (2005). A parametric approach to the estimation of cointegration vectors in panel data. *Econometric Reviews.* 24. pp. 151-173.

Dickey, D.A. and Fuller, W.A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica.* 49. pp. 1057-1072.

Dumitrescu, E.I. and Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling*. 29(4). pp. 1450-1460.

Emirmahmutoglu, F. and Kose, N. (2011). Testing for Granger causality in heterogeneous mixed panels. *Economic Modelling*. 28. pp. 870-876.

European Bank for Development and Reconstruction-EBRD 2013. *Stock in Transition- Transition Report 2013*: Retrieved on December 2014. Available on http://www.ebrd.com/downloads/research/transition/tr13.pdf

Fisher, R.A. (1932). *Statistical methods for research workers*, 4th Edition. Oliver and Boyd, Edinburgh.

Granger, C.W.J. (2003). Some aspects of causal relationships. *Journal of Econometrics.*112. pp. 69-71.

Kadir, N. and Jusoff, K. (2010). The cointegration and causality tests for tourism and trade in Malaysia. *International Research Journal of Finance and Economics*. 2(1). pp. 138-143.

Katircioglu, S.T. (2009). Revisiting the tourism-led-growth hypothesis for Turkey using the Bounds test and Johansen approach for cointegration. *Tourism Management.* 30(1). pp. 17-20.

Khan, H., Rex, T.S. and Chua, L. (2005). Tourism and trade: Cointegration and Granger causality tests. *Journal of Travel Research*. 44. pp. 171-176.

Konya, L. (2006). Exports and growth: Granger causality analysis on OECD countries with a panel data approach. *Economic Modelling.* 23. pp. 978-992.

Kulendran, N., and Wilson, K. (2000). Is there a relationship between international trade and international arrivals? *Applied Economics*. 32(8). pp. 1001-1009.

Landes, D. (1998). *The Wealth and Poverty of Nations*. London: Abacus.

Luintel, K.B. and Khan, M. (2004). Are international R&D spillovers costly for the US?" *The Review of Economics and Statistics.* 86(4). pp. 896-910.

Luintel, K. and Khan, M. (2009). Heterogeneous ideas production and endogenous growth: An empirical investigation. *Canadian Journal of Economics.* 42(3). pp. 1176-1205.

Narayan, P.K. (2004). Economic impact of tourism on Fiji's economy: Empirical evidence from the computable general equilibrium model. *Tourism Economics.* 10(4). pp. 419-433

Narayan, P.K., Narayan, S., Prasad, A. and Prasad, B.C. (2010). Tourism and economic growth: A panel data analysis for Pacific island countries. *Tourism Economics.* 16(1). pp. 169-183.

Nazlioglu, S. (2011). World oil and agricultural commodity prices: Evidence from nonlinear causality. *Energy Policy.* 39(5). pp. 2935-2943.

OECD Report 2015. *General information to the tourism sector in Bulgaria,* Retrieved on December 2014. Accessed from: http://www.oecd.org/industry/tourism/40239491.pdf

Pesaran, M.H. and Smith, R.P. (1995). Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics.* 68. pp. 79-113.

Pesaran, M.H., Shin, Y. and Smith, R.P. (1999). Pooled mean group estimation of dynamic heterogenous panels. *Journal of the American Statistical Association.* 94(446). pp. 621-634.

Pesaran, M.H. (2004). General diagnostic tests for cross section dependence in panels. *Cambridge Working Papers in Economics.* No. 0435, Faculty of Economics, University of Cambridge.

Pesaran, M.H. (2006). Estimation and inference in large heterogeneous panels with multifactor error structure. *Econometrica.* 74. pp. 967-1012.

Pesaran, M.H. and Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of Econometrics.* 142. pp. 50-93.

Pesaran, M.H., Ullah, A. and Yamagata, T. (2008). A bias-adjusted LM test of error cross-section independence. *Econometrics Journal.* 11. pp. 105-127.

Soukiazis, E. and Proenca, S. (2008). Tourism as an alternative source of regional growth in Portugal: A panel data analysis at NUTS II and III Levels. *Portuguese Economic Journal*. 7(1). pp. 43-61.

Toda, H.Y. and Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics.* 66. pp. 225-250.

World Travel and Tourism Council (WTTC) (2011). Travel and tourism economic impact 2011. Retrieved on December 2014. Accessed from: http://www.wttc.org/bin/pdf/original_pdf_file/

World Travel and Tourism Council (WTTC) (2012). *Tax burden on the US travel and tourism sector*. Retrieved on December 2014. Accessed from: http://www.wttc.org/-/media/files/reports/policy%20research/us_tax_burden_on_travel_final.pdf

Zellner, A. (1962). An efficient method of estimating seemingly unrelated regression equations and tests of aggregation bias. *Journal of the American Statistical Association*, 57. pp. 500-509.

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 213-236

Economic freedom index and stock returns in Malaysia

Devinaga RASIAH
Multimedia University, Melaka, Malaysia
devinaga.rasiah@mmu.edu.my
Tay Lee YING
Multimedia University, Melaka, Malaysia
tay_0731@hotmail.com
Sakiru Adebola SOLARIN
Multimedia University, Melaka, Malaysia
sasolarin@mmu.edu.my

Abstract. *The objective of this study is to investigate the relationship between economic freedom index and stock return in the Kuala Lumpur Stock Exchange, Malaysia for the period, 1995 to 2013. The analysis is conducted within the framework of Capital Asset Pricing Model (CAPM), while using the pooled ordinary least square as the method of estimation. The findings show that economic freedom index does not have significant impact on stock returns in the long run. However, overall economic freedom index has significant impact on stock returns in the short run. We further consider the impact of five components of economic freedom index. It is observed that the components do not have significant long run impact on stock returns. The components-limited government and open markets- have strong short run significant explaining powers. The results are consistent across different levels of inflation and wealth in Malaysia. The results indicate that investors can obtain better mean-variance efficiency when a country exhibit greater economic freedom. This paper should be of interest to both investors and market researchers.*

Keywords: freedom index, capital asset pricing model, investor, investment, equity.

JEL Classification: G10; P1.

1. Introduction

Previous researchers had studied on the relationship between economic freedom and stock returns. Many studies illustrated significant positive relationship between economic freedom and stock returns (Porta et al., 1996; Lombardo and Pagano, 2000; Bekaert et al., 2001; Li, 2002; Stocker, 2005; Blau et al., 2014; Dewandaru et al., 2014). For instance, Lombardo and Pagano (2000) exhibit a positive correlation between stock returns and the quality of government's system across different countries. Li (2002) found that improvement in macroeconomic variables such as inflation and real interest rate are the key factors contribute to the growth of global equity markets. Blau et al. (2014) found limited government control in the home country leads to more stable American Depository Receipts prices. Dewandaru et al. (2014) investigate the determinant of stock market development for both Islamic and developed countries by using Economic Freedom Index as a proxy for quality of institution. The findings exhibited significant relationship between economic freedom index and stock market development only in developed countries.

As indicated by Henry (2000), emerging countries restrict foreigners to buy shares in its stock markets. However, from the theoretical perspective of international asset pricing model (IAPM), we should see an increase in equity price index (the discount rate of equity capital will fall) only if the country opens its stock market to foreigners. For example, Porta et al. (1997) claim that a country's legal environment is very important for investor protection and it affects market capitalization. Li (2002) confirms that greater economic freedom is always related to stronger shareholder protections and the relative market capitalization. Stocker (2005) investigates the relationship between economic freedom and stock returns for the period of 1970 to 2000. He claimed that investment strategy that based on the changes in economic freedom produces significant abnormal returns. In other words, for investors seeking superior returns from investment, countries that are undergoing greater economic freedom improvement should be chosen for their investment portfolios. In addition, Stocker (2005) points out that increases in economic freedom would provide investors with above-average investment returns. Lombardo and Pagano (2000) discover that there is a positive association between stock returns and the quality of legal systems across different countries. Bekaert et al. (2001) further conclude that financial liberalization improves economic growth. This study aims to fill the gap by investigating the relationship between economic freedom and the stock market returns in developing country such as Malaysia. A standard capital asset pricing model (CAPM) is employed to see whether the Malaysian stock returns can be explained by economic freedom.

1.1. Problem statement

It is still an on-going debate among academicians and practitioners that which model is the best to explain the risk and return of security due to the dynamic nature of the economy. Theoretically, CAPM states that "beta is stable over time". However, Groenewold and Fraser (1999) argued that beta is unstable and should only use to estimate expected returns for short term horizon for example, five years periods. Series of empirical test by researchers have brought out a number of anomalies in the asset pricing

model (Black and Scholes, 1973; Jensen and Meckling, 1976; Fama and French, 1996; Carhart 1997). They have conducted a series of testing and have found abnormal return situations explaining pricing anomalies and tracking error.

Throughout the years, there are limited studies have been carried out to test on the standard CAPM without modification of the model. However, the principle of it still hold an important role to guide investors in investing. According to Womack and Zhang (2003) and Javed (2010), CAPM provides nearly 85 per cent of explanatory power stock returns. In other words, it also emphasizes that there are remaining 15 per cent of variations of stock returns being unexplained by the model. Lately, the dynamism of various economies and markets due to economic globalisation has challenged the portfolio managers (International Economics, 2010). Thus, our main thoughts of the variation being unexplained is caused by beta do not include new information from different aspects such as economic factors. (Fraser-Jenkins et al., 2013). All these new information can bring great impact on a stock.

As evidence from previous studies done in developed countries, economic freedom is significant positive relationship with stock returns. Karthik and Kannan (2012) claim that emerging countries are experiencing the surge of share of capital flows in their economies due to the integration of global equity market. Mrak (2000) claims that some nationalists considered globalisation will reduce national sovereignty, and possibly reduced the freedom, rights, and liberty. Malaysia is one of the Asian countries (other than Singapore and India) that attract high rates of foreign direct investment. The process of international integration has become an important source of finance and at the same time, it poses a challenge to economic freedom (Maskay et al., 2006).

1.2. Objectives of the study

The objectives of this study are:
1. To examine the relationship between absolute value of economic freedom index and stock returns using CAPM.
2. To identify the relationship between the change of the economic freedom index and stock returns CAPM.

2. Literature review

Throughout these years, many researchers have identified number of different variables that predict the future stock returns. However, the variables that used to predict the stock returns were mostly company's fundamental. Although the literature covers a wide variety of variables that have an effect on stock returns done by previous researchers, this review will focus more on freedom indices throughout the literature review. Section 2.1 reviews the standard CAPM theory and the incorporation of different firm's fundamental variables into the standard model; section 2.2 reviews the economic freedom; section 2.3 highlights the increasing importance of freedom indices in stock returns.

2.1. Capital asset pricing model (CAPM)

The capital asset pricing model also denoted as CAPM, was developed by Sharpe (1964) and Lintner (1965). It gives the birth of asset pricing theory. CAPM shows the pricing of security by providing an expression that the expected returns of a security is depending on systematic risk. In other words, CAPM serves as a tool to calculate expected return of a stock to its systematic risk over a risk free rate. The calculation of expected return is based on the average covariance of asset return with the market portfolio which completely diversified and comprises all assets in world of finance market (Sharpe, 1964; Lintner, 1965).

2.1.1. Assumptions of CAPM

The CAPM is constructed on the portfolio choice model developed by Harry Markowitz (1959). An investor can hand-pick a portfolio by using the Markowitz's model, example in time t-1 that makes a stochastic return at t. Naturally, all investors are risk averse and they will focus on the mean and variance of stock at one period of time to reduce the risk and increase the expected return. Consequently, the Markowitz approach is repeatedly recognised as "mean variance model." The portfolio model offers an algebraic condition on asset weights in mean variance-efficient portfolios. The CAPM chances this algebraic statement relationship between risk and expected return by identifying a portfolio be useful if asset market prices are clear. Sharpe (1964) and Lintner (1965) intensified their idea with two key assumptions; the first hypothesis in concurrence that given market clearing asset prices at t - 1, investors would approve on the joint distribution of asset returns from t - 1 to t as in indicated by Fama and French (2004). Furthermore, they also highlighted that all investors perform the borrowing and lending activities at risk free rate without noticing the amount of money.

2.2. Economic freedom

The Heritage Foundation (2014) explains "economic freedom" as the "absence of government coercion or constraint on the production, distribution, or consumption of goods and services beyond the extent necessary for citizens to protect and maintain liberty itself. In other words, people are free to work, produce, consume, and invest in the ways they feel are most productive". Hristova (2012) indicated that "the Heritage Index, unlike the Fraser and the Freedom House indices, not only attempts to measure macroeconomic outcome variables for each individual country, such as inflation, tariff rates, government expenditure, etc. but it also qualitatively analyses the ability of the institutions currently in place in each country to foster and sustain economic freedom".

Kešeljević (2007) examined 24 countries which experienced a transition of economic freedom covering a period from 1995 to 2004. In another study by Peláez (2009), he employed the Economic Freedom Index of year 2007 for the regression model and found Islamic countries exhibit less free than the benchmark countries in eight out of the ten classifications: property rights, freedom from corruption, investment freedom, business freedom, financial freedom, trade freedom, labor freedom, and monetary freedom.

Economic Freedom Index

The home country's economic freedom is imperative as it mostly shows high economic freedom associates with economic growth as indicated by Easton and Walker (1997), Gwartney, Lawson and Holcombe (1999), and Haan and Sturm (2000)). Researchers such as Alfaro, Chanda, Kalemli Ozcan and Sayek (2004) mentioned that dependable financial markets are connected with greater economic growth. On examining the association between economic freedom and a measure for the functionality of financial markets, such as volatility, is a motivating study. Secondly, economic freedom suggests that greater political steadiness as shown by Graeff, and Mehlkop (2003)). Researchers such as Smimou and Karabegovic (2010) discovered that economic freedom helps to facilitate a country's financial market directly and indirectly. Subsequently, Gwartney, Lawson and Hall (2013) mentioned that an extreme level of economic freedom postures smaller restriction on capital flow and therefore, it responsively alters the investors to freely trade locally and internationally in financial instruments. Blau et al. (2014) claimed that political stability and government policy caused fluctuation in economic freedom which indirectly affect country's financial market. Researchers such as Haan and Sturm (2000) indicated that economic freedom will foster production and resources efficiency and positively affect economic growth and national competitiveness as well.

2.3. Economic freedom and stock returns

Pearce (1985) had thoroughly reviewed the literature on the role of stock prices on real economic activity in United States. He claimed that stock price movement appeared to be important but not a reliable leading indicator of business instabilities in the United States. The main effects of stock price changes are directly associated with the levels of household consumption and business investment spending. He also claimed that the rise in stock prices is resulting from the rise in consumption through household wealth. Stocker (2005) investigated the impact of economic freedom gauged by Fraser Institute's Economic Freedom of the World report on stock returns from 1970 to 2002. Results showed that cross-country stock returns were directly associated with percentage change in economic freedom. He found that 1 per cent increased in economic freedom was allied with a 2.7 per cent increase in stock returns. He encouraged selection of investment portfolio should be done in countries that experienced an improved in economic freedom and ideally for those countries with low level of economic freedom at starting period. Billmeier and Massa (2007) employed economic freedom index by The Heritage Foundation as a proxy for institution to examine the relationship with stock market capitalization in 17 panel countries in the Middle East and Central Asia from 1995 to 2005. The results suggested that economic freedom contributed significantly to stock market development.

Lawson and Roychoudhury (2008) found evidence that company's stock price that located in United States experienced higher stock returns when the economic freedom increased. Smimou and Karabegovic (2010) analyzed the association between economic freedom and stock returns in Middle East and North Africa (MENA) equity markets from 2000 to 2007. They found that overall economic freedom had positive effect on equity returns. All the five areas of economic freedom were statistically significant with stock

returns. Among all, legal structure and security of property rights showed the strongest impact on returns. The result was consistent with Gwartney and Lawson (2003) which supported that legal structure and property rights are important to stock returns.

3. The data and methodology

3.1. Data

This study examines the emerging stock market, Malaysia for two main reasons. The first reason is that Malaysia is one of the countries where the degree of freedom has shown more declines than gains in past seventh consecutive years (Puddington, 2013). Another reason is that Malaysia as one of the emerging Asian markets is deemed as one of the potential investment options for both developing and developed stock market investors. Thus, the feature of Malaysian stock market provides an appropriate framework in which to examine the market reaction to country's degree of freedom (Kawakatsu and Morey, 1999).

3.1.1. Data on economic freedom index

The economic freedom index is downloaded from the Heritage Foundation website. The measure of the Economic Freedom Index is an annual guide published by The Wall Street Journal and the Heritage Foundation. According to The Heritage Foundation (2014), the index includes 10 freedoms covering from property rights to entrepreneurship for 186 countries. The Heritage Foundation computes economic freedom based on 10 quantitative and qualitative factors, which grouped into four broad categories. *The 10 factors are averaged equally into a total score.* The total score ranges from 0 to 100. The higher the score, the more freedom the country is. A country that scores 0 is perceived as a 'Repressive' country. It is a country that having tight supervision and tight regulation to prevent the existence of private financial institution. A country that scores 100 is described as a country that is 'negligible government interference' (The Heritage Foundation, 2014).

3.2. Methodology

3.2.1. Excess returns measure

Let $R_{i,t}$ denotes the returns for security *i* at day *t*; $A_{i,t}$ as the excess return for security *i* at day *t*. For each security, the excess return for each day is estimated using the following procedures:

$$\ln(p_{i,t} / p_{i,t-1}) \times 100\% \quad (1)$$

Once the daily excess return for each security *i* is calculated, the average annual excess return for each security *i* is computed. It is the summation of daily excess returns for security *i divided by the* number of trading days of year *t. It is denotes as:*

$$\sum A_{i,t} / N \quad (2)$$

Last but not least, annualized excess stock returns for security *i* for year *t* is calculated as following:

((1+ Average Annual Return)^{365})-1) (3)

3.2.2. Risk premium measure

The daily opening and closing prices of the FBM KLCI is used as a proxy for market portfolio (R^m). On the other hand, risk-free rate (R^f) is based on the three months treasury bills. The market risk premium is the function of excess return of the market. It is denotes as:

$$RP = E(R^m) - R^f \quad (4)$$

3.2.3. The standard CAPM measure

The standard CAPM developed by Sharpe (1964) was adjusted to apply to emerging market (in Malaysia context). The expected returns on an asset of Bursa Malaysia can be written as:

$$E(R_{it}) - R_{ft} = \beta_1[E(R_{mt}) - R_{ft}] + \varepsilon_{it} \quad (5)$$

Where:

$E(R_{it})$ =Expected Return for Stock *i* at Time *t;*

R_{ft} = Risk free rate;

$E(R_{mt})$ = Expected Return on Market at Time *t;*

β_1, β_2 = Coefficients of Risk Premium, Aggregate Index of Economic Freedom;

ε_{it} = Error Term.

As mentioned above, this study is to test on both absolute value and change on the EFI. Thus, parsimonious sets of equations that incorporate the variables –Aggregated Index of Economic Freedom (COS), absolute value of Rule of Law (RL), absolute value of Limited Government (LG), absolute value of Regulatory Efficiency (RE), and absolute value of Open Markets (OM) are specified.

Since the above equilibrium relation of CAPM (Eq. 5) is stated in terms of expected returns, it is essential to transform Eq. (5) to the following estimating equation (Eq. 6 – Eq. 12) in order to test the model using historical data. The equations are written as:

$$R_{it} - R_{ft} = a_0 + a_1(R_{mt} - R_{ft}) + \varepsilon_{i1t} \quad (6)$$

$$R_{it} - R_{ft} = a_0 + a_1(R_{mt} - R_{ft}) + a_2 OS_{it} + \varepsilon_{i1t} \quad (7)$$

$$R_{it} - R_{ft} = b_o + b_1(R_{mt} - R_{ft}) + b_2 RL_{it} + \varepsilon_{i2t} \quad (8)$$

$$R_{it} - R_{ft} = c_0 + c_1(R_{mt} - R_{ft}) + c_2 LG_{it} + \varepsilon_{i3t} \quad (9)$$

$$R_{it} - R_{ft} = d_0 + d_1(R_{mt} - R_{ft}) + d_2 RE_{it} + \varepsilon_{i4t} \quad (10)$$

$$R_{it} - R_{ft} = e_0 + e_1(R_{mt} - R_{ft}) + e_2 OM_{it} + \varepsilon_{i5t} \quad (11)$$

$$R_{it} - R_{ft} = e_0 + e_1(R_{mt} - R_{ft}) + e_3 RL_{it} + e_4 LG_{it} + e_5 RE + e_6 OM + \varepsilon_{i6t} \quad (12)$$

where R_{it} denotes annualised excess return of stock *i* at time *t;* R_{ft} denotes risk free rate; R_{mt} denotes annualized return on market; OS denotes change of aggregate index of economic freedom; RL denotes absolute value of rule of law; CLG denotes absolute value of limited government; CRE denotes absolute value of regulatory efficiency; OM denotes absolute value of open markets; Ɛ's denotes the stochastic error term. Once the absolute value being tested, all the variables will be replaced by using the changes on the EFI.

Based on the Eq. (6) to Eq. (12), few hypotheses are formulated:
H_1: Risk Premium and Stock Returns
H_{1a}: There is a relationship between risk premium and stock returns.
H_2: Rule of Law and Stock Returns
H_{2a}: There is a no relationship between absolute value of rule of law and stock returns.
H_{2b}: There is a relationship between change of rule of law and stock returns.
H_3: Limited Government and Stock Returns
H_{3a}: There is a no relationship between absolute value of limited government and stock returns.
H_{3b}: There is a relationship between change of limited government and stock returns.
H_4: Regulatory Efficiency and Stock Returns
H_{4a}: There is a no relationship between absolute value of regulatory efficiency and stock returns.
H_{4b}: There is a relationship between change of regulatory efficiency and stock returns.
H_5: Open Markets and Stock Returns
H_{5a}: There is a no relationship between absolute value of open markets and stock returns.
H_{5b}: There is a relationship between change of open markets and stock returns.
H_6: Overall Score of Economic Freedom Index and Stock Returns
H_{6a}: There is a no relationship between absolute value of overall score of economic freedom and stock returns.
H_{6b}: There is a relationship between change of overall score of economic freedom and stock returns.

4. Analysis

4.1. Descriptive statistics

Table 4.1 depicts the descriptive statistics of the independent and dependent variables. Despite the absolute value of Rule of Law (RL), absolute value of Regulatory Efficiency (RE), absolute value of Open Markets (OM), absolute value of Aggregate Index of

Economic Freedom (OS) show positive mean values, all of the change in absolute value show a negative mean of -1.780128, -0.4018, -0.1823, and -0.4198 respectively. Thus, we can tentatively conclude that all these components (CRL, CRE, COM, and COS) are in the decreasing rate of growth. The absolute value of Economic Freedom Index and its absolute values of individual components exhibit greater standard deviation than the change of its absolute values.

Table 4.1. *Summary statistics of variables*

Variable	Mean	Standard Deviation	Minimum	Maximum
Excess Stock Returns (ER)	24.8698 (9.39)	98.3754	-101.3887	1582.956
Market Risk Premium (RP)	7.5023 (11.70)	33.0896	-70.6133	66.3023
Rule of Law (RL)	10.8632 (10.10)	1.4305	9.4000	14.0000
Change RL	-1.780128 (-0.50)	5.7954	-17.8862	4.9505
Limited Government (LG)	16.0832 (16.07)	0.3942	15.2400	16.6100
Change LG	0.2514 (0.72)	2.4244	-5.8288	4.5932
Regulatory Efficiency (RE)	23.1945 (22.82)	1.0434	21.8000	25.1250
Change RE	-0.4018 (-0.10)	2.8096	-8.1683	5.5963
Open Markets (OM)	15.4516 (15.68)	1.7666	12.6000	18.7000
Change OM	-0.1823 (0.40)	7.4050	-15.3226	14.7877
Overall Score (OS)	64.8632 (64.86)	3.3898	59.9000	71.9000
Change OS	-0.4198 (0.15)	3.0045	-8.7879	3.5714

Note: Reported in parentheses is median.

4.2. Pearson correlation analysis

Table 4.2 provides the correlation matrix for variables in absolute value. From the table, it depicts a negative correlation between RL and Y($r = -0.07$), $p < 0.10$. Besides, RE and Y ($r = -0.12$), RP and RL ($r = -0.14$), RE and RP ($r = -0.20$), LG and RL ($r = -0.27$), LG and RE ($r = -0.36$), LG and OM ($r = -0.24$), LG and OS ($r = -0.25$) are show a negative correlation with p-value less than 0.01 per cent. OM and RE are strongly correlated, $r = 0.56$, $p < 0.01$ as expected, thereby reiterating the notion that the better the regulatory efficiency, the more open the market is. The correlation between OS and Y ($r = -0.004$), OS and RP ($r = -0.03$) were statistically insignificant, $p > 0.05$.

Apart from the correlation analysis, the results in Table 4.2 could be inferred as there are few cases of multicollinearity among the variables. For instance, RE and RL (0.78), OS and RL (0.75), RE and OS (0.78) show slightly less than the 0.80 threshold of

multicollinearity (Gujarati, 1995). However, the correlation coefficient of OM and OS is facing the multicollinearity problem, is 0.91.

Table 4.2. *Correlation matrix for variables in absolute value*

Variables	Y	RP	RL	LG	RE	OM	OS
Y	1.00						
RP	0.46***	1.00					
RL	-0.07**	-0.14***	1.00				
LG	0.05*	0.08***	-0.27***	1.00			
RE	-0.12***	-0.20***	0.78***	-0.36***	1.00		
OM	0.05*	0.08***	0.43***	-0.24***	0.56***	1.00	
OS	-0.004	-0.03	0.75***	-0.25***	0.78***	0.91***	1.00

Notes: Y denotes stock excess returns; RP denotes risk premium; RL denotes rule of law; LG denotes limited government; RE denotes regulatory efficiency; OM denotes open markets; OS denotes overall scores. Significant at: *10, **5 and ***1 percent levels.

Table 4.3 provides the correlation matrix for variables in change of absolute value. From the table, it depicts a negative correlation between COS and CLG ($r = -0.08$), $p < 0.05$. Besides, CLG and CRL ($r = -0.14$), CRE and CLG($r = -0.54$), COM and CLG ($r = -0.11$) are showing a negative correlation with p-value less than 1 per cent. COS and CRL($r = 0.58$), CRE and COM($r = 0.56$), COS and CRE ($r = 0.59$) are positively strongly correlated at p-value less than 1 per cent. On the other hand, CLG and CRE are negatively strongly correlated with correlation coefficient of 0.54, $p < 0.01$. The correlation between OS and Y ($r = -0.004$), OS and RP ($r = -0.03$) were statistically insignificant, $p > 0.05$.

Apart from the correlation analysis, the results in Table 4.3 could be inferred as there is a multicollinearity problem between COM and COS with the correlation coefficient of 0.90.

Table 4.3. *Correlation matrix for variables in changes of economic freedom index*

Variables	Y	RP	CRL	CLG	CRE	COM	COS
Y	1.00						
RP	0.46***	1.00					
CRL	0.17***	0.36***	1.00				
CLG	0.12***	0.10***	-0.14***	1.00			
CRE	-0.04	-0.03	0.12***	-0.54***	1.00		
COM	0.22***	0.36***	0.31***	-0.11***	0.56***	1.00	
COS	0.19***	0.35***	0.58***	-0.08**	0.59***	0.90***	1.00

Notes: Y denotes stock excess returns; RP denotes risk premium; CRL denotes change of rule of law; CLG denotes change of limited government; CRE denotes change of regulatory efficiency; COM denotes change of open markets; COS denotes change of aggregate index of economic freedom.
Significant at: *10, **5 and ***1 percent levels.

4.3. Panel unit root test

Before we conduct the regression analysis the series are tested for possible unit roots. Levin and Lin (1993), Quah (1994), Im, Pesaran and Shin (1997), Pedroni (1999), Maddala and Wu (1999) had developed the framework for panel unit root test. With the use of panel unit root, it helps to overcome low power and large-size distortions in individual unit root test (Perman and Stern, 2003). The null hypothesis for panel unit root tests states the

autoregressive root for all cross section units, whereas an individual unit root tests has the null a unit root in that series, independently of what might be the case elsewhere.

In this study, two forms of panel unit root test statistics are performed, one similar in spirit to the Levin and Lin (1993) testing framework, and the other based on the group mean t statistic developed by Im, Pesaran and Shin (1997). In panel unit root test, hypothesis has been formulated as below:

H_0: Variable is non-stationary.

H_1: Variable is stationary.

Table 4.4 depicts the test statistics for regression with inclusion and exclusion of trends. Based on the table, it shows that panel unit root test rejects the null hypothesis of non-stationary (unit root) in all variables across stocks. Thus, it can be concluded that the variables is in zero order integration. Even though some LLC or IPS test statistics suggesting not to reject the null hypothesis on variables (limited government (LG), regulatory efficiency (RE), open markets (OM), overall score (OS) change of limited government (CLG)) but as overall the widespread to reject the null of non-stationary is ascribable to high power.

Table 4.4. *Panel unit root test statistics*

Variable	Method	Level	
		Individual Intercept	Individual Intercept and Trend
Y	LLC	-24.9873***	-22.9867***
	IPS	-21.5798***	-21.9119***
RP	LLC	-25.5748***	-35.8373***
	IPS	-22.0609***	-32.1636***
RL	LLC	-11.8952***	-10.0262***
	IPS	-5.86163***	1.24408
LG	LLC	-4.55814***	1.73948
	IPS	-13.0624***	-7.62401***
RE	LLC	-8.12299***	-7.17200***
	IPS	-4.38226***	5.05577
OM	LLC	-0.10792	-11.3332***
	IPS	-1.02966	1.16975
OS	LLC	-6.49125***	-5.74585***
	IPS	-4.17745***	4.50027
CRL	LLC	-18.6245***	-18.0952***
	IPS	-14.0738***	-11.3380***
CLG	LLC	3.82281	10.4444
	IPS	-7.15032***	-1.90637**
CRE	LLC	-18.0812***	-20.7843***
	IPS	-13.8681***	-13.8756***
COM	LLC	-22.6653***	-25.0166***
	IPS	-15.4868***	-14.7967***
COS	LLC	-18.8169***	-17.5671***
	IPS	-11.1422***	-8.51503***

Notes: Y denotes stock excess returns; RP denotes risk premium; RL denotes rule of law; LG denotes limited government; RE denotes regulatory efficiency; OM denotes open markets; OS denotes overall scores; CRL denotes change of rule of law; CLG denotes change of limited government; CRE denotes change of

regulatory efficiency; COM denotes change of open markets; COS denotes change of aggregate index of economic freedom.
LLC denotes Levin, Lin, and Chu t; Breitung denotes Breitung t-stat; IPS denotes Im, Pesaran and Shin W-stat; ADF denotes Augmented Dickey-Fuller Fisher Chi-Square; PP denotes Phillips-Perron Fisher Chi-Square.
***, **, and * indicate significance at 1%, 5%, and 10% levels respectively. Then, reject the null hypothesis of non-stationary.
Lag length selection criteria is based on Schwarz Automatic selection.

4.4. Regression: the pooled effect approach

Since the series are free of unit roots, we employ the Pooled Ordinary Least Square (Pooled OLS) regression approach, fixed effect, random effect and Hausman test are performed. However, the Hausman test results showed that the Random Effects of estimate of cross section variance is zero. In other words, it shows no evidence of individual effects (see Appendix 1.2 to Appendix 1.7). According to Glenn (2011), the model is not efficient for a computation of the Hausam test variance. Thus, all our analysis is based on the results by using the Pooled OLS regression approach.

Our key results are illustrated in the Tables 4.5 and 4.6. We estimated all models using White's correction for heterosckedasticity. Pooled OLS regression approach is used in this study. In all the models, we only include one institutional variable at a time to avoid multicollinearity issue. We started the presentation with the key variables of our interest: aggregate score of Economic Freedom Index and followed by all the individual components (rule of law, limited government, regulatory efficiency, open markets). It is to examine the impact of the freedom index on stock returns and to check whether the explanatory power of standard CAPM can be improved.

Based on Table 4.5, the adjusted R-square statistics range from 0.2094 to 0.2101. All models have F-statistics ranging from 54.2930 to 134.7580. Compare to the original CAPM model (Model 1), all the extended version of CAPM that incorporate freedom index (Model 2 to Model 7) yields low adjusted R-square and F statistics than the original model. The original CAPM model yields 0.2103 of adjusted R-square and 268.9354 of F-statistics. Besides, it can be noticed that no variables is significant to explain stock returns except for Risk Premium (RP), is supported that the expected returns of a security is derived from the summation of risk free rate and market risk premium (Sharpe, 1964; Lintner, 1965).Thus, hypothesis (H_{1a}) is supported.

In addition, it is noted in above texts that any absolute value of economic freedom index will not cause the change in stock returns. The results is consistent with Stocker (2005) whereby the absolute value of economic freedom index could not change the valuation of equity based on the concept of discounted cash-flow equity pricing model. The results in Table 4.5 confirm the hypotheses (H_{2a}, H_{3a}, H_{4a}, H_{5a}, and H_{6a}). Despite all the absolute value of Economic Freedom Index insignificant to explain stock returns, Rule of Law (RL) in Model 3, Regulatory Efficiency (RE) in Model 5 and Model 7 yields a negative

statistically insignificant coefficient of -0.3475, -2.2077, and -6.8880 respectively. Overall, all the extended version of CAPM that incorporate absolute value of Economic Freedom Index and its components show low R-square and low adjusted R-square than the original model.

Table 4.5. *Regression results: absolute value of economic freedom index and stock returns*

Explanatory Variables	Model 1 Coeffi-cient (Standard Error)	Model 2 Coeffi-cient (Standard Error)	Model 3 Coeffi-cient (Standard Error)	Model 4 Coeffi-cient (Standard Error)	Model 5 Coeffi-cient (Standard Error)	Model 6 Coeffi-cient (Standard Error)	Model 7 Coeffi-cient (Standard Error)
Constant	14.6219*** (2.4110)	-0.3868 (36.5151)	18.4127 (17.1888)	-45.4200 (79.0074)	65.9349 (54.7486)	2.3320 (18.3979)	75.5095 (162.9442)
RP	1.3660*** (0.0762)	1.3667*** (0.0763)	1.3638*** (0.0758)	1.3624*** (0.0759)	1.3518*** (0.0739)	1.3626*** (0.0754)	1.3233*** (0.0695)
OS		0.2313 (0.5675)					
RL			-0.3475 (1.4811)				2.3151 (2.8563)
LG				3.7349 (4.8652)			2.2538 (6.1885)
RE					-2.2077 (2.3372)		-6.8880 (4.8953)
OM						0.7970 (1.2561)	2.4463 (1.7767)
R2	0.2111	0.2112	0.2111	0.2113	0.2116	0.2113	0.2133
Adjusted R2	0.2103	0.2096	0.2096	0.2098	0.2101	0.2097	0.2094
F-statistic	268.9354***	134.3851***	134.3541***	134.5134***	134.7580***	134.4981***	54.2930***
Observation	1007	1007	1007	1007	1007	1007	1007

Notes: The data are in panel form. All the method are using OLS regression. Reported in parentheses is robust standard error using the option White (diagonal) in Eviews 6.0.
***, **, and * indicate significance at 1%, 5%, and 10% levels respectively.
Model 1 is the original Sharpe (1964) standard CAPM with RP as independent variable.
Model 2 until Model 7 is the extended model of Sharpe (1964) standard CAPM model. The independent variables of Model 2 are RP and OS; The independent variables of Model 3 are RP and RL; The independent variables of Model 4 are RP and LG; The independent variables of Model 5 are RP and RE; The independent variables of Model 6 are RP and OM; The independent variables of Model 7 are RP, RL, LG, RE, and OM. Since the OS is the overall score, it is not included to the model 7 as to avoid multicollinearity issue.

Table 4.6 exhibits the results using the change of absolute value of Economic Freedom Index on stock returns. From the table, the adjusted R-square statistics range from 0.2090 to 0.2183. All models have F-statistics ranging from 54.2372 to 254.0080. Risk Premium shows significant in all the models. Change of Limited Government (CLG) is significant in Model 4 with coefficient of 3.1713 ($p < 0.01$) and Hypothesis (H_{3b}) is supported. The result is consistent with Feldstein (1983). He illustrated how the increased in tax rates affect the total fall of equity prices. According to Dincecco and Katz (2014), the establishment of limited government could have given more state capacity to plan the policy that more suitable to local environment. Besides, Thaveesangsakulthai (2012) also pointed out that when the tax rate is cut and government decreases its share of

investment, the financial and operating cost will reduce and thus increase the free cash flows to a firm. Both of these will increase equity values.

Change of Open Markets (COM) is significant with coefficient of 2.7583($p < 0.01$) in Model 6. This result is consistent with Demirgüç and Lenine (1996), Gilpin and Gilpin (2000) saying that the more open the market is, the more 'wealth effect' of a country's stock market. Hypothesis (H_{5b}) is supported. In Model 7, Change of Limited Government (CLG) and Change of Open Market (COM) are significant with the coefficient of 2.7585 ($p < 0.01$) and 1.4122 ($p < 0.05$). According to Zirak and Mehrara (2013), Malaysia are ranked among the Top 23 countries that able to attract foreign direct investment due to appropriate economic and structures policies. When Malaysia practicing trade freedom, it allows foreign investors to set up their operation in Malaysia and also allows investing in Malaysian stock market. With this stock market liberalisation, more foreign funds will flow in to Malaysian stock market and will bring future vibrancy in stock market which will increase the equity value (The Edge, 2014).

On the other hand, COS (Model 2), CRL (Model 3 and Model 7), and CRE (Model 5 and Model 7) are not contribute significantly to explain the relationship with stock returns. Thus, the hypotheses (H_{6b}, H_{2b}, H_{4b}) are rejected. COS is not significant explaining the relationship with stock returns probably due to the reason that only few components of Economic Freedom Index are important to explain stock market in Malaysian context. Overall, most of the extended version of CAPM that incorporate absolute value of Economic Freedom Index and its components (Model 2, Model 4, Model 5, Model 6, and Model 7) show higher R-square and higher adjusted R-square than the original model. Among all, Model 7 yields the highest R-square (0.2224) and highest adjusted R-square (0.2183).

Table 4.6. *Regression results: change in economic freedom index and stock returns*

Explanatory Variables	Model 1 Coeffi-cient (Standard Error)	Model 2 Coeffi-cient (Standard Error)	Model 3 Coeffi-cient (Standard Error)	Model 4 Coeffi-cient (Standard Error)	Model 5 Coeffi-cient (Standard Error)	Model 6 Coeffi-cient (Standard Error)	Model 7 Coeffi-cient (Standard Error)
Constant	15.3154*** (2.5306)	16.0855*** (2.7243)	15.5249*** (3.1059)	14.6957*** (2.4434)	15.0005*** (2.3933)	16.0074*** (2.6667)	15.4411*** (2.9403)
RP	1.3603*** (0.0755)	1.3246*** (0.0691)	1.3547*** (0.0798)	1.3382*** (0.0723)	1.3584*** (0.0754)	1.2934*** (0.0661)	1.2217*** (0.0786)
COS		1.15 (0.7123)					
CRL			0.0922 (0.4007)				0.0730 (0.4303)
CLG				3.1713*** (0.9117)			2.7585*** (0.9561)
CRE					-0.8212 (0.7334)		-1.6962 (1.7574)
COM						0.8503* (0.4365)	1.4122** (0.7843)
R2	0.2106	0.2117	0.2106	0.2164	0.2111	0.2140	0.2224

Explanatory Variables	Model 1 Coeffi-cient (Standard Error)	Model 2 Coeffi-cient (Standard Error)	Model 3 Coeffi-cient (Standard Error)	Model 4 Coeffi-cient (Standard Error)	Model 5 Coeffi-cient (Standard Error)	Model 6 Coeffi-cient (Standard Error)	Model 7 Coeffi-cient (Standard Error)
Adjusted R2	0.2098	0.2100	0.2090	0.2148	0.2095	0.2124	0.2183
F-statistic	254.0080***	127.6648***	126.8893***	131.3235***	127.2724***	129.4864***	54.2373***
Observation	954	954	954	954	954	954	954

Notes: The data are in panel form. All the method is using OLS regression. Reported in parentheses is robust standard error using the option White (diagonal) in Eviews 6.0.
***, **, and * indicate significance at 1%, 5%, and 10% levels respectively.
Model 1 is the original Sharpe (1964) standard CAPM with RP as independent variable.
Model 2 until Model 7 is the extended model of Sharpe (1964) standard CAPM model. The independent variables of Model 2 are RP and COS; The independent variables of Model 3 are RP and CRL; The independent variables of Model 4 are RP and CLG; The independent variables of Model 5 are RP and CRE; The independent variables of Model 6 are RP and COM; The independent variables of Model 7 are RP, CRL, CLG, CRE, and COM. Since the COS is the overall score, it is not included to the overall short run model as to avoid multicollinearity issue.

5. Conclusion

The objective of this study is to examine the effect of economic freedom on stock return in the Kuala Lumpur Stock Exchange, Malaysia, for the period, 1995 to 2013. Within the framework of Capital Asset Pricing Model (CAPM), the pooled OLS is used in the estimation process. Besides, we have also decompose the index of economic freedom to examine relationship between economic freedom index and stock return. The findings illustrate that the aggregate index of economic freedom does not influence stock return in the country. Furthermore, the results suggest that the various components do not yield any significant effect on stock returns. The gist is different, when we conduct the short run analysis. The implication of these results is that the authorities may need to look beyond index of economic freedom, when attempting to improve stock market performance in the long run. Besides, existing and potential investors may not necessarily rely on the economic freedom index, when evaluating the possible long run returns on their investment.

References

Bekaert, G., Harvey, C.R. and Lundblad, C. (2001). Does liberalization spur growth? *Journal of Financial Economics.* 77(1). pp. 3-55.

Berk, J., DeMarzo, P. and Harford, J. (2012). *Fundamentals of corporate finance* (2nd ed). The United States of America: Pearson Global Edition.

Billmeier, A. and Massa, I. (2007). What drives stock market development in the Middle East and Central Asia-Institutions, remittances, or natural resources? *IMF Working Papers.* 1-21. Retrieved August 7. 2014. from http://www.mfa-2008.com/papers/Paper%20Billmeier-Massa.pdf

Black, F. and Scholes, M. (1973). The valuation of options and corporate liabilities. *The Journal of Political Economy.* pp. 637-659.

Blau, B.M., Brough, T.J. and Thomas, D.W. (2014). Economic Freedom and the Stability of Stock Prices: A Cross-Country Analysis. *Journal of International Money and Finance.* 41. pp. 182-196.

Booth, L., Aivazian, V., Demirguc-Kunt, A. and Maksimovic, V. (2001). Capital structures in developing countries. *The Journal of Finance.* 56(1). pp. 87-130.

Butt, B.Z., Rehman, K., Khan, M.A. and Safwan, N. (2010). Do economic factors influence stock returns? A firm and industry level analysis. *African Journal of Business Management.* 4(5). pp. 583-593.

Carhart, M.M. (1997). On persistence in mutual fund performance. *The Journal of Finance.* 52(1). pp. 57-82.

Demirgüç, A.K. and Lenine, R. (1996). Stock markets, corporate finance, and economic growth: An overview. *The World Bank Economic Review.* pp. 223-239.

Dewandaru, G., Rizvi, S.A.R., Bacha, O.I. and Masih, M. (2014). What factors explain stock market retardation in Islamic countries. *Emerging Markets Review.* 19. pp. 106-127.

Dincecco, M. and Katz, G. (2014). State capacity and long-run economic performance. *The Economic Journal.* Retrieved August 7. 2014. from http://mpra.ub.uni-muenchen.de/55275/1/MPRA_paper_55275.pdf

Econometrics of Panel Data (N.D.). Retrieved June 26. 2014. from http://www.econ.kuleuven.ac.be/public/ndbae06/courses/advanced_econometrics/panelshort.pdf.

Engle, R.F. and Granger, C.W.J. (1987). Cointegration and error correction representation: Estimation and testing. *Econometrica*. 55. pp. 251-276.

Fama, E. and French, K.R. (1996). Multifactor explanations of asset pricing anomalies. *The Journal of Finance.* 51. pp. 55-84.

Fama, E.F. and French, K.R. (2004). The capital asset pricing model: Theory and evidence. *Journal of Economic Perspectives.* 18. pp. 25-46.

Feldstein, M. (1983). *Inflation, tax rules, and the stock market. In Inflation, Tax Rules, and Capital Formation.* University of Chicago Press. Retrieved August 1. 2014. from http://www.nber.org/chapters/c11336.pdf

Freedom House (2012a). *Freedom in the World 2012.* Retrieved July 21. 2014. from http://www.freedomhouse.org/reports

Freedom House (2012b). *Freedom of the Press 2012.* Retrieved July 25. 2014. from http://www.freedomhouse.org/ reports

FTSE Bursa Malaysia KLCI Index Research Paper (2009). Retrieved June 23. 2014. from http://www.ftse.com/Indices/FTSE_Bursa_Malaysia_Index_Series/Downloads/FTSE_Bursa_Malaysia_KLCI_Research_Paper_0609.pdf

Gilpin, R. and Gilpin, J.M. (2000). *The challenge of global capitalism: The world economy in the 21st century*, Vol. 5, Princeton: Princeton University Press.

Glenn. (2011). Hausman test correlated random effects [Eviews forum]. Retrieved August 11, 2014, from http://forums.eviews.com/viewtopic.php?f=18&t=2688

Godlewski, C.J., Turk, R.A. and Weill, L. (2011). *Do markets perceive sukuk and conventional bonds as different financing instruments?* Retrieved August 2. 2014. from http://www.suomenpankki.fi/bofit_en/tutkimus/tutkimusjulkaisut/dp/Documents/DP0611.pdf

Granger, C.W.J. (1969). Investigating causal relation by econometric models and spectral methods. *Econometrica.* 37. pp. 424-438.

Groenewold, N. and Fraser, P. (1999).Time-varying estimates of CAPM betas. *Mathematics and Computers in Simulation.* 48(4). pp. 531-539.

Gujarati, D.N. (1995). *Basic econometrics,* 3rd edition, McGraw-Hill, New York: NY.

Gwarney, J. and Lawson, R. (2003). The concept and measurement of economic freedom. *European Journal of Political Economy.* 19(3). pp. 405-430.

Gwartney, J.D., Lawson, R. and Block, W. (1996). *Economic freedom of the world, 1975-1995.* Fraser Institute. Retrieved June 18. 2014. from http://www.fraserinstitute.org/research-news/display.aspx?id=12990

Gwartney, J., Lawson, R. and Hall, J. (2012). *Economic Freedom of the World: 2012 Annual Report.* Retrieved July 5. 2014. from www.freetheworld.com

Gwartney, J., Lawson, R. and Hall, J. (2013). 2013 Economic Freedom Dataset, published in Economic Freedom of the World: 2013 Annual Report, Fraser Institute 2013. Retrieved July 1. 2014. from http://www.freetheworld.com/datasets_efw.html

Haan, D.J., and Sturm, J.E. (2000). On the relationship between economic freedom and economic growth. *European Journal of Political Economy.* 16(2). pp. 215-241.

Henry, P.B. (2000). Stock market liberalisation, economic reform, and emerging market equity prices. *Journal of Finance.* 55(2). pp. 529-564.

Hristova, K.D. (2012). *Does economic freedom determine economic growth? A discussion of the Heritage Foundation's Index of Economic Freedom.* (Doctoral dissertation). Retrieved August 6. 2014. from https://ida.mtholyoke.edu/xmlui/bitstream/handle/10166/3197/Hristova_Thesis_Final.pdf?sequence=1

Im, K.S., Pesaran, M.H. and Shin, Y. (1997). Testing for unit roots in heterogeneous Panels. *Journal of Econometrics.* 115(1). pp. 53-74.

International Economics. (2010). What is globalisation? Retrieved Aug 1, 2014, from http://intl.econ.cuhk.edu.hk/topic/index.php?did=20

Javed, A.Y. (2010). Alternative capital asset pricing models: a review of theory and evidence. *Working Papers and Research Reports,* RR-No. Retrieved July 15, 2014, from http://www.pide.org.pk/pdr/index.php/wp/article/viewFile/2387/2360

Jenkins, F.I., Morris, A., Lee, S. and Murakami, A. (2013). Alternative beta: A primer (pp. 1-57). Nomura Equity Research.

Jensen, M.C. and W.H. Meckling (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics.* Vol. 3. pp. 303-360.

Jong R.A.P. and Haan, D.J. (2011). Political regime change, economic liberalization and growth accelerations. *Public Choice.* 146(1-2). pp. 93-115.

Kao, C. (1999). Spurious regression and residual based tests for cointegration in panel data. *Journal of Econometrics.* 90. pp. 1-44.

Karthik, R. and Kannan, N. (2011). Impact of foreign direct investment on stock market development: A study with reference to India. *International Journal of Management.* 2(2). pp. 75-92.

Kawakatsu, H. and Morey, M.R. (1999). Financial liberalisation and stock market efficiency: An empirical examination of nine emerging market countries. *Journal of Multinational Financial Managemnet.* 9(3). pp. 353-371.

Keseljevic, A. (2007). Indexes of Economic Freedom - An outline and open issues. Zbornik Radova Ekonomskog Fakulteta u Rijeci: Casopis Za Ekonomsku Teoriju i Praksu-Proceedings of Rijeka School of Economics. *Journal of Economics and Business.* 25(2). pp. 223-243.

Lawson, R.A. and Roychoudhury, S. (2008). Economic freedom and equity prices among U.S. states. *The Credit and Financial Management Review.* 14(4). pp. 25-35.

Levin, A. and Lin, C.F. (1993). Unit root test in panel data: New results. University of California at San Diego. *Discussion Paper*. pp. 93-56.

Li, K. (2002). What explains the growth of global equity markets? *Canadian Investment Review.* 15. pp. 23-30.

Lintner, J. (1965). The valuation of risk assets and the selection of risky investment in stock portfolios and capital budgets. *Review of Economics and Statistics.* 47. pp. 13-37.

Lombardo, D., and Pagano, M. (2000). Legal determinants of the return on equity 1. *Corporate and Institutional Transparency for Economic Growth in Europe.* 19. p. 235.

Luo, X., Gu, B. and Cheng, Z. (2013). IT applications, financial analyst recommendations, and firm stock market value. Retrieved August 1, 2014, from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2430028

Maddala, G.S. and Wu, S. (1999). Cross-country growth regressions: Problems of heterogeneity, stability and interpretation. *Applied Economics.* 32(5). pp. 635-642.

Maskay, N.M., Panta, R.K. and Sharma, B.P. (2006). *Foreign investment liberalization and incentives in selected Asia-Pacific Developing Countries: Implications for the health service sector in Nepal* (No. 2206). Retrieved August 5, 2014, from http://artnet.unescap.org/pub/wp2206.pdf

Miller, T., Holmes, K.R., Feulner, E.J., Gigot, P.A., Kim, A.B., Riley, B., Roberts, J.M., Foster, J.D., Anaraki, N.K. and Ezekwesili, O. (2012*). 2012 Index of Economic Freedom.* Washington, DC: The Heritage Foundation/The Wall Street Journal. Retrieved August 1, 2014, from http://www.heritage.org/index/pdf/2012/book/index_2012.pdf in Applied Economics.

Miller, T., Holmes, K.R., Feulner, E.J., Kim, A.B., Riley, B., Roberts, J.M., Walsh, C., Lieberman, B. and Bavetta, S. (2011). 2011 *Index of Economic Freedom.* Washington, DC: The Heritage Foundation/The Wall Street Journal. Retrieved August 1. 2014. from http://www.heritage.org/Index/pdf/2011/Index2011_Full.pdf

Mrak, M. (2000). *Globalisation: trends, challenges and opportunities for countries in transition*. UNIDO paper. Retrieved June 15. 2014. from http://www.unido.org/fileadmin/import/userfiles/puffk/mrak.pdf

Pearce, D.K., and Roley, V.V. (1985). Stock prices and economic news. *The Journal of Business*, 58(1). pp. 49-67.

Pedroni P. (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics.* 61(S1). pp. 653-678.

Pedroni, P. (2004). Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric Theory.* 20(3). pp. 597-625.

Peláez, R.F. (2009). Economic freedom: A comparative study. *Journal of Economics and Finance.* 33(3). pp. 246-258.

Perman, R. and Stern, D.I. (2003). Evidence from panel unit root and cointegration tests that the environmental Kuznets curve does not exist. *Australian Journal of Agricultural and Resource Economics.* 47. pp. 325-347.

Pesaran, M.H. and Shin, Y. (1997). Long-run structural modeling. Unpublished manuscript. University of Cambridge. Retrieved July 25. 2014. from http:\\www.econ.cam.ac.uk\faculty\pesaran\

Pitlik, H. (2002). The path of liberalization and economic growth. *Kyklos.* 55(1). pp. 57-80.

Porta, R.L., Lopez-de-Silanes, F., Shleifer, A. and Vishny, R.W. (1996). *Trust in large organizations*. National Bureau of Economic Research.

Porta, R.L., Lopez-de-Silanes, F., Shleifer, A. and Vishny, R.W. (1997). Legal determinants of external finance. *Journal of Finance.* 52(3). pp. 1131-1150.

Puddington, A. (2013). *Freedom in the world 2013: democratic breakthroughs in the balance.* Retrieved June 4, 2014, from http://www.freedomhouse.org/sites/default/files/FIW%202013%20Booklet%20-%20for%20Web_1.pdf

Qadir, A.B.A. and Yaroson, E. (2013). Does corruption matter in the development of the stock market in Nigeria? *ESUT Journal of Accountancy, 4*(1). Retrieved August 8. 2014. from http://www.academia.edu/4763397/corruption_and_stock_market_development

Quah, D. (1994). Exploiting cross-section variation for unit root inference in dynamic data. *Economics Letters.* 44. pp. 9-19.

Reilly, F.K. and Brown, K.C. (2005). *Investment analysis and portfolio management.* 8th edition. USA. Thomson South Western.

Sharpe, W. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *Journal of Finance.* 19. pp. 425-442.

Smimou, K. and Karabegovic, A. (2010). On the relationship between economic freedom and equity returns in the emerging markets: Evidence from the Middle East and North Africa (MENA) stock markets. *Emerging Markets Review*. 11(2). pp. 119-151.

Stocker, M. (2005). Equity returns and economic freedom. *Cato Journal.* 25. pp. 583-594.

Thaveesangsakulthai, T. (2012). Will corporate tax cut impact discount rate, valuation? Retrieved August 8. 2014. from http://www.nationmultimedia.com/opinion/Will-corporate-tax-cut-impact-discount-rate-valuat-30183465.html

Taft, W.H., Kramer, D.J. and Puddington, A. (2012). *Freedom in the World 2012.* Washington, DC: Freedom House. Retrieved June 26. 2014. from http://www.freedomhouse.org/sites/default/files/FIW%202012%20Booklet_0.pdf

The Edge. (2014). Fund managers positive on Malaysia's capital market liberalisation. Retrieved August 10. 2014. from http://www.theedgemalaysia.com/business-news/294489-fund-managers-positive-on-malaysias-capital-market-liberalisation.html

The Heritage Foundation. (2014). *2014 Index of Economic Freedom.* Retrieved August 8. 2014. from http://www.heritage.org/index/fiscal-freedom

Tufte, K. (2013). *Economic freedom and stock market returns.* Published by Five Star Wealth Manager, Five Star Wealth Manager as published in Twin Cities Business Magazine. Retrieved June 26. 2014. from http://www.cherrytree.com/wealth/pdfs/ASA_nwsltr0213.pdf

Womack, K. and Zhang, Y. (2003). Understanding risk and return, the CAPM, and the Fama-French three-factor model. *Tuck Case.* (03-111).

Zirak, M. and Mehrara, M. (2013). Ranking of developing countries based on Economic Freedom Index. *International Letters of Social and Humanistic Sciences.* 2. pp. 32-38.

Appendix 1.1. List of company

No.	Name of Stock	Code
1	BIMB	5258
2	BJCORP	3395
3	BJTOTO	1562
4	CARLSBG	2836
5	CMSB	2852
6	DLADY	3026
7	DRBHCOM	1619
8	E&O	3417
9	GAMUDA	5398
10	GENP	2291
11	GENTING	3182
12	KLK	2445
13	PBBANK	1295
14	HLCAP	5274
15	IGB	1597
16	IJM	3336
17	IJMLAND	5215
18	KPJ	5878
19	KSENG	3476
20	KULIM	2003
21	HAPSENG	3034
22	CIMB	1023
23	TENAGA	5347
24	IOICORP	1961
25	GENM	4715
26	YTL	4677
27	MAYBANK	1155
28	TM	4863
29	MISC	3816
30	SIME	4197
31	LAFMSIA	3794
32	MAGNUM	3735
33	MAHSING	8583
34	MAS	3786
35	MBSB	1171
36	MMCCORP	2194
37	MRCB	1651
38	OSK	5053
39	PARKSON	5657
40	POS	4634
41	SPSETIA	8664
42	RHBCAP	1066
43	UMW	4588
44	AMBANK	1015
45	PETDAG	5681
46	BAT	4162
47	HLBANK	5819
48	PPB	4065
49	HLFG	1082
50	AFG	2488
51	TDM	2054
52	TROP	5401
53	TSH	9059

Appendix 1.2. Fixed effect model: absolute of economic freedom index and stock returns

Explanatory Variables	Model 1 Coeffi-cient (Standard Error)	Model 2 Coeffi-cient (Standard Error)	Model 3 Coeffi-cient (Standard Error)	Model 4 Coeffi-cient (Standard Error)	Model 5 Coeffi-cient (Standard Error)	Model 6 Coeffi-cient (Standard Error)	Model 7 Coeffi-cient (Standard Error)
Constant	14.6219*** (0.0772)	-0.3868	18.4127 (17.5461)	-45.4200 (82.8797)	65.9349 (55.8232)	2.3320 (19.1082)	75.5095 (164.5156)
RP	1.3660*** (0.0772)	1.3666*** (0.0773)	1.3638*** (0.0769)	1.3624*** (0.0770)	1.3518*** (0.0754)	1.3626*** (0.0765)	1.3233*** (0.0718)
OS		0.2313 (0.5896)					
RL			-0.3475 (1.5156)				2.3150 (2.8983)
LG				3.7349 (5.1088)			2.2538 (6.3462)
RE					-2.2077 (2.3842)		-6.8880 (4.9542)
OM						0.7970 (1.2980)	2.4463 (1.8161)
R^2	0.2400	0.2401	0.2400	0.2403	0.2406	0.2402	0.2423
Adjusted R^2	0.1978	0.1970	0.1970	0.1972	0.1975	0.1971	0.1968
F-statistic	5.6794***	5.5703***	5.5691***	5.5751***	5.5844***	5.5746***	5.3232***
Observation	1007	1007	1007	1007	1007	1007	1007

Notes: Reported in parentheses is robust standard error using the option White (diagonal) in Eviews 6.0.
***, **, and * indicate significance at 1%, 5%, and 10% levels respectively.
Model 1 is the original Sharpe (1964) standard CAPM with RP as independent variable.
Model 2 until Model 7 is the extended model of Sharpe (1964) standard CAPM model. The independent variables of Model 2 are RP and OS; The independent variables of Model 3 are RP and RL; The independent variables of Model 4 are RP and LG; The independent variables of Model 5 are RP and RE; The independent variables of Model 6 are RP and OM; The independent variables of Model 7 are RP, RL, LG, RE, and OM. Since the COS is the overall score, it is not included to the model 7 as to avoid multicollinearity issue.

Appendix 1.3. Random effect model: absolute of economic freedom index and stock returns

Explanatory Variables	Model 1 Coeffi-cient (Standard Error)	Model 2 Coeffi-cient (Standard Error)	Model 3 Coeffi-cient (Standard Error)	Model 4 Coeffi-cient (Standard Error)	Model 5 Coeffi-cient (Standard Error)	Model 6 Coeffi-cient (Standard Error)	Model 7 Coeffi-cient (Standard Error)
Constant	14.6219*** (2.4110)	-0.3868 (36.5151)	18.4127 (17.1888)	-45.4200 (79.0074)	65.9349 (54.7486)	2.3320 (18.3979)	75.5095 (162.9442)
RP	1.3660*** (0.0762)	1.3666*** (0.0763)	1.3638*** (0.0758)	1.3624*** (0.0759)	1.3518*** (0.0739)	1.3626*** (0.0754)	1.3233*** (0.0695)
OS		0.2313 (0.5675)					
RL			-0.3475 (1.4811)				2.3150 (2.8563)
LG				3.7349 (4.8652)			2.2538 (6.1885)
RE					-2.2077 (2.3372)		-6.8880 (4.8953)
OM						0.7970 (1.2561)	2.4463 (1.7767)
R^2	0.2111	0.2112	0.2111	0.2113	0.2116	0.2113	0.2133
Adjusted R^2	0.2103	0.2096	0.2096	0.2098	0.2101	0.2097	0.2094
F-statistic	268.9354***	134.3851***	134.3541***	134.5134***	134.7580***	134.4981***	54.2930***
Observation	1007	1007	1007	1007	1007	1007	1007

Notes: Reported in parentheses is robust standard error using the option White (diagonal) in Eviews 6.0.
***, **, and * indicate significance at 1%, 5%, and 10% levels respectively.
Model 1 is the original Sharpe (1964) standard CAPM with RP as independent variable.
Model 2 until Model 7 is the extended model of Sharpe (1964) standard CAPM model. The independent variables of Model 2 are RP and OS; The independent variables of Model 3 are RP and RL; The independent variables of Model 4 are RP and LG; The independent variables of Model 5 are RP and RE; The independent variables of Model 6 are RP and OM; The independent variables of Model 7 are RP, RL, LG, RE, and OM. Since the COS is the overall score, it is not included to the model 7 as to avoid multicollinearity issue.
The data are based on weighted statistics.

Appendix 1.4. Random effect Hausman test: absolute of economic freedom index and stock returns

Test Summary	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Chi-Sq statistics	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Chi-Sq. d.f.	1.0000	2.0000	2.0000	2.0000	2.0000	2.0000	5.0000
Prob.	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Appendix 1.5. Fixed effect model: change of economic freedom index and stock returns

Explanatory Variables	Model 1 Coeffi-cient (Standard Error)	Model 2 Coeffi-cient (Standard Error)	Model 3 Coeffi-cient (Standard Error)	Model 4 Coeffi-cient (Standard Error)	Model 5 Coeffi-cient (Standard Error)	Model 6 Coeffi-cient (Standard Error)	Model 7 Coeffi-cient (Standard Error)
Constant	15.3154*** (2.5975)	16.0855*** (2.7794)	15.5249*** (3.1611)	14.6957*** (2.5195)	15.0004*** (2.4727)	16.0074*** (2.7218)	15.4410*** (3.0035)
RP	1.3603*** (0.0769)	1.3246*** (0.0712)	1.3547*** (0.0814)	1.3382*** (0.0740)	1.3584*** (0.0767)	1.2934*** (0.0682)	1.2217*** (0.0800)
COS		1.1516 (0.7388)					
CRL			0.0922 (0.4203)				0.0730 (0.4493)
CLG				3.1713*** (0.9375)			2.7585*** (0.9980)
CRE					-0.8212 (0.7668)		-1.6962 (1.7483)
COM						0.8503* (0.4335)	1.4122* (0.7668)
R^2	0.2436	0.2447	0.2436	0.2494	0.2441	0.2470	0.2554
Adjusted R^2	0.1991	0.1993	0.1982	0.2043	0.1987	0.2018	0.2081
F-statistic	5.4692***	5.3922***	5.3626	5.5318***	5.3772***	5.4617***	5.3925***
Observation	954	954	954	954	954	954	954

Notes: Reported in parentheses is robust standard error using the option White (diagonal) in Eviews 6.0.
***, **, and * indicate significance at 1%, 5%, and 10% levels respectively.
Model 1 is the original Sharpe (1964) standard CAPM with RP as independent variable.
Model 2 until Model 7 is the extended model of Sharpe (1964) standard CAPM model. The independent variables of Model 2 are RP and COS; The independent variables of Model 3 are RP and CRL; The independent variables of Model 4 are RP and CLG; The independent variables of Model 5 are RP and CRE; The independent variables of Model 6 are RP and COM; The independent variables of Model 7 are RP, CRL, CLG, CRE, and COM. Since the COS is the overall score, it is not included to the model 7 as to avoid multicollinearity issue.

Appendix 1.6. Random effect model: change of economic freedom index and stock returns

Explanatory Variables	Model 1 Coeffi-cient (Standard Error)	Model 2 Coeffi-cient (Standard Error)	Model 3 Coeffi-cient (Standard Error)	Model 4 Coeffi-cient (Standard Error)	Model 5 Coeffi-cient (Standard Error)	Model 6 Coeffi-cient (Standard Error)	Model 7 Coeffi-cient (Standard Error)
Constant	15.3154*** (2.5306)	16.0855*** (2.7243)	15.5249*** (3.1059)	14.6957*** (2.4434)	15.0004*** (2.3933)	16.0074*** (2.6667)	15.4411*** (2.9403)
RP	1.3603*** (0.0755)	1.3246*** (0.0691)	1.3547*** (0.0798)	1.3382*** (0.0723)	1.3584*** (0.0754)	1.2934*** (0.0661)	1.2217*** (0.0786)
COS		1.1516 (0.7123)					
CRL			0.0922 (0.4007)				0.0730 (0.4303)
CLG				3.1713*** (0.9117)			2.7585*** (0.9561)
CRE					-0.8212 (0.7334)		-1.6962 (1.7574)
COM						0.8503* (0.4365)	1.4122* (0.7843)
R^2	0.2106	0.2117	0.2106	0.2164	0.2111	0.2140	0.2224
Adjusted R^2	0.2098	0.2100	0.2090	0.2148	0.2095	0.2124	0.2183
F-statistic	254.0080***	127.6648***	126.8893***	131.3235	127.2724	129.4864	54.2373
Observation	954	954	954	954	954	954	954

Notes: Reported in parentheses is robust standard error using the option White (diagonal) in Eviews 6.0.
***, **, and * indicate significance at 1%, 5%, and 10% levels respectively.
Model 1 is the original Sharpe (1964) standard CAPM with RP as independent variable.
Model 2 until Model 7 is the extended model of Sharpe (1964) standard CAPM model. The independent variables of Model 2 are RP and COS; The independent variables of Model 3 are RP and CRL; The independent variables of Model 4 are RP and CLG; The independent variables of Model 5 are RP and CRE; The independent variables of Model 6 are RP and COM; The independent variables of Model 7 are RP, CRL, CLG, CRE, and COM. Since the COS is the overall score, it is not included to the model 7 as to avoid multicollinearity issue.
The data are based on weighted statistics.

Appendix 1.7. Random effect Hausman test: change of economic freedom index and stock returns

Test Summary	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Chi-Sq statistics	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Chi-Sq. d.f.	1.0000	2.0000	2.0000	2.0000	2.0000	2.0000	5.0000
Prob.	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 237-246

How budget deficit and current account deficit are interrelated in Indian economy

U.J. BANDAY
Jamia Millia Islamia University Delhi, India
ubanday@gmail.com
Ranjan ANEJA
Central University of Haryana, India
ranjananeja@cuh.ac.in

Abstract. *The development in Indian economy brings the question of validity of the twin deficit hypothesis. The main aim of the article is theoretical and empirical analysis of the causal relationship between the budget deficit and the current account deficit in the Indian economy from the period 1990-2013. A co-integration test suggests that both the variables have a long run association between each other and move with each other for a long period of time. The Granger causality test clearly finds the existence of bidirectional relationship between the twin deficit variables. The results indicate that twin deficit hypothesis exists in India as opposed by direction between budget deficit and current account deficit. The study finds the government need to find adequate monetary and fiscal policy for policy variables.*

Keywords: current account deficit, budget deficit, co-integration, granger causality.

JEL Classification: H62, F32, C23.

1. Introduction

Like most developing countries a steady fiscal deficit in India is the foremost cause of all primary ills of the economy. It has varied between 5.1 to 9.6 percent during last two decades. On the other hand the current account deficit varied between 0.4 to 4.7 percent during the same period. The alteration in fiscal policy can lead foreseeable developments in the open economy's rendition of current account deficit, remains a contentious issue. An important aspect of this issue distress what is called as twin deficit examination, according to which fiscal deficit and current account deficit are very closely related so that reduction in both are necessary and adequate to obtain enhancement in the future.

Theoretical relationship that exists between variation in fiscal policy and the current account deficit has been based on two models. These models purport to describe how the economy works in aggregate without explaining the behavior of economic agents. The twin deficit hypothesis can be explained using the Keynesian income-expenditure framework and the Mundell Flemming framework. According to the former, an expansionary budget leads to increased income ultimately resulting in increase in aggregate demand for domestic and imported goods. The increase in imports leads to a worsening of the current account balance. According to Mundell Flemming, an increase in budget deficit causes an upward rise in interest rates if government borrows domestically to finance the deficit. This rise in interest rate leads to capital inflows and consequently an appreciation of the exchange rates. This means exports become less attractive while imports become attractive ending up worsening the current account. This approach however depends on the openness of the economy and the exchange rate regime. In a fixed exchange rate regime expansionary fiscal policy would lead to increased income a process that would still worsen the current account. There however exists contradicting views whereby some scholars believe there exists no relationship between the variables while others believe the relationship exists and its bi directional. Various researchers support the evidence of bi-directional causality while reverse causality was confirmed for Indonesia.

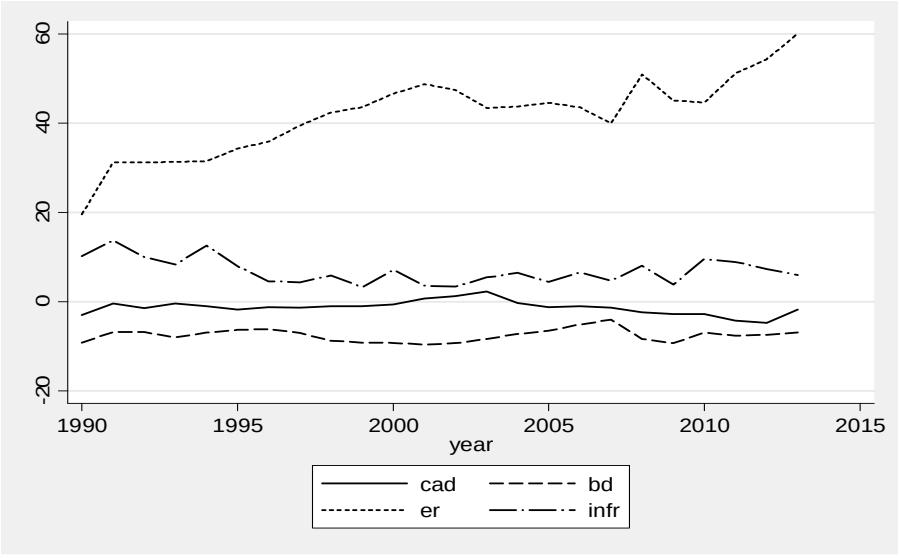
The more conducive export environment with the introduction of export promoting schemes, which include also devaluation of rupee in 1966 as rupee got devaluated from 4.7 Rs to 7.5 Rs per dollar. This improvement in trade facilities improved export performance's by promoting export incentives which boasts Indian current account during 1960 and early 1970. But the situation turned different aftermath of oil shock (Gulf war crises) which generates low exports for the country.

After late 1970s the increase in inflation, large fiscal deficit and hike in oil prices and pegged exchange rate generates low exports, ore imports, increase in current account deficit and Indian reserves fall critically low. However in 1990s the balance of payment (BOP) crises also hit badly the Indian economy in which oil led crises increase rapidly,

the increase in oil prices the huge current account deficit (CAD) which affects budget deficit (BD).

Recently Indian economy from 1990 to 2013 was hit by the balance the balance of payment crises, Asian crises, FRMB Act and financial crises. In 1990s the budget deficit (BD) was 9.1 percent and current account deficit (CAD) was 3 percent at the percentage of GDP. But due to some policies in 2001 to 2004 the CAD was in surplus. The Indian economy is being characterized at twin deficit economy same from 1990 to 2013, the economy has 7 percent of budget deficit (BD) and 4.7 percent of current account deficit (CAD) at the percentage of GDP in year 2013. It is therefore instructive to investigate whether it is a current account deficit or budget deficit which brings the economy in deficit and what are the directions between the two deficits.

Figure 1. *Shows behavior of B.D AND C.A.D and other macroeconomic variables*



Source: Author's computation with Stata 12.0.

Baharumshah et al. (2006) examining the twin deficit hypothesis for (ASEAN-4 Countries) using Quarterly data from (1975:1-2000:4) for analysis and sampling period differs from country to country due the availability of data. He has used cointegration and there vectors is based on two likelihood ratio test statistic. Toda and Yamamoto modified WALD method for testing Granger Causality that conducts inferences in the level VAR and needs to determine the true lag length of the model and at the end he used variance decomposition and impulse response function to find relationship between current account deficit and budget deficit in the long run. The paper find long run relationship between the twin variables and Keynesian proposition fits for ASEAN countries. The results find direct causal link from budget deficit to current account deficit

and find it is the interest rate which appreciates the exchange rate and this leads the widening of current account deficit.

Bose and Jha (2011) investigated the twin deficits hypothesis in the Indian context. Jha tried to find out the existence of any such causal relationship between the two deficits within a multi-dimensional system with interest rate and exchange rate acting as interlinking variables. However, the results claimed that the causal linkage could be established between fiscal deficit and interest rate and exchange rate. However, none of the variables statistically significantly cause the current account deficit. The direction of causality is seen to run unambiguously from oil prices to the current account deficit to fiscal deficit. Moreover, oil price is seen to cause significant influence in short run on all other variables in the system.

Osoro et al. (2014) the paper test the twin deficit hypothesis and empirical relationship between current account balance and budget deficit while including other important macroeconomic variables such as growth, interest rates, money supply (M3) in Kenya from 1963-2012. The study was based on co integration analysis and error correction model (ECM). The results showed a positive and significant relationship between budget deficit and current account. The signs of the normalized co integrating coefficients suggest that there is also a positive relationship between current account deficit and interest rates, GDP and negatively related to money supply. In other words, current account deficit tends to increase along with the increase in fiscal deficit, GDP, interest rates and decrease with money supply in the long run. This means, a rise in budget deficit would be followed by an increase in external balance. We find the causal relationship works through two channels: first is the direct causal link from budget deficit to current account deficit, and the second is the indirect channel that runs from budget deficit to higher interest rate; which lead to appreciation of the currency, in turn worsening the current account deficit.

Ratha (2011) finds that twin deficit theory hold true for India in the short-term, but not in the long run. Using monthly and quarterly data for the 1998-2009 periods and employed bound testing approach to cointegration, she finds evidence that by exercising Fiscal Discipline, Indian government should be able to mitigate the country's trade deficit in the short run. However in the long run, the importance of austerity measures as a trade deficit reduction tool becomes weak. His conclusion is supporting the Ricardian Equivalence Hypothesis (REH) which negates any relationship between these variables and the Keynesian view prevails in the short run.

Basu and Datta (2005) undertakes econometrics analysis to study the impact of fiscal deficit (FD) and trade deficit (TD), and finds both n the percentage of GDP are not found to be twin in the Indian economy.

The rest of the study is organized as follows. Section 2 specifies the theoretical models to support the existence of a long-run relationship between exports and imports and macroeconomic variables explaining CAD. The empirical methodology used for investigating the sustainability of current account deficit and its determinants is presented in Section 3. Section 4 reports and discusses the empirical results. Final Section summarizes the main findings and draws their policy implications to preserve India's current account sustainability.

2. Theoretical framework

The relationship between budget deficit and current account deficit could be written as:

$$CA = SPvt - I-(G-T). \quad (1)$$

Where, CA stands for current account balance, Spvt for private saving; I for investment, G for government purchases; and T for direct taxes collected from household firms by the government. The government deficit is given by G-T. A rise in the government deficit will increase the current account deficit if the rise in government deficit decreases total national saving. If the current taxes are held constant and (Spvt-I) remains the same or stable, an increase in temporary purchase will raise the government deficit (G-T) which affects the current account positively. In this way a government deficit resulting from increased purchases reduces the nations' current account surplus or widens the nation's current account deficit.

The upward shift in budget deficit and current account deficit could be the feature of twin deficit phenomenon. Other features would lead a positive effect of budget deficit on interest rates. The upward shift in interest rates entices investments from abroad, that lead increase in demand of domestic currency and leads appreciation of its value, which implicit inexpensive imports and expensive exports, and leads economy in deficit.

The deficit due to governmental purchase will reduce and both desired consumption and national savings and increase in current account deficit. The Ricardians and Keynesians have different views over the effects of budget deficit caused by tax cut or tax increase. According to Ricardian the tax cut will not lead people to consume more if the planned and future government remains unchanged. If the tax cut in present would be balanced by the increase in future tax, and the tax payers don not fell well off due to decrease in current tax though their income will be increased. Thus, national savings, current account balance, consumption, interest rates and investment remain unaffected. On the other side Keynes argue that consumers respond to the current tax cut by increasing their consumption patterns due to the change in tax rate because they expect higher deficit will lead higher tax rates in future and will create an impact on national savings, increases current account deficit and will affect the transmission mechanism between the macroeconomic variables. This leads twin deficit hypothesis. Moreover there is another

link between budget deficit and current account deficit. The government will increase its borrowings due to increase in budget deficit, this increase the rate of interest and will increase foreign capital inflow. This results cheaper imports and expensive exports. This would lead merchandise trade deficit. There are other channels through which these two deficits are interlinked. Some researchers used four important macro variables like economic growth, rate of inflation, exchange rate and money supply as directly affecting these deficits in U.S. Rapid economic growth boast investments by higher interest rates and attract foreign capital. This leads increase in foreign imports which worsens trade deficit. The rate of inflation also is another factor which affects the desirability of internationally traded goods and leads trade balance. The change in deficits cause change in trade deficit not only by exchange rate linkage but also by interest rate linkage.

3. Econometrics methodology

The cointegration test of the variables needs all the series of variables should be stationary. To avoid the spurious relationship we need to check stationarity of variables when the variables are non-stationarity at the level form we employ Augmented Dickey Fuller Test (ADF) which takes the following form:

$$\Delta yt = \propto + \beta t + \rho Y t - 1 + \sum_{=1} \delta \Delta Yt - j + \varepsilon t. \quad (2)$$

Moreover if the variables are stationary at level then we can apply VAR analysis, if the variables are non-stationary at level then we can apply cointegration test. This can be defined after unit Root test. This test helps us to find out the long run relationship among the variables. If the variables are nonstationary we need to difference them before we can apply regression at level without leading the spurious relationship. There are many tests in the literature for cointegration investigation that were acknowledged in the literature for cointegration analysis such as the *Engle-Granger Cointegraion test* and *Johansen Cointegration test, Cointegrating regression Durbin- Watson test*. We will apply Johansen test for cointegrartion among the variables because it has advantages to consider the possibility of multiple cointgration vectors Johansen (1991).

The regression model indicates only the statistical relationships between the dependent variable of concern and other independent "explanatory" variables, but it does not indicate the causal relationship and the direction of it. There might be a unidirectional causality relationship running from one variable to the other one, a bidirectional relationship, also independence may exist. We will use the *Granger causality test* to know the direction of the causal relationship among the variables in our empirical model. The intuition behind Granger causality tests can be expressed using the following equations:

$$Yt = \alpha 0 + \sum_{=1} \alpha 1, i\, Yt - i + \sum_{=1} \beta 2, i\, Xt - i + \varepsilon 1t. \quad (3)$$

$$Xt = \mu + \sum_{=1} \delta 1, i\, Xt - i + \sum_{=1} \theta 2, i\, Yt - i + \varepsilon 2t . \quad (4)$$

4. Data

The data for study covers the period from 1990-13 for India. The data for Budget Deficit (BD), Current Account Deficit (CAD), Inflation (INF) and Exchange Rate (ER) has been taken from Reserve Bank of India (RBI). Moreover, figures for current account balance (CAD) and Budget Deficit (BD) at the percentage of GDP have been taken from Indian statistic (both RBI). However interest rate has been calculated on the basis Call Money Rate of and Exchange rate on the basis U.S. Dollar.

5. Estimation of results

To check the stationarity of variables we first applied Unit Root test for all the time series variables because cointegration test requires all series of variables should be stationary. Therefore, Augmented Dickey fuller (ADF) will be employed to check the stationarity and non-stationarity of variables the results are presented in Table 1a and Table 1b.

Table 1a. *Augmented Dickey fuller (ADF) Unit Root Test*

Series	t statistic	ADF at 1% Level	ADF at 5% Level
CAD	-2.737323	-3.75296	-2.998064
BD	-2.118445	-3.752946	-2.998064
ER	-1.804653	-3.752946	-2.998064
INF	-2.965073	-3.752946	-2.998064

Table 1b. *Augmented Dickey fuller (ADF) Unit Root Test at First Difference*

Series	t statistic	ADF at 1% Level	ADF at 5% Level
CAD	-4.820096	-3.769597	-3.004861
BD	-4.769597	-3.769597	-3.004861
ER	-6.237862	-3.769597	-3.004861
INF	-8.120664	-3.769597	-3.004861

Source: Author's computation with Stata 12.0.

CAD = Current Account Deficit;
BD = Budget Deficit;
ER = Exchange Rate;
INF = Inflation Rate.

Subsequently, we applied Johanen cointegration (1987) test to check the long Run Relationship between the variables. The test is more suitable when we use more than two variables in the equation and can make use of 1(0) variable also. We check the cointegration among all the four variables CAD, BD, ER and INF. There are two values one is Trace statistic and another Max statistic. The results of Table 2a and Table 2b shows all the variable are cointegrated and have a common stochastic trend, both the test clarifies that all the four variables are having long run association among the variables and have a one cointegration vector demonstrated by both tests.

After finding the variables are cointegrated and have a long run relationship between the variables, we employ Granger Casualty to find out the direction and causality among the variables, test and can find out that variable which is creating an imbalance in the economy. We take all the variables like CAD, BD, ER and INF to find out the direction and causality among variables. We first make BD as a dependent variable and other three variables independent variables and find all the variables are creating impact on the dependent variables at lag 4. When we take CAD as a dependent variable we also find all the independent variables are creating a significant impact on the dependent variable that means the relationship is bidirectional. When we check direction and causality among other variables like ER and INF the relationship was notable. That means if in an economy there is a disturbance in any of the variable CAD, BD, ER and INF the economy will be affected in Indian scenario. Anoruo and Ramchander (1998) finds that the direction of causality is seen to run unambiguously from oil prices to the current account deficit to fiscal deficit. Moreover, oil price is seen to cause significant influence in short run on all other variables in the system. It could also be possible that the expansion in the fiscal deficit due to the small pass-through of oil price shocks appears akin to current account targeting in the case of India, but rather the two deficits are closely related to each other.

Our all models say that Budget deficit have a significant long run effect on Current account deficit and also Current account deficit have a significant long run impact on Budget deficit. The results of Granger causality show the bidirectional results among all the four variables. However other policy variables like INF and ER have a strong causality relation between the CAD and BD in Indian Scenario.

Table 2a. *Johansen Co-integration Test (For Trace Value stat)*

Maximum Ranks	Eigen Value	Trace Statistic	5% Critical Value
0	0.808581	64.03466	47.85
1	0.565973	29.31559	29.90
2	0.380640	11.78797	15.49
3	0.078971	1.727533	3.84

Table 2b. *Johansen Co-integration Test (For Max-Eigen Value stat)*

Maximum Ranks	Eigen Value	Max Statistic	5% Critical Value
0	0.808581	34.71907	27.58434
1	0.565973	17.52761	21.13162
2	0.380640	10.06044	14.26460
3	0.078971	1.727533	3.841466

Source: Author's computation with Stata 12.0.

Max-Eigen stats indicate 1 co-integrating equation at 0.05 level.

Granger causality Wald tests

Table 3a. *Dependent Variable; D (BD)*

Excluded	Chi-Square	Df	Prob
D(CAD)	61.925	4	0.000
D(ER)	15.652	4	0.004
D(INF)	22.485	4	0.000
D(ALL)	106.12	12	0.000

Table 3b. *Dependent Variable; D (CAD)*

Excluded	Chi-Square	Df	Prob
D(BD)	56.333	4	0.000
D(ER)	117.83	4	0.000
D(INF)	12.295	4	0.015
D(ALL)	233.53	12	0.000

Table 3c. *Dependent Variable; D (ER)*

Excluded	Chi-Square	Df	Prob
D(BD)	97.705	4	0.000
D(CAD)	143.03	4	0.000
D(INF)	63.863	4	0.000
D(ALL)	298.27	12	0.000

Table 3d. *Dependent Variable; D (INF)*

Excluded	Chi-Square	Df	Prob
D(BD)	32.428	4	0.000
D(CAD)	31.156	4	0.000
D(ER)	79.164	4	0.000
D(ALL)	131.45	12	0.000

Note: when probability value is more than 0.05% we accept null hypothesis.
Source: Author's computation with Stata 12.0.

6. Conclusion

The study is based on Johansen co-integration analysis and Granger causality Wald tests. The empirical results indicate that budget deficit and current account deficit have significant long run relationship in India. However looking to the Granger causality relationship between budget deficit and current account deficit, it is both current account deficit and budget deficit which have a bidirectional causality relationship between each other. The other variables like exchange rate and inflation do affect the budget deficit and current account deficit in India. It is important for the policy makers to use those policy variables to be used in an effectively in India to reduce twin deficit problem.

References

Anoruo, E. and Ramchander, S. (1998). Current Account and Fiscal Deficits: Evidence from Five Developing Economies of Asia. *Journal of Asian Economics.* Vol. 9. Issue 3. pp. 487-501.

Baharumshah, A.Z., Lau, E. and Khalid, A.M. (2006). Testing Twin Deficit Hypothesis using VAR and Variance Decomposition, *Journal of Asian Pacific Economy,* Vol. 8. No. 1. pp. 331-354.

Basu, S. and Datta, D. (2005). Does Fiscal Deficit Influence Deficit? An Econometric Enquiry, *Economics & Political Weekly*. Vol. 40. No. 30. pp. 3311-3318.

Bose, S. and Jha, S. (2011). India's Twin Deficits: Some Fresh Empirical Evidence. *ICRA Bulletin, Money and Finance.*

Johansen, S. (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. *Econometrica.* 59. pp. 1551-80.

Osoro, K.O., Gor, S.O. and Mbithi, M.O. (2014). The Twin Deficit and the Macroeconomic Variables in Kenya. *International Journal for Innovation Education and Research.* Vol. 2, No. 9. pp. 64-84.

Ratha, A. (2011). Twin Deficits or Distant Cousins? Evidence from India, *Economics Working Paper.* No. 5. in the *Department of Economics at the Repository at St. Cloud State*.

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 247-254

Study regarding the influence of the endogenous and exogenous factors on credit institution's return on assets

Maria-Daciana RODEAN (COZMA)
"Lucian Blaga" University, Sibiu, Romania
maria.daciana89@yahoo.com
Nicolae BALTEŞ
"Lucian Blaga" University, Sibiu, Romania
baltes_n@yahoo.com

Abstract. *The goal of each credit institution is represented by profitability, an objective hardly to be achieved, taking into account that banks are practicing their usual activities within a banking system that hardly tries to recover. The main purpose of this research is to identify the existence of a dependency relationship between return on assets and endogenous factors (growth rate of the loan portfolios; the rate of growth of the provisions and solvency ratio) and the exogenous ones (GDP and inflation rate). The analysis done over the horizon of the last 10 years, a period that includes both economic boom, recession and recovery, illustrated the vulnerability of the credit institution in front of the business environment. The study demonstrated a significant dependence relationship, between return on assets recorded by Carpatica Commercial Bank and the intern determinants, while the variation of the exogenous factors does not explain the variation of ROA recorded by the bank.*

Keywords: ROA, endogenous and exogenous factors, profitability, write-off processes, regression equation.

JEL Classification: G32.

1. Introduction

Macroeconomic conditions, the volatility of the business environment that appeared after the outbreak of the financial crisis determined the supervisory authority to tighten the capital requirements and also the liquidity ones in order to avoid further bankruptcies such as those that characterized the year 2008. The Romanian banking system is in the full process of re-stabilizing and strengthening the commercial banks that operates in the Romanian banking market as a result of:

- The obligation to be aligned to the capital requirements and the liquidity ones etc. imposed by the International Agreements. This determine credit institutions to resort to capital increases through various ways (subordinated loans, contribution of capital or mergers).
- The non-performing loans rate arrived at alarming shares for many banks that are activating in the system, thus the management of credit institutions was determining to use the write-off operations or their full provisioning.

In these circumstances, the profitability of credit institutions is a goal difficult to be achieved due to the instability of the business environment, the low growth rate of the new credit portfolio that is characterizing the Romanian banking system.

2. Literature review

The determinants of the credit institution's profitability have been widely studied by many researchers especially in times of economic crisis due to the need to identify a relationship between this one and other exogenous and endogenous factors.

The credit and risk policy adopted by credit institutions directly affects all indicators obtained by a bank. The literature shows that in times of economic boom, the banks reduce their lending standards and the requirements regarding the warranties due to mainly positive forecasts of future income; higher values of price guarantee (Ruckes, 2004); reduce information asymmetry (Dell'Arricia and Marquez, 2006).

Regarding the evolution of the provisions, an intern determinant extensively studied by researchers, because this indicator, on the one hand expresses the evolution of credit portfolio quality and on the other hand it affects the profitability of the credit institution. In 2008 the researcher Kosmidou defines credit risk as the quality of assets through risk provisions. According to Greek researchers, Athanasoglou, Brissimis and Delis (2008) an upward trend of provisions indicates an increased risk and a greater probability of deteriorating the loan portfolio by higher values of the non-performing loans. As such there emerges an inverse relationship between profitability and the volume of provisions. Several researchers have found conclusive evidence to support the theory according to that provisions are made for the management of income (Greenawalt and Sinkey, 1988; Wahlen, 1994; Laeven and Majnoni, 2003; Liu and Ryan, 2006).

Return on assets and capital (the solvency ratio) are the main indicators that provide the image on the bank's ability to recover after capital losses incurred. Indeed, the profitability is the first line of defense of any bank against credit risk, but not only. A

sufficiently profitable bank can earn enough to restore its level of capitalization, either by attracting promising new capital gains dividends or fix earnings. A bank with a low profitability will be less able to recover itself even the smallest shock (Hardy and Schmieder, 2013).

Among the determinants of foreign origin with impact on the profitability of credit institutions we mention the GDP and the inflation rate. The researchers Pasiouras and Kosmidou in 2007 identified the existence of a positive relationship between real GDP and profitability of a credit institution. The inflation rate has a significant impact in a financial year of expenditure and revenue of the credit institution. In the year 1992, the researcher Perry have appreciated that the relationship between inflation and profitability depends on the type of inflation (expected / unexpected).

3. Data and methodology

The purpose of this research is to identify the dependency relationship between the indicator of profitability (return on assets – ROA) and internal and external determinants of banking environment. Internal determinants considered in this study are: the growth rate of the loan portfolio; the growth rate of provisions and the solvency ratio. GDP and inflation are considered to be external determinants of the banking environment.

The research focuses on a credit institution listed on the Bucharest Stock Exchange, as Carpatica Commercial Bank. The data involved in the model are the results obtained by the bank over a horizon of 10 years (2004-2013), taken from the financial statements and annual reports. As regards the external data bank's environment (GDP and the inflation rate), they were purchased by calling the databases available on the website of the National Institute of Statistics. The data were processed using statistical and mathematical software. The dependency relationship between variables was identified using Multilinear Regression and F tests and Student.

In the determining of the dependency relationship between return on assets (ROA) and the internal factors, we start with the following model:

$$\widehat{ROA}_i = \alpha_0 + \alpha_1 * RGLP_i + \alpha_2 * RGP_i + \alpha_3 * S_r + \varepsilon_i ,$$

Where:

$i = \overline{1,10}$;
ROA – Return on assets;
α – Percentage contribution rate fluctuation growth of the loan portfolio (RCPC), growth rates provisions (SPC) and the solvency ratio (Is) to the variation of the return on assets;
S_r – indicator of solvency;
RGLP – Growth rate of the loan portfolio;
RGP – growth rate provisions;
Ɛ – residual.

In the determining of the dependency relationship between return on assets (ROA) and the external factors it was taken into consideration the following model:

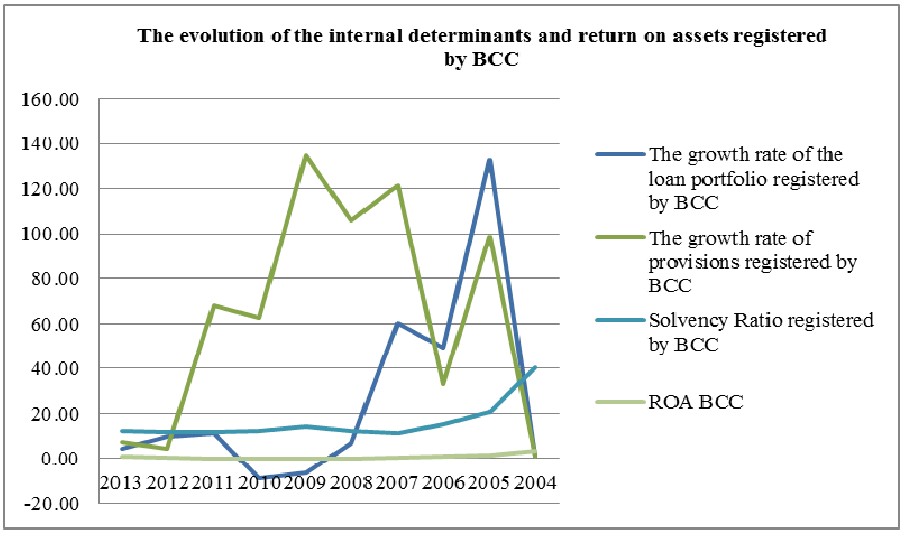
$\widehat{ROA}_i = \alpha_0 + \alpha_1 * GDP_i + \alpha_2 * RI_i + Ɛ_i$,

Where:
$i = \overline{1,10}$;
ROA – Return on assets;
α – Percentage contribution rate fluctuation of the Gross Domestic Product, inflation rate to the variation of the return on assets:
GDP – Gross Domestic Product;
RI – inflation;
Ɛ – residual.

4. Study regarding the impact of the internal determinants on ROA

The evolution of endogenous factors and rates of return on assets registered by Carpatica Commercial Bank (BCC), during 2004-2013 is shown in Figure 1.

Figure 1. *The evolution of the internal determinants and return on assets registered by BCC*



Source: authors, according to the Bank's financial statements Carpathian during 2004-2013.

In this study the goal was to identify a dependency relationship between return on assets of the credit institution (ROA), an indicator considered explained variable and determinants of domestic and foreign origin, considered explanatory variables.

The result of applying multiline regression model, using statistical and mathematical software Excel, we think it is an acceptable one (Table 1). From the analysis of the regression model ROA – internal determinants (growth rate loan portfolio growth rate provisions and the solvency ratio), the variation of return on assets is explained in the proportion of 95.80% by their variation. The adjusted value of the determination coefficient is 93.70%. Since the coefficient of determination is not significantly different

from the one registered by the adjusted one, the acceptability of the model is demonstrated.

Table 1. *Regresssion Statistics*

Regression Statistics					
Multiple R	0,978753602				
R Square	0,957958613				
Adjusted R Square	0,936937919				
Standard Error	0,258253378				
Observations	10				
ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	9,118281158	3,039427053	45,57216955	0,000159963
Residual	6	0,400168842	0,066694807		
Total	9	9,51845			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0,53991	0,24916	-2,16692	0,07337	-1,14958	0,06976	-1,14958	0,06976
The growth rate o the loan portfolio	0,00550	0,00164	3,34858	0,01545	0,00148	0,00952	0,00148	0,00952
The growth rate of the provisions	-0,00558	0,00184	-3,02929	0,02312	-0,01009	-0,00107	-0,01009	-0,00107
Solvency Ratio	0,09237	0,01025	9,00835	0,00010	0,06728	0,11746	0,06728	0,11746

Source: data processed by the authors based on the financial statements of Carpatica Bank, during 2004-2013.

On an average the observed values are deviating from the theoretical values situated on the regression line with 25.82%. The results of the ANOVA table as well as the connection obtained between the coefficient of determination (R2 = 0.958), standard error (Sε̇ = 0.07) and the calculated value of the F Test (Snedcor = 45.57) demonstrates that the model is significant in the whole. The probability in which the null hypothesis can be validated in the model (0.02%) is positioned further more below the materiality threshold chosen by 5%, which shows that the null hypothesis cannot be validated into the model.

The resulting regression equation is as follows:

ROA_{BCC}= -0.54 + 0.005 * RGLP - 0.005RGP + 0.092S_r.

For the materiality chosen, α = 0.05, the null hypothesis over the coefficients is rejected for the growth rate of the loan portfolio, the growth rate provisions and for the solvency ratio (0.05 > 0.015 - RGLP; 0.023 - RGP and 0.0001 $\mathbf{S_r}$). In case of the intercept the null hypothesis cannot be invalidated due to the calculated value of the T test, which registered values above the chosen materiality.

Basically the regression equation's coefficients can take values between -1.15 and 0.07 – in case of intercept, 0.001 and 0.009 – in case of the growth rate of the loan portfolio -0.01 and -0.001 – in case of the growth rate provision, 0, 07 and 0.12 – in case of the solvency ratio.

The estimated value of the growth rate of the loan portfolio of 0,005 shows that an increase of 1% of the loan portfolio will result in an increase in return on assets acquired by BCC 0.5%.

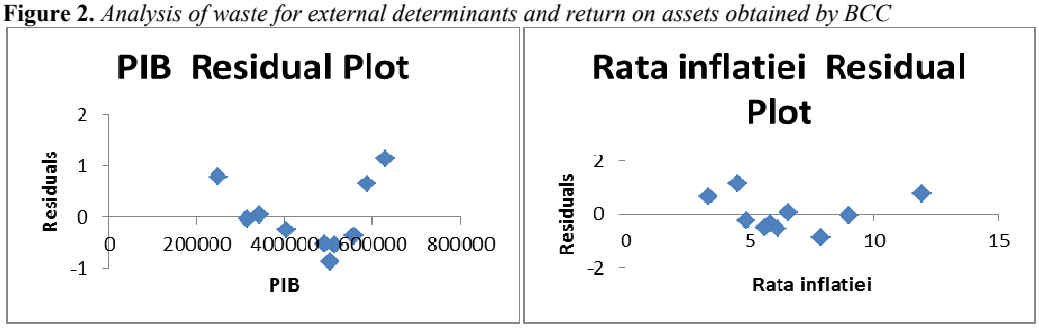
5. Study regarding the impact of external determinants of ROA indicator

The two external determinants analyzed illustrates the actual state of the national economy at time. Starting from the assumption that domestic product illustrates the welfare of the players from the economical environment and the inflation rate through its consequences on the monetary devaluation and the purchasing power affects the costs and revenues within a financial year, it was considered that the two determinants have a significant role in identifying their dependency relationships on return on assets of the credit institution.

The undertaken study identifies a dependency relationship between return on assets and external determinants (Fig. 2) showed that in case of the analyzed credit institution the regression equation obtained is hardly to be validated and to be accepted. The considerations invalidate the model for Carpatica Commercial Bank are:

- In case of the equation's coefficients the null hypothesis cannot be countered if any of them.
- The determinant coefficient value (0.59) illustrates a weak significant regression equation as a whole. Furthermore the coefficient of determination differ significantly from the adjusted one denoting a hardly validated model (0.59/0.47).
- Dispersion of errors is not a constant one.

Figure 2. *Analysis of waste for external determinants and return on assets obtained by BCC*



Source: Data processed by the authors, according to the financial statements and the Carpathian National Institute of Statistics.

In case of Carpatica Commercial Bank the variation of the return on assets is not justified by varying GDP or inflation rate. This may be due to the financed sectors is not in line with GDP structure and developments in their fields.

6. Conclusions

The study showed that in case of the analyzed credit institution, return on assets is mainly influenced by intern determinants, so the top management have a decisive central role in increasing the profitability of the credit institution.

The external determinants have no decisive influence on profitability of the analyzed commercial bank assets, due to the fact that the write-off processes and full provisioning of the non-performing loans have an important contribution in the minimization of the unwanted effects generated by the business environment and strengthen their positions at the expense of profitability. To obtain a higher return on assets, Carpathian Commercial Bank should have mainly focused on increasing the loan portfolio and a decrease of provisions to improve the solvency ratio.

Acknowledgements

This work was supported by the strategic grant POSDRU/159/1.5/S/133255, Project ID 133255 (2014), co-financed by the European Social Fund within the Sectorial Operational Program Human Resources Development 2007-2013.

References

Athanasoglou, P.P., Brissimis, S.N. and Delis, M.D. (2008). Bank-specific, industry-specific and macroeconomic determinants of bank profitability. *Journal of International Financial Markets, Institutions and Money.* 18(2). pp. 121-136.

BNR (2014). Raportul asupra stabilităţii financiare 2014. available online at: http://www.bnro.ro/ Publicatii-periodice-204.aspx

Dell'Arricia, G. and Marquez, R. (2006). Lending Booms and Lending Standards. *Journal of Finance.* 61(5). pp. 2511-2546.

Greenawalt, M. and Sinkey, J., 1988. Bank loan loss provisions and the income smoothing hypothesis: An empirical analysis, 1976-1984. *Journal of Financial Services Research.* 1. pp. 301-318.

Hardy D. and Schmieder C. (2013). Rules of Thumb for Bank Solvency Stress Testing. IM*F Working Paper*. 13/232. International Monetary Fund. Washington D.C.

Kosmidou, K. (2008). The determinants of banks' profits in Greece during the period of EU financial integration. *Managerial Finance.* 34(3). pp. 146-159.

Laeven, L. and Majnoni, G. (2003). Loan loss provisioning and economic slowdowns: Too much, too late?. *Journal of Financial Intermediation.* 12. pp. 178-197.

Liu, C. and Ryan, S. (2006). Income smoothing over the business cycle: changes in banks' coordinated management of provisions for loan losses and loan charge-offs from the pre-1990 bust to the 1990s boom. *The Accounting Review.* 81. pp. 421-441.

Pasiouras, F. and Kosmidou, K. (2007). Factors influencing the profitability of domestic and foreign commercial banks in the European Union. International Business and Finance. 21. pp. 222-237.

Perry, P. (1992). Do banks gain or lose from inflation. *Journal of Retail Banking.* 14(2). pp. 25-40.
Popovici, A. (2013). *Probabilităţi, statistică şi econometrie asistate de programul Excel.* Niculescu. Bucuresti.
Rapoartele anuale ale Băncii Carpatica SA din perioada 2004-2013, avaialable online at: www.carpatica.ro
Ruckes, M.E. (2004). Bank Competition and Credit Standards. *Review of Financial Studies.* 17(4). pp. 1073-1102.
Wahlen, J. (1994). The nature of information in commercial bank loan loss disclosures. *The Accounting Review*. 69. pp. 455-478.
www.insse.ro

Theoretical and Applied Economics
Volume XXIII (2016), No. 1(606), Spring, pp. 255-262

Effects of oil returns and external debt on the government investment: A case study of Syria

Adel Shakeeb MOHSEN
University Sains Malaysia, Penang, Malaysia
adelmhsen@hotmail.com

Abstract. *This study attempts to investigate the effect of oil returns and external debt on the government investment in Syria over the period 1970-2010. The Johansen cointegration test showed that oil returns and external debt have a positive and significant long run relationship with the government investment. The Granger causality test indicated bidirectional causality relationships between oil returns, external debt and government investment in the short and long run. The IRFs showed that when there is a shock to oil returns or external debt, the government investment will respond positively in the following years. The study result indicates that oil returns have the biggest effect on the government investment, and both oil returns and external debt play a vital role in supporting the Syrian economy by financing the government investment.*

Keywords: Syria, public sector, oil country, cointegration test, VAR.

JEL Classification: O11, E20.

1. Introduction

Government investment plays a vital role in supporting the economic growth by improving the infrastructure and creating an attractive investment claimant. Besides, oil returns and external debt also can play an important role in supporting the economic growth by financing the government investment in the country.

In the case of Syria, since 1963, Syrian economic policy was transformed toward the socialist direction, with highly centralized planning and under full public sector control (Seifan, 2009). Based on the socialist direction of the Syrian economy, the government adopted the policy of nationalization and confiscated estates from large landowners and distributed some land to the peasants and landless farmers. Furthermore, the public sector become the owner of manufacturing and mining industries, additional to natural resources, electric power plant, telecommunication companies, transportation companies, insurance companies, and banks. Moreover, the government supported the agriculture sector, created many projects to improve the infrastructure, and most international and domestic trade were controlled by the public sector (Seifan, 2009). However, since 2000, the government has worked gradually to reform the Syrian economy from a central planning to a social market economy (Brück et al., 2007). Therefore, the government has worked to improve the infrastructure, reduce the bureaucracy and administrative obstacles, create an attractive investment climate, establish industrial cities, reform the public sector, and motivate private sector investment (NAPC, 2008). Furthermore, the government has worked to upgrade the standard of living by expanding public investment in infrastructure besides education and health services, in addition to raising the purchasing power of citizens by increasing salaries and creating new job opportunities in order to achieve a social development in the country (Dardari, 2008). Unfortunately, the war which started in 2011 has caused a huge damage to the Syrian economy and created a new situation quite different than in before 2011. Many factories have been destroyed, investment has declined, the infrastructure has been damaged, public debt has increased, and many oil wells were controlled by the terrorists (SCPR, 2014).

Given this backdrop, the aim of this study is to investigate the effect of oil returns and external debt on the government investment in Syria over the period 1970-2010, in order to evaluate whether oil returns and external debt where being used properly by the government to support the Syrian economy through financing the government investment. The organization of this study is as follows. The next section is the literature review and Section 3 provides a brief discussion on the methodology. Section 4 reports the empirical results, and the conclusion and recommendations are presented in Section 5.

2. Previous Studies

Many studies have tested the effect of oil price and external debt on the government investment of different countries. The findings from these studies tend to vary from one country to another. Fasano and Wang (2002) found that total government expenditure follows oil revenue in GCC countries during 1975-2000. Garkaz et al. (2012) and Petanlar and Sadeghi (2012) also concluded that there is a positive relationship between

oil revenues and government expenditure in Iran and oil exporting countries, respectively. However, Farzanegan (2011) indicated that oil revenues affect positively and significantly the military expenditures in Iran, but it does not have any significant effect on the non-military expenditure. Hong (2010) showed that oil price has a positive effect on the government expenditure and revenue in Malaysia. Sanz and Velazquez (2002) explained that income, prices, institutional factors, population density and its age structure have significant effects on the composition of government expenditure of OECD countries during 1970-1997. Moalusi (2004) argued that there is a negative unidirectional causality relationship running from revenue to spending in Botswana during 1976-2000, and the government budget deficit can be corrected by raising taxes. However, Eita and Mbazima (2008) found that there is a positive unidirectional causality relationship moving from revenue to expenditure in Namibia during 1977-2007. Other researchers such as Narayan and Narayan (2006), Chang and Chiang (2009), Elyasi and Rahimi (2012) and Al-Zeaud (2015) also concluded that there is a positive relationship between government revenues and government expenditure in different countries. Koksal (2008) indicated that population elasticity and income elasticity affect positively the government expenditures in Turkey, while price elasticity affect it negatively. Besides, by using the Ordinary Least Square (OLS) regression method, Okafor and Eiya (2011) found that population, public debt and tax revenue have a positive relationship with total government expenditure in Nigeria, while inflation has a negative relationship with it. However, Cashel-Cordo and Craig (1990) pointed out that external debt has a negative effect on the government spending.

3. Methodology

The vector autoregression (VAR) model will be used in this study. Our model consists of three variables: government investment, oil returns, and external debt in Syria. Government investment is the dependent variable. The model is presented as follows:

$$lnGI = \alpha + \beta_1 lnOR + \beta_2 lnED + \varepsilon_t ,$$

where α is the intercept, β_1 and β_2 are the coefficients of the model, *lnGI* is the natural log of government investment in real value (millions of SYP), *lnOR* is the natural log of oil returns in real value (millions of SYP), *lnED* is the natural log of external debt in real value (millions of SYP), and ε_t is the error term.

The analysis begins with the unit root test to determine whether the time series data are stationary at levels or first difference. The Augmented Dickey Fuller (ADF) unit root test is used in this study to test for the stationary of the variables. After determining the order of integration of each of the time series, and if the variables are integrated of the same order, the Johansen cointegration test will be used to determine whether there is any long-run or equilibrium relationship between the government investment and the other independent variables in the model. If the variables are cointegrated, the Granger causality test will be conducted on the vector error correcting model (VECM) to determine the causality relationships among variables. On the other hand, if there is no cointegration among the variables, the VAR model will be employed to test for short-run

Granger causality between the variables. Furthermore, the VECM will be subjected to the statistical diagnostic tests, namely, normality, serial correlation, heteroskedasticity and Ramsey RESET tests to ascertain its statistical adequacy. Lastly, impulse response functions (IRF) and variance decomposition (VD) analysis are used in this study to help in determining whether the independent variables play any important role in explaining the variation of the forecasted government investment.

This study uses annual time series data of Syria during the period from 1970 to 2010. This data are collected from the Central Bureau of Statistics in Syria (CBS) and the World Bank (WB). All variables in this study are in real value and expressed in the logarithmic form.

4. Empirical Results and Discussion

From the results of the ADF unit root test in Table 1, we can see that all the variables are not stationary at level, but became stationary after first differencing at least at the 5 percent level of significance. This means that all the variables are integrated of order one, that is I(1).

Table 1. *ADF unit root test results*

ADF	Level			First difference		
	Intercept	Trend and intercept	None	Intercept	Trend and intercept	None
lnGI	-2.182500	-2.084947	1.556743	-5.497626**	-5.520791**	-5.294474**
lnOR	-2.354454	-2.447874	2.108806	-5.898245**	-6.117964**	-5.417661**
lnED	-2.145715	-0.387202	1.629056	-4.497559**	-6.491848**	-4.336350**

Note: ** Denotes significance at the 1 per cent level, and * at the 5 per cent level.

4.1. Johansen Cointegration Test Results

Since all the variables are stationary in the first difference, we use the cointegration test to determine the presence of any cointegration or long-run relationship among the variables based on the Johansen cointegration test. However, before running the cointegration test, we run the VAR model first to determine the optimal lag length, based on the minimum Akaike Information Criterion (AIC). The maximum lag has been set to five in the lag length selection process. The optimal lag length selected is three lags based on the AIC.

After we have determined the number of lags, we proceed with the cointegration test for the model. Table 2 shows that there are one cointegration equation based on the trace test, and two cointegration equations based on the maximum eigenvalue test. In other words, the results indicate that there is a long-run relationship between lnGI, lnOR and lnED.

Table 2. *Johansen cointegration test results*

No. of CE(s)	Trace Statistic	Probability	Max-Eigen Statistic	Probability
r = 0	53.34045***	0.0002	36.09273***	0.0003
r ≤ 1	17.24771	0.1235	15.90725**	0.0497
r ≤ 2	1.340463	0.9010	1.340463	0.9010

Note: *** Denotes significance at the 1 per cent level, and ** at the 5 per cent level.

After having found cointegration relationships among the variables lnGI, lnOR and lnED, the cointegrating equation was normalized using the real GI variable. Table 3 shows the normalized cointegrating vector.

Table 3. *Cointegration equation normalized with respect to GI*

lnGI	lnOR	lnED	C
1.000000	-4.795108	-1.950586	-177.1949
	(1.11272)	(0.94023)	(24.3415)

From the Table 3, the long-run lnGI equation can be written as:

$$lnGI = 177.1949 + 4.795108\ lnOR + 1.950586\ lnED\ .$$

The cointegration equation above shows that the GI is positively related to OR and ED. When oil returns increases by one percent, government investment will increase by 4.795 percent, and when the external debt increases by one percent, government investment will increase by 1.951 percent. This suggests that oil returns and external debt play a vital role in supporting the government investment in the country through providing the state treasury with funds that can be used by the government to finance its production activities, improve the infrastructure and create development projects that can enhance the economic growth in the country. Our finding is in the line with Fasano and Wang (2002), Hong (2010), Garkaz et al. (2012), and Okafor and Eiya (2011).

4.2. Granger Causality Tests Results

Since the variables in the model are cointegrated, the Granger causality tests based on the VECM are used to determine the short and long run causal relationships among the variables. The Granger causality test results based on the VECM are shown in Table 4. The significance of the coefficient of the lagged error correction term shows the long run causal effect. It is clear that there are bidirectional causality relationships between lnOR, lnED and lnGI in the short and long run.

Table 4. *Granger causality test results*

	Independent variables			
	∑ Δ lnGI	∑ Δ lnOR	∑ Δ lnED	ect(-1)
Δ lnGI	-	3.122074(4)**	2.764306(3)**	-2.844203**
Δ lnOR	2.094875(3)*	-	2.740743(3)**	-2.190425*
Δ lnED	3.370327(3)**	1.633204(2)	-	-3.087164**

Note: ect(-1) represents the error correction term lagged one period. The numbers in the brackets show the optimal lag based on the AIC. D represents the first difference. Only F-statistics for the explanatory lagged variables in first differences are reported here. For the ect(-1) the t-statistic is reported instead. ** denotes significance at the 5 per cent level and * indicates significance at the 10 per cent level.

4.3. Statistical Diagnostic Tests Results

It is important to subject the VECM to a number of diagnostic tests, namely, the normality, serial correlation, heteroskedasticity (BPG and ARCH) and Ramsey RESET tests to ascertain its statistical adequacy. A 5% level of significance will be used in all these tests. The results of the diagnostic tests are reported in Table 5. The VECM with lnGI, lnOR and lnED as the dependent variables pass the normality, serial correlation, heteroskedasticity (BPG and ARCH) and Ramsey RESET tests.

Table 5. *Results of the statistical diagnostic tests on the VECM*

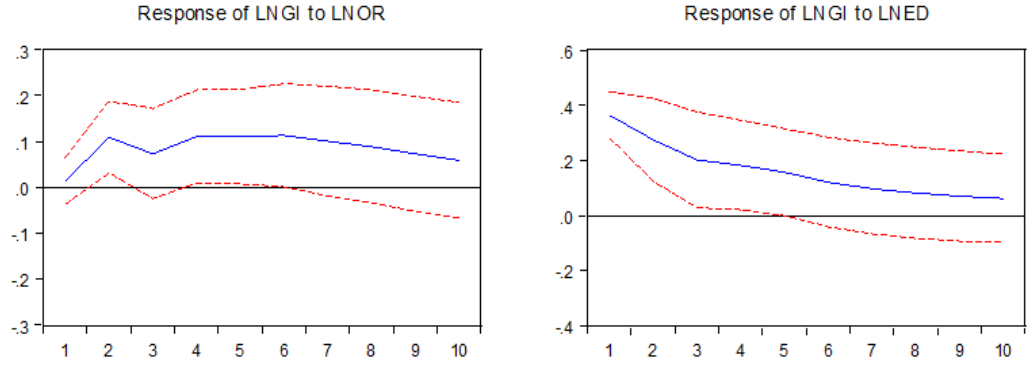
The Depended Variables	lnGEX	lnOR	lnED
Normality tests	0.544171	0.560631	0.64214
Serial correlation tests	0.3912	0.4135	0.5621
Heteroskedasticity (BPG) test	0.4312	0.3703	0.4204
Heteroskedasticity (ARCH) test	0.3236	0.5614	0.3417
Ramsey RESET tests	0.7164	0.7638	0.5276

Note: ** Denotes significance at the 1 percent level, and * at the 5 per cent level.

4.4. Impulse Response Functions (IRF) Test Results

Impulse response functions (IRF) allow us to study the dynamic effects of a particular variable's shock on the other variables that are included in the same model. Besides, we can examine the dynamic behavior of the times series over ten-year forecast horizon. There are many options for transforming the impulses. We will use the generalized impulse response functions (GIRF). Figure 1 shows that when there is a shock to lnOR or lnED, lnGI will respond positively in the following years.

Figure 1. *Generalized impulse response functions (GIRF) results*



4.5. Variance Decomposition (VD) Analysis Results

The variance decomposition (VD) for 1-year to 10-year forecast horizons will be applied to explain how much of the uncertainty concerning the prediction of the dependent variable can be explained by the uncertainty surrounding the other variables in the same model during the forecast horizon. The forecast error variance decompositions of the variables in our model are given in Table 6. In the first year, the error variance of lnGI is exclusively generated by its own innovations and has been decreasing since then for the various forecast horizons. However, at the 10-year forecast horizon, its own shocks contribute about 42% of the forecast error variance. On the other hand, lnOR and lnED shocks explain 35% and 22% of the forecast error variance of lnGI respectively. Furthermore, the contributions of lnOR and lnED in explaining lnGI forecast error variance have increased during the 10-year forecast period.

Table 6. *Variance decomposition (VD) analysis results*

Period	S.E.	lnGI	lnOR	lnED
1	0.157293	100.0000	0.000000	0.000000
2	0.239233	83.24347	16.22915	0.527386
3	0.292208	81.59974	15.17787	3.222393
4	0.333307	72.67866	20.93001	6.391328
5	0.365538	64.37190	25.54502	10.08308
6	0.394106	56.31054	29.83690	13.85256
7	0.416753	50.53617	32.34209	17.12173
8	0.434460	46.52614	33.89722	19.57664
9	0.446847	43.99910	34.68461	21.31629
10	0.455157	42.44922	35.07953	22.47125

5. Conclusion

This study investigated the effect of oil returns and external debt on the government investment in Syria using annual time series data from 1970 to 2010. The ADF unit root test, Johansen cointegration test, Granger causality tests, impulse response functions (IRF), and variance decomposition (VD) analysis were utilized in this study. The ADF test results indicate that all the variables are I(1). The Johansen cointegration test showed that that oil returns and external debt have a positive and significant long-run relationship with government investment. Furthermore, the Granger causality tests showed that bidirectional causality relationships between oil returns, external debt and government investment in the short and long run. The IRFs indicated that when there is a shock to oil returns or external debt, government investment will respond positively in the following years. The VD analysis showed that over a ten-year forecasting horizon, oil returns and external debt shocks explain 35% and 22% of the forecast error variance of government investment, respectively.

Based on the results of this study, both oil returns and external debt where being used properly by the government to support the Syrian economy through financing the government investment. Furthermore, when the war finish in Syria, oil returns and external debt can be used again by the government to rebuild what was destroyed by this war through financing and supporting the government investment in the country.

References

Al-Zeaud, H.A. (2015). The Causal Relationship between Government Revenue and Expenditure in Jordan. *International Journal of Management and Business Research.* 5(2). pp. 117-127.

Brück, T., Binzel, C. and Handrich, L. (2007). *Evaluating Economic Reforms in Syria.* Berlin: Deutsches Institut Für Wirtschaftsforschung (DIW).

Cashel-Cordo, P. and Craig, S.G. (1990). The public sector impact on international resource transfers. *Journal of Development Economics.* 32(1). pp. 17-42.

Chang, T. and Chiang, G. (2009). Revisiting the Government Revenue-expenditure Nexus: Evidence from 15 OECD Countries Based on the Panel Data Approach. *Czech Journal of Economics and Finance.* 59(2). pp. 165-172.

Dardari, A. (2008). Arab Greek Economic Relations: Present Situation & Perspectives. *In: The Second Arab Greek Economic Forum.* November 19-20. Athena.

Eita, J.H. and Mbazima, D. (2008). The Causal Relationship between Government Revenue and Expenditure in Namibia. *MPRA Paper.* (9154). pp. 1-17.

Elyasi, Y. and Rahimi, M. (2012). The Causality between Government Revenue and Government Expenditure in Iran. *International Journal of Economic Sciences and Applied Research.* 5(1). pp. 129-145.

Farzanegan, M.R. (2011). Oil Revenue Shocks and Government Spending Behavior in Iran. *Energy Economics.* 33(6). pp. 1055-1069.

Fasano, U. and Wang, Q. (2002). Testing the Relationship between Government Spending and Revenue: Evidence from GCC Countries*. IMF Working Paper*. WP/02/201.

Garkaz, M., Azma, F. and Jafari, R. (2012). Relationship between Oil Revenues and Government Expenditure Using Wavelet Analysis Method: Evidence from Iran. *Economics and Finance Review.* 2(5). pp. 52-61.

Hong, T.J. (2010). Impact of Oil Price Shocks on Government Revenue and Expenditure: Evidence for Malaysia. *Banker's Journal Malaysia.* (134). pp. 51-57.

Koksal, E. (2008). An analysis of public expenditures using the median voter theorem for Turkey. *Deü İşletme Fakültesi Dergisi.* 9(1). pp. 211-225.

Moalusi, D.K. (2004). Causal Link between Government Spending and Revenue a Case Study of Botswana*. Fordham Economics Discussion Paper Series.* Number dp2007-07.

Narayan, P.K. and Narayan, S. (2006). Government Revenue and Government Expenditure Nexus: Evidence from Developing Countries. *Applied Economic Letters.* 38(3). pp. 285-291.

National Agricultural Policy Center (NAPC). (2008). *Syrian Agricultural Trade 2007.* Damascus: National Agricultural Policy Center.

Okafor, C. and Eiya, O. (2011). Determinants of Growth in Government Expenditure: An Empirical Analysis of Nigeria. *Research Journal of Business Management.* 5(1). pp. 44-50.

Petanlar, S.K. and Sadeghi, S. (2012). Relationship between Government Spending and Revenue: Evidence from Oil Exporting Countries. *International Journal of Economic and Management Engineering.* 2(2). pp. 33-35.

Sanz, I. and Velazquez, F.J. (2002). Determinants of the Composition of Government Expenditure by Functions*.* The European Economy Group (EEG), *Working Paper.* No. 13/2002.

Seifan, S. (2009). *The Social Consequences of the Economic Policies in Syria.* Damascus: Syrian Economic Sciences Association, 9th February.

Syrian Centre for Policy Research (SCPR). (2014). *Socioeconomic Monitoring Report on Syria.* Damascus: Syrian Centre for Policy Research (SCPR).