International Journal of Economic Sciences and Applied Research

Volume 7 Issue 1 April 2014

Print ISSN: 1791-5120 Online ISSN: 1791-3373

International Journal of Economic Sciences and Applied Research

Contents

Volume 7 Issue 1 April 2014

Growth and inequality examined by integrating the Walrasian general equilibrium and neoclassical growth theories

Wei-Bin Zhang[1]

Abstract

This paper builds a heterogeneous-households growth model of a small open economy with fixed resource (land) by integrating the Walrasian general equilibrium and neoclassical growth theories. The production side consists of two sectors. We use an alternative utility function proposed by Zhang, which enable us to develop a dynamic growth model with genuine heterogeneity. The wealth and income inequality is due to household heterogeneity in preferences and human capital as well as the households' initial wealth. This is different from the standard Ramsey-type heterogeneous-households growth models, for instance, by Turnovsky and Garcia-Penalosa (2008), where agents are heterogeneous only in their initial capital endowment, not in preference or/and human capital. We simulate the model for an economy with three types of households. The system has a unique stable equilibrium point. We also simulate the motion of the national economy and carry out comparative dynamic analysis with regard to changes in the rate of interest, the population, the propensity to stay at home, and the propensity to save. The comparative dynamic analysis provides some important insights.

Keywords: growth, inequality, capital accumulation, small open economy, wealth and income distribution

JEL Classification: O31, E31

1. Introduction

Growth and inequality in wealth and income distribution has caused a lot of attention in economic growth theory (e.g., Alesina and Rodrik, 1994; Persson and Tabellini, 1994; Perotti, 1996; Li and Zou, 1998; Forbes, 2000; Barro, 2000; Chen and Turnovsky, 2010; Zhang, 2012b). Issues about growth and inequality are often main concerns in public debates in different parts of the world. It has become clear that it is necessary to study growth and inequality in wealth and income distribution in a general equilibrium growth framework. The purpose of his study is to examine growth and inequality in an integrated framework

[1] Ritsumeikan Asia Pacific University, Jumonjibaru, Beppu-Shi, Oita-ken, 874-8577 Japan; wbz1@apu.ac.jp

of the Walrasian general equilibrium and neoclassical growth theory. The Walrasian general equilibrium theory deals with analyzing equilibrium of economic exchanges with heterogeneous households and multiple sectors, while the neoclassical growth theory is focused on wealth accumulation.

The Walrasian general equilibrium theory of pure exchange and production economies has been the mainstream in economic theories with microeconomic foundation. It is proposed by Walras and further developed and refined by Arrow, Debreu and others in the 1950s (e.g., Walras, 1874; Arrow and Debreu, 1954; Gale, 1955; Nikaido, 1956, 1968; Debreu, 1959; McKenzie, 1959; Arrow and Hahn, 1971; Arrow, 1974; Mas-Colell et al., 1995). The theory is mainly concerned with market equilibrium with economic mechanisms of production, consumption, and exchanges with heterogeneous industries and households. The model in our study is Walrasian in the sense that for given levels of wealth there are competitive market equilibriums with heterogeneous industries and households. Our model is also based on neoclassical growth theory. It is well-known that the Walrasian general theory fails to be generalized and extended to growth theory of heterogeneous households with endogenous wealth. Although Walras introduced saving and capital accumulation in his general equilibrium theory, he did not succeed in taking account of capital accumulation in the general equilibrium theory (e.g., Impicciatore et al., 2012). Different attempts have been made to introduce capital accumulation into Walras' framework of heterogeneous households (e.g., Morishima, 1964, 1977; Diewert, 1977; Eatwell, 1987; Dana et al., 1989; Jensen and Larsen, 2005; Montesano, 2008). All these models lack proper microeconomic foundation for wealth accumulation of heterogeneous households. On the other hand, neoclassical growth theory has been developed since the 1950s (e.g., Solow, 1956; Burmeister and Dobell, 1970; Barro and Sala-i-Martin, 1995). The theory models endogenous wealth accumulation with microeconomic foundation (e.g., Ramsey model). This study follows Uzawa's two sector growth model in describing capital accumulation and economic structure (Uzawa, 1961). Uzawa's two-sector model has been generalized and extended in different ways over years (see, Diamond, 1965; Stiglitz, 1967; Mino, 1996; and Drugeon and Venditti, 2001; Jensen, 2003; and Jensen, 2005). Nevertheless, only a few attempts have been done to examine inequality in income and inequality within the Uzawa two-sector model. We will basically follow the Uzawa model in modelling economic structural change. Our approach is influenced not only by the neoclassical growth theory but also by the post-Keynesian theory of growth and distribution (e.g., Pasinetti, 1974; Salvadori, 1991). In most of the Post-Keynesian growth models with heterogeneous classes economic systems have a single production sector. One exception is by Stiglitz (1967) who proposes a growth model of two sectors and two classes. The Stigliz model synthesizes the post-Keynesian theory and Uzawa's two-sector model. But there are few further studies along the research line. This study deals with similar economic issues to those addressed by the Stigliz model but in an alternative approach to household behavior. Moreover, labor supply is an endogenous variable and economy is open in our approach, while labor supply is fixed and the economy is closed in the Stiglitz model.

This study deals with growth and inequality by integrating the neoclassical growth

theory with the general equilibrium theory. Moreover, our model is designed for an open economy. As observed by Chen and Turnovsky (2010, p. 332), "virtually the entire growth-inequality literature is restricted to a closed economy, which is a severe shortcoming given the increasing openness characterizing most economies". As most of economies in the world are open, it is significant to examine effects of international markets on open national economies. This study deals with dynamics of an open small economy. There are many studies on economic growth of small open economies (e.g., Obstfeld and Rogoff, 1998; Gali and Monacelli, 2005), even though most of these theoretical growth models are built for open small economies with homogeneous population. The purpose of this paper is to build a two-sector heterogeneous-households growth model for a small open economy to examine dynamics of wealth and income distribution with capital accumulation as the main engine of economic growth.

Chen and Turnovsky (2010, pp. 331-332) recognized that "Because an economy's growth rate and its income distribution are both endogenous equilibrium outcomes of the economic system, the income inequality-growth relationship – whether positive or negative – will reflect the underlying set of forces to which both are reacting. To understand these linkages, it is necessary to adopt a structural, consistently-specified general equilibrium approach." Yet, it is argued that economics still needs an analytical framework for properly dealing with issues related to income and wealth distribution and economic growth with microeconomic foundation. It is not easy to model economic growth with heterogeneous households (Sorger, 2000). The reason is summarized by Chen and Turnovsky (2010, p. 332) as follows: "In a completely general setup, where the equilibrium growth rate and income distribution are mutually dependent, their joint determination and the analysis of their relationship becomes intractable". Hence, irrespective of many efforts over years by theoretical economists, issues related to growth and inequality remain unsolved in a general dynamic equilibrium approach. This study develops a general equilibrium growth model by combining the economic mechanisms of the Walrasian general equilibrium and neoclassical growth theories with an alternative approach to households proposed by Zhang (1993). This approach helps us to overcome the problem of "analysis of their relationship becomes intractable". The paper synthesizes the ideas in the economic growth model for an open-small economy by Zhang (2012a) and the one-sector neoclassical growth model with heterogeneous households by Zhang (2012b). By combing the basic structures of the two models, we build a framework for unifying the Walrasian general equilibrium theory and the neoclassical growth theory. This study is similar to the growth model for an open economy and elastic labor supply with heterogeneous households proposed by Chen and Turnovsky (2010). Like this study, their model is also concerned with issues related to the growth and inequality relations for a small open economy. The main difference is that this study uses an alternative utility function proposed by Zhang, while Chen and Turnovsky use the traditional Ramsey approach to deal with household behavior. As mentioned later on, the Ramsey approach implies that they have to assume that heterogeneous agents differ only in their initial endowments of wealth, while the model based on Zhang's approach allows us not only allow different agents to have different initial endowments of wealth, but

also allow heterogeneous households to differ in preferences. The remainder of this study is organized as follows. Section 2 defines the model. Section 3 examines dynamic properties of the model. Section 4 carries out comparative dynamic analysis with regard to some parameters. The appendix gives the procedure for determining the monotonous differential equations in section 3.

2. The Growth Model of Economic Structure and Heterogeneous Households

We now build a small open growth model with heterogeneous households and multiple sectors. The small-open economy produces two goods: an internationally traded good (called industrial good) and a non-traded good (called services). The classification of the economic sectors is similar to that in a growth model of a small open economy, for instance, by Brock (1988), in which goods and services are divided into traded and non-traded. It should be noted that the core model in the neoclassical growth theory was the Solow one-sector growth model (Solow, 1956). The one-sector model is not suitable for analyzing economic structural change and price changes of various goods, initial extensions of the Solow model to multiple sectors were initially proposed by Uzawa (1961, 1963), Meade (1961) and Kurz (1963). In the traditional two-sector economy, output of the capital sector is used entirely for investment and that of the consumption sector for consumption. Economists have made many efforts in generalizing and extending the Uzawa two-sector model by, for instance, introducing more general production functions, more sectors, money, externalities, knowledge, human capital, and fictions in different markets (for instance, Takayama, 1985; Galor, 1992; Azariadis, 1993; Harrison, 2003; Jensen, 2003; Cremers, 2006; Herrendorf and Valentinyi, 2006; Li and Lin, 2008; Stockman, 2009; Jensen and Lehmijoki, 2011). This study adapts the traditional two-sector economic structure to an open economy. It should be noted that Jensen et al. (2001) develop a framework for analyzing the dynamics of small open economies with CES sector technologies. Although the economic production structure of our model is similar to this model, the model by Jensen et al. is developed with the homogeneous population and the traditional approach to the behavior of households. An open economy can import goods and services and borrow resources from the rest of the world or exports goods and lend resources abroad. There is a single internationally tradable good, called industrial good, in the world economy and the price of the industrial good is unity fixed in global markets. Capital depreciates at a constant exponential rate, δ_k, which is independent of the manner of use. We assume that the economy is too small to affect the world rate of interest, r^*. The households hold wealth and land and receive income from wages, land rent, and interest payments of wealth. Land is only for residential and service use. Technologies of the production sectors are characterized of constant returns to scale. All markets are perfectly competitive and capital and labor are completely mobile between the two sectors. Capital is perfectly mobile in international market and we neglect possibility of emigration or/and immigration. We assume that labor is homogeneous and is fixed.

The population is classified into J groups, each group with fixed population, $\bar{N}_j$.

Let $T_j(t)$ stand for the work time of a representative household of group j and $N(t)$ for the flow of labor services used at time t for production. We assume that labor is always fully employed. We have

$$N(t) = \sum_{j=1}^{J} h_j T_j(t) \bar{N}_j, \tag{1}$$

where h_j are the levels of human capital of group j.

Industrial sector

The industrial sector uses capital and labor as inputs. We use subscript index, i and s, to denote respectively the industrial and service sectors. Let $K_j(t)$ and $N_j(t)$ stand for the capital stocks and labor force employed by sector j, $j = i, s$, at time t. We use $F_j(t)$ to represent the output level of sector j. The production function of the industrial sector is

$$F_i(t) = A_i K_i^{\alpha_i}(t) N_i^{\beta_i}(t), \ \alpha_i, \beta_i > 0, \ \alpha_i + \beta_i = 1, \tag{2}$$

where A_i, α_i, and β_i are parameters. Markets are competitive; thus labor and capital earn their marginal products, and firms earn zero profits. The wage rate, $w(t)$, is determined in domestic market. Hence, for any individual firm, r^* and $w(t)$ are given at any point in time. The industrial sector chooses $K_i(t)$ and $N_i(t)$ to maximize profits. The marginal conditions are

$$r^* + \delta_k = \alpha_i A_i k_i^{-\beta_i}(t), \ w(t) = \beta_i A_i k_i^{\alpha_i}(t), \tag{3}$$

where $k_i(t) \equiv K_i(t) / N_i(t)$. As r^* is fixed, from (3) we have

$$k_i = \left(\frac{\alpha_i A_i}{r^* + \delta_k} \right)^{1/\beta_i}, \ w = \beta_i A_i k_i^{\alpha_i}. \tag{4}$$

Hence, we can treat k_i and w as functions of r^* and A_i.

Service sector

The service sector employs three inputs, capital $K_s(t)$, labor force $N_s(t)$, and land $L_s(t)$, to produce services. We specify the production function as

$$F_s(t) = A_s K_s^{\alpha_s}(t) N_s^{\beta_s}(t) L_s^{\gamma_s}(t), \ \alpha_s, \beta_s, \gamma_s > 0, \ \alpha_s + \beta_s + \gamma_s = 1, \tag{5}$$

where A_s, α_s, β_s, and γ_s are parameters. We use $p(t)$ and $R(t)$ to represent respectively the price of services and the land rent. The marginal conditions are

$$r^* + \delta_k = \alpha_s A_s p(t) k_s^{\alpha_s - 1}(t) l_s^{\gamma_s}(t), \quad w = \beta_s A_s p(t) k_s^{\alpha_s}(t) l_s^{\gamma_s}(t),$$
$$R(t) = \gamma_s A_s p(t) k_s^{\alpha_s}(t) l_s^{\gamma_s - 1}(t), \tag{6}$$

where

$$k_s(t) \equiv \frac{K_s(t)}{N_s(t)}, \quad l_s(t) \equiv \frac{L_s(t)}{N_s(t)}.$$

Equations (6) imply

$$k_s = \frac{\alpha_s w}{\beta_s r_\delta}. \tag{7}$$

Hence, we can treat k_s as a function of r^* and A_i.

Full employment of capital and labor

The total capital stocks utilized by the small-open economy, $K(t)$, is distributed between the two sectors. The capital stock utilized by the economy is not necessary to be owned by domestic residents. Full employment of labor and capital implies

$$K_i(t) + K_s(t) = K(t), \quad N_i(t) + N_s(t) = N(t). \tag{8}$$

Equations (8) imply

$$k_i N_i(t) + k_s N_s(t) = K(t), \quad N_i(t) + N_s(t) = N(t). \tag{9}$$

In (9), k_i and k_s, are uniquely determined by the rate of interest which is fixed in international market. Solve (8)

$$N_i(t) = \big(K(t) - k_s N(t)\big) k_v, \quad N_s(t) = \big(k_i N(t) - K(t)\big) k_v, \tag{10}$$

where $k_v \equiv (k_i - k_s)^{-1}$. We require $k_i \neq k_s$. The labor distribution is uniquely determined by the total capital utilized by the economy.

Behavior of households

We use L and $R(t)$ to stand for the fixed land and land rent, respectively. The representative household obtains income from land ownership, wealth and wage. To decide income, we need to determine who owns the land and how the land rent is distributed. Land may be owned by different agents under different institutions. For instance, in the literature of urban economics two types of land distribution are often assumed. The one is the so-

called absentee landlord. Under this assumption the landlords spend their land incomes outside the economic system. The another type, for instance as accepted in Kanemoto (1980), assumes that the urban government rents the land from the landowners at certain rent and sublets it to households at the market rent, using the net revenue to subsidize city residents equally. This study assumes the land equally owned by the population, which implies that the households equally share the land rent income. The national land rent income is equal to $LR(t)$. The land rent income per household $\overline{r}(t)$ is

$$\overline{r}(t) = \frac{LR(t)}{\overline{N}}, \tag{11}$$

where $\overline{N}$ is the total population

$$\overline{N} = \sum_{j=1}^{J} \overline{N}_j .$$

Households choose lot size, consumption levels of industrial goods and services, and save. We use $\overline{k}_j(t)$ to stand for wealth per capita owned by household j. The current income is

$$y_j(t) = r^* \overline{k}_j(t) + h_j wT_j(t) + \overline{r}(t), \tag{12}$$

where $r^* \overline{k}_j$ is the interest income, $h_j wT_j(t)$ the wage income, and $\overline{r}(t)$ the land rent income. We call $y(t)$ the current income in the sense that it comes from consumers' wages and current earnings from ownership of wealth. In the Solow one-sector growth model it is assumed that a fixed proportion of the current income is saved for the future consumption. Nevertheless, the Solowian approach neglects possible effects of wealth on households. Moreover, the available expenditure that a household spends is not necessary less than the current income as assumed in the Solow model. When the current income is not sufficient for consuming, the household may spend the past saving. We note that the total value of the wealth of household is $p_i(t)\overline{k}_j(t)$, with $p_i(t) = 1$ at any t, where $p_i(t)$ is the price of the industrial good. It is assumed that selling and buying wealth can be conducted instantaneously without any transaction cost. The disposable income is the current income plus the value of the household's wealth

$$\hat{y}_j(t) = y_j(t) + \overline{k}_j(t) . \tag{13}$$

The disposable income is used for saving and consumption. Let $T_{hj}(t)$ stand for the leisure time at time t and T_0 the (fixed) available time for work and leisure. The time is distributed between leisure and work

$$T_j(t) + T_{hj}(t) = T_0 . \tag{14}$$

The household spends the disposable income on the lot size, consumption of services, consumption of industrial goods, and saving. The budget constraint is

$$R_j(t)l_j(t) + p(t)c_{sj}(t) + c_{ij}(t) + s_j(t) = \hat{y}_j(t). \tag{15}$$

This equation implies that the household's disposable income is entirely distributed between the consumption and saving. Inserting (14) and (13) in (15) implies

$$w_j T_{hj}(t) + R_j(t)l_j(t) + p(t)c_{sj}(t) + c_{ij}(t) + s_j(t) = \bar{y}_j(t), \tag{16}$$

in which $w_j \equiv h_j w$ and

$$\bar{y}_j(t) \equiv (1 + r)\bar{k}_j(t) + w_j T + \bar{r}(t). \tag{17}$$

The utility function, $U_j(t)$, of the household is dependent on $T_{hj}(t)$, $l_j(t)$, $c_{sj}(t)$, $c_{ij}(t)$ and $s_j(t)$ as follows

$$U_j(t) = \theta_j T_{hj}^{\sigma_{0j}}(t) l_j^{\eta_{0j}}(t) c_{sj}^{\gamma_{0j}}(t) c_{ij}^{\xi_{0j}}(t) s_j^{\lambda_{0j}}, \quad \sigma_{0j}, \eta_{0j}, \gamma_{0j}, \xi_{0j}, \lambda_{0j} > 0,$$

in which σ_{0j}, η_{0j}, γ_{0j}, ξ_{0j}, and λ_{0j} are a typical household's utility elasticity of leisure time, lot size, services, industrial goods, and saving. We call σ_{0j}, η_{0j}, γ_{0j}, ξ_{0j}, and λ_{0j} household $j's$ propensities to leisure time, to consume housing, to consume services, to consume industrial goods, and to hold wealth, respectively.

It should be noted that there are some other studies which deal with similar issues like in this study. The main difference of the traditional approach from this study is about behavior of households. To illustrate the difference, we mention a study by Turnovsky and Garcia-Penalosa (2008). Their model also studies the dynamics of the distributions of wealth and income. But their model is developed in in a Ramsey model in which agents differ in their initial capital endowment and where the labor supply is endogenous. Their model assumes that the agent maximizes lifetime utility, which is a function of both consumption and the amount of leisure time as

$$Max \int_0^{\infty} T_{hj}^{\sigma}(t) c_{ij}^{\xi}(t) e^{-\beta t} \, dt.$$

The preference parameters σ, ξ, and β are the same for all types of the households. Accordingly, the so-called heterogeneous households in this approach are not heterogeneous in preference, but are different only in initial wealth. The identical preference among different types of households is "necessary" because of a well-known property of the Ramsey-type growth theory as described by Turnovsky and Garcia-Penalosa (2008), "Early work examining the evolution of the distribution of wealth in the Ramsey model assumed agents that differ in their rate of time preferences. In this framework, the most patient agent ends up holding all the capital in the long run…". This implies that if households are different in their time preferences, the entire wealth is help only by one household and

the rest of the population has no wealth in the long term. Obviously, this type of models with different time preferences is not interesting. Nevertheless, real world requires that a useful growth theory deals with heterogeneous households with different preferences. The Ramsey-type growth may not be suitable for exploring variety and heterogeneity in economic systems. Zhang (1993) proposes an alternative approach to household behavior to analyze heterogeneous households. This study is another application of Zhang's idea for modeling behavior of households.

Maximizing $U_j(t)$ subject to the budget constraint (17) implies

$$T_{hj}(t) = \frac{\sigma_j \overline{y}_j(t)}{w_j},\ l_j(t) = \frac{\eta_j \overline{y}_j(t)}{R(t)},\ c_{sj}(t) = \frac{\gamma_j \overline{y}_j(t)}{p(t)},\ c_{ij}(t) = \xi_j \overline{y}_j(t),\ s_j(t) = \lambda_j \overline{y}_j(t), \tag{18}$$

where

$$\sigma_j \equiv \rho_j \sigma_{0j},\ \gamma_j \equiv \rho_j \gamma_{0j},\ \xi_j \equiv \rho_j \xi_{0j},\ \lambda_j \equiv \rho_j \lambda_{0j},$$
$$\rho_j \equiv \frac{1}{\sigma_{0j} + \eta_{0j} + \gamma_{0j} + \xi_{0j} + \lambda_{0j}}.$$

According to the definition of $s_j(t)$, the change in wealth per capita of household j is

$$\dot{\overline{k}}_j(t) = s_j(t) - \overline{k}_j(t). \tag{19}$$

This equation simply implies that the change in wealth is the saving minus dissaving.

Full use of land and demand of and supply for services

Land is used for the residential use and service production

$$\sum_{j=1}^{J} l_j(t) \overline{N}_j + L_s(t) = L. \tag{20}$$

The equilibrium condition for services is

$$\sum_{j=1}^{J} c_{sj}(t) \overline{N}_j = F_s(t). \tag{21}$$

The national wealth is equal to the sum of the wealth owned by all the households in the country

$$\overline{K}(t) = \sum_{j=1}^{J} \overline{k}_j(t) \overline{N}_j. \tag{22}$$

The current return from net asset

As $\bar{K}(t)$ is the wealth owned by the population and $K(t)$ is the capital stock employed by the country, $\bar{K}(t) - K(t)$ is net asset in trade balance. We use $E(t)$ to denote the current return from net asset, that is

$$E(t) = r^* \left(\bar{K}(t) - K(t) \right). \tag{23}$$

We have thus built the model. It can be seen that the model is structurally a unification of the Walrasian general equilibrium and neoclassical growth theory. If we neglect the wealth accumulation and capital depreciation (i.e., capital being constant), then the model with heterogeneous households and multiple sectors belongs to the Walrasian general equilibrium theory. If we allow the households to be homogeneous, then the model is similar to the Uzawa model in the neoclassical growth theory. It should be noted that our model is not identical to the neoclassical growth theory. A main deviation from the traditional neoclassical growth theory is how to model behavior of households. We use an alternative utility function proposed by Zhang.

3. The Dynamics of the Economy

The model has many variables and these variables are interrelated to each other in complicated ways. As there are different types of households and households have different propensities and human capital levels, the dynamics should be nonlinear and of high dimension. It is difficult to get analytical properties of the nonlinear differential equations. Nevertheless, we show that we can plot the motion of the system with initial conditions with computer. Before stating the lemma, we note that we have determined k_i, w, w_j, and k_s as functions of r^*, h_j and A_i. This implies that these variables are exogenously determined by the domestic technology, the human capital levels, and the global goods and capital markets. In the rest of this study we consider these variables constant. The following lemma gives a computational procedure for plotting the motion of the dynamic system.

Lemma

The motion of the economic system with J types of household is governed the following J nonlinear differential equations

$$\begin{aligned} \dot{R}(t) &= \Omega_1 \left(R(t), \left\{ \bar{k}_j(t) \right\} \right), \\ \dot{\bar{k}}_j(t) &= \Omega_j \left(R(t), \left\{ \bar{k}_j \right\}(t) \right), \quad j = 2, ..., J, \end{aligned} \tag{24}$$

where Ω_j are functions of $R(t)$ and $\left\{ \bar{k}_j(t) \right\} = \left(\bar{k}_2(t), ..., \bar{k}_J(t) \right)$ given in the Appendix.

The lemma confirms that we have a set of nonlinear differential equations from which we can explicitly determine the motion of the J variables, $R(t)$ and $\left(\bar{k}_2(t), ..., \bar{k}_J(t)\right)$. The dimension of the dynamic system is equal to the number of types of household. In a Walrasian general equilibrium theory where households are different from each other, the dimension of the dynamic system is the same as the population. As shown in the Appendix, we use $R(t)$ rather than $\bar{k}_1(t)$ in the dynamic analysis as this enables us to find the set of differential equations by which we can solve the motion of all the variables by simulation. As shown in the Appendix, once we determine the values of $R(t)$ and $\left\{\bar{k}_j(t)\right\}$ at any point in time by the equations in the lemma, then we can obtain the values of all the other variables as functions of $R(t)$ and $\left\{\bar{k}_j(t)\right\}$ by the following procedure: $\bar{k}_1(t)$ by (A13) $\rightarrow$ $\bar{y}(t)$ by (A4) $\rightarrow$ $p(t)$ by (A10) $\rightarrow$ $T_j(t)$ by (A15) $\rightarrow$ $T_{hj}(t)$, $l_j(t)$, $c_{ij}(t)$, $c_{sj}(t)$, $s_j(t)$ by (18) $\rightarrow$ $N(t)$ by (A16) $\rightarrow$ $K(t)$ by (A12) $\rightarrow$ $K_i(t)$ and $K_s(t)$ by (A1) $\rightarrow$ $N_i(t)$ and $N_s(t)$ by (9) $\rightarrow$ $D_T(t)$ by (10) $\rightarrow$ $\bar{K}(t)$ by (22) $\rightarrow$ $L_s(t)$ by (A2) $\rightarrow F_i(t)$ by (2) $\rightarrow$ $F_s(t)$ by (5).

The lemma and this computational procedure allow us to plot the motion of the economic system once we know the initial conditions of the system and the rate of interest in the global market. It should be noted that from the proving process of the lemma in the appendix, it is straightforward to see that we still can simulate the motion of the system with the rate of interest as a function of time. Following the procedure with portable computer, we can illustrate the motion of the system. For simulation, we choose $J = 3$ and specify the parameter values

$$\begin{gathered}\bar{N}_1 = 2,\ \bar{N}_2 = 3,\ \bar{N}_3 = 5,\ h_1 = 3,\ h_2 = 1,\ h_3 = 0.5,\ A_i = 1.5,\ A_s = 1,\ \alpha_i = 0.3,\\ \alpha_s = 0.3,\ \beta_s = 0.6,\ r = 0.06,\ T_0 = 1,\ L = 10,\ \lambda_{01} = 0.8,\ \xi_{01} = 0.15,\ \gamma_{01} = 0.06,\\ \eta_{01} = 0.08,\ \sigma_{01} = 0.2,\ \lambda_{02} = 0.7,\ \xi_{02} = 0.15,\ \gamma_{02} = 0.07,\ \eta_{02} = 0.06,\ \sigma_{02} = 0.22,\\ \lambda_{03} = 0.65,\ \xi_{03} = 0.18,\ \gamma_{03} = 0.08,\ \eta_{03} = 0.05,\ \sigma_{03} = 0.25,\ \delta_k = 0.05.\end{gathered} \tag{25}$$

The rate of interest is fixed at 6 per cent. Group 1's, 2's, and 3's population are respectively 2, 3, and 5. Group 1's, 2's, and 3's level of human capital are respectively 3, 1, and 0.5. Group 1 (3) has the smallest (largest) population size and highest (lowest) human capital. The groups have also different preferences. The total available time is unity and the land is 10. From the previous section we know that capital intensities and wage rates are determined by the international rate of interest and the domestic technology. From (25) we calculate

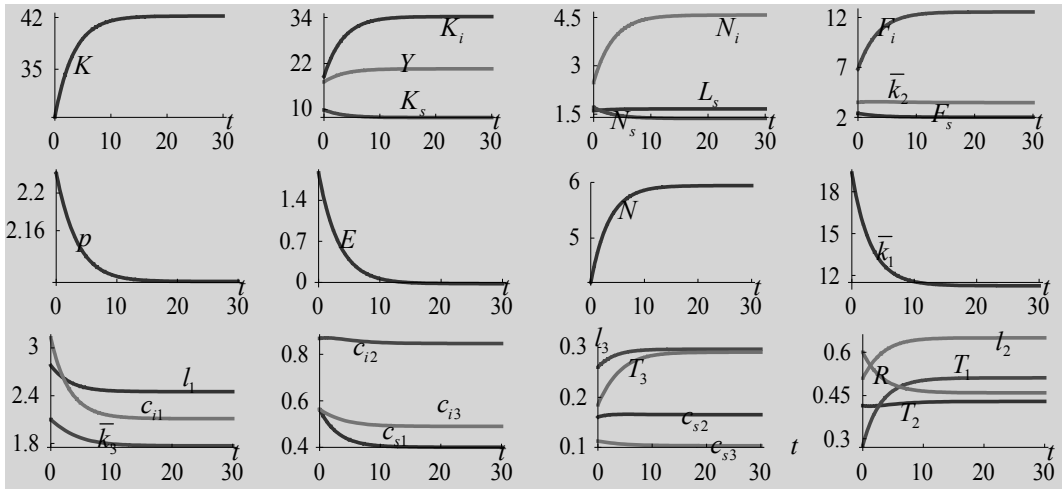
$$k_i = 7.48,\ k_s = 5.82,\ w_1 = 5.76,\ w_2 = 1.92,\ w_3 = 0.96.$$

The capital intensity of the industrial sector is higher than that of the service sector. Group 1's wage rate is highest among the three groups because of its highest human capital level. The initial conditions are specified as

$$R(0) = 0.6,\ \bar{k}_2(0) = 3.5,\ \bar{k}_3(0) = 2.1.$$

The motion of the economic system is plotted in Figure 1.

Figure 1: The Motion of the Economic System



In Figure 1, $Y(t)$ stands for the national product, defined as

$$Y(t) \equiv F_i(t) + p(t)F_s(t) + \sum_{j=1}^{J} l_j(t)\bar{N}_j .$$

The simulation confirms that the dynamic system achieves a stationary state by $t = 30$. From Figure 1 we see that the initial values of the land rent and price of services is fixed higher than their long-term equilibrium values. The two variables fall over time. The output level of the service sector falls. The output of the industrial good rises over time. The national product rises over time. The three groups all augment their work hours and the total labor force is increased. Over time the economy uses increasingly more foreign capital. The three groups reduce their consumption levels of the industrial good. Group $1's$ and Group $3's$ wealth are reduced, while Group $2's$ wealth level is slightly affected. Group $1's$ lot size is reduced, while Group $2's$ and Group $3's$ wealth level are increased. We confirmed that the system achieves at a stationary state in the long term. Simulation finds the following equilibrium values of the variables

$$Y = 20.64,\ K = 42.19,\ \bar{K} = 41.83,\ N = 5.94,\ E = -0.02,\ R = 0.46,\ p = 2.11,$$
$$F_s = 2.02,\ F_i = 12.55,\ N_i = 4.58,\ N_s = 1.37,\ K_i = 34.23,\ K_s = 7.96,\ L_s = 1.67,$$
$$\bar{k}_1 = 11.26,\ \bar{k}_2 = 3.49,\ \bar{k}_3 = 1.77,\ c_{i1} = 1,\ c_{i2} = 0.4,\ c_{i3} = 0.23,\ c_{s1} = 0.4,$$
$$c_{s2} = 0.17,\ c_{s3} = 0.1,\ l_1 = 2.45,\ l_2 = 0.65,\ l_3 = 0.30,\ T_1 = 0.51,\ T_2 = 0.43,$$
$$T_3 = 0.29.$$

We also calculate the three eigenvalues as follows

$$\{-0.42, -0.38, -0.33\}.$$

Hence, the equilibrium point is stable. The existence of a unique stable equilibrium point is important as we can effectively conduct comparative dynamic analysis.

4. Comparative Dynamic Analysis

We plotted the motion of the economic system in the previous section. This section conducts comparative dynamic analysis, demonstrating how a change in a parameter alternates paths of the economic growth. As we can describe the motion of the system for any set of parameters, it is straightforward to make comparative dynamic analysis. This study uses the variable, $\overline{\Delta}x(t)$, to represent the change rate of the variable, $x(t)$, in percentage due to changes in the parameter value.

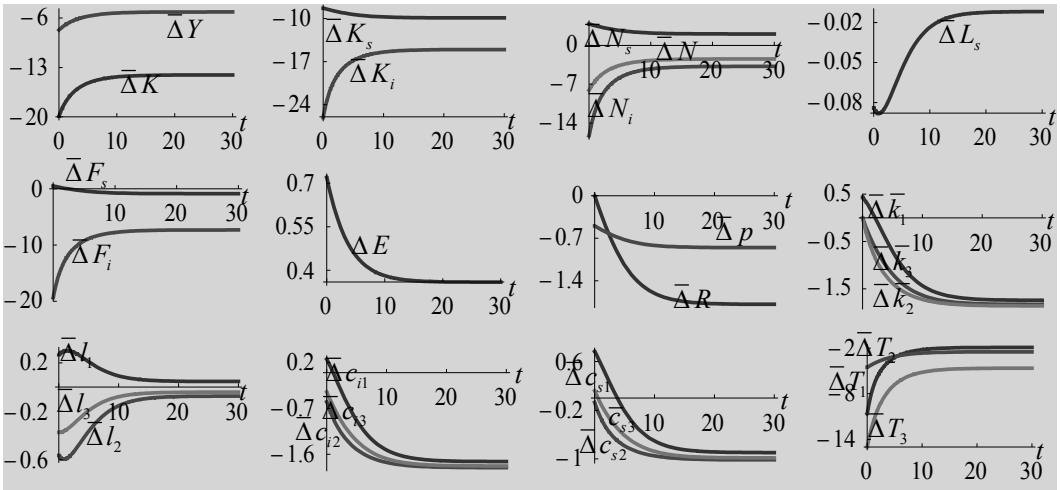
4.1 A Rise in the International Rate of Interest

First, we examine what will happen to the motion of the economic variables if the rate of interest is changed as follows: $r^* = 0.06 \Rightarrow 0.07$, where "$\Rightarrow$" stands for "being changed to". As the cost of capital in global markets is increased, the capital intensities of the two sectors and wage rates of the three groups are affected as follows

$$\overline{\Delta}k_i = \overline{\Delta}k_s = -11.69, \ \overline{\Delta}w_1 = \overline{\Delta}w_2 = \overline{\Delta}w_3 = -3.66.$$

The impacts on the time-dependent variables are plotted in Figure 2. As the wage rates are reduced, the work time of each group is reduced. The total supply of labor force and national output are decreased. As the cost of capital becomes more expensive, the economy utilizes less capital. Each sector uses less capital. The industrial sector's labor input is reduced, but the service sector's labor input is augmented. The service sector also employs less land. The price of service and land rent are reduced. The two sectors' output levels are lowered. The economy employs less capital socks and owns less wealth. The net result raises the return from net asset. Group 1's lot size is increased. The group's consumption levels of industrial goods and services are augmented initially but reduced subsequently. Group 2's and Group 3's lot sizes and consumption levels of industrial goods and services are reduced.

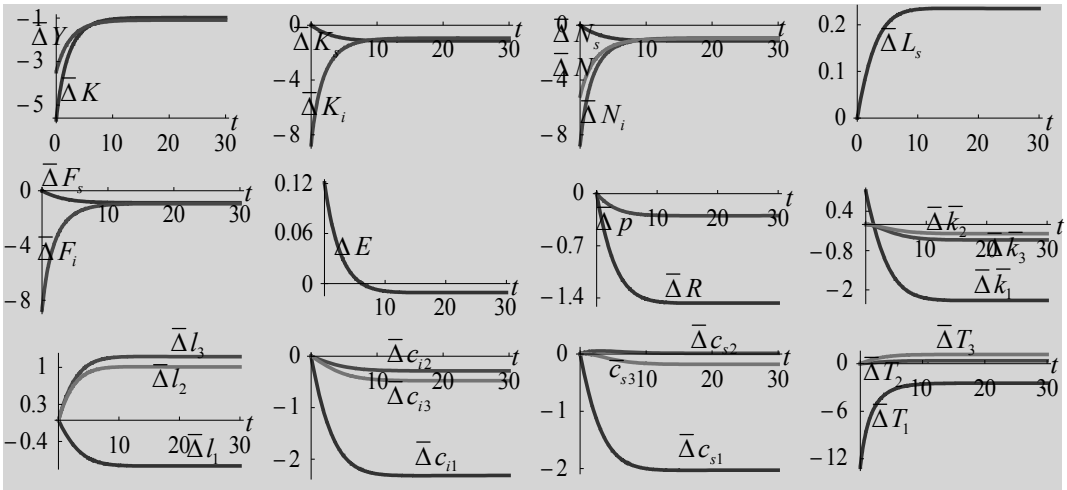
Figure 2: A Rise in the Rate of Interest in International Markets



4.2 A Rise in Group 1's Propensity to Stay at Home

Different preferences of different households are important for analyzing economic equilibrium and structure in the Walrasian general equilibrium theory. Nevertheless, the Walrasian theory does not contain proper economic mechanisms for analyzing effects of changes in one type of households on national economic growth as well as wealth and income distribution among different households. As our analytical framework integrates the economic mechanism of the Walrasian general equilibrium theory and neoclassical growth theory, in principle we can analyze effects a change in the preference of any people on the dynamic path of the economic growth. We now allow Group 1's propensity to stay at home to be increased as follows: $\sigma_{01} = 0.2 \Rightarrow 0.21$. As the group appreciates more the time staying at home, Group 1's typical household stays home longer. The change in the propensity to stay has no impact on the capital intensities and wage rates, $\bar{\Delta} k_i = \bar{\Delta} k_s = \bar{\Delta} w_j = 0$. The national labor force is reduced. The two sectors' labor inputs are reduced. As the capital intensities are fixed by international markets, the falling in the labor inputs also implies that the two sectors' capital intensities are reduced. The total capital employed by the economy is reduced. The service sector uses more land. The two sectors' output levels are lowered. As the output levels are reduced and the price and land rent are reduced, the national output falls. As the household from Group 1 works less hours, the per capita consumption levels of service and industrial goods are reduced. As the land rent falls, the household's income from land also falls. The households from Group 2 and Group 3 work more hours as their incomes fall. The two groups have larger lot sizes, even though they consume less services and industrial goods.

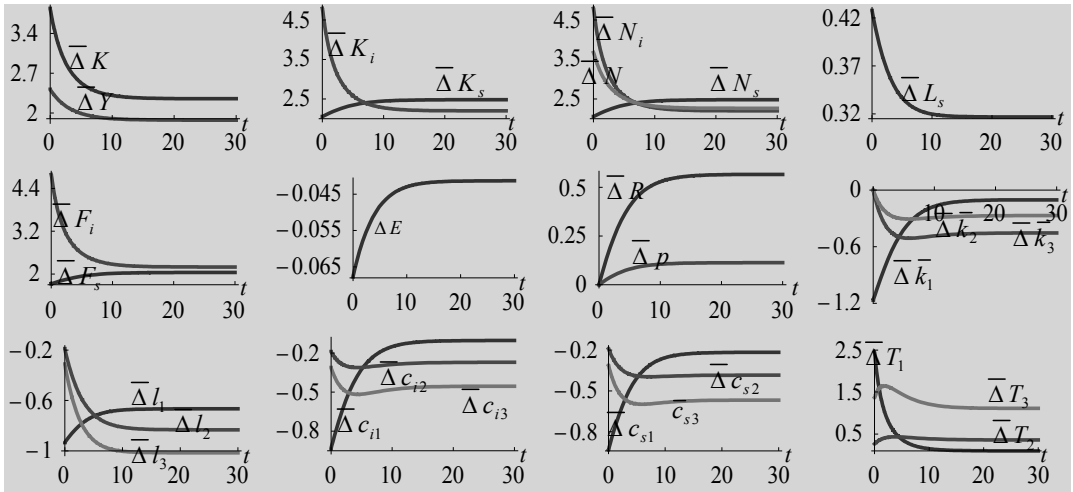
Figure 3: A Rise in Group 1's Propensity to Stay at Home



4.3 Group 3's Population Being Increased

It has been observed that the effect of population growth varies with the level of economic development and can be positive for some developed economies. Theoretical models with human capital predict situation-dependent interactions between population and economic growth (see, Ehrlich and Lui, 1997; Galor and Weil, 1999; Boucekkine, et al., 2002; Bretschger, 2013). There are also mixed conclusions in empirical studies on the issue (e.g., Furuoka, 2009; Yao et al., 2013). Our model also allows us to examine how each group's population may affect growth and inequality. We now allow group 3's population to be increase as follows: $N_3 : 5 \Rightarrow 5.2$. We have $\bar{\Delta} k_i = \bar{\Delta} k_s = \bar{\Delta} w_j = 0$. The rise in the population reduces all the groups' lot sizes and increases the land rent. The three groups also work longer hours. The three groups' consumption levels of service and industrial levels are all reduced. The total labor force, labor and capital inputs and output levels of the two sectors are all increased. We see that the national economic performance is increased, while the households suffer from the rise in the population.

Figure 4: Group 3's Population Being Increased



4.4 Group 1 Augmenting Human Capital

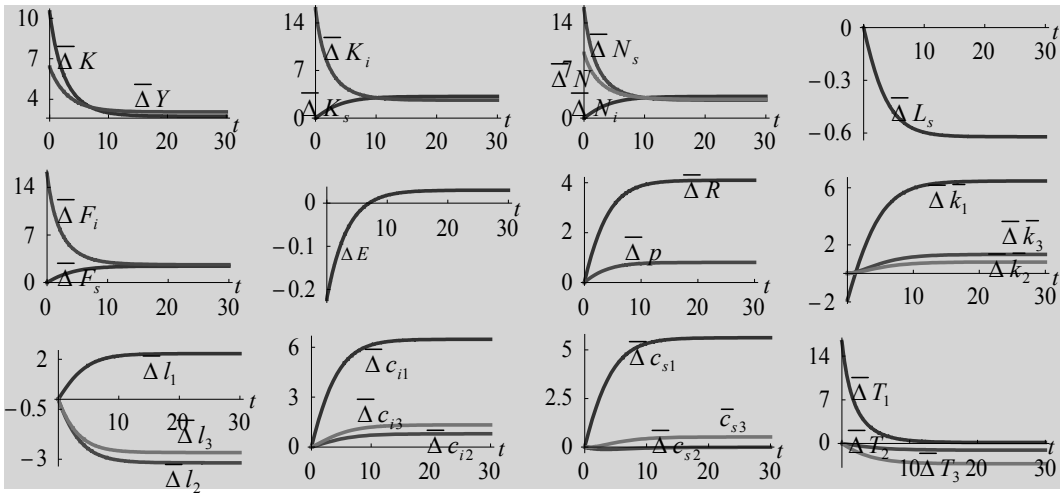
How changes in human capital can affect economic growth and inequality has been a main topic in modern economic theory and empirical research. Before the 1950s, as observed by Easterlin (1981), there were few people who had any formal education, outside North-Western Europe and North America. It has been argued by many researchers that human capital is an important factor for economic growth (e.g., Hanushek and Kimko, 2000; Barro, 2001; Krueger and Lindahl, 2001; Dimitra, et al. 2011; Castelló-Climent and Hidalgo-Cabrillana, 2012). Possible relations between human capital accumulation and earnings has caused great attention in empirical economics since Mincer (1974) published the seminal work in 1974. Earlier studies (e.g., Tilak, 1989) conclude that inequality is negatively related to spread education within countries. Could et al. (2001) find that the primary source of inequality growth within uneducated workers is due to increasing randomness, but inequality growth within educated workers is mainly due to changes in the composition and return to ability (see also Tselios, 2008; Fleisher et al. 2011). We now study how all the economic variables are connected to a change in Group 1's human capital during transitory processes and in long-term steady state. We now allow Group 1 to improve its human capital as follows: $h_1 : 3 \Rightarrow 3.2$. The effects on the capital intensities and wage rates are given as follows

$$\overline{\Delta} w_1 = 6.67, \ \overline{\Delta} k_i = \overline{\Delta} k_s = \overline{\Delta} w_2 = \overline{\Delta} w_3 = 0.$$

Group 1's wage rate is increased, while the other two groups' wage rates and capital intensities are not affected. As the group's wage rate is increased, the opportunity cost of staying at home becomes higher and Group 1 works longer hours. The total labor supply

is increased. The two sectors' labor and capital inputs and output levels are all increased. The price of service and land rent are increased. The national output rises. As Group 1 demands more housing consumption, the group's lot size is increased, while the land input of the service sector and the other two groups' lot sizes are reduced. Group 1's wealth falls initially and rises subsequently. The other two groups' wealth levels are increased. The net result reduces initially and then raises the return from net asset. Group 1 and Group 3 consume more service and industrial good. Group 1's consumption of services and industrial good are slightly affected.

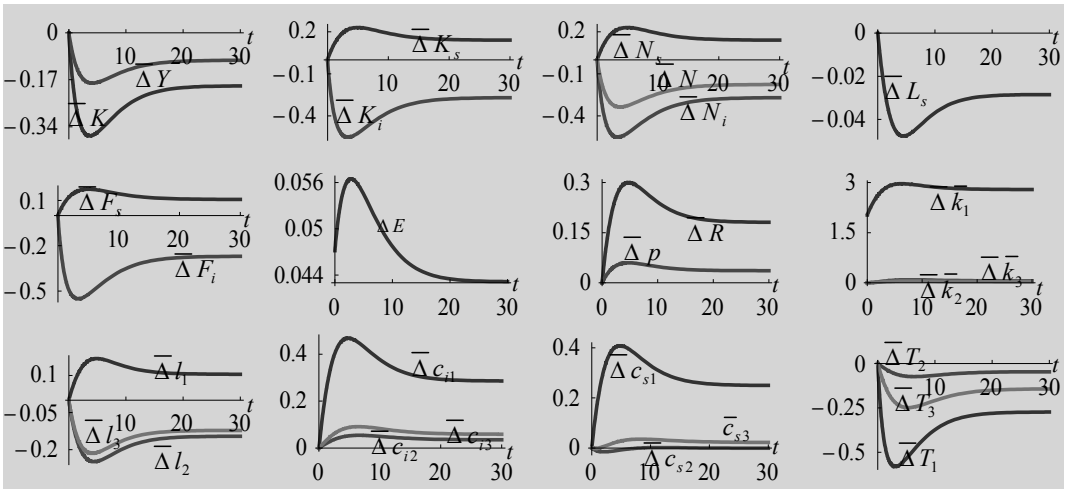
Figure 5: Group 1 Augmenting Human Capital



4.5 Group 1 Augmenting the Propensity to Save

First, we examine the case that Group 1 increases its propensity to save in the following way: $\lambda_{01} : 0.8 \Rightarrow 0.82$. The simulation results are given in Figure 6. Group 1's per capita wealth is increased. The capital intensities and wage rates are not affected. That is, $\overline{\Delta} k_i = \overline{\Delta} k_s = \overline{\Delta} w_j = 0$. We see that as Group 1 increases the propensity to save, the household from the group consumes more service and industrial good and has larger lot size. The household also reduces work hours. As the three groups all reduce work hours, the total labor supply falls. The labor input of the service sector is increased in association with the rise in the price of service. The labor input employed by the industrial sector is reduced. The total capital and capital employed by the industrial sectors are reduced, while the capital stock employed by the service sector is increased. The output level of the service sector rises, while the output level of the industrial sector falls. The return from net asset is slightly affected. It can be seen that the inequality between Group 1 and the other two groups are enlarged.

Figure 6: Group 1 Augmenting the Propensity to Save



5. Conclusion

This paper is concerned with the relationship between growth and inequality in a two-sector growth modeling framework. Both extensive theoretical and empirical studies find ambiguous relationships between growth and inequality. This paper proposed an economic growth model of a small open economy with fixed resource (land) in a perfectly competitive economy. The production side consists of one service sector and one industrial sector. Following the traditional literature of small open growth economies, we treat the rate of interest fixed in international market. We used an alternative utility function proposed by Zhang to describe the behavior of households. In our approach the wealth and income inequality is due to heterogeneity in households' preferences and human capital levels as well as the households' initial wealth. We first built a model for any number of types of household. Then we gave a computation procedure for simulating model with proper initial conditions. For illustration we simulated the model for the economy with three types of household. The system has a unique stable equilibrium point for the given parameters. We simulated the motion of the national economy and carried out comparative dynamic analysis with regard to changes in the rate of interest, the population, the propensity to stay at home, and the propensity to save. The comparative dynamic analysis provides some important insights. For instance, as the rich group increases its propensity to save, not only the group's per capita wealth is increased, but also the group's consumption levels of service and industrial good and lot size are increased. All the households of the three groups reduce work hours. The labor input of the service sector is increased in association with the rise in price of service. The labor input employed by the industrial sector is reduced. The total capital and capital employed by the industrial sectors are reduced, while the capital stock employed by the service sector is increased. The output level of the service sector rises, while the output level of the industrial sector falls. The inequality between the rich group and the other two groups are enlarged.

Acknowledgment

The author is grateful for the constructive comments and suggestions of the anonymous referee and Editor Anastasios Karasavvoglou. He is also grateful for the financial support from the APU Academic Research Subsidy, FY2013.

References

Aggelopoulou, D., Zografakis, St. and Sypsas, P., 2011, 'Distribution of poverty and inequality indices for various groups in Greece using the bootstrap technique', *International Journal of Economic Sciences and Applied Research*, 4, 2, pp. 81-97.

Alesina, A. and Rodrik, D., 1994, 'Distributive politics and economic growth', *Quarterly Journal of Economics*, 109, 2, pp. 465-490.

Arrow, K. J., 1974, 'General economic equilibrium: purpose, analytic techniques, collective choice', *American Economic Review*, 64, 3, pp. 253-272.

Arrow, K.J. and Debreu, G., 1954, 'Existence of an equilibrium for a competitive economy,' *Econometrica*, 22, 3, pp. 265–290.

Arrow, K.J. and Hahn, F.H., 1971, *General competitive analysis*, Holden-Day, Inc., San Francisco.

Azariadis, C., 1993, *Intertemporal macroeconomics*, Blackwell, Oxford.

Barro, R.J., 2000, 'Inequality and growth in a panel of countries', *Journal of Economic Growth*, 5, 1, pp. 5-32.

Barro, R.J., 2001, 'Human capital and growth', *American Economic Review*, 91, 1, pp. 12-17.

Barro, R.J. and Sala-i-Martin, X., 1995, *Economic growth*, McGraw-Hill, Inc., New York.

Boucekkine, R., de la Croix, D. and Licandro, O., 2002, 'Vintage human capital, demographic trends, and endogenous growth,' *Journal of Economic Growth*, 104, 2, pp. 340-375.

Bretschger, L., 2013, 'Population growth and natural-resource scarcity: Long-run development under seemingly unfavorable conditions', *The Scandinavian Journal of Economics*, 115, 3, pp. 722-755.

Brock, P.L., 1988, 'Investment, the current account, and the relative price of non-traded goods in a small open economy', *Journal of International Economics*, 24, 3-4, pp. 235-253.

Burmeister, E. and Dobell, A.R., 1970, *Mathematical theories of economic growth*, Collier Macmillan Publishers, London.

Castelló-Climent, A. and Hidalgo-Cabrillana, A., 2012, 'The role of education quality and quantity in the process of economic development', *Economics of Education Review*, 31, 4, pp. 391-409.

Chen, Y.C. and Turnovsky, S.T., 2010, 'Growth and inequality in a small open economy', *Journal of Macroeconomics*, 32, 2, pp. 497-514.

Could, E.D., Moav, O. and Weinberg, B.A., 2001, 'Precautionary demand for education, inequality, and technological progress', *Journal of Economic Growth*, 6, 4, pp. 285-315.

Cremers, E.T., 2006, 'Dynamic efficiency in the two-sector overlapping generalizations model', *Journal of Economic Dynamics & Control*, 30, 11, pp. 1915-1936.

Dana, R.A, Florenzano, M. and Levy, D., 1989, 'Production prices and general equilibrium prices: A long-run property of a Leontief economy', *Journal of Mathematical Economics*, 18, 3, pp. 263–280.

Debreu, G., 1959, *Theory of value*, Wiley, New York.

Diewert, W., 1977, 'Walras' theory of capital formation and the existence of a temporary equilibrium', Schwödiauer, G., *Equilibrium and Disequilibrium in Economic Theory*, Reidel, Dordrecht.

Drugeon, J.P. and Venditti, A., 2001, 'Intersectoral external effects, multiplicities & indeterminacies', *Journal of Economic Dynamics & Control*, 25, 5, pp. 765-787.

Easterlin, R., 1981, 'Why isn't the whole world developed?', *Journal of Economic History*, 41, 1, pp. 1-19.

Eatwell, J., 1987, 'Walras' theory of capital', Eatwell, J., Milgate, M., and Newmann, P., *The New Palgrave Dictionary of Political Economy*, MacMillan, London.

Ehrlich, I. and Lui, F., 1997, 'The problem of population and growth: A review of the literature from Malthus to contemporary models of endogenous population and endogenous growth', *Journal of Economic Dynamics and Control*, 21,1, pp. 205-224.

Fleisher, B., Hu, Y.F., Li, H.Z., and Kim, S.H., 2011, 'Economic transition, higher education and worker productivity in China', *Journal of Development Economics*, 94, 1, pp. 86-94.

Forbes, K., 2000, 'A reassessment of the relationship between inequality and growth', *American Economic Review*, 90, 4, pp. 869-887.

Furuoka, F., 2009, 'Population growth and economic development: New empirical evidence from Thailand', *Economics Bulletin*, 29, 1, pp. 1-14.

Hanushek, E. and Kimko, D., 2000, 'Schooling, labor-force quality and the growth of nations', *American Economic Review*, 90, 5, pp. 1194-11204.

Harrison, S.G., 2003, 'Returns to scale and externalities in the consumption and investment sectors', *Review of Economic Dynamics*, 6, 4, pp. 963-976.

Herrendorf, B. and Valentinyi, A., 2006, 'On the stability of the two-sector neoclassical growth model with externalities', *Journal of Economic Dynamics and Control*, 30, 8, pp. 1339-1361.

Gale, D., 1955, 'The law of supply and demand', *Mathematica Scandinavica*, 3, 1, pp. 33-44

Gali, J. and Monacelli, T., 2005, 'Monetary policy and exchange rate volatility in a small open economy', *Review of Economic Studies*, 72, 4, pp. 707-734.

Galor, O., 1992, 'Two-sector overlapping-generations model: A global characterization of the dynamical system', *Econometrica*, 60, 6, pp.1351-1386.

Galor, O. and Weil, D., 1999, 'From Malthusian stagnation to modern growth', *American Economic Review*, 89, 2, pp. 150-154.

Impicciatore, G., Panaccione, L. and Ruscitti, F., 2012, 'Walras' theory of capital formation: An intertemporal equilibrium reformation', *Journal of Economic Theory*, 106, 1, pp. 99-118.

Jensen, B.S., 2003, 'Walrasian general equilibrium allocations and dynamics in two-sector growth models', *German Economic Review*, 4, 1, pp. 53-87.

Jensen, B.S., Alsholm, P.K., Larsen, M.E. and Jensen, J.M., 2005, 'Dynamic structure, exogeneity, phase portraits, growth paths, and scale and substitution elasticities', *Review of International Economics*, 13, 1, pp. 59-89.

Jensen, B.S. and Larsen, M.E., 2005, 'General equilibrium dynamics of multi-sector growth models', *Journal of Economics,* 10, 1, pp. 17-56.

Jensen, B.S. and Lehmijoki, U., 2011, 'Homothetic multisector growth models', La Grandville, O. de., *Frontiers of Economics and Globalization*, Emerald, United Kingdom.

Jensen, B.S., Richter, M., Wang, C. and Alsholm, P.K., 2001, 'Saving rates, technology, trade and stochastic dynamics', *Review of Development Economics*, 5, 2, pp. 182-204.

Kanemoto, Y., 1980, *Theories of urban externalities*, North-Holland Publishing, Amsterdam.

Krueger, A.B. and Lindahl, M., 2001, 'Education for growth: Why and for whom', *Journal of Economic Literature*, 39, 4, pp. 1101-1136.

Kurz, M., 1963, 'The two sector extension of Swan's model of economic growth: The case of no technical change', *International Economic Review*, 4, 1, pp. 1-12.

Li, H.Y. and Zou, H.F., 1998, 'Income inequality is not harmful to growth: Theory and evidence', *Review of Development Economics*, 2, 3, pp. 318-334.

Li, J.L. and Lin S.L., 2008, 'Existence and uniqueness of steady-state equilibrium in a two-sector overlapping generations model', *Journal of Economic Theory*, 141, 255-75.

Mas-Colell, A., Whinston, M.D. and Green, J.R., 1995, *Microeconomic theory*, Oxford University Press, New York.

McKenzie, L.W., 1959, 'On the existence of general equilibrium for a competitive market', *Econometrica*, 27, 1, pp. 54-71.

Meade, J.E., 1961, *A neoclassical theory of economic growth*, Allen and Unwin, London.

Mino, K., 1996, 'Analysis of a two-sector model of endogenous growth with capital income taxation', *International Economic Review*, 37, 1, pp. 227-251.

Montesano, A., 2008, 'A restatement of Walras' theory of capitalization and money', *History of Economics Review*, 47, 1, pp. 86–109.

Morishima, M., 1964, *Equilibrium, stability and growth*, Oxford University Press, Oxford.

Morishima, M., 1977, *Walras' economics*, Cambridge University Press, Cambridge.

Nikaido, H., 1956, 'On the classical multilateral exchange problem', *Metroeconomica*, 8, 2, pp. 135-145.

Nikaido, H., 1968, *Convex structures and economic theory*, Academic Press, New York.

Obstfeld, M. and Rogoff, K., 1998, *Foundations of international macroeconomics*, MIT Press, Mass., Cambridge.

Pasinetti, L.L., 1974, *Growth and income distribution - essays in economic theory*, Cambridge University Press, Cambridge.

Perotti, R., 1996, 'Growth, income distribution, and democracy: What the data say', *Journal of Economic Growth*, 1, 2, pp. 149-187.

Persson, T. and Tabellini, G., 1994, 'Is inequality harmful for growth?', *American Economic Review*, 84, 3, pp. 600-621.

Salvadori, N., 1991, 'Post-Keynesian theory of distribution in the long run', Nell, E.J. and Semmler, W., *Nicholas Kaldor and mainstream economics - Confrontation or convergence?*, Macmillan, London.

Solow, R., 1956, 'A contribution to the theory of growth', *Quarterly Journal of Economics* 70, 1, pp. 65-94.

Sorger, G., 2000, 'Income and wealth distribution in a simple growth model', *Economic Theory*, 16, 1, pp. 43-62.

Tilak, J.B.C., 1989, *Education and its relation to economic growth, poverty and income distribution: past evidence and future analysis*, World Bank, Washington.

Tselios, V., 2008, 'Income and educational inequalities in the regions of the European Union: Geographically spillovers under welfare state restrictions', *Papers in Regional Science*, 87, 3, pp. 403-430.

Stiglitz, J.E., 1967, 'A two sector two class model of economic growth', *Review of Economic Studies*, 34, 2, pp. 227-238.

Stockman, D.R., 2009, 'Chaos and sector-specific externalities', *Journal of Economic Dynamics and Control*, 33, 12, pp. 2030-2046.

Takayama, A., 1985, *Mathematical economics*, Cambridge University Press, Cambridge.

Turnovsky, S.T. and Garcia-Penalosa, C., 2008, 'Distributional dynamics in a neoclassical growth model: The role of elastic labor supply,' *Journal of Economic Dynamics & Control*, 32, 5, pp. 1399-1431.

Uzawa, H., 1961, 'On a two-sector model of economic growth', *Review of Economic Studies*, 29, 1, pp. 47-70.

Uzawa, H., 1963, 'On a Two-Sector Model of Economic Growth I', *Review of Economic Studies*, 30, 2, pp. 105-18.

Walras, L., 1874, *Elements of pure economics*, translated from the French by W. Jaffé, 1954, Allen and Unwin, London.

Yao, W.J., Kinugasa, T., and Hamori, S., 2013, 'An empirical analysis of the relationship between economic development and population growth in China', *Applied Economics*, 45, 33, pp. 4651-4561.

Zhang, W.B., 1993, 'Woman's labor participation and economic growth - Creativity, knowledge utilization and family preference', *Economics Letters*, 42, 1, pp. 105-110.

Zhang, W.B., 2012a, 'Tourism and economic structure in a small-open growth model', *Journal of Environmental Management and Tourism***,** 3, 2, pp. 76-92.

Zhang, W.B., 2012b, 'Economic growth with heterogeneous households, gender division of labor, and elastic labor supply', *Journal of Income Distribution*, 21, 2, pp. 15-37.

Appendix

Proving the Lemma

We determined k_i, w, and k_s as functions of r^* and A_i. From $K_j = k_j N_j$ and (9), we have

$$K_i = \left(K - k_s N\right) k_v k_i, \quad K_s = \left(k_i N - K\right) k_v k_s, \tag{A1}$$

where we omit time variable in expressions. From (5), we solve

$$R = \frac{w_s N_s}{L_s}, \tag{A2}$$

where we also use $l_s = L_s / N_s$ and $w_s \equiv w\gamma_s / \beta_s$. Inserting (A2) in (20) implies

$$\sum_{j=1}^{J} l_j \bar{N}_j + \frac{w_s N_s}{R} = L. \tag{A3}$$

From the definition of $\bar{y}_j$, we get

$$\bar{y}_j = \left(1 + r^*\right)\bar{k}_j + w_j T_0 + \frac{RL}{\bar{N}}. \tag{A4}$$

Equation (A4) and $l_j = \eta_j \bar{y}_j / R$ in (13) implies

$$l_j = \frac{\left(1 + r^*\right)\eta_j \bar{k}_j + w_j \eta_j T_0}{R} + \frac{\eta_j L}{\bar{N}}. \tag{A5}$$

Inserting (A5) in (A3) implies

$$\sum_{j=1}^{J} \bar{n}_j \bar{k}_j + w_s N_s = \eta_0 R - \bar{\eta}_0, \tag{A6}$$

where

$$\bar{n}_j \equiv \left(1 + r^*\right)\eta_j \bar{N}_j, \quad \bar{\eta}_0 \equiv T_0 \sum_{j=1}^{J} w_j \eta_j \bar{N}_j, \quad \eta_0 \equiv \left(1 - \frac{1}{\bar{N}} \sum_{j=1}^{J} \eta_j \bar{N}_j\right) L.$$

From $r^* + \delta_k = \alpha_s p F_s / K_s$ and (16) we have

$$\sum_{j=1}^{J} c_{sj} \bar{N}_j = \frac{\left(r^* + \delta_k\right) K_s}{\alpha_s p}. \tag{A7}$$

Inserting $c_{sj} = \gamma_j \overline{y}_j / p$ in (A7) implies

$$\sum_{j=1}^{J} \gamma_j \overline{y}_j \overline{N}_j = \frac{\left(r^* + \delta_k\right) K_s}{\alpha_s}. \tag{A8}$$

Insert (A4) into (A8)

$$\sum_{j=1}^{J} \overline{\gamma}_j \overline{k}_j + \overline{\gamma}_0 = \frac{\left(r^* + \delta_k\right) K_s}{\alpha_s}, \tag{A9}$$

where we also use (10) and

$$\overline{\gamma}_j \equiv \left(1 + r^*\right) \gamma_j \overline{N}_j, \ \ \overline{\gamma}_0 \equiv \sum_{j=1}^{J} \left(w_j \gamma_j \overline{N}_j T_0 + \frac{R L}{\overline{N}} \gamma_j \overline{N}_j \right).$$

We assume $\varepsilon \neq 1$. From (6) we have

$$p = p_0 R^{\gamma_s}, \tag{A10}$$

where we also use $l_s = w_s / R$ from (A2) and

$$p_0 \equiv \frac{w}{\beta_s A_s k_s^{\alpha_s} w_s^{\gamma_s}}.$$

Insert (A10) in (A9)

$$\sum_{j=1}^{J} \overline{\gamma}_j \overline{k}_j + \overline{\gamma}_0 + a\, p_0^{1-\varepsilon} y_f^{\varphi} R^{\gamma_s (1-\varepsilon)} = \frac{\left(r^* + \delta_k\right) K_s}{\alpha_s}. \tag{A11}$$

Substitute $N_s = \left(k_i N - K\right) k_v$ from (9) into (A6) and $K_s = \left(k_i N - K\right) k_v k_s$ from (A1) into (A11) respectively yields

$$\sum_{j=1}^{J} \overline{n}_j \overline{k}_j + \left(k_i N - K\right) w_s k_v = \eta_0 R - \overline{\eta}_0,$$

$$\sum_{j=1}^{J} \overline{\gamma}_j \overline{k}_j + \overline{\gamma}_0 = \left(k_i N - K\right) \overline{k}_v, \tag{A12}$$

where

$$\overline{k}_v \equiv \left(\frac{r^* + \delta_k}{\alpha_s} \right) k_v k_s.$$

From (A12), we solve

$$\bar{k}_1 = \Omega\left(R, \left\{\bar{k}_j\right\}\right), \tag{A13}$$

where

$$\Omega\left(R, \left\{\bar{k}_j\right\}\right) \equiv \frac{\left(\eta_0 R - \bar{\eta}_0\right)\bar{k}_v - w_s \bar{\gamma}_0 k_v - \sum_{j=2}^{J}\left(\bar{k}_v \bar{n}_j + k_v w_s \bar{\gamma}_j\right)\bar{k}_j}{\bar{k}_v \bar{n}_1 + k_v w_s \bar{\gamma}_1}.$$

From (18), we have

$$T_j = T_0 - \frac{\sigma_j \bar{y}_j}{w_j}. \tag{A14}$$

Inserting (A4) in (A14) implies

$$T_j = \left(1 - \sigma_j\right)T_0 - \left(1 + r^*\right)\frac{\sigma_j}{w_j}\bar{k}_j - \frac{\sigma_j L}{w_j \bar{N}}R. \tag{A15}$$

From (1) and (A15), we have

$$N = \tilde{N} - \sum_{j=1}^{J}\bar{\sigma}_j \bar{k}_j - \tilde{\sigma} R, \tag{A16}$$

where

$$\tilde{N} \equiv T_0 \sum_{j=1}^{J}\left(1 - \sigma_j\right)h_j \bar{N}_j, \quad \bar{\sigma}_j = \left(1 + r^*\right)\frac{h_j \bar{N}_j \sigma_j}{w_j}, \quad \tilde{\sigma} \equiv \frac{L}{\bar{N}}\sum_{j=1}^{J}\frac{\sigma_j h_j \bar{N}_j}{w_j}.$$

The following procedure shows how to find all the variables as functions of R and $\left\{\bar{k}_j\right\}$: $\bar{k}_1$ by (A13) $\rightarrow$ $\bar{y}$ by (A4) $\rightarrow$ p by (A10) $\rightarrow$ T_j by (A15) $\rightarrow$ T_{hj}, l_j, c_{ij}, c_{sj}, s_j by (18) $\rightarrow$ N by (A16) $\rightarrow$ K by (A12) $\rightarrow$ K_i and K_s by (A1) $\rightarrow$ N_i and N_s by (9) $\rightarrow$ $\bar{K}(t)$ by (22) $\rightarrow$ L_s by (A2) $\rightarrow F_i$ by (2) $\rightarrow$ F_s by (5). From this procedure and (19), we have

$$\dot{\bar{k}}_1 = \Omega_0\left(R, \left\{\bar{k}_j\right\}\right) \equiv s_1 - \bar{k}_1, \tag{A17}$$

$$\dot{\bar{k}}_j = \Omega_j\left(R, \left\{\bar{k}_j\right\}\right) \equiv s_j - \bar{k}_j, \quad j = 2, ..., J. \tag{A18}$$

Taking derivatives of (A13) with respect to time implies

$$\dot{\bar{k}}_1 = \frac{\partial \Omega}{\partial R}\dot{R} + \sum_{j=2}^{J}\Omega_j \frac{\partial \Omega}{\partial \bar{k}_j}, \tag{A19}$$

where we use (A18). We do not provide the expression of the partial derivatives because they are tedious. Equaling the right-hand sides of (A17) and (A19), we get

$$\dot{R} = \Omega_1\left(R, \left\{\overline{k}_j\right\}\right) \equiv \left(\Omega_0 - \sum_{j=2}^{J} \Omega_j \frac{\partial \Omega}{\partial \overline{k}_j}\right)\left(\frac{\partial \Omega}{\partial R}\right)^{-1}. \tag{A20}$$

We thus proved Lemma.

Business cycle correlation between the Euro area and the Balkan countries

Sofia Gouveia[1]

Abstract

This paper examines the degree of trade integration and business cycle synchronisation between eight Balkan countries and the Euro area over the period 2000:1-2011:4. The main findings are that Slovenia and the Former Yugoslav Republic of Macedonia exhibit a high level of openness relative to Euro area and seem to have achieved a large degree of business cycle synchronisation with the aggregate Euro area cycle. The other Balkan countries are characterized by high trade integration with the EMU (except Greece and Turkey) and a rather modest degree of association with the Euro area cycle, although Turkey is nearest the average of the EMU countries. We further document that there is a tendency for an increase in the degree of synchronisation with EMU for all Balkan countries. We also note, however, that at the end of the period, the degree of synchronisation has become less pronounced.

Keywords: Business cycles, Synchronization, Balkan countries, European integration, Euro area

JEL Classification: E32, F15, F41

1. Introduction

Over the last decade, the future of the Balkan economies in Europe has increasingly become a subject of attention in economic literature. Also the European Commission has expressed an interest in the development of civic society in these countries, giving priority to administrative and judicial reforms and strengthening the rule of law.

In January 2007, Bulgaria and Romania joined European Union (EU) and in July 2013, Croatia became the twenty-eighth Member State. Meanwhile, other Balkan countries are at various stages of candidacy for membership in the EU. It is likely that the Balkan economies will benefit from joining the European and Monetary Union (EMU) by reduction of trade costs between its Member States and an increase in the convergence in their relations. Therefore, a relevant question is whether these economies should also expect to face high costs from EMU membership.

[1] Centre for Transdisciplinary Development Studies, Department of Economics, Sociology and Management, University of Trás-os-Montes and Alto Douro, Complexo Pedagógico, Quinta de Prados, 5001-801 Vila Real, Portugal, sgouveia@utad.pt

The traditional theory of Optimum Currency Areas (OCA), first developed by Mundell (1961), and enriched with contributions from McKinnon (1963) and Kenen (1969), among others, explores the criteria and the costs and benefits associated with participation in a monetary union. These criteria provide helpful guidelines for the investigation into whether or not certain countries would be good candidates for a monetary union[1]. The economic costs of a common currency increase with: the intensity and the frequency with which countries are affect by asymmetric shocks; the inflexibility of prices and wages; the immobility of production factors; the degree of specialisation of the economy; and the absence of fiscal federalism. In short, OCA literature holds that two countries are able to form a stable monetary union if the benefits are greater than the costs of renouncing individual monetary and exchange rate policy. Thus, the net economic benefit of a currency union with asymmetric shocks is greater the larger the trade volume, the smaller the asymmetric shocks and the larger the correlations of disturbances (Bayoumi, 1994).

A second strand in OCA literature deals with the potential endogenous effects of a common currency. Frankel and Rose (2008) argue that the fact of monetary union itself may increase trade and synchronization business cycles so that, even if a country group had not qualified as an OCA *ex ante*, it may turn into an OCA *ex post*[2]. However, Krugman (1993) suggests that a rise in trade would facilitate industry specialization across countries and hence trade would become increasingly inter-industry giving rise, consequently, to less synchronized cycles.

Regarding empirical evidence of OCAs, some seminal papers appeared in the run-up to the inception of the euro. These studies assessed why specific groups of countries may form an OCA by analyzing and comparing a variety of OCA proprieties using several econometric techniques (e.g. Bayoumi and Eichengreen, 1993, 1997; Artis and Zhang, 1997, 1999). The investigation was gradually expanded to other European countries, firstly to the Central and Eastern European countries and more recently the new Balkan countries[3]. The majority of authors used samples that included only a limited number of countries from the Balkan group (Fidrmuc, 2004; Babetskii, 2005; Afonso and Furceri, 2008; Darvas and Szapáry, 2008; Gligorov et al., 2008; Damyanov and Stefanov, 2010; Dumitru and Dumitru, 2010; Savva et al., 2010; Sideris, 2010; Benčík, 2011; Akkoyun et al., 2012; Tsanana et al., 2012; Gomez, 2012; Vesselinov, 2012; Botrić, 2013). Conversely this paper extends the analysis to a large set of Balkan countries.

In our analysis, we focus on two of the most relevant criteria: (i) the degree of economic openness and; (ii) business cycle synchronisation which has been regarded as a "meta-property" in operationalization the OCA. On the one hand, the more a country is integrated in international trade, the more benefits it can enjoy from belonging to a currency union. On the other hand, the closer the degree of cycle synchronization, the lower the stabilization costs of renouncing individual monetary and exchange rate policy will be.

[1] For a survey of the OCA literature see Mongelli (2005).

[2] See De Grauwe and Mongelli (2005) for a survey concerning the endogeneity of OCAs.

[3] Firdmuc and Korhonen (2006) provide an excellent overview on the fulfilment of the OCA criteria by Central and Eastern European Countries.

The relevance of these two criteria for assessing the costs and benefits of adopting a common currency and the fact that there is a major lack of research on them, especially in the case of the Balkan countries, has contributed to our decision to undertake the research described in this paper. In summary, the contribution of this paper is threefold: 1) to analyse how trade integration has evolved over time in the Balkan economies; 2) to explore whether the cycles of the Balkan countries are increasingly synchronised relative to that of the Euro area as a whole; 3) to provide a joint empirical assessment of these two criteria by using Frankel´s (1999) diagram.

The remainder of this paper is structured as follows. Section 2 provides a description of the data and the methods used in the empirical analysis. Section 3 presents and discusses the results. Section 4 summarizes and concludes.

2. Data and methods

We focus our assessment on two key criteria for membership in an OCA: trade intensity and business cycle synchronisation. Our investigation applies to eight countries situated in Southeastern Europe[4]. Two of them (Greece and Slovenia) are EMU members. Bulgaria and Romania have been members of the EU since 2007, and Croatia joined the Club on July 1st 2013[5]. The three other countries of our sample - The Former Yugoslav Republic of Macedonia (FYROM), Serbia, and Turkey – are formal candidates for membership. Almost all Balkan non-EMU members are using the euro as an anchor currency but they have different exchange rate regimes. Bulgaria has a euro-base currency board while the exchange rate regimes of FYROM, Croatia and Romania are characterized by a managed float, and Serbia and Turkey has an inflation-targeting strategy with a freely floating exchange rate[6].

The methodology consists of three steps. First, we analyse the degree of trade integration between the Euro area and the Balkan countries for 2000-2011. We use three measures: (i) the sum of total exports and imports of goods divided by the country´s gross domestic product (GDP); (ii) the sum of exports to and imports from the Euro area as a fraction of the country's GDP; and (iii) the sum of exports to and imports from the Euro area as a fraction of total trade. The results are compared with those of the simple (unweighted) average of the Euro area countries (EMU17) with the aim of understanding to what extent the Balkan countries are similar to EMU countries[7].

---

[4] The remaining four Balkan countries (Albania, Bosnia and Herzegovina, Kosovo and Montenegro) were not included due to data constraints.

[5] Croatia is the second, after Slovenia in 2004, of the seven states that emerged from the wreckage of Yugoslavia to join the club.

[6] For a more detailed overview of these exchange rate regimes see the IMF, 2012, Annual Report on exchange arrangements and exchange restrictions.

[7] Along the paper, Euro area, EMU and EMU17 have the same meaning. However, the use of EMU17 is to emphasize that the empirical study includes all the 17 countries that were members of the EMU at May 2013 (Austria, Belgium, Finland, France, Germany, Spain, Ireland, Italy, Luxembourg, Netherlands, Portugal, Greece, Slovenia, Cyprus, Malta, Slovakia and Estonia).

For the Balkan countries, the annual bilateral trade flows in goods, total exports and imports, and GDP are from the Statistical Database of the United Nations Conference on Trade and Development (UNCTAD)[8]. The trade indicators for EMU17 were provided by Eurostat (accessed in March 2013).

The second step in our assessment is a comparison of the association between the aggregate Euro area and Balkan countries' business cycles. We use seasonally adjusted quarterly real GDP, which in general covers the 2000:1-2011:4 period. The Euro area aggregate includes the seventeen current EMU Member States. Full details about the data sources are provided in Table 1. The definition of the sample period was constrained by the unavailability of quarterly GDP data further back in time.

The econometric framework adopted here corresponds to a *deviation cycle* approach to the measurement of the business cycle. The cyclical components were obtained by filtering the log of real GDP with the band-pass (BP) filter (Baxter and King, 1999) and the Hodrick-Prescott (HP) filter (Hodrick and Prescott, 1997)[9].

Table 1: Data sources

Country (EU/EMU accession year)	Sample period	Source
Bulgaria (EU - 2007)	2000:1-2011:4	Eurostat (1997:1-2012:4)
Croatia (EU - July 2013)	2000:1-2011:4	Eurostat (2000:1-2012:3)
FYROM (candidate)	2004:1-2011:4	Eurostat (2004:1-2012:3)
Greece (EMU - 2001)	2000:1-2011:1	Eurostat (2000:1-2011:1)
Romania (EU - 2007)	2000:1-2011:4	Eurostat (2000:1-2012:4)
Serbia (candidate)	2001:1-2011:4	NBS (2001:1-2012:3)
Slovenia (EMU - 2007)	2000:1-2011:4	Eurostat (1995:1-2012:4)
Turkey (candidate)	2000:1-2011:4	OECD (1998:1-2012:3)
EMU17	2000:1-2011:4	Eurostat (1995:1-2012:4)

Note: The main source is the Eurostat, but the real GDP for Serbia has been extracted from databases of the National Bank of Serbia (NBS), and the real GDP for Turkey from OECD National Accounts database (accessed in March 2013).

We gauge synchronisation using two measures: (i) the Spearman's rank correlation coefficient, computed between the business cycle of individual Balkan countries and the Euro area aggregate cycle; and (ii) the indices of concordance introduced by Harding and Pagan (2002), which measure the proportion of time in which two series are in the same cyclical phase. As a reference, we also compute the degree of business cycle synchronization within

[8] For Serbia, trade data are only available from 2008. Before this, Serbia and Montenegro were constituted as a state union.

[9] For the HP the smoothing parameter λ was set at 1600, which is the conventional value for quarterly data. We obtained results that are qualitatively similar with both filters. The results obtained with HP filter are available on request.

the Euro area, measured as the simple average of the correlations coefficients/concordance indices of each EMU17 member's cyclical component with the cyclical component of the aggregate EMU17. We also calculate the mean absolute deviation of the corresponding business cycle, which enables us to see the volatility of the Balkans' business cycles.

In order to study the development of business cycle synchronisation along the sample period we employ versions of the correlation/concordance indices for several sub-samples. First, we compute rolling measures using a window of 16 observations. Then, we calculate the indices in fixed intervals of four years, defined according to relevant events in European integration for the Balkan countries.

The first is from 2000 to 2003, which is a period marked by the setting up of the Stabilization and Association Process, the framework for EU negotiations with the Western Balkan countries. The second sub-period is from 2004 to 2007, and it covers the enlargement of EU with countries from Central and Eastern Europe. The last sub-period, from 2008 to 2011, corresponds to the global economic crisis and sovereign debt crisis in the Euro area.

In a final step, we use the Frankel's (1999) diagram relating trade integration with business cycle sychronisation as joint criteria for assessing how appropriate the adoption of the euro by Balkan countries would be. We consider the overall period and two sub-samples: the pre-crisis period (2000-2007) and the crisis period (2008-2011).

3. Results and discussion

3.1 Trade integration

Table 2 displays the degree of openness relative to EMU17, the total degree of openness to the World, and the share of trade with EMU17 as percentage of total trade for each Balkan country and for the average of the EMU17 countries. The figures reported are averages for the period 2000-2011.

Table 2: International trade in goods for Balkan countries, 2000-2011

	Bulgaria	Croatia	FYROM	Greece	Romania	Serbia	Slovenia	Turkey	EMU17
Trade with EMU (% of GDP)	46.6	32.7	40.8	13.8	36.7	23.2[1)]	59.9	14.4	31.7
Trade with world (% of GDP)	99.2	58.6	92.3	30.9	67.5	60.2[1)]	109.0	40.3	62.7
Trade with EMU (% of total trade)	47.3	55.8	44.4	44.9	54.4	38.6[1)]	55.6	36.1	50.6

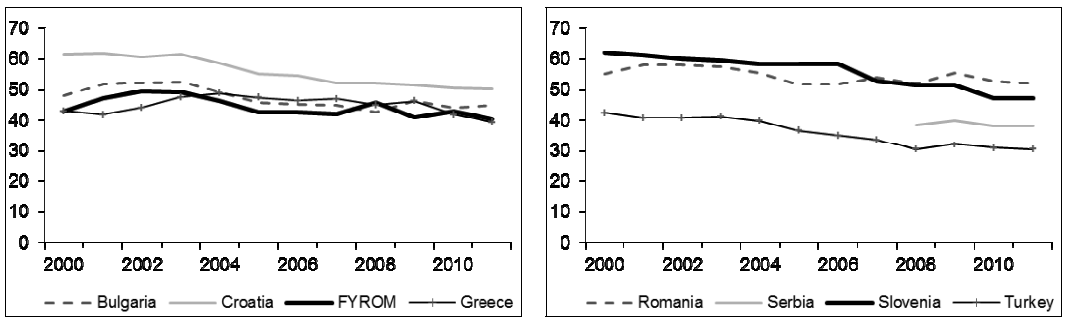
Sources: United Nations Conference on Trade and Development (accessed in March 2013); Values for EMU17 are from the Eurostat (accessed in March 2013)

Note: [1)] Data for 2008-2011.

It can clearly be seen that there are significant differences in the degree of openness among the countries under analysis. It is important to note that five countries (Slovenia, Bulgaria, FYROM, Romania and Croatia) have a degree of openness with EMU17 higher than the average of intra-EMU trade. The lowest openness ratios are those of Greece and Turkey, whose average of exports to and imports from EMU17 represents about 14% of the respective GDP. The proportion of trade with EMU17 varies from 36% of total trade (Turkey) to 55.8% (Croatia).

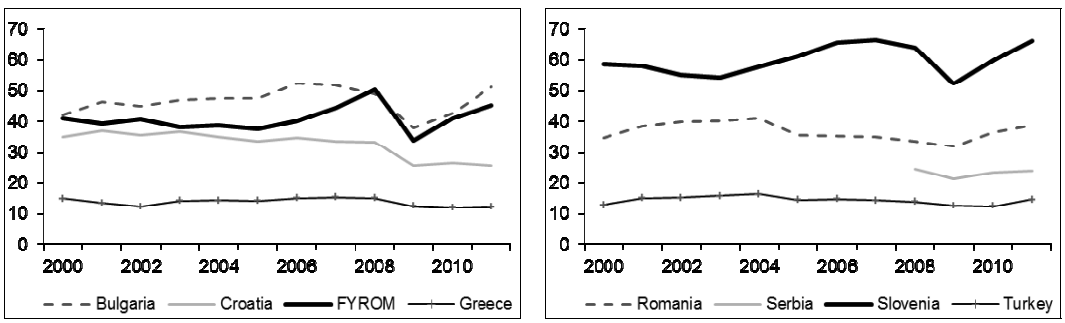
The evolution of trade with EMU both as a percentage of overall trade and of GDP through the period between 2000 and 2011 is given in Figures 1 and 2.

Figure 1: Trade with the EMU as a percentage of total trade for Balkan countries, 2000-2011



Source: United Nations Conference on Trade and Development (accessed in March 2013)

Figure 2: Trade with the EMU as a percentage of GDP for Balkan countries, 2000-2011



Source: United Nations Conference on Trade and Development (accessed in March 2013)

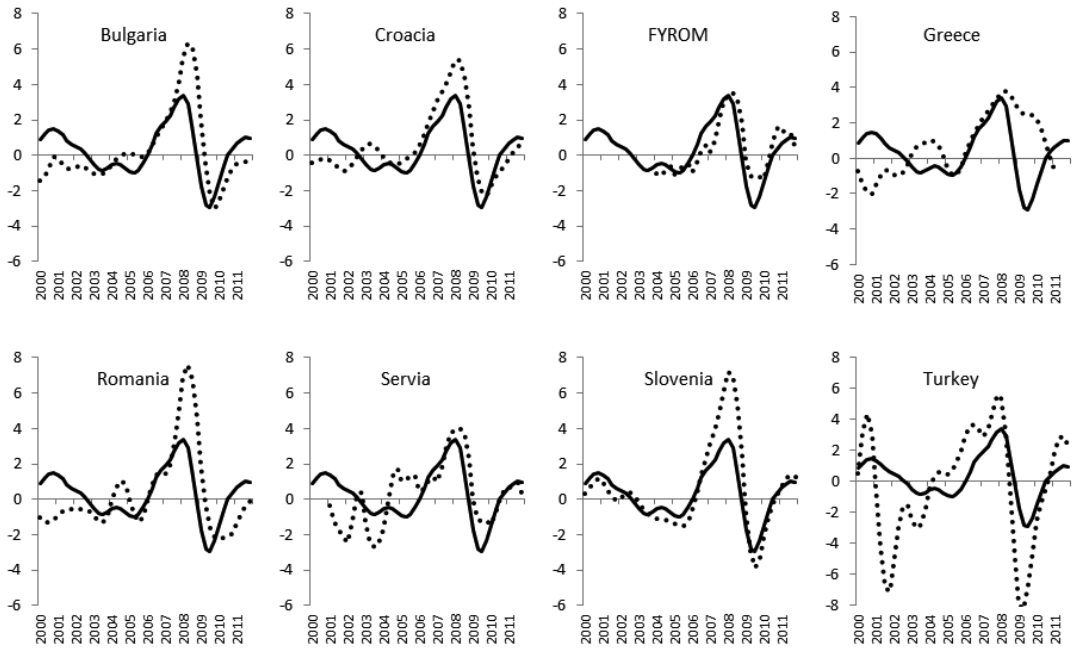
Figures 1 and 2 show some relevant tendencies over the past eleven years. On the one hand, there is a visible tendency to decrease the share of EMU trade as a proportion of total trade in all countries, this being more pronounced in Slovenia and Turkey. On the other hand, if we ignore the year of 2009, when the world crisis caused a contraction in

global trade (IMF, 2010), almost all countries had a tendency to increase their openness ratio or at least, to maintain it.

3.2 Business cycle synchronization

Figure 3 displays the cyclical component of real GDP, identified with the BK filter, with solid and dotted lines representing the cycle of Euro area aggregate (EMU17) and of each of the eight Balkan countries respectively, over the period of 2000:1-2011:4. Visual inspection of the figure suggests that all countries experienced expansionary business cycles from the first quarter of 2006 to the fourth quarter of 2008 when the global economic and financial crisis affected the Balkan economies. This is followed by a period of recession which seems to have been particularly prevalent in Turkey, which records a deviation from the trend of -8.2% in 2009:2, which is higher than the deviation from the trend of -7.1% in 2001:4.

Figure 3: Business cycles of Balkan countries and EMU



Source: Author's calculations

Table 3 displays, for the overall period, our two measures of synchronization of each country's cyclical component with that of EMU, as well as the measure of the volatility of business cycles.

Table 3: Business cycle synchronization vis-à-vis the EMU, 2000:1-2011:4

	Bulgaria	Croatia	FYROM	Greece	Romania	Serbia	Slovenia	Turkey	EMU17
Correlation	0.48*	0.54*	0.83*[2)]	0.03	0.45*	0.49*[3)]	0.93*	0.67*	0.81*
Concordance	0.56	0.56	0.88[2)]	0.36	0.52	0.61[3)]	0.92	0.67	0.84
Volatility of business cycle	1.50	1.37	1.25[2)]	1.42	1.73	1.42[3)]	1.76	3.01	1.14

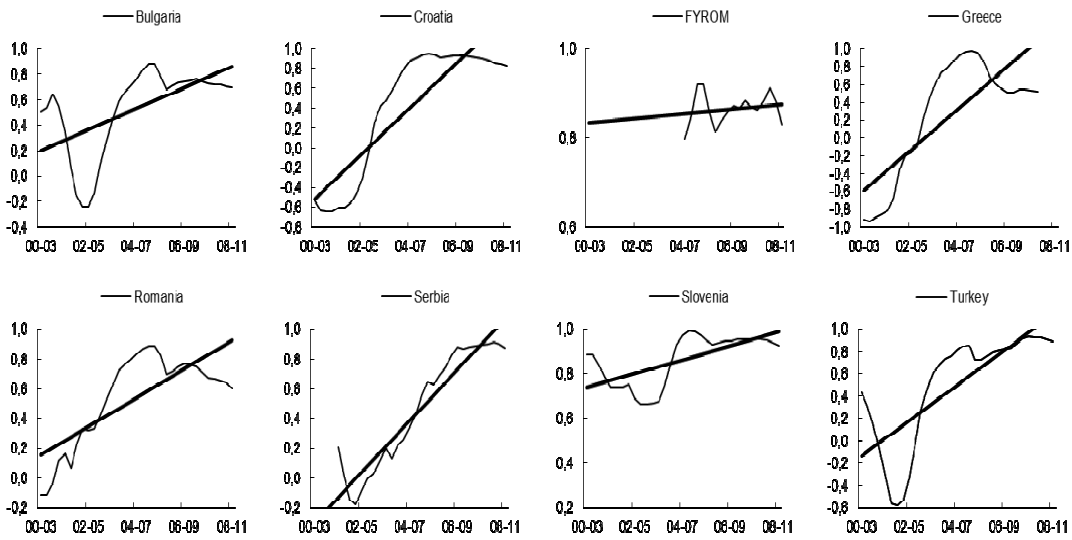
Source: Author's calculations

Notes: (*) Indicates statistical significance at a level of 1%.
[2)] Data for 2004-2011
[3)] Data for 2001-2011

As Table 3 shows, we obtained similar results with the two measures of synchronization. All countries, except Greece, display a positive and statistically significant business cycle correlation with EMU. Out of the eight Balkan countries, Slovenia and FYROM exhibit a strong association with the Euro area cycle. It is remarkable that these two countries show a higher degree than the synchronization recorded by the individual members of EMU (they display a simple mean of 0.81 and 0.84, for correlation and concordance, respectively). The remaining countries display rather modest levels of association with the Euro area cycle. Concerning the amplitude of the cycles, all the countries are above the EMU17 average. Turkey registers the highest volatility (3.01) while FYROM and Croatia are the countries with the lowest volatility (1.25 and 1.37, respectively).

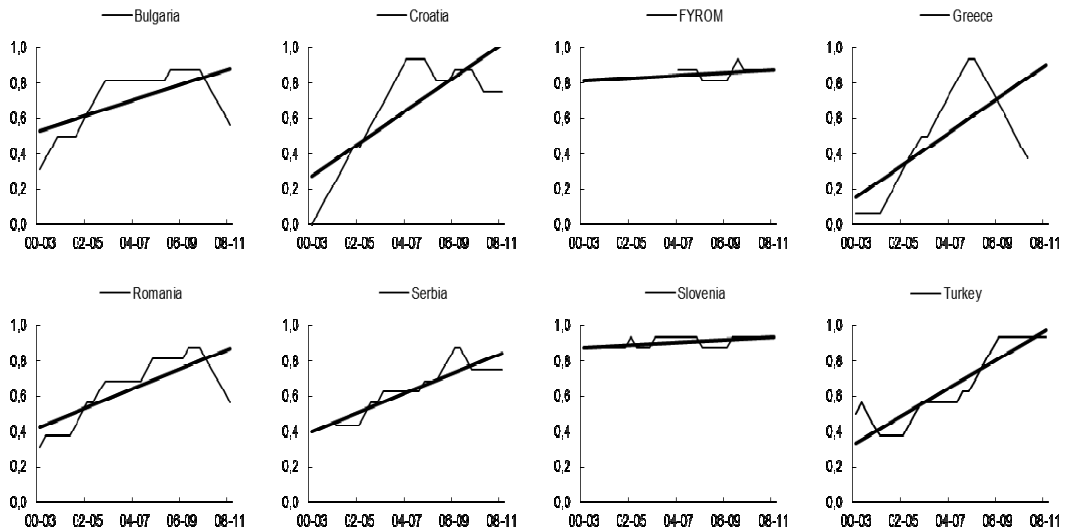
Next, we move to a sequential analysis of the 2000-2011 period. Figures 4 and 5 show the rolling-estimations for business cycle synchronization, as well as a linear trend of sequential synchronization. Overall, analysis of figures 4 and 5 suggests that there is a gradual tendency for an increase in the degree of synchronization with EMU17 for all Balkan countries. However, at the end of the period, we should point out a slight reduction of synchronization.

Figure 4: Rolling correlations coefficients of individual cycles with the EMU



Source: Author's calculations

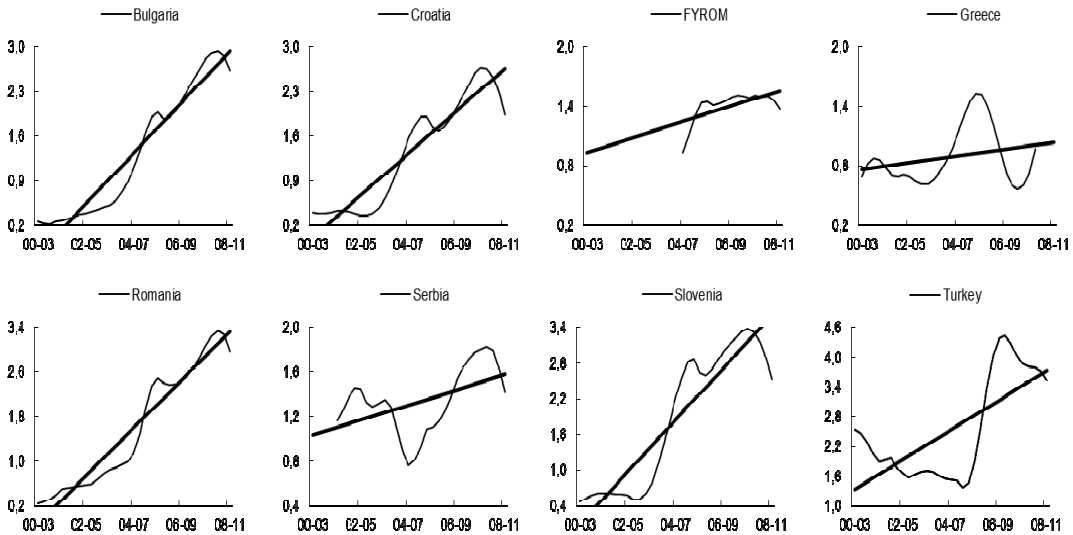
Figure 5: Rolling concordances of individual cycles with the EMU



Source: Author's calculations

Figure 6 compares the volatility of the business cycles of each Balkan country, presenting the value of the mean absolute deviation for rolling periods of 4 years. The figure clearly shows that all Balkan countries exhibit a clear upward trend in the amplitude of their cycles.

Figure 6: Rolling mean absolute deviation in business cycles



Source: Author's calculations

The results of business cycle synchronization between each Balkan country and the Euro area for the three selected sub-samples are provided in Table 4. Looking at the period 2000-2003 it is clear that Slovenia has business cycles that may be considered significantly synchronized with that of the Euro area, with a correlation coefficient and a concordance index of 0.89 and 0.88, respectively. In the case of Bulgaria and Turkey the degree of synchronization is relatively modest. Among the remaining four countries, there are two cases of negative and statistically significant correlations (Greece and Croatia). In the second sub-period we can see that for all countries (with the exception of Serbia) the cycle is relatively well synchronized, and Slovenia shows an almost perfect correlation with the Euro area. The most striking fact to emerge from comparing the first to the second sub-period is that the degree of synchronisation with EMU has increased remarkably for all countries. By contrast, in the recent recession period almost all countries show a decrease in the synchronization between their cycles and the Euro area cycle.

Table 4: Business cycle synchronization vis-à-vis the EMU for sub-periods

	Sub-period	Bulgaria	Croatia	FYROM	Greece	Romania	Serbia	Slovenia	Turkey
Correlation		0.51	-0.53	–	-0.91	-0.11[a]	0.45[a]	0.89	0.44
Concordance	2000-2003	0.31	0.00	–	0.06	0.31	0.31	0.88	0.50
Volatility		0.27	0.40	–	0.69	0.25	0.87	0.47	2.55
Correlation		0.76	0.88	0.80	0.92	0.83	0.34[a]	0.98	0.81
Concordance	2004-2007	0.81	0.94	0.88	0.75	0.69	0.63	0.94	0.56
Volatility		1.11	1.57	0.94	1.11	1.15	0.76	2.21	1.53
Correlation		0.70	0.83	0.83	0.25[a]	0.61	0.88	0.93	0.90
Concordance	2008-2011	0.56	0.75	0.88	0.38	0.56	0.75	0.94	0.94
Volatility		2.64	1.94	1.37	1.09	2.98	1.43	2.54	3.52

Source: Author's calculations

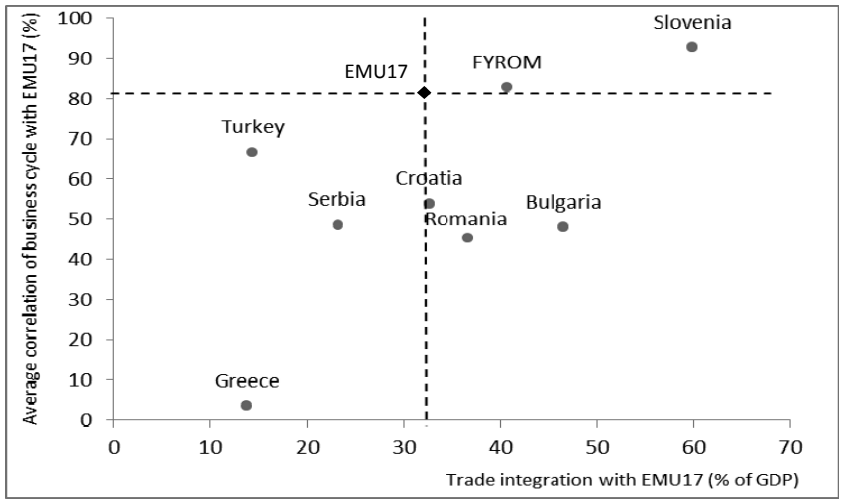
Note: ([a]) The correlation coefficient is not statistically significant at the 10% level.

As an analysis from the Economist Intelligence Unit (2012) notes, the Balkan transition economies (such as Bulgaria, Croatia, FYROM, Romania and Serbia) suffered the most from the global recession of 2008-09 with the recession lasting into 2010. This was partly because Romania, the largest of the Balkan economies, dragged the average figure down.

3.3 A joint assessment

Following Frankel (1999), in order to judge the readiness of Balkan countries to join the euro we provide in Figure 7 a joint assessment of the two criteria. The figure jointly displays the degree of trade integration with EMU17 (as a percentage of the GDP) from Table 2 and the cyclical correlation of each country with the Euro aggregate cycle from Table 3. As a reference point, our diagram includes the average figures of intra-EMU trade and cyclical correlation for EMU17, as well as a vertical and a horizontal line crossing the EMU17 *locus*. These lines define four quadrants in the diagram.

Figure 7: Trade integration and Cyclical correlation with EMU, 2000-2011

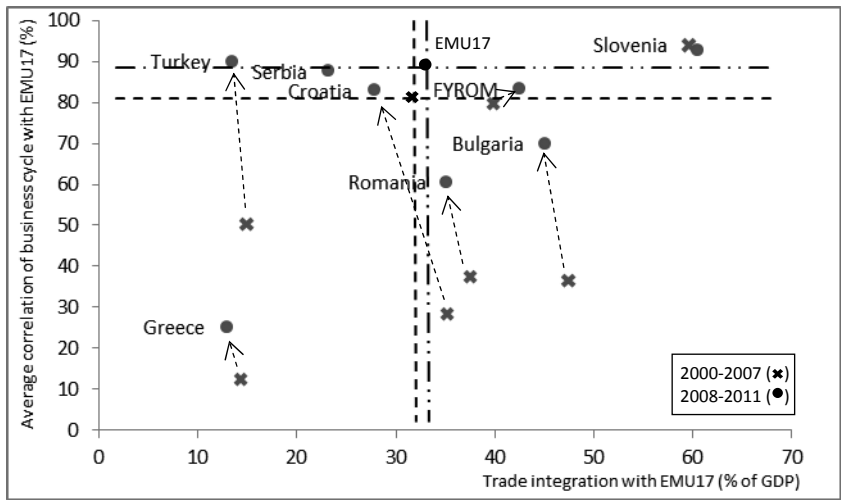


Source: Author's calculations

The figure shows that two countries lie in the first quadrant: Slovenia and FYROM are the countries in the sample that perform better than the average of EMU17 in both criteria. Three countries: Greece, Serbia and Turkey, fall in the third quadrant. These fare worse than the average of EMU17 in both criteria, although Turkey is nearest the EMU average concerning cycle correlation. The remaining countries (Croatia, Romania and Bulgaria) fall into the fourth quadrant because they perform better than the EMU average concerning trade with Euro area whilst faring worse than the average concerning synchronization of business cycles.

As Frankel (1999) points out, "such parameters as openness and cyclical correlation are not fixed for all time". To understand better the evolution of the two criteria over the sample period we provided in figure 8 a diagram with the average of the openness to EMU and the average of cycle correlation for the period pre-crisis (2000-2007) and the average openness to EMU and the cyclical correlation for the crisis period (2008-2011). The values for the sub-period 2000-2007 are represented with crosses and those for the sub-period 2008-2011 with circles. Essentially, from the 2000-2007 to the 2008-2011 period, the Balkan countries intensified in terms of cycle correlation; in contrast there appears to be a slight decrease of trade openness relative to EMU17. Only Slovenia and FYROM increased slightly in trade openness. In this analysis by sub-periods the EMU17 average recorded an increase in cycle correlation slightly larger than the increase in correlation in trade openness.

Figure 8: Trade integration and Cyclical correlation with EMU, for sub-periods



Source: Author's calculations

4. Summary and conclusions

In this paper we have examined elements that could help us decide whether a country entering the EMU has the conditions to be successful, and how successful of the countries under analysis are likely to be. According to traditional OCA theory, the best suited candidates for currency union are characterized by a high degree of trade integration and a large business cycle synchronisation so that renouncing their individual monetary and exchange rate policies would not give rise to major economic costs. Bearing this in mind, we analised the degree of economic integration between the Euro area and eight Balkan countries. Two of them (Greece and Slovenia) are EMU Members, three are EU Members (Bulgaria, Romania and Croatia) and the remaining three (FYROM, Serbia, and Turkey) are candidates for EU membership.

First, we have computed three measures of trade intensity between the Euro area and the Balkan countries for 2000-2011. Second, we have calculated a number of alternative measures of synchronisation and volatility in order to characterise the degree of association between the aggregate Euro area and Balkan countries' business cycles, as well as their progress during the period between 2000 and 2011. With regard to the first criteria, the results of the paper show that, with the exception of Greece and Turkey, the Balkan countries are relatively open to trade and have significant trade links with the EMU, implying potential benefits from decreased transaction costs and a lower risk of asymmetric shocks.

With regard to the second criteria, our results point to a positive and statistically significant degree of synchronisation of Balkan countries (except Greece) vis-à-vis the EMU-wide business cycle. Croatia, Turkey, Bulgaria and Romania show a strong increase

in business cycle correlation from the period 2000-2007 to 2008-2011. Notwithstanding, when we consider the full period the majority of countries present a moderate degree of association, quite far away from those of the EMU average. Slovenia and FYROM are an exception as they have a high degree of association with the Euro area cycle, with correlation/concordance above the average correlation/concordance for the EMU Member States. Greece is a very special case as it presents both poor synchronisation of its cycles, as well as a very low level of openness with the Euro area. On the other hand, all the Balkan countries present a high volatility in their cycles, which is greater than the EMU average.

We have documented that the degree of business cycle synchronisation in Balkan countries has changed over the time studied, on the basis of measures of correlation, concordance, and standard deviation for a 4 year rolling sample. In general the rolling correlations and concordances have shown that the synchronisation of the Balkan countries has increased. However, at the end of the period, we have noted a slight decrease of synchronisation. When we split the sample period into three sub-periods (2000-2003; 2004-2007; 2008-2012), we observe a notable increase in the degree of synchronisation from the first to the second sub-period for all countries (except for Serbia). Regarding the evolution from the second to the third sub-period we can observe a greater heterogeneity where we observe a slight decrease in the degree of synchronisation in almost all countries, with the exception of Serbia and Turkey; FYROM remains with a similar synchronisation pattern, while Greece behaves in a substantially different fashion from all the other countries. We have found that business cycle volatility has increased during all three periods studied and is particularly relevant from the second to the third sub-periods and for countries like Bulgaria, Romania and Turkey the volatility over the third sub-period more than doubled.

All in all, we conclude that the relative position of the Balkan countries varies from one to another. Slovenia and FYROM seem to display the best conditions for a currency union. Greece is the country presenting the biggest challenges as it exhibits looser connections to the Euro area cycle. On the other hand, Bulgaria, Romania and Croatia are well positioned with regards to trading integration with the Euro area, while Turkey and Serbia show little trade integration with the EMU. Despite the fact that the cycles in Turkey have been increasingly correlated with the Euro area aggregate they remain very volatile. The synchronisation of business cycles in Croatia, Serbia, Romania and Bulgaria are still quite distant from the average of the EMU, so they need to progress further with regards to these criteria in order to adopt the euro without major stabilization costs.

Finally, two caveats are in order. First, our data are for a relatively short sample period. As time proceeds, a longer series would allow for a refinement of the econometric approach and, thus, yield potentially more robust results. Second, if our analysis, which is based on two criteria of OCA, took into account other criteria (such as the flexibility of prices and wages, the mobility of production factors, the degree of specialization of the countries' production structure, the ability of insurance mechanisms and fiscal policies to smooth out shocks) we believe that the conclusions would not be substantially different.

Acknowledgement

I would like to thank the editor, an anonymous referee and the participants at the 5th International Conference on the Economies of Balkan and Eastern Europe Countries in the Changed World (Istanbul, Turkey, 2013) for kindly comments and suggestions. The usual disclaim applies.

References

Afonso, A. and Furceri, D., 2008, 'EMU enlargement, stabilization costs and insurance mechanisms', *Journal of International Money and Finance*, 27, 2, pp. 169-187.

Akkoyun, H., Günay, M. and Şen-Doğan, B., 2012, 'Business Cycle Synchronization of Turkey with Euro Area and the US: What Has Changed After 2001?' *Central Bank of the Republic of Turkey Working Paper*, 12/15, Turkey.

Artis, M. and Zhang, W., 1997, 'International Business Cycles and the ERM: Is there a European Business Cycle?', *International Journal of Finance and Economics*, 2, 1, pp. 1-16.

Artis, M. and Zhang, W., 1999, 'Further evidence on the international business cycle and the ERM: Is there a European business cycle', *Oxford Economic Papers*, 51, 1, pp. 120-132.

Babetskii, I., 2005, 'Trade integration and synchronization of shocks - Implications for EU enlargement', *Economics of Transition*, 13, 1, pp. 105-138.

Baxter, M. and King, R., 1999, 'Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series', *Review of Economics and Statistics*, 81, pp. 575-93.

Bayoumi, T. and Eichengreen B., 1993, 'Shocking Aspects of European Monetary Unification', Torres F. and Giavazzi, F., *Adjustment and Growth in the European Monetary Union*, Cambridge University Press, pp. 193-229.

Bayoumi, T. and Eichengreen, B., 1997, 'Ever closer to heaven? An optimum-currency-area index for European countries', *European Economic Review*, 41, 3-5, pp. 761–770.

Bayoumi, T., 1994, 'A formal model of optimum currency areas', *IMF Staff Papers*, 41, 4, pp. 537-554.

Benčík, M., 2011, 'Business cycle synchronisation between the V4 countries and the euro area', *National Bank of Slovakia Working and Discussion Papers*, 1, Slovakia.

Botrić, V., 2013, 'Determinants of Intra-industry Trade between Western Balkans and EU-15: Evidence from Bilateral Data', *International Journal of Economic Sciences and Applied Research*, 6, 2, pp. 7-23.

Damyanov, A. and Stefanov, G., 2010, 'Business Cycle Synchronizations between the Bulgarian Economy and the European Union', *South-Eastern Europe Journal of Economics*, 8, 2, pp. 171-185.

Darvas, Z. and Szapáry, G, 2008, 'Business cycle synchronization in the enlarged EU' *Open Economies Review*, 19, 1, pp. 1-19.

De Grauwe, P. and Mongelli, F., 2005, 'Endogeneities of Optimum Currency Areas: What Brings Countries Sharing a Single Currency Closer Together?', *European Central Bank Working Paper Series*, 468.

Dumitru, I. and Dumitru, I., 2010, 'Business cycle correlation of the new member states with Eurozone - the case of Romania', *Romanian Journal of Economic Forecasting*, 13, 4, pp. 16-31.

Fidrmuc, J., 2004, 'The Endogeneity of the Optimum Currency Area Criteria, Intra-Industry Trade, and EMU Enlargement', *Contemporary Economic Policy*, 22, pp. 1-12.

Fidrmuc, J. and Korhonen, I., 2006, 'Meta-analysis of the business cycle correlation between the euro area and the CEECs', *Journal of Comparative Economics*, 34, 3, pp. 518-537.

Frankel J., 1999, 'No Single Currency Regime is Right for all countries or at all times', *Essays in International Finance*, 215, Princeton University.

Frankel, J. and Rose, A., 1998, 'The Endogeneity of the Optimum Currency Area Criteria' *Economic Journal*, 108, pp. 1009-1025.

Gligorov, V., Iara, A., Landesmann, M., Stehrer, R. and Vidovic, H., 2008, *Western Balkan Countries: Adjustment Capacity to External Shocks, with a Focus on Labour Markets*, The Vienne Institute for International Economic Studies Research Reports, 352, Austria.

Gomez, D., Ortega, G. and Torgler, B., 2012, 'Synchronization and diversity in business cycles: A network approach applied to the European Union', Center for Research in Economics, Management and the Arts (*CREMA) Working Paper Series*, 1, CREMA, Switzerland.

Harding, D. and Pagan, A., 2002, 'Dissecting the cycle: a methodological investigation.' *Journal of Monetary Economics*, 49, pp. 365-81.

Hodrick, R. and Prescott, E., 1997, 'Postwar U.S. Business Cycles: An Empirical Investigation', *Journal of Money Credit and Banking,* 29, pp. 1-16.

International Monetary Fund (IMF), 2010, *World Economic Outlook October 2010*, International Monetary Fund Publication Services, Washington.

International Monetary Fund (IMF), 2012, *Annual Report on exchange arrangements and exchange restrictions 2012*, International Monetary Fund Publication Services, Washington.

Kenen, P., 1969, 'The Theory of Optimum Currency Areas: An Eclectic View', Mundell, R. and Swoboda, A., *Monetary Problems of the International Economy*, University of Chicago Press, Chicago, pp. 41-60.

Krugman, P. 1993, 'Lessons from Massachusetts for EMU', Torres, F. and Giavazzi, F., *Adjustment and Growth in the European Union*, Cambridge University Press, Cambridge, pp. 241-60.

McKinnon, R., 1963, 'Optimum Currency Areas', *The American Economic Review*, 53, 4, pp. 717-25.

Mongelli, F., 2005, 'What is European Economic and Monetary Union Telling us About the Properties of Optimum Currency Areas?' *Journal of Common Market Studies*, 43, 3, pp. 607-35.

Mundell, R., 1961, 'A Theory of Optimum Currency Areas', *The American Economic Review*, 51, 4, pp. 657-65.

Savva, C., Neanidis, C. and Osborn, D., 2010, 'Business cycle synchronization of the euro area with the new and negotiating member countries', *International Journal of Finance & Economics.* 15, 3, pp. 288-306.

Sideris, D., 2010, 'The Western Balkans on the road to the EU: An assessment of their integration with the euro zone using the Generalized Purchasing Power Parity approach', Bank of Greece.

The Economist Intelligence Unit, 2012, 'Eastern Europe economy: Balkan vulnerability', June 14th.

Tsanana, E., Katrakilidis, C. and Pantelidis, P., 2012, 'Balkan Area and EU-15: An Empirical Investigation of Income Convergence', Karasavvoglou, A. and Polychronidou, P., *Balkan and Eastern European Countries in the Midst of the Global Economic Crisis*, Contributions to Economics, Springer-Verlag Berlin Heidelberg.

Vesselinov, R., 2012, 'New Composite Indicators for Bulgarian Business Cycle', *International Journal of Economic Sciences and Applied Research,* 5, 2, pp. 101-111.

BRICs in the global economy under the prism of economic nationalism of IPE

Spyros A. Roukanas[1], Gabriel V. Diamantis[2]

Abstract

The international economic crisis which began in 2007 has limited developed countries' growth rates and manifested debt crises in certain economies in the Eurozone. It is the aim of this article to analyze the role that the BRIC group of nations has played in international financial institutions under the prism of economic nationalism of International Political Economy. Firstly, it aims to deepen our understanding of the emergence of the BRICs in the world economy. To this end, a macroeconomic analysis is carried out with the aim of making clear the changes the BRICs have brought to the world economy. Secondly, an analysis is made of the extent to which the global economic crisis has enhanced the role of the BRICs in the world economy, for instance in the decisions taken by powerful institutions such as World Trade Organization, the International Monetary Fund and its sister organization the World Bank. An analysis of the findings of the study is also provided.

Keywords: BRICs, International Political Economy, World Trade Organization, International Monetary Fund, World Bank

JEL Classification: F33, F5, F52

1. Introduction

In 2001, Jim O'Neill, an economist and head of Global Economic Research at Goldman Sachs, published an article entitled "Building Better Global Economic BRICs", which introduced to the international bibliography the term BRICs to refer to the fast emerging economies of Brazil, Russia, India and China. The article makes clear certain global economic issues related to the emergence of the BRICs (O'Neill, 2001). The present study carries out an analysis of economic indices/rates at an international level, as well as the progress of the highly developed economies compared to that of the BRICs. This comparison highlights the dispute between the developed countries and the developing ones and especially BRICs. It is the aim of the present article to analyze the role the BRICs

[1] Corresponding Author, Lecturer, Dept. of International and European Studies, University of Piraeus, Piraeus, Greece, sroukana@webmail.unipi.gr

[2] Associate professor, Dept. of International and European Studies, University of Piraeus, Piraeus, Greece, gabriel.diamantis@gmail.com

have played in the world economy. The school of thought of economic nationalism of International Political Economy has two main principles. Firstly, the international system is anarchic and at the same time the role of state is centric and sovereign for the configuration of world political and economic environment (O' Brien and Williams, 2011). According to Robert Gilpin, anarchy means that there is no higher authority than the nation-state for the configuration of world economic and political system (Gilpin, 2004, p. 30). The market operation is under the control of each nation state and functions in a certain social context. The international economic and political system reflects the national interests of the most powerful nation-states of the world economy. The nation-states serve their national interests according to their power in the international economic and political environment. The participation of powerful states in international organizations is not an option that restricts their interests. On the contrary, they do participate in order to reinforce their interests through their actions in the international economic organizations. Besides, this study underlines the fact that BRICs are trying to strengthen their national interests in the international economic organizations. In short, BRICs must be seen as four different nation states that are trying to amplify their power to the main international economic institutions. To follow this pursuit BRICs should reduce the power of highly developed economies to the international economic organizations.

At the same time the analysis undertaken in this study will examine to what extent is the empowerment of BRICs at world economy and in consequence to the main global economic institutions driven by the national interests. For this reason, this study firstly aims to deepen our understanding of the emergence of the BRICs in the world economy. To this end, a macroeconomic analysis is carried out aiming to specify the changes the BRICS have brought about. Then, what is investigated is the extent to which the global economic crisis has enhanced their role in the world economy. Moreover, emphasis is also placed on the roles they/the BRICS play in the decisions taken by powerful institutions such as World Trade Organization, the International Monetary Fund (IMF) and the World Bank are studies. Finally, an analysis of the findings is presented.

2. Macroeconomic analysis of the BRICs

The present section analyzes indices that demonstrate the strong progress made by the BRICs over the period from 2001 up to 2010, in other words, since the coinage/ invention of the term BRICs. The aim is to make clear the significance of the BRICs' growth. To this end, and in order to elaborate on the dynamics of the BRICs, a comparison of certain countries which belong to what is termed the "Trinity of Developed Economies" is made. More specifically, we will study the USA, Germany, France and Japan. The choice of these particular countries was based on the dynamic role they have played in recent years in the world economy. The indices to be studied are as follows: gross domestic product (GDP), participation in global GDP (as a percentage), the GDP growth rate, the GDP per capita, foreign direct investment (FDI) as a percentage of the global total, and the reserves of the countries studied.

Table 1: GDP (Billion US dollars, at current prices)

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Brazil	1278	1333	1377	1494	1584	1701	1857	1996	2001	2172
Russia	1073	1166	1335	1473	1696	2138	2387	2888	2699	2812
India	1681	1786	1949	2161	2434	2756	3118	3382	3644	4060
China	3337	3700	4157	4697	5364	6242	7338	8219	9057	10085
USA	10233	10590	11089	11812	12579	13336	13995	14296	14043	14582
Germany	2211	2275	2357	2466	2586	2776	2930	3052	2974	3071
France	1627	1704	1692	1761	1860	1991	2144	2178	2152	2194
Japan	3330	3417	3509	3708	3872	4071	4290	4316	4082	4301

Source: OECD (2011)

As illustrated in Table 1, the USA is still the largest economy in the world. At the same time, the size of GDP has also increased for the rest of the developed countries under consideration. A tendency for increased GDP can also be seen for the BRICs. However, in the last decade the size of China's GDP has increased very rapidly. What can also be seen is that China comprises the majority of the GDP of the BRICs. Of all the countries under investigation, the two countries that have displayed the sharpest increase in GDP in the last decade are China and India.

Table 2: Participation in Global GDP (in purchasing power parity, %)

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Brazil	2.9	2.9	2.8	2.8	2.8	2.7	2.7	2.8	2.8	2.8
Russia	2.7	2.7	2.8	2.9	3.0	3.0	3.1	3.2	3.0	3.0
India	3.6	3.7	3.8	3.9	4.1	4.3	4.5	4.7	5.0	5.2
China	7.5	8.0	8.5	8.9	9.4	10.0	10.7	11.4	12.5	13.2
USA	23.3	23.1	22.9	22.6	22.3	21.8	21.2	20.7	20.4	20.1
Germany	5.0	4.9	4.7	4.6	4.4	4.3	4.2	4.2	4.0	3.9
France	3.6	3.5	3.4	3.3	3.3	3.2	3.1	3.0	3.0	2.9
Japan	7.4	7.2	7.1	6.9	6.8	6.6	6.4	6.2	6.0	5.9

Source: IMF (2011a)

The table above confirms the dynamic changes that have been made both in China and other BRIC nations in relation to the international economy. China has enjoyed the biggest increase among the countries under study. The USA's share of global GDP has fallen from 23% in 2001 to 20% in 2010. The total participation in global GDP of the four developed countries studied has also reduced from approximately 40% in 2001 to approximately 33% in 2010. By contrast, the BRICs increased their share from almost 17% in 2001 to 24.3% in 2010.

Table 3: GDP Growth Rate (% annually)

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Brazil	1.3	2.7	1.1	5.7	3.2	4.0	6.1	5.2	-0.6	7.5
Russia	5.1	4.7	7.3	7.2	6.4	8.2	8.5	5.2	-7.8	4.0
India	5.2	3.8	8.4	8.3	9.3	9.3	9.8	4.9	9.1	9.7
China	8.3	9.1	10.0	10.1	11.3	12.7	14.2	9.6	9.2	10.3
USA	1.1	1.8	2.5	3.6	3.1	2.7	1.9	0.0	-2.7	2.9
Germany	1.2	0.0	-0.2	1.2	0.8	3.4	2.7	1.0	-4.7	3.6
France	1.8	0.9	0.9	2.5	1.8	2.5	2.3	-0.1	-2.7	1.5
Japan	0.2	0.3	1.4	2.7	1.9	2.0	2.4	-1.2	-6.3	5.1

Source: World Bank (2011a)

As Table 3 illustrates, the emerging economies display much higher growth rates than the developed economies in most of the reference years. The international economic crisis that emerged in 2007 has influenced all of the economies under study. In 2009, negative GDP growth rates are observable for all of the countries studied except for China and India. It should be pointed out that China and India enjoy the highest rates throughout the decade that has elapsed. In particular, China's high GDP growth rates reflect the rapid increase in its share of global GDP which have already been illustrated in Table 2 above.

Table 4: GDP per capita (current US dollars)

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Brazil	3,130	2,812	3,042	3,610	4,743	5,793	7,197	8,628	8,251	10,170
Russia	2,101	2,375	2,976	4,109	5,337	6,947	9,146	11,700	8.615	10,440
India	463	484	563	668	762	857	1,105	1,065	1,195	1,477
China	1,042	1,135	1,274	1,490	1,731	2,069	2,651	3,414	3,749	4,393
USA	35,898	36,797	38,196	40,309	42,534	44,663	46,606	43,277	35,143	36,084
Germany	22,967	24,445	29,588	33,269	33,811	35,429	40,468	44,264	40,670	40,542
France	21,867	23,555	28,870	32,874	33,913	35,558	40,460	44,117	40,663	39,460
Japan	32,210	30,475	33,113	36,051	35,627	34,148	34,264	38,212	39,456	43,161

Source: World Bank (2011b)

Table 4 highlights the intense economic inequalities between the developed and developing economies. The residents of the developed economies enjoy a much higher standard of living than the residents of the developing countries. In 2010 both Brazil and Russia's per capita GDP were over 10,000 US dollars. However, although China and India have particularly high GDP growth rates, as shown earlier, they have the lowest per capita GDP.

Table 5: Inward Foreign Direct Investment (% of global total)

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Brazil	2.718	2.646	1.771	2.444	1.533	1.288	1.755	2.583	2.190	3.895
Russia	0.333	0.552	1.389	2.080	1.311	2.032	2.794	4.300	3.080	3.312
India	0.663	0.898	0.754	0.778	0.776	1.391	1.286	2.439	3.008	3.312
China	5.674	8.414	9.341	8.167	7.369	4.974	4.238	6.210	8.107	8.502
USA	19.303	11.884	9.277	18.299	10.667	16.221	10.957	17.566	12.902	18.353
Germany	3.197	8.538	5.651	-1.372	4.828	3.805	4.070	0.242	3.175	3.709
France	6.110	7.822	7.420	4.386	8.645	4.915	4.882	3.680	2.871	2.726
Japan	0.756	1.474	1.104	1.053	0.282	-0.445	1.144	1.400	1.007	-0.101

Source: UNCTAD (2011)

FDI reflects how attractive the economies are to investors. During the last decade, as Table 5 illustrates, the BRICs overall became increasingly attractive to investments from abroad. In 2001, the BRICs received 8.4% of global FDI. By 2010, their share had reached 19%, with China holding a predominant position. By contrast, the four developed economies studied here saw a fall in their share of global FDI, from 29.3% to 24.6%.

Table 6: Reserves of Foreign Exchange and Gold (in trillion US dollars)

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Brazil	-	-	49.3	52.94	53.8	-	180.3	193.8	238.5	288.6
Russia	-	-	76.94	124.5	182.2	303.7	476.4	427.1	439.4	479.4
India	-	-	102.3	126	136	176.1	273.9	254	274.7	287.1
China	212.2	286.4	412.7	609.9	825.6	1.073	1.534	1.955	2.426	2.876
USA	-	-	85.94	86.94	-	65.89	70.57	77.65	130.8	132.4
Germany	-	-	96.84	-	101.7	111.6	136.2	138	180.8	216.5
France	-	-	70.76	-	74.36	115.7	115.7	102.9	133.1	166.2
Japan	-	-	664.6	-	835.5	954.1	954.1	1.011	1.024	1.063

Source: The World Factbook (2011a)

The reserves of foreign exchange and gold, illustrated in Table 6, form an index that shows the potential of each economy to respond to recessionary conditions such as those being experienced today on a global level. According to the data shown in Table 6, the BRIC group of nations increased its reserves of foreign exchange and gold over the last decade. China achieved a huge increase in reserves by augmenting its reserves of US dollars. This increase has created an interdependent relationship between China and the USA. China has invested in dollars because it considers it to be a particularly safe investment. At the same time, China has put a great deal of pressure on the USA in exchange for the enormous pressure exerted on China because of its monetary policy. The USA believes that China

is keeping its national currency devalued so that its products are more competitive in the international markets. According to the USA, this has resulted in an imbalance in the world economy, which in turn has pushed the USA into a deficit in its current account balance. The USA has announced that in order to protect its industry it may have to apply trade restrictions.

In contrast, China holds the view that its currency displays its real value and a potential revaluation would simply restrict the competitiveness of Chinese exports for the benefit of other countries. China also claims that the weakening of the competitiveness of the American economy is imprinted in the restricted exchange reserves that the USA affords (Morrison and Labonte, 2008). Increases in reserves of foreign exchange and gold are seen for all the developing countries under study. Japan differs from the other three developed economies as it increased its reserves particularly dramatically.

The analysis of the six macroeconomic indicators presented above leads to the following three conclusions. First, the BRICs have enhanced their position in the world economy over the last decade and are now relatively closer to the developed countries than they were in the past in terms of competitiveness. The creation of regional unions has enabled emerging economies to exert more pressure. However, it seems that the structures of regional unions aim at satisfying national interests. For example, the BRICs seem to be focused on the reinforcement of their national interests against those of the developed states. They are less interested in the development of regional competition that would restrict the potential for enhancing their national interests. This position confirms the argument of economic nationalism about the centric role of a nation state for the configuration of world economic and political environment.

Second, the economies of the BRICs are still very inferior to those of the developed countries. The per capita GDPs of the emerging economies highlight that there is still a long way for the emerging economies to go before their people can enjoy the same prosperity levels enjoyed by those of the developed countries. Third, in the last decade the world economy has changed without precedent ever since World War II. It was the first time the traditionally strong powers have seen other countries to join them by contributing greatly to the world economy. The aim of the emerging economies is to reap the benefits of world development. However, the 2007 global crisis has highlighted that global development is neither continuous nor stable.

3. The WTO and the BRICs

The end of Second World War II created the preconditions for the determination of international trade environment. The experience of interwar period was negative because of the protectionism to merchandise transactions. For this reason, USA and Great Britain received the initiative for the beginning of trade negotiations. In 1947 the negations ended by the establishment of General Agreement on Tariffs and Trade with the participation of 27 countries (Cohn, 2009). The main role of GATT was the liberalization of world trade

even if it had limited jurisdictions. In 1995 World Trade Organization was established as a consequence of the willingness of the states for a more effective conformation of world trade issues. GATT was a contractual agreement among its members-states. By contrast, WTO is an international organization with legal personality.

The adoption of the trade policy of its nation-state is related to its comparative advantages. But more than (the comparative advantage) this, what should be pointed out is that the trade policy of its nation state is also related to national security issues. For this reason, WTO is making an effort to solve disputes among its member-states and at the same time to control the tariffs policies to its member state. It was for these reasons that both China and Russia delayed to become member states of WTO. According to Zimmermann:

> "China applied for membership in 1986. The complicated accession process began in the same year with the establishment of a GATT Working Party. However, it was clear that the bilateral negotiations with the US and the EU would be by far the most important arenas and they would also determine the success or failure of the Chinese quest. Hampered by delays and setbacks, such as a two-year break after the massacre of Tiananmen Square in June 1989, the negotiations dragged on interminably. In particular, US–Chinese negotiations were marked by a high degree of mistrust and the corrosive effects of American domestic conflicts. In the end, the WTO accession negotiations lasted for 15 years until China was definitely admitted in December 2001 (Zimmermann, 2007, p. 820)".

Furthermore, Russia applied to join WTO in 1993 and became a member on 22 August 2012. According to Zimmermann:

> "Thus, the WTO/Russia negotiations appear to be an instance in which commercial aspects were finally subordinated to larger geostrategic considerations and the interest to posit the EU as global actor.
>
> Of course, once the EU had secured its over-riding objective (and Russia in fact had signed the Kyoto protocol), it also tried to take care of the unresolved economic issues (Zimmermann, 2007, p. 827)".

The foregoing two accession cases to the World Trade Organization that of China and Russia posit the fact that the developed economies through their agreement for accession are trying to solve political issues of high importance for their own interests. At the same time, the powerful nation states utilize their power for the maintenance of the leadership to the decision making of international economic organizations.

The rest of the countries under study became member of WTO on 1 January 1995. In the subsequent discussion we analyze the goods and services exported as a percentage of GDP and the current account balance as a percentage of GDP.

Table 7: Exports of goods and services (% of GDP)

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Brazil	12	14	15	16	15	14	13	14	11	11
Russia	37	35	35	34	35	34	30	31	28	30
India	13	14	15	18	19	21	20	23	20	22
China	23	25	30	34	37	39	38	35	27	30
USA	10	9	9	10	10	11	12	13	11	29
Germany	35	36	36	38	41	45	47	47	41	47
France	28	27	26	26	26	27	27	27	23	25
Japan	11	11	12	13	14	16	18	18	13	15

Source: World Bank (2011c)

The statistics in Table 7 highlight the export dynamics of the economies under study. It was at the beginning and the end of the decade that the exports of both the emerging and the developed economies did show some movement. Both China and Germany deserve a special mention. In the year 2010 China's exports as a proportion of GDP amounted to 30%. Taking into account the country's rapid GDP growth rates in the last decade, it is evident that China has increased its exports very rapidly over the same time period. In 2010, it was ranked second in the world in terms of exports. Germany too displays a particularly high rate of exports. In 2010, it was ranked third in the world (The World Factbook, 2011b).

Table 8: Current Account Balance (% of GDP)

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Brazil	-4.199	-1.527	0.752	1.755	1.571	1.248	0.114	-1.724	-1.544	-2.561
Russia	11.609	8.436	8.229	10.067	11.057	9.530	5.925	6.222	4.020	4.728
India	0.287	1.373	1.473	0.113	-1.270	-1.024	-0.701	-2.021	-2.884	-3.083
China	1.314	2.436	2.796	3.554	7.126	9.336	10.641	9.649	5.960	4.697
USA	-3.861	-4.304	-4.673	-5.313	-5.915	-5.990	-5.107	-4.655	-2.680	-3.190
Germany	0.020	2.005	1.891	4.651	5.112	6.452	7.611	6.729	4.890	6.055
France	1.754	1.241	0.720	0.541	-0.483	-0.572	-0.998	-1.907	-1.931	-1.790
Japan	2.144	2.874	3.221	3.736	3.640	3.907	4.819	3.214	2.796	3.088

Source: IMF (2011b)

The current account balances plotted or illustrated in Table 8 show the degree to which the countries under study are performing well. There is no single dominating image for the BRICs. Brazil has displayed a negative current account balance since the beginning of the global financial/economic crisis in 2007. Both Russia and China have been influenced

by the crisis as their current account balances have fallen, without going negative however. India had shown a deficit in the current account balance before the crisis began. The total picture for India in the last decade is of an economy that is not yet particularly competitive on a global level.

The developed countries also display individualities. Over the whole decade, the USA has shown a deficit. This demonstrates the restriction on export possibilities in the American economy. According to certain economists, the high deficit in the current account balance in the USA limits its ability to attract FDI. As a consequence, it is very likely for the country to increase its interest rates so as to attract foreign capital. In addition, the high interest rates and low investment percentage can lead to a restriction of long-term development (Morrison and Labonte, 2008). Germany and Japan both display a surplus in their current account balances throughout the decade. By contrast, France has run a deficit since 2005. To recapitulate then, what the figures in the table show is that both the emerging and the developed economies are trying to make use of their comparative advantages in order to enhance their position in the world economy.

4. The IMF and the BRICs

The IMF is an international economic organization which was created at the Bretton Woods summit in the USA in 1944. After the end of World War II, there was a need for a stable monetary environment. The basic aim of the IMF was to maintain fixed exchange rates so that the negative economic repercussions that had been seen in the inter-war period could be avoided. The IMF members were obliged to contribute currency and gold in order to establish a reserve fund that would help countries suffering from a liquidity shortage. At the same time, if a country was experiencing a fundamental imbalance in its economy, a readjustment of its exchange rate in relation to the dollar would be possible. A fundamental disequilibrium considered as restricting international demand for the products of a country. In this situation, if the currency of the country is not devalued, its economy will be led into recession, causing both unemployment and external deficits to rise (Krugman and Obstfeld, 2011, p. 390).

All of the eight countries studied in this survey joined the IMF when it was established, apart from Russia, which became a member after the collapse of the Soviet Union, in June 1992 (IMF, 2011c). The voting shares in the IMF are related to the countries' contribution to the capital of the IMF. In the first section, the increased contribution which the emerging economies are making to the world economy was pointed out. However, the limited role they play in world decision making indicates a mismatch between their economies and their ability to maximize their national interests (Woods and Lombardi, 2006). In Table 9, the participation quotas of the eight countries are displayed, both in terms of IMF capital and votes, and the changes made within the IMF over the last few years.

Table 9: Quota Shares of the Countries under Study in terms of IMF Capital and Voting Shares

	Quota Shares				Voting Shares			
Country	Prior to Singapore (2006)	March 2011	After the 2008 Reform	After the 2010 Reform	Prior to Singapore (2006)	March 2011	After the 2008 Reform	After the 2010 Reform
Brazil	1.420	1.395	1.782	2.315	1.402	1.377	1.713	2.217
Russia	2.782	2.732	2.493	2.705	2.734	2.686	2.385	2.586
India	1.945	1.911	2.441	2.749	1.916	1.882	2.336	2.627
China	2.980	3.718	3.994	6.390	2.928	3.651	3.803	6.068
USA	17.380	17.071	17.661	17.398	17.023	16.723	16.718	16.741
Germany	6.086	5.978	6.107	5.583	5.968	5.863	5.800	5.306
France	5.024	4.935	4.502	4.225	4.929	4.842	4.284	4.022
Japan	6.228	6.118	6.553	6.461	6.108	6.000	6.221	6.135

Source: IMF (2011d)

The decision taken at the annual IMF meeting held in Singapore in September 2006 was to increase the participation of China, Korea and Turkey. The reforms of 2008 and 2010 further reinforced the role of the emerging economies in the decisions of the IMF. It should be pointed out that the quota change reform of 2010 was put into force on March 3, 2011 (IMF, 2013). According to a statement made in November 2010 by the former Managing Director of the IMF, Dominique Strauss Kahn, this reform constitutes the most drastic change made to the IMF structure since its establishment. It plots a course for an enhanced role for the emerging economies in the world economy (IMF, 2011e). The IMF's aim is to adjust the quotas of its state members according to the roles they play in the world economy. Overall, the top ten members of the IMF are the USA, Japan, the BRICs and the four strongest economies in Europe, namely Germany, France, the UK and Italy.

What the figures in the above table demonstrate is that the role of the emerging economies in the IMF has increased in the last five years. The macroeconomic analysis presented earlier highlights why the BRICs will shortly belong among the ten strongest state members of the IMF. At the same time the USA remains the most powerful country in the IMF, highlighting its position in the world economy.

Before the Singapore meeting of the IMF, the emerging countries had held approximately 9% of the votes. After the implementation of the reform decisions of 2010, they share 13.5% of the votes. Although this increase is evident, it does not correspond to the rapid development of the BRICs, particularly China. This highlights that the nation states that currently dominate the decision making are pursuing a slow transition to a new system of decision making in which their national interests will be quite restricted.

To sum up, the analysis of the role of the emerging economies in the world economy highlights two points. First, the BRICs now play a much stronger role in international economic organizations, specifically the IMF. Second, this increase in participation does

not match their increased contributions to the world economy (Rapkin and Strand, 2006). Should the traditional countries continue to maintain these imbalances in the decision-making power then it is very likely that the emerging economies will aim to secure their national interests either by weakening the role of the IMF, and therefore that of the developed countries, or by adopting economic policies that intensify the negative consequences on the world economy that occurred as a result of the 2007 crisis.

5. The World Bank and the BRICs

The World Bank, like the IMF, was established as a result of the Bretton Woods summit. Today, it comprises five institutions. In 1944, the International Bank for Reconstruction and Development (IBRD), the first organization of the World Bank, was founded. Its basic aim was the financing of Europe's reconstruction following World War II. Today, it aims to diminish poverty in middle-income countries and poorer countries. These aims are achieved through loans, guarantees, the provision of counseling services and the promotion of risk management products that enhance sustainable development (World Bank, 2012a). States finance and participate in the decision making of the World Bank organizations through votes defined by their contribution to the WB's finances.

The member states hold the power to make decisions related to World Bank policy, the entry of new members and the financing of the World Bank. The main decision-making organs of the World Bank are the Board of Governors, which is the main policy body, and the Boards of Executive Directors. The Board of Governors is comprised of representatives of the member states. In most cases, these are the Ministers of Finance or Development of the member states.

The governors assign specific competences to the 25 executive directors. The USA, the UK, Germany, France and Japan – the countries with the highest economic participation in the World Bank – each of them appoint an executive director, while the remaining member states are represented through elected executive directors. Thus, the structure of the World Bank allows the more developed countries of the planet to control the World Bank's decisions to a large extent. This also highlights that the international economic system is still structured very much alike as it was after World War II (World Bank, 2012b).

In order for a country to become a member of the World Bank, and more specifically of the IBRD, it must first become a member of the IMF. Under the IMF framework, each new member state is assigned a quota based on its economic participation in the IMF. Each new member state of the World Bank receives 250 votes plus one for each share the country contributes to the capital of the Bank. The quota assigned by the IMF is used to define the number of shares each new member state contributes to the Bank. The voting power also varies between different organizations of the World Bank (World Bank, 2012c).

In the subsequent discussion an analysis is carried out of the member states' participation and corresponding shares of the votes in the various organizations of the World Bank. The main aim is to highlight the role of the developed and BRIC countries in the World Bank's decision making.

Table 10 below shows the eight focal countries' subscriptions in the IBRD, depicting that the developed countries under study contribute more than 35% of the capital in the Bank. The USA contributes the highest share. Their voting power is similarly around 35%. The BRICs hold 9% of the capital and a similar share of the votes. Thus there is a marked divergence between the developed countries under study and the BRICs. The enhanced role of the BRICs in the world economy, shown in the first part of this study, is not reflected in their participation in the IBRD, just as it is not in the IMF.

Table 10: Subscriptions and Voting Power of Eight Member Countries of the IBRD

	Total Subscriptions		**Voting Power**	
Country	Amount (in US $ millions)	Percentage of total	Number of votes	Percentage of total
Brazil	3,328.7	1.97	33,537	1.93
Russia	4,479.5	2.65	45,045	2.60
India	1,498.1	0.89	15,231	0.88
China	5,886.4	3.49	59,114	3.41
USA	28,118.3	16.66	281,433	16.22
Germany	8,245.0	4.88	82,700	4.77
France	7,369.5	4.37	73,945	4.26
Japan	15,840.4	9.38	158,654	9.14

Source: World Bank (2011d)

Table 11 shows the member states' voting power in the International Development Association. The developed countries under study hold 28.3% of the votes, while the BRICs hold just under 7%.

Table 11: Voting Power in the International Development Association

	Voting Power	
Country	Number of votes	Percentage of total
Brazil	330,266	1.51
Russia	68,902	0.31
India	661,909	3.03
China	449,652	2.06
USA	2,270,761	10.38
Germany	1,219.662	5.57
France	833,247	3.81
Japan	1,882,463	8.60

Source: World Bank (2011d)

Table 12 shows the member states' subscriptions and voting power in the International Finance Corporation. It is evident that he developed countries under study contribute more than 40% of the capital subscriptions and hold 39.4% of the votes. At the same time the BRICs make 9.5% of the total capital subscriptions and hold a corresponding share of the votes.

Table 12: Subscriptions and Voting Power in the International Finance Corporation

	Total Membership		**Voting Power**	
Country	Amount (in US $ thousands)	Percentage of Total	Number of votes	Percentage of Total
Brazil	39,479	1.66	39,729	1.64
Russia	81,342	3.43	81,592	3.37
India	81,342	3.43	81,592	3.37
China	24,500	1.03	24,750	1.02
USA	569,379	24.01	569,629	23.56
Germany	128,908	5.43	129,158	5.02
France	121,015	5.10	121,265	5.02
Japan	141,174	5.95	141,424	5.85

Source: World Bank (2011d)

The subscriptions and voting power in the Multilateral Investment Guarantee Agency are given in Table 13. The developed countries under study contribute 33.3% of the total capital subscriptions and hold 27.4% of the votes. The BRICs contribute 10% of the capital and hold 9.1% of the votes.

Table 13: Subscriptions and Voting Power of the Member Countries in the Multilateral Investment Guarantee Agency

	Total Membership		**Voting Power**	
Country	Amount (in millions of USD	Percentage of total	Number of votes	Percentage of total
Brazil	26.06	1.47	2,844	1.30
Russia	55.28	3.12	5,766	2.63
India	53.71	3.04	5,609	2.56
China	55.30	3.13	5,768	2.64
USA	325.64	18.40	32,802	14.99
Germany	89.36	5.05	9,174	4.19
France	85.65	4.84	8,803	4.02
Japan	89.79	5.07	9,217	4.21

Source: World Bank (2011d)

The above analysis of the organizations of the World Bank highlights the power the developed countries under study hold over decision making in comparison to the BRICs. Almost seventy years after the World Bank came into existence, the USA still maintains its leadership position, based on the fact that it played a leading role in its foundation and continues to be the strongest economy in the world. In most of the World Bank organizations, the BRICs are represented by no more than a 10% voting share. However, their role in the international economy has increased rapidly in the last decade. The analysis in the first part of this study showed that their contribution to 2010 global GDP was 24.3%. Clearly there is a mismatch between their contribution to their global GDP and their voting power in the World Bank.

In conclusion, the World Bank remains a financial organization which is controlled by developed countries, particularly the USA, disproportionately to their role in the global economy. It is worth pointing out that it was the USA that defined the sovereign financial policies of the World Bank, extending its influence over the Bank's economists (Wade, 2002). The mismatch in decision making combined with the intense consequences of the global financial crisis in the developed countries means that they must take initiatives to enhance the integration of the emerging economies into the global economy, and in this way limit the likelihood that the BRICs will pursue protective policies.

6. Conclusion

The widely held view that economic power is shifting from the traditionally rich to the emerging economies is hardly new, but it is taking a new form. For the past couple of decades, emerging economies have been grabbing a rising share of world manufacturing production and exports, thanks to their lower wage costs (Woodall, 2012). They already produce more than half the world's exports. P. Woodall, a senior economics writer, argues that in 2012 the upstarts will import more goods than the rich economies. To give his words, "that is a dramatic change since 2000, when they imported barely half as much as rich countries did. This rapid growth in developing countries' buying power will boost the profits of companies in rich economies over the coming years."

The rich world's financial crisis has hastened the shift in global economic power towards the newcomers. At the beginning of 2012, the total real GDP of the rich economies was not much higher than at the end of 2007. In contrast, the output of the emerging economies jumped by almost a quarter over the same period.

Emerging economies need to import advanced machinery and equipment from rich countries in order to build new factories and improve their infrastructure. Consumer spending is also rising rapidly. Even more important is the increase in their spending in absolute dollar terms, at twice the rate of the developed world. China will overtake America as the world's biggest importer by 2014. Selling to China and the (world) other world emerging markets will keep many Western firms busy for the years to come.

This study on the role BRICs should take in the world economy raises issues that will be at the center of the global political economy over the next few years. The macroeconomic

analysis carried out in this paper has pointed to two basic conclusions. First, it was in the first decade of the twenty-first century when the strongest emerging economies developed at a very rapid rate and have managed to integrate themselves into the world economy to a far higher degree than previously. Second, the BRIC group of nations still trails the traditionally strong economies in terms of their involvement in the international system. In the years to come, the challenge for the emerging economies will be to raise their prosperity levels at home. For this aim to be achieved it must be combined with continued strong development (People's Daily Online, 2013). This should also ensure that the development gap between the developed and the developing countries is gradually reduced.

The analysis of the role the BRICs play in decision making in the framework of WTO, the IMF and the World Bank raises two main issues. First, the emerging economies' integration into these three major institutions of the world economy is happening at a much slower rate than their integration into the world economy. Second, the nation state remains sovereign and centric in the global political economy as the developed countries pursue the slow integration of the emerging economies into the decision making of the IMF and the World Bank. The obvious reason behind this is that it serves their own interests according to school of thought of economic nationalism of International Political Economy.

At a time when many developed countries face major fiscal problems, what is needed is the integration of the emerging economies in decision making in a way that reflects their integration into the world economy (Sklias, 2011). Otherwise, the emerging economies may limit their participation in the IMF and the World Bank, which would restrict the developed countries' role in the world, or they may create new institutions in cooperation with other emerging economies, as is the case with BRICS. The creation of competitive regional unions and the reinforcement of national economic/financial competition could drastically limit the development of the world economy, leading a number of strong economies into prolonged recession. If the findings of this study succeed in arousing discussion among scholars, the main object of it will have been achieved.

References

Cohn, T. H., 2009, *International Political Economy: Theory and Practice (in Greek)*, Gutenberg, Athens.

Gilpin, R., 2004, *Global Political Economy: The International Economic Order (in Greek),* Poiotita Publications, Athens.

International Monetary Fund, 2011a, 'Report for Selected Countries and Subjects', http://www.imf.org/external/pubs/ft/weo/2010/01/weodata/weorept.aspx?sy=2001&ey=2010&scsm=1&ssd=1&sort=country&ds=.&br=1&pr1.x=55&pr1.y=7&c=223%2C924%2C922%2C132%2C134%2C534%2C158%2C111&s=PPPSH&grp=0&a=#download, (accessed 02/09/2011).

International Monetary Fund, 2011b, 'Report for Selected Countries and Subjects', http://www.imf.org/external/pubs/ft/weo/2010/02/weodata/weorept.aspx?sy=2001&ey=20

10&scsm=1&ssd=1&sort=country&ds=.&br=1&pr1.x=52&pr1.y=19&c=223%2C924%2C922%2C132%2C134%2C534%2C158%2C111&s=BCA_NGDPD&grp=0&a, (accessed 07/09/2011).

International Monetary Fund, 2011c, 'Russian Federation: Financial Position in the Fund as of November 30, 2011', http://www.imf.org/external/np/fin/tad/exfin2.aspx?memberKey1=819&date1key=2012-01-03, (accessed 03/01/2012).

International Monetary Fund, 2011d, 'Quota and Voting Shares Before and After Implementation of Reforms Agreed in 2008 and 2010 (In percentage shares of total IMF quota)', http://www.imf.org/external/np/sec/pr/2011/pdfs/quota_tbl.pdf, (accessed 03/01/2012).

International Monetary Fund, 2011e, 'IMF Executive Board Approves Major Overhaul of Quotas and Governance', http://www.imf.org/external/np/sec/pr/2010/pr10418.htm, (accessed 03/01/2012).

International Monetary Fund, 2013, 'IMF Quota and Governance Publications', http://www.imf.org/external/np/fin/quotas/pubs/ (accessed 25/09/2013).

Krugman, R.P. and Obstfeld, M., 2011, *International Economics: Theory and Policy*, Volume B, 1st Kririki Publications, Athens.

Morrison, M.W. and Labonte, M., 2008, 'China's Holdings of U.S. Securities: Implications for the U.S. Economy', *CRS Report for Congress*, Congressional Research Service.

O' Brien, R. and Williams, M., 2011, *Global Political Economy: Evolution and Dynamics* (in Greek), Papazisi Publications, Athens.

OECD, 2011, 'Production and Income. Production. Size of GDP', http://www.oecd-ilibrary.org/docserver/download/fulltext/3011041ec017.pdf?expires=1338214098&id=id&accname=guest&checksum=E2A62D064FADEA3423DA66F74DD2DFA8, (accessed 28/05/2012).

O'Neill, J., 2001, Building Better Global Economic BRICs, *Global Economics*, 66.

People's Daily Online, 2013, 'China stresses boosting consumption, investing in public sector', http://english.peopledaily.com.cn/90778/8156092.html, (accessed 30/08/2013).

Rapkin, D.P. and Strand, J.R., 2006, 'Reforming the IMF's Weighted Voting System', *The World Economy*, 29, 3, pp. 305-324.

Sklias, P., 2011, 'The Political Economy of the Greek Crisis in the Framework of the European Monetary Union' *in* Botsiou, K.E. and Klapsis, A. (eds) *The Konstantinos Karamanlis Institute for Democracy Yearbook 2011*. Springer, New York, pp. 67-76.

The World Factbook, 2011a, 'Country Comparison: Reserves of Foreign Exchange and Gold', https://www.cia.gov/library/publications/the-world-factbook/rankorder/2188rank.html, (accessed 03/01/2012).

The World Factbook, 2011b, 'Country Comparison: Exports', https://www.cia.gov/library/publications/the-world factbook/rankorder/2078rank.html?countryName=China&countryCode=ch&regionCode=eas&rank=2#ch, (accessed 03/01/2012).

UNCTAD, 2011, 'Inward and Outward Foreign Direct Investment Flows, Annual, 1970-2010', http://unctadstat.unctad.org/TableViewer/tableView.aspx, (accessed 07/09/2011).

Wade, R.H., 2002, 'US Hegemony and the World Bank: The Fight over People and Ideas', *Review of International Political Economy*, 9, 2, pp. 215-243.

Woodall, P., 2012, 'Hey Big Spenders. Emerging Economies will Buy over Half of the World's Imports in 2012', http://www.economist.com/node/21537925, (accessed 25/06/2012).

Woods, N. and Lombardi, D., 2006, 'Uneven Patterns of Governance: How Developing Countries are Represented in the IMF', *Review of International Political Economy,* 13, 3, pp. 480-515.

World Bank, 2011a, 'GDP Growth (annual %)', http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG, (accessed 31/08/2011).

World Bank, 2011b, 'GDP per Capita (current US$)', http://data.worldbank.org/indicator/NY.GDP.PCAP.CD, (accessed 31/08/2011).

World Bank, 2011c, 'Exports of Goods and Services (% of GDP)', http://data.worldbank.org/indicator/NE.EXP.GNFS.ZS, (accessed 04/01/2012).

World Bank, 2011d, 'Voting Powers', http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/ORGANISATION/BODEXT/0,,contentMDK:21429866~menuPK:64020035~pagePK:64020054~piPK:64020408~theSitePK:278036,00.html, (accessed 08/05/2012).

World Bank, 2012a,'International Bank for Reconstruction and Development'. http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/EXTIBRD/0,,menuPK:3046081~pagePK:64168427~piPK:64168435~theSitePK:3046012,00.html, (accessed 08/05/2012).

World Bank, 2012b, 'Leadership', http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/0,,contentMDK:22428930~menuPK:1697011~pagePK:51123644~piPK:329829~theSitePK:29708,00.html, (accessed 08/05/2012).

World Bank, 2012c, 'Boards of Directors', http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/0,,contentMDK:22494475~menuPK:8336906~pagePK:51123644~piPK:329829~theSitePK:29708,00.html, (accessed 08/05/2012).

Zimmermann, H., 2007, 'Realist Power Europe? The EU in the Negations about China's and Russia's WTO Accession', *Journal of Common Market Studies*, 45, 4, pp. 813-832.

Is there a relationship between fiscal sustainability and currency crises? International evidence based on causality tests

Alexis Cruz-Rodríguez[1]

Abstract

This paper uses Granger causality tests on a fiscal sustainability indicator (FSI) and currency crises for 17 countries to evaluate the direction of causality between the FSI and currency crises. The FSI developed by Croce and Juan-Ramón (2003) is used. Also, different definitions for currency crises are used to evaluate whether they induce different results in the analysis. In general, the results suggest evidence of causality between the lagged FSI and currency crises.

Keywords: Currency crisis, foreign exchange, fiscal sustainability, Granger causality

JEL Classification: F31, F33, E62

1. Introduction

The establishment of an early warning system that can anticipate the occurrence of currency crises has led to debates, both theoretical and empirical. Most of the literature on currency crises focuses on the causal role of monetary policy in a crisis. However, theoretical and empirical literature on this subject provides a useful framework for the analysis of fiscal causes. The first generation models, called speculative attack models, indicate that an immoderate fiscal policy is the main cause of currency crises (Krugman, 1979, 1996; Flood and Garber, 1984; Flood and Marion, 1996; Van Wijnbergen 1991; Daniel, 2001; Corsetti and Mackowiak, 2005, 2006; Burnside et al., 2003, 2006). The second generation models accentuate the self-fulfilling characteristics of a currency crisis and the occurrence of multiple equilibria (Obstfeld, 1986, 1996; Rangvid, 2001). In these models, the currency attacks occur when investors gain new information that government net liabilities exceed a threshold, or when the government decides to extract seigniorage, instead of undertaking a fiscal adjustment, to meet the intertemporal budget constraint. In other words, the immediate cause of the crisis is a sign that the government can only resolve policy inconsistencies abandoning the rules of the exchange rate, rather than trying to

[1] Pontificia Universidad Católica Madre y Maestra, Av. Abraham Lincoln Esq. Rómulo Betancourt, Ensanche La Julia, Santo Domingo, Dominican Republic, alexiscruz@pucmm.edu.do

contain public sector imbalances. Finally, third generation models stress the consequences of moral hazard in the banking system and the contagion effect as key determinants of a currency crisis (Burnside et al., 2000; Chang and Velasco, 2001; Marini and Piersanti, 2003). Here, a sudden loss of confidence triggers a twin crisis, combining banking and currency problems, once maturity and currency mismatches in banking balance sheets enter a zone of vulnerability. The idea is that a banking system crisis will lead to a currency crisis using the first generation models' mechanism, because government contingent liabilities (implicit guarantees) become commitments in the moments of crisis and result in unsustainable fiscal deficits, with central banks as lenders of last resort. However, the measures taken are inconsistent with the maintenance of fixed exchange rates.

Empirical studies as developed by Nashashibi and Bazzoni (1993), Eichengreen et al. (1994), Kaminsky and Reinhart (1999), Aziz et al. (2000), Siwinska (2000), and Bird and Mandilaras (2006) found that fiscal imbalances have a significant effect on the probability of a foreign exchange crisis. However, the literature on the subject has paid little attention to the role of an indicator of fiscal sustainability in assessing the likelihood of currency crises. On the contrary, there are numerous empirical studies on currency crises, which attempt to deduce the main indicators that make such crises more predictable, but from the point of view of monetary policy (Goldfajn and Valdes, 1997, Burkart and Coudert, 2002, Broome and Morley, 2004, Crepo-Cuaresma and Slacik, 2007; Frankel and Saravelos, 2012).

The aim of this paper is to assess whether a Fiscal Sustainability Indicator (FSI) can be used as a leading indicator in predicting currency crises. To do that, the alternative approach proposed by Croce and Juan-Ramón (2003) is employed to measure the fiscal sustainability of each country. Then, the direction of causality between the FSI and currency crises is investigated. In addition, three empirical definitions of currency crises are employed. Firstly, an exchange market pressure index is constructed as an indicator of currency crises. This indicator is calculated by computing a weighted average of the nominal depreciation rate, the change in interest rates and international reserves using the United States as the country of reference. The quarter in which the index exceeds a certain threshold is taken to be the crisis period. Secondly, a crisis is defined as a nominal currency depreciation. Finally, from previously mentioned definitions, two binary definitions of currency crises are constructed.

To carry out the research, we used quarterly data from 17 developing countries: Argentina, Brazil, Chile, Colombia, Costa Rica, Czech Republic, Dominican Republic, El Salvador, Honduras, Hungary, Indonesia, Malaysia, Mexico, Peru, Philippines, Thailand and Turkey. These countries were selected based on data availability and because most of these countries experienced episodes of currency crises in the period 1990-2004. Therefore, the countries and period make a good sample to test our hypothesis. Note that this paper does not give a detailed overview of the causes and development of currency crises, but instead, it focuses primarily on assessing if the FSI helps predict currency crises.

The remainder of the paper is organised as follows: Section 2 presents the different definitions of currency crises used. Section 3 describes the sets of data obtained and the

methodology. Section 4 discusses the empirical results. Finally, Section 5 presents the concluding remarks.

2. Defining Currency Crises

The definition of a currency crisis is of paramount importance in the process of identifying the leading indicators for predicting a crisis itself. Several approaches exist in the literature reviewed. In some theoretical works, a currency crisis is predominantly defined only in the context of fixed exchange rate regimes, usually as the official devaluation or abandonment of the fixed exchange rate regime. However, this definition is not flexible enough to use in empirical studies.

Other empirical studies define a currency crisis as a large (either nominal or real) devaluation or depreciation of the domestic currency. However, this last definition does not consider that monetary authorities can fight a speculative attack by intervening in the foreign exchange market or by increasing interest rates. Under these circumstances, a currency crisis (defined as a speculative attack) may not lead to an actual devaluation. As a consequence, unsuccessful speculative attacks should be included in the definition of a currency crisis since they point to the vulnerability of the system as seen in a fall in international reserves and a rise in interest rates (Girton and Roper, 1977; Eichengreen et al., 1996). This paper employs different methodologies to define a currency crisis and compares their results. Firstly, an indicator is constructed based on the movements in nominal exchange rates according to the definition of a currency crisis proposed by Frankel and Rose (1996). This definition of a currency crisis only encompasses currency devaluation without a decrease in international reserves or an increase in interest rates. We define a crisis as a nominal depreciation of the domestic currency in any given quarter that is greater than 6%, exceeding the previous year's depreciation level by at least 10%. In other words, this definition assumes that there are only successful speculative attacks. This definition is utilised to create a binary variable, a crisis indicator called Exchange Rate Depreciation (ERD), equal to one if a crisis occurs and equal to zero otherwise.

Secondly, a definition of a currency crisis is used to refer to an intense increase in speculative pressure on the country's currency. Therefore, the measure of exchange rate pressure (MPI) developed by Girton and Roper (1977) and modified by Eichengreen et al. (1996) is used. The idea being that a successful speculative attack on a currency would show up as a change in the exchange rate, but that monetary authorities can fend off these attacks either by raising interest rates or by selling off international reserves. The advantage of using this index is that both successful and unsuccessful attacks on a currency can be asserted. Then, a given episode can be classified as a speculative attack or crisis period if the MPI is greater in value than 1.5 standard deviations over the country's own mean value. Mean values and standard deviations are country-specific. As a result, the binary variable is used, identifying the speculative attack regime in the sample. However, a major drawback to this approach is that the weights, as well as the threshold value used to identify the speculative attacks, are somewhat arbitrary.

3. Data and Summary Statistics

3.1 Data

The empirical analysis of this paper is performed using quarter frequencies and covers the period from the first quarter of 1990 to the fourth quarter of 2004. For the analysis of fiscal sustainability in developing countries, data was obtained from the World Bank's Global Development Finance (GDF), the IMF's Government Finance Statistics (GFS), the CD-ROM version of the IMF's International Financial Statistics (IFS), and the respective Ministry of Finance websites. The macroeconomic variables used for MPI calculations were taken from the IFS CD-ROM of the International Monetary Fund (IMF). Unfortunately, the data for Czech Republic were not available before 1993.

In order to avoid a spurious regression situation, unit root tests are performed on the Market Pressure Index (MPI) and the exchange rate to investigate whether these variables are stationary or not. If the variables are stationary, then the standard Granger causality test is appropriate. The augmented Dickey-Fuller (ADF) unit root test is used for this purpose. The results suggest that the variables are stationary (these regressions are not presented here, but are available upon request).

3.2 Descriptive Statistics

The summary of descriptive statistics for the dependent variables (market pressure index and the exchange rate depreciation) is listed in Table 1 and 2, respectively. In addition, the movements of these variables during the sampled period are depicted in Figure 1. The exchange rates are expressed as variations of the foreign currency per US dollar.

According to Tables 1 and 2, Brazil, Peru and Turkey show the highest quarter averages of the MPI and depreciation in their exchange rates. Most of the countries considered displayed high degrees of volatility in their exchange markets, given that the standard deviations are always more than double their mean value. Nonetheless, Table 1 shows that Chile, Costa Rica, Dominican Republic, El Salvador and Hungary have negative skewness (and only Chile in Table 2), which implies that more tranquil periods in which the exchange rates remain more or less stable tend to occur more often than large speculative attacks or depreciations in their foreign exchange markets. Similarly, for some countries, the maximum MPI is recorded in the first half of the 1990s when the exchange rate depreciation reached its peak (see Figure 1). In contrast, for countries which presented currency crises in the late 1990s, the maximum of MPI and exchange rate depreciation are recorded in the second half of the 1990s.

Table 1: Summary Statistics for Market Pressure Index

Country	Mean	Median	Max.	Min.	St.Dev.	Skew.	Kurtosis	Obs
Argentina	0.719	-1.856	131.121	-81.828	23.878	2.428	18.608	60
Brazil	5.638	1.940	123.626	-78.875	23.404	1.442	14.359	60
Chile	-0.326	-0.151	6.366	-9.064	3.017	-0.332	2.997	60
Colombia	0.320	0.025	7.878	-6.276	2.596	0.326	3.496	60
Costa Rica	1.363	1.183	7.110	-5.701	1.939	-0.186	6.037	60
Czech Rep.	-1.084	-1.055	11.492	-7.881	3.163	0.947	6.970	47
Dom. Rep.	0.330	0.169	8.079	-8.431	3.063	-0.003	3.714	60
El Salvador	-0.245	-0.218	2.775	-3.556	0.916	-0.072	6.449	60
Honduras	0.217	-0.117	4.017	-2.878	1.290	0.822	4.036	60
Hungary	0.039	0.066	5.0602	-4.841	1.758	-0.144	4.626	60
Indonesia	-0.606	-0.950	13.789	-8.670	3.879	1.289	7.249	60
Malaysia	-0.127	-0.184	2.841	-3.706	0.902	0.159	8.909	60
Mexico	0.056	-0.834	26.327	-13.777	5.181	2.426	13.745	60
Peru	-0.178	-0.410	59.533	-60.950	15.827	0.961	11.504	60
Philippines	0.128	0.073	9.484	-5.994	3.330	0.452	3.346	60
Thailand	-0.561	-0.852	11.781	-7.433	2.786	1.485	8.615	60
Turkey	3.381	2.708	35.815	-31.467	9.427	0.402	7.706	60
All Countries	0.554	-0.116	131.122	-81.828	9.701	4.146	75.881	1007

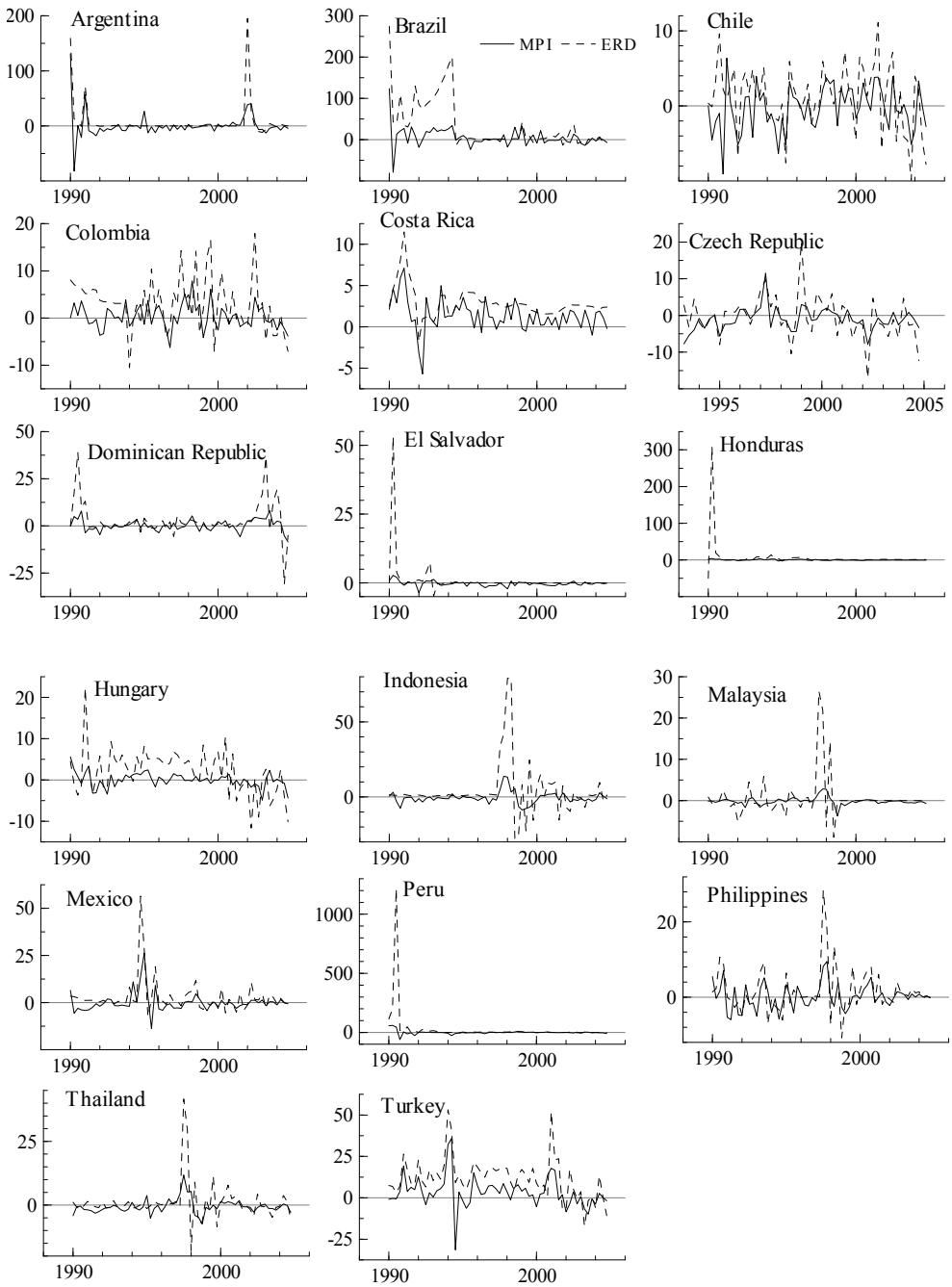
Source: Author's calculations.

Table 2: Summary Statistics for Exchange Rate Depreciation

Country	Mean	Median	Max.	Min.	St.Dev.	Skew.	Kurtosis	Obs
Argentina	7.583	0.000	195.147	-11.747	33.581	4.664	24.209	60
Brazil	34.339	2.964	274.715	-14.700	60.368	1.977	6.688	60
Chile	1.153	1.548	11.103	-9.879	4.257	-0.380	3.155	60
Colombia	3.046	3.107	17.928	-10.525	5.552	0.340	3.638	60
Costa Rica	2.878	2.517	11.492	-1.784	1.866	1.995	10.279	60
Czech Rep.	-0.366	-0.757	20.063	-16.991	5.923	0.277	5.589	47
Dom. Rep.	3.083	1.178	38.926	-30.896	9.271	1.173	10.362	60
El Salvador	1.117	0.000	53.200	-4.798	6.972	7.125	53.694	60
Honduras	6.951	1.337	310.000	-50.000	40.531	7.094	53.935	60
Hungary	1.921	2.615	22.326	-11.627	5.425	0.321	5.424	60
Indonesia	3.987	1.197	79.032	-28.187	17.684	2.592	12.167	60
Malaysia	0.690	0.000	26.485	-8.851	5.244	3.285	15.764	60
Mexico	2.758	0.904	56.433	-7.455	8.889	4.204	24.341	60
Peru	29.157	1.651	1216.065	-3.731	158.675	7.172	53.986	60
Philippines	1.709	0.241	28.384	-10.842	6.021	1.778	8.651	60
Thailand	0.955	-0.197	41.617	-17.869	7.694	3.108	17.452	60
Turkey	11.823	10.856	53.116	-17.200	12.313	0.948	5.823	60
All Countries	7.583	0.000	195.147	-11.747	33.581	4.664	24.209	60

Source: Author's calculations.

Figure 1: Index of Speculative Pressure and Exchange Rate Depreciation



Source: Author's calculations.

4. Methodology

To evaluate fiscal sustainability, this paper uses the recursive algorithm developed by Croce and Juan-Ramón (2003). In order to derive a simple expression for the index of fiscal sustainability, it is assumed that the debt ratio (debt to GDP) at time $t-1$ is higher than the long-term objective for that ratio $\left(d_{t-1} > d^*\right)$. Hence, d_t would converge to d^*, if and only if $\left|\beta_t - \lambda_t\right| < 1$, where d_t is public debt as a share of GDP (the law of motion in the debt to GDP ratio), d^* is the target debt ratio, $\beta = \dfrac{1+r_t}{1+g_t}$, r_t is the real interest rate and g_t denotes the rate of growth of real output. The parameter λ_t indicates the intensity of the policy response at time t, given the debt ratio gap in the previous period. Therefore, we can use $\left(\beta_t - \lambda_t\right)$ as an indicator of fiscal sustainability. Accordingly, an alternative expression for the Fiscal Sustainability Indicator (FSI) is:

$$FSI_t = \left(\beta_t - \lambda_t\right) = \left(\frac{1+r_t}{1+g_t} - \frac{ps_t - ps^*}{d_{t-1} - d^*}\right) \tag{1}$$

where ps_t is the ratio of the primary surplus to GDP. This expression states that a persistently higher spread between the observed real interest rate and the observed growth rate of real GDP would, other than being equal, lead to higher public indebtedness (high parameter β_t). The second parameter (λ_t), measures the ratio between the deviation of observed and target values of the primary surplus and the public debt ratios. In addition, a fiscal position would be sustainable if $FSI_t < 1$. In contrast, if $FSI_t \geq 1$ then the fiscal position is unsustainable.

To test for the causal relationship between the FSI and the occurrence of currency crises, the standard Granger test is employed. This test is used to evaluate how much of the current currency crisis can be explained by lagged values of the FSI. Thus, the FSI is said to Granger cause the currency crisis if the FSI variable is statistically significant and therefore improves the forecasted value of the currency crisis. The test equations used are given by:

$$Y_t = \alpha + \sum_{i=1}^{k} \phi_i X_{t-i} + \varepsilon_t \tag{2}$$

$$X_t = \gamma + \sum_{i=1}^{k} \delta_i Y_{t-i} + \varepsilon_t \tag{3}$$

where Y is a currency crisis, X is a leading indicator (in this case, the FSI), α and γ are the respective intercepts, and ε_t is a white noise error term. If the inclusion of variable X with lag i in the test equation helps in the prediction of Y, then Y is said to be Granger caused by X_{t-i}. Separately, if $\sum_{i=1}^{k} \delta_i$ in equation (2) is significantly different from zero, then we conclude that currency crises cause the FSI. Granger causality in both directions

is, of course, a possibility. This can be possibly explained by high fiscal costs of defense of fixed exchange rates. The fiscal sustainability indicator is supposed to capture the state of fiscal fundamentals. Then, an unsustainable fiscal position would be expected to help in the prediction of the risk of devaluation or a speculative attack. It is important to note that Granger causality mainly concerns prediction and does not refer to real causality.

5. Empirical Results

To construct the Fiscal Sustainability Indicator (FSI), following Croce and Juan-Ramón (2003), we use d^* equal to the lowest value reached by the debt ratio during the period under study in each country. The value of β^* represents the median of the distribution of the observed values of β for the group of developing countries. Its value was set at 1.026. This implies that the expected value of the real interest rate is 2.6 percentage points higher than the real growth rate, in a steady state.

Table 3 shows the countries with problems of fiscal sustainability during 1990Q1-2004Q4. Countries for which the FSI was above the threshold of 1 at least 75% of the times were classified as having been fiscally unsustainable $(\beta - \lambda > 1)$ during the period considered. Also, Table 3 shows the frequency of β values being higher than β^*, and the frequency of λ assuming a negative value (implying primary deficit). In general, the developing countries in the sample present an unsustainable fiscal stance explained mostly by government fiscal deficits rather than spreads between the real interest rates and the growth rates. Figure 2 presents the result of the FSI for each country considered, arranged alphabetically to facilitate the discussion. As shown in Figure 2, a higher FSI reflects fiscal unsustainability.

According to Table 3, Argentina shows an unsustainable fiscal position in 87% of the period studied, while Brazil shows an unsustainable fiscal stance in about 62%. On the contrary, Chile shows a sustainable fiscal stance in most of the period considered. The FSI for Colombia, Costa Rica and the Czech Republic has consistently maintained an unsustainable fiscal position as a result of a primary fiscal deficit and a higher real interest rate-growth gap, respectively. For El Salvador, Honduras and Hungary the FSI persistently presented an unsustainable fiscal stance, explained fundamentally by the primary government deficit. The Dominican Republic shows an unsustainable fiscal position in 40% of the period studied, while Indonesia shows a sustainable fiscal position in 50% of period. Malaysia shows a consistently sustainable fiscal balance in the period under study. However, the FSI for Mexico, Peru and Philippines presents an unsustainable fiscal position stance during most of the period consided. On contrary, the fiscal sustainability indicator for Thailand indicated sustainability in 38% of the period. Finally, the fiscal sustainability indicator for Turkey shows an unsustainable fiscal position overall in the period studied.

In summary, Argentina, Colombia, Costa Rica, the Czech Republic, El Salvador, Honduras, Hungary, Mexico, Peru, the Philippines and Turkey present large unsustainable fiscal positions throughout most of the period studied, which is fundamentally explained by primary fiscal deficits.

Table 3: Analysis of Fiscal Sustainability Indicators

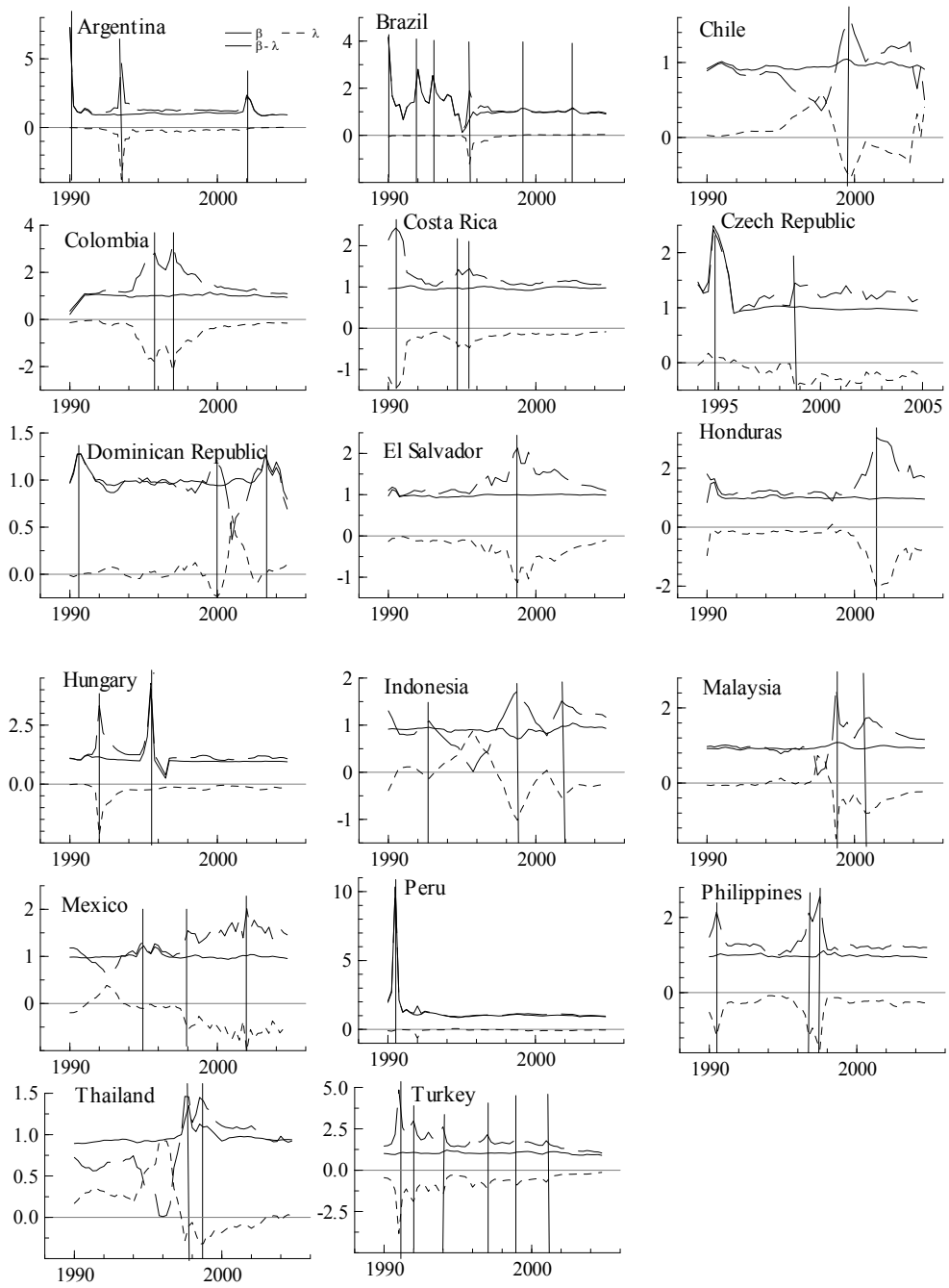
Country	Frequency		
	$\beta - \lambda > 1$	$\beta > \beta^*$	$\lambda < 0$
Argentina	87%	42%	95%
Brazil	62%	42%	60%
Chile	33%	3%	33%
Colombia	93%	37%	100%
Costa Rica	100%	2%	100%
Czech Republic	95%	20%	84%
Dominican Republic	40%	20%	40%
El Salvador	97%	3%	100%
Honduras	98%	13%	100%
Hungary	95%	30%	97%
Indonesia	50%	2%	60%
Malaysia	47%	7%	77%
Mexico	83%	18%	85%
Peru	80%	42%	93%
Philippines	98%	10%	100%
Thailand	38%	13%	38%
Turkey	100%	50%	100%
Developing Countries	76%	21%	80%

Source: Author's calculations.

Note: Number of quarters as a percentage of total quarters.

The issue of causality between the Fiscal Sustainability Indicator and currency crises is analysed for each country and for the sample as a whole. To do this, the Granger causality test is used, as well as three different definitions of currency crises. Firstly, we use the Market Pressure Index (MPI) defined earlier. Then, we use the binary definition of currency crises (defined to be one if the deviation of the MPI exceeds 1.5 standard deviations over the country's own mean value). Finally, we use the binary definition of the exchange rate depreciation (equal to one if the nominal depreciation of the domestic currency is greater than 6%, but exceeding the previous year's depreciation level by at least 10%).

Figure 2: Fiscal Sustainability Indicators



Source: Author's calculations.

Note: Straight line indicates crisis.

The results for the Granger causality test are very sensitive to the selection of lag lengths. If the chosen lag length is less than the true lag length, the omission of relevant lags can cause bias. If the chosen lag length is greater, the irrelevant lags in the equation cause the estimates to be inefficient. To deal with this problem, we use the Final Prediction Error (FPE) and the Akaike criterion. We estimated ten regressions according to equation (2) and compute the FPE for each regression as:

$$FPE = \frac{\frac{T+m+1}{T-m-1} RSS}{T}$$

where T is sample size, m is the lag length and RSS is the residual sum of squares. We choose the optimal lag length as the lag length which produces the lowest FPE.

The conventional Granger causality tests are reported in Tables 4, 5 and 6. The results for the whole sample considered in this study show that there is not causality between FSI and currency crises (see Table 4). On the contrary, when a definition of currency crises according to nominal exchange rate depreciation (ERD) is used, the Granger causality test results show that the FSI affects ERD; but nominal exchange rate depreciation does not affect the FSI in the whole sample (see Table 5). Similarly, the results demonstrate that there is a one-directional relationship between the FSI and the index of speculative pressure (see Table 6). In other words, the fiscal sustainability index helps predict the probability of currency crisis. In Argentina's case, the null hypothesis that the FSI does not Granger cause currency crises in both definitions is rejected, but not the other way around. Similarly, the results in Table 6 show that there is causality only from the FSI to the MPI. It is important to note that Argentina shows an unsustainable fiscal stance in 87% of the period studied (see Table 3).

The result of the bivariate Granger tests for Brazil show that the FSI affects the MPI and vice versa. However, the results suggest no evidence of causality from the FSI to currency crises. On the contrary, for Chile, the Granger causality test results show that the FSI causes ERD, but not the other way around. In the case of Chile, we cannot reject the null hypothesis that the FSI does not Granger cause currency crises. Similarly, the results for this country show no causality relationship from the FSI to the MPI. This is according with the results showed in Tables 1 and 2. Chile has negative skewness, which implies that more stable periods in the exchange market tend to occur more often than large speculative attacks or depreciations. For Colombia, the results of the Granger causality test show that the FSI only causes currency crises, but not ERD and MPI. Colombia has consistently maintained an unsustainable fiscal position as a result of a primary fiscal deficit and a higher real interest rate-growth gap (Table 3). Meanwhile, for Costa Rica, the FSI causes currency crises, exchange rate depreciation and speculative pressure in the exchange market. On the contrary, in the Czech Republic, the results show there is no relationship between the FSI, currency crises and the MPI. Results for the Dominican Republic show that causality runs from the FSI to crises and from the FSI to the MPI. That is, the FSI helps predict the probability of currency crisis occurrence.

Table 4: Granger Causality Tests between the FSI and Currency Crises

Country	Null Hypothesis	Obs	Lags	F-Statistic	Probability
All Countries	FSI does not Granger cause Crises Crises do not Granger cause FSI	970	2	0.092 0.159	0.912 0.853
Argentina	FSI does not Granger cause Crises Crises do not Granger cause FSI	56	4	2.714 0.496	0.041 0.738
Brazil	FSI does not Granger cause Crises Crises do not Granger cause FSI	-	-	- -	- -
Chile	FSI does not Granger cause Crises Crises do not Granger cause FSI	56	4	0.032 0.019	0.998 0.999
Colombia	FSI does not Granger cause Crises Crises do not Granger cause FSI	56	4	4.119 0.447	0.006 0.774
Costa Rica	FSI does not Granger cause Crises Crises do not Granger cause FSI	58	2	7.267 2.746	0.001 0.073
Czech Republic	FSI does not Granger cause Crises Crises do not Granger cause FSI	42	2	0.488 0.093	0.617 0.911
Dominican Republic	FSI does not Granger cause Crises Crises do not Granger cause FSI	58	2	2.477 1.385	0.094 0.259
El Salvador	FSI does not Granger cause Crises Crises do not Granger cause FSI	58	2	0.369 1.264	0.692 0.290
Honduras	FSI does not Granger cause Crises Crises do not Granger cause FSI	57	3	0.393 0.644	0.758 0.589
Hungary	FSI does not Granger cause Crises Crises do not Granger cause FSI	55	5	1.917 3.364	0.110 0.011
Indonesia	FSI does not Granger cause Crises Crises do not Granger cause FSI	56	4	1.185 2.208	0.329 0.082
Malaysia	FSI does not Granger cause Crises Crises do not Granger cause FSI	56	4	4.611 18.658	0.003 0.000
Mexico	FSI does not Granger cause Crises Crises do not Granger cause FSI	55	5	0.734 0.698	0.602 0.627
Peru	FSI does not Granger cause Crises Crises do not Granger cause FSI	59	1	78.501 996.609	0.000 0.000
Philippines	FSI does not Granger cause Crises Crises do not Granger cause FSI	56	4	7.073 6.114	0.000 0.000
Thailand	FSI does not Granger cause Crises Crises do not Granger cause FSI	56	4	6.567 1.843	0.000 0.136
Turkey	FSI does not Granger cause Crises Crises do not Granger cause FSI	59	1	0.674 6.587	0.415 0.013

Source: Author's calculations.

Table 5: Granger Causality Tests between the FSI and ERD

Country	Null Hypothesis	Obs	Lags	F-Statistic	Probability
All Countries	FSI does not Granger cause ERD	953	3	3.993	0.008
	ERD does not Granger cause FSI			0.487	0.691
Argentina	FSI does not Granger cause ERD	56	4	3.610	0.012
	ERD does not Granger cause FSI			0.365	0.832
Brazil	FSI does not Granger cause ERD	59	1	1.854	0.178
	ERD does not Granger cause FSI			5.172	0.026
Chile	FSI does not Granger cause ERD	56	4	2.521	0.053
	ERD does not Granger cause FSI			0.636	0.639
Colombia	FSI does not Granger cause ERD	57	3	0.148	0.931
	ERD does not Granger cause FSI			0.211	0.888
Costa Rica	FSI does not Granger cause ERD	55	5	24.306	0.000
	ERD does not Granger cause FSI			15.746	0.000
Czech Republic	FSI does not Granger cause ERD	40	4	0.593	0.670
	ERD does not Granger cause FSI			0.508	0.729
Dominican Republic	FSI does not Granger cause ERD	59	1	0.949	0.334
	ERD does not Granger cause FSI			0.350	0.556
El Salvador	FSI does not Granger cause ERD	58	2	0.399	0.672
	ERD does not Granger cause FSI			1.359	0.265
Honduras	FSI does not Granger cause ERD	59	1	0.518	0.474
	ERD does not Granger cause FSI			1.698	0.197
Hungary	FSI does not Granger cause ERD	59	1	0.235	0.629
	ERD does not Granger cause FSI			0.021	0.882
Indonesia	FSI does not Granger cause ERD	58	2	0.191	0.826
	ERD does not Granger cause FSI			2.455	0.095
Malaysia	FSI does not Granger cause ERD	57	3	6.489	0.000
	ERD does not Granger cause FSI			8.428	0.000
Mexico	FSI does not Granger cause ERD	56	4	3.720	0.010
	ERD does not Granger cause FSI			1.586	0.193
Peru	FSI does not Granger cause ERD	56	4	6.311	0.000
	ERD does not Granger cause FSI			19.301	0.000
Philippines	FSI does not Granger cause ERD	58	2	2.650	0.079
	ERD does not Granger cause FSI			5.885	0.004
Thailand	FSI does not Granger cause ERD	56	4	4.865	0.002
	ERD does not Granger cause FSI			1.087	0.373
Turkey	FSI does not Granger cause ERD	58	2	3.492	0.037
	ERD does not Granger cause FSI			1.197	0.309

Source: Author's calculations.

Table 6: Granger Causality Tests between the FSI and MPI

Country	Null Hypothesis	Obs	Lags	F-Statistic	Probability
All Countries	FSI does not Granger cause MPI MPI does not Granger cause FSI	919	5	6.566 0.510	0.000 0.769
Argentina	FSI does not Granger cause MPI MPI does not Granger cause FSI	59	1	6.490 0.067	0.013 0.795
Brazil	FSI does not Granger cause MPI MPI does not Granger cause FSI	56	4	5.112 2.393	0.001 0.063
Chile	FSI does not Granger cause MPI MPI does not Granger cause FSI	56	4	0.153 2.561	0.960 0.050
Colombia	FSI does not Granger cause MPI MPI does not Granger cause FSI	56	4	1.143 2.122	0.348 0.093
Costa Rica	FSI does not Granger cause MPI MPI does not Granger cause FSI	55	5	4.799 2.309	0.001 0.060
Czech Republic	FSI does not Granger cause MPI MPI does not Granger cause FSI	42	2	1.359 0.428	0.269 0.655
Dominican Republic	FSI does not Granger cause MPI MPI does not Granger cause FSI	56	4	2.867 0.454	0.033 0.769
El Salvador	FSI does not Granger cause MPI MPI does not Granger cause FSI	56	4	0.092 0.998	0.984 0.418
Honduras	FSI does not Granger cause MPI MPI does not Granger cause FSI	56	4	0.209 1.066	0.932 0.383
Hungary	FSI does not Granger cause MPI MPI does not Granger cause FSI	59	1	1.911 0.042	0.172 0.838
Indonesia	FSI does not Granger cause MPI MPI does not Granger cause FSI	56	4	0.689 1.021	0.603 0.405
Malaysia	FSI does not Granger cause MPI MPI does not Granger cause FSI	56	4	1.949 2.858	0.117 0.033
Mexico	FSI does not Granger cause MPI MPI does not Granger cause FSI	55	5	0.444 0.999	0.815 0.429
Peru	FSI does not Granger cause MPI MPI does not Granger cause FSI	56	4	4.527 5.834	0.003 0.000
Philippines	FSI does not Granger cause MPI MPI does not Granger cause FSI	57	3	4.666 3.356	0.006 0.026
Thailand	FSI does not Granger cause MPI MPI does not Granger cause FSI	56	4	4.088 1.145	0.006 0.347
Turkey	FSI does not Granger cause MPI MPI does not Granger cause FSI	58	2	2.797 0.394	0.070 0.676

Source: Author's calculations.

For El Salvador, Honduras, Hungary and Indonesia, the results show that there is no causality between the variables considered, except from currency crises to the FSI in Hungary and Indonesia. Results for El Salvador and Hungary are in accordance with results showed in Tables 1 and 2. Those two countries have more stable periods than large speculative attacks or depreciations in their foreign exchange market. On the contrary, the results for Malaysia show that the Granger causality runs both ways between the FSI and currency crises, and between the FSI and the ERD. However, it only shows causality from the MPI to the FSI. While the results for Mexico reveal that the Granger causality runs one-way from the FSI to the ERD. This result indicates that a lagged FSI helps predict the risk of a currency attack.

The results of the Granger tests using four lags for Peru show that there is bi-directional causality between the FSI and the ERD, and between the FSI and the MPI. In addition, when one lag is used, the causality runs in two-ways between the FSI and currency crises. Similarly, the results for the Philippines show a bi-directional relationship between the FSI and currency crises, the FSI and the MPI, and the FSI and ERD. The Granger causality test results for Thailand show that the FSI affects currency crises, the MPI and the ERD. Those results suggest that a lagged FSI helps predict currency crises. While for Turkey, the null hypothesis that the FSI does not Granger cause currency crises cannot be rejected, but the results show that there is Granger causality from the FSI to the MPI and from the FSI to the ERD. The results for this country indicate that an unsustainable fiscal position helps predict the probability of a currency crisis.

On the other hand, it is possible that devaluation or depreciation worsens the debt burden and the fiscal sustainability through an increase in the real value of foreign currency debt. Similarly, an increase in the domestic interest rate (to defend the currency) may also affect the debt burden if it is a variable-rate or a short-term, in which case it has to be rolled-over regularly. Of course, a major concern here is the potential endogeneity of the explanatory variable. Then, the Davidson and MacKinnon (1989) version of Hausman's specification test was performed as a formal test for endogeneity of the FSI. To carry out the Hausman test, we run two simple ordinary least squares (OLS) regressions (these regressions are not presented here, but are available upon request). A set of potential instrumental variables that are correlated with the suspected FSI variable is used, including lagged values of MPI. In the first regression, we regress the potentially endogenous FSI variable on instrumental variables and retrieve the residuals. Then, the residuals were used as an additional explanatory variable in a regression of the MPI on the actual FSI. An F-statistic was used to test the null hypothesis that the estimated coefficients of the residuals are jointly equal to zero. If they are, there is no endogeneity. The results show that most of the models pass the test (see Table 7). The null hypothesis was not rejected at the 1% and 5% levels. In the case of El Salvador, the test rejected the hypothesis of no endogeneity at the 5% level. Also, a cross correlation between the lagged MPI and the error term is carried out. Results show that the lagged MPI and the error term are uncorrelated.

To summarise, the results suggest that the fiscal sustainability indicator helps predict the probability of currency crises. The analysis reveals interesting results, particularly for

those countries with large unsustainable fiscal positions in the period considered. Results for Argentina show that there are deep connections between unsustainable fiscal positions (in 87% of the period studied) and currency crises (those occurring in 1990, 1995, and 2000). Similar results are drawn for Turkey (for the crises occurring in 2000 and 2001) and countries in South-East Asia, among others. Also, we no found endogeneity between variables in most of the countries.

Table 7: Hausman Endogeneity Test

Country	Null Hypothesis	F-Statistic	Probability
Argentina	There is no endogeneity	1.829	0.073
Brazil	There is no endogeneity	-1.097	0.277
Chile	There is no endogeneity	-1.389	0.173
Colombia	There is no endogeneity	0.461	0.647
Costa Rica	There is no endogeneity	-0.645	0.521
Czech Republic	There is no endogeneity	1.270	0.211
Dominican Republic	There is no endogeneity	-1.484	0.143
El Salvador	There is no endogeneity	2.384	0.022
Honduras	There is no endogeneity	1.864	0.068
Hungary	There is no endogeneity	1.984	0.052
Indonesia	There is no endogeneity	-1.204	0.233
Malaysia	There is no endogeneity	-0.129	0.897
Mexico	There is no endogeneity	-0.609	0.544
Peru	There is no endogeneity	1.017	0.313
Philippines	There is no endogeneity	-5.002	0.618
Thailand	There is no endogeneity	-1.645	0.105
Turkey	There is no endogeneity	-0.734	0.466

Source: Author's calculations.

6. Conclusion

This paper addressed the issue of the leading indicators that can anticipate the occurrence of currency crises. None of the previous empirical studies had focused on whether a Fiscal Sustainability Indicator may predict a currency crisis. This work attempted to bridge this gap. Firstly, a Fiscal Sustainability Indicator has been constructed for 17 developing countries and we classified the countries for which the FSI was above the threshold of 1 at least 75% of the time as having been fiscally unsustainable, and then different measures of currency crises were defined. Eleven countries were identified as presenting large unsustainable fiscal positions in most of the period studied, explained basically by a primary fiscal deficit.

A Granger causality test was used in order to analyse the issue of causality between the Fiscal Sustainability Indicator and currency crises. This paper documents that the fiscal sustainability indicator helps predict the probability of currency crises, but in some cases this relationship is dependent on the definition of currency crises employed. Also, the empirical evidence is equally ambiguous. In some of the countries considered, the Granger causality tests suggest evidence of bi-causality between the FSI and currency crises. In others, there is evidence of causality running only from currency crises to the FSI. An explanation could be that changes in exchange rates can cause changes in the sustainability of fiscal policy and an unsustainable fiscal position provokes pressure on the exchange rate markets. However, in most of the countries, we found no evidence of endogeneity between the FSI and the MPI. Interestingly, for El Salvador, the results show that there is no causality between the variables considered. However, there is endogeneity between the FSI and the MPI.

Obviously, the analysis of only fiscal indicators is not enough to fully assess the probability of the occurrence of a currency crisis. Of course, the Granger causality test is at the expense of a more sophisticated econometric model that could potentially assess the quantitative relationship between the FSI and currency crises. In spite of these, our empirical findings seem to provide supporting evidence for some authors, who argue that fiscal policy plays an important role in generating currency crises.

Acknowledgment

I would like to thank Alexandros Mandilaras, Paul Levine, Vasco Gabriel, Keith Pilbeam, Jose Amado Requena and anonymous referees of this journal for many helpful suggestions and comments on the preliminary stages of this paper. All errors are mine.

References

Aziz, J., Caramazza, F., and Salgado, R., 2000, 'Currency crises: In search of common elements', Working Paper WP/00/67, International Monetary Fund.

Bird, G. and Mandilaras, A., 2006, 'Regional heterogeneity in the relationship between fiscal imbalances and foreign market pressure', *World Development*, 34, 7, pp. 1171-1181.

Broome, S. and Morley, B., 2004, 'Stock prices as a leading indicator of the East Asian financial crisis', *Journal of Asian Economics*, 15, pp. 189-197.

Burkart, O. and Coudert, V., 2002, 'Leading indicators of currency crises for emerging countries', *Emerging Markets Review*, 3, pp. 107-133.

Burnside, C., Eichenbaum, M. and Rebelo, S., 2000, 'On the fundamentals of self-fulfilling speculative attacks', Working Paper 7554, National Bureau of Economics Research.

Burnside, C., Eichenbaum, M. and Rebelo, S., 2003, 'On the fiscal implications of twin crises', In Dooley, M. P. and Frankel, J. A., editors, *Managing Currency Crises in Emerging Markets*, University of Chicago Press, Chicago.

Burnside, C., Eichenbaum, M. and Rebelo, S., 2006, 'Government finance in the wake of currency crises', *Journal of Monetary Economics*, 53, pp. 401-440.

Chang, R. and Velasco, A., 2001, 'A model of financial crises in emerging markets', *Quarterly Journal of Economics*, 116, pp. 489-514.

Corsetti, G. and Mackowiak, B., 2005, 'A fiscal perspective on currency crises and the original sin', In Eichengreen, B. and Hausmann, R., editors, *Other People's Money: Debt Denomination and Financial Instability in emerging Market Economies*, The University of Chicago Press, Chicago.

Corsetti, G. and Mackowiak, B., 2006, 'Fiscal imbalances and the dynamics of currency crises', *European Economic Review*, 50, pp. 1317-1338.

Crepo-Cuaresma, J. and Slacik, T., 2007, 'Predicting currency crises using the term structure of relative interest rates: Case studies of the Czech Republic and Russia', *Focus on European Economic Integration*, 1, pp. 135-149.

Croce, E. and Juan-Ramón, V. H., 2003, 'Assessing fiscal sustainability: A cross-country comparison', Working Paper WP/03/145, International Monetary Fund.

Daniel, B. C., 2001, 'A fiscal theory of currency crises', *International Economic Review*, 42, 4, pp. 969-988.

Davidson, R. and MacKinnon, J. G., 1989, 'Testing for consistency using artificial regressions', *Econometric Theory*, 5, 3, pp. 363-384.

Eichengreen, B., Rose, A. K. and Wyplosz, C., 1994, 'Speculative attacks on pegged exchange rates: An empirical exploration with special reference to the European Monetary System', Working Paper 4898, National Bureau of Economics Research.

Eichengreen, B., Rose, A. K. and Wyplosz, C., 1996, 'Contagious currency crises: First tests', *Scandinavian Journal of Economics*, 98, pp. 463-484.

Flood, R. and Garber, P., 1984, 'Collapsing exchange rate regimes: Some linear examples', *Journal of International Economics*, 17, pp. 1-13.

Flood, R. and Marion, N., 1996, 'Speculative attacks: Fundamentals and self-fulfilling prophecies', Working Paper 5789, National Bureau of Economic Research.

Frankel, J. A. and Rose, A. K., 1996, 'Currency crashes in emerging markets: An empirical treatment', *Journal of International Economics*, 41, pp. 351-366.

Frankel, J. A. and Saravelo, G., 2012, 'Can leading indicators assess country vulnerability? Evidence from 2008-09 global financial crisis', *Journal of International Economics*, 87, 2, pp. 216-231.

Girton, L. and Roper, D., 1977, 'A monetary model of exchange market pressure applied to the post-war Canadian experience', *American Economic Review*, 67, pp. 537-548.

Goldfajn, I. and Valdés, R. O., 1997, 'Are currency crises predictable?', Working Paper WP/97/159, International Monetary Fund.

Kaminsky, G. and Reinhart, C., 1999, 'The twin crises: The causes of banking and balance of payments problems', *American Economic Review*, 89, 3, pp. 473-500.

Krugman, P., 1979, 'A model of balance of payments crises', *Journal of Money, Credit and Banking*, 11, pp. 311-325.

Krugman, P., 1996, 'Are currency crises self-fulfilling?', In NBER Macroeconomic Annual, 2, pp. 345-378.

Marini, G. and Piersanti, G., 2003, 'Fiscal deficits and currency crises', Working Paper No. 15, CEIS Tor Vergata.

Nashashibi, K. and Bazzoni, S., 1993, 'Alternative exchange rate strategies and fiscal performance in Sub-Saharan Africa', Working Paper WP/93/68, International Monetary Fund.

Obstfeld, M., 1986, 'Rational and self-fulfilling balance of payments crises', *American Economic Review*, 76, pp. 72-81.

Obstfeld, M., 1996, 'Models of currency crises with self-fulfilling features', *European Economic Review*, 40, pp. 1037-1048.

Rangvid, J., 2001, 'Second generation models of currency crises', *Journal of Economic Survey*, 15, 5, pp. 613-641.

Siwinska, J., 2000, 'Currency crises and fiscal imbalances: The transition countries perspective', Studies and Analyses 219, Center for Social and Economic Research.

Van Wijnbergen, S., 1991, 'Fiscal deficits, exchange rate crises and inflation', *Review of Economic Studies*, 58, 1, pp. 81-92.

A partial equilibrium analysis of NAFTA's impact on U.S. bilateral trade

Cephas Naanwaab[1] and Osei-Agyeman Yeboah[2]

Abstract

This paper examines the effects of the North American Free Trade Agreement on agricultural commodity trade using extensive data. The data cover agricultural exports and imports between the U.S. and NAFTA partners over the extended period of 1989-2010. The commodities covered in the analyses include; corn, soy bean, cotton, wheat, fresh vegetables, poultry, dairy products, and red meats. A partial equilibrium model, in which we derive each trading partner's excess demand and excess supply, is used to study the impact of NAFTA on trade, controlling for other trade-inducing variables such as exchange rates, tariffs, per capita incomes, and relative prices. Regression results show mixed effects of NAFTA on different commodities while graphical and counterfactual analyses indicate strictly positive effects.

Keywords: NAFTA, Agricultural commodity trade, partial equilibrium analysis

JEL Classification: F130, F140, F150

1. Introduction

The foundation of free trade, emphasizing comparative advantage, was laid by Adam Smith in *The Wealth of Nations*, published in 1776. Economists, since Adam Smith, have believed that free trade, defined by absence of tariffs, quotas, or other non-tariff barriers, is a good thing, and that all countries that engage in it stand to benefit. Since the General Agreement on Tariffs and Trade (GATT) was signed in 1947, average tariff rates in industrial countries have fallen from 40% to about 5%, increasing world trade by volumes never before seen. The GATT[1] served as the only multilateral conduit for regulating international trade from 1948 until it gave way to the World Trade Organization (WTO) in 1995.

The idea of Regional Trade Agreements (RTAs) originated from Viner's (1950)

[1] Corresponding Author, cbnaanwa@ncat.edu, ph: +1 336-285-3351, Assistant Professor of Economics, School of Business and Economics, North Carolina A&T State University, 1601 East Market Street, Greensboro, NC 27411, USA.

[2] Associate Professor and Interim Director, L.C. Cooper Jr. International Trade Center, North Carolina A&T State University, 1601 East Market Street, Greensboro, NC 27411, USA.

[1] At its signing in 1947 the GATT had 23 members which has increased to the current 153 WTO member countries.

piece "The Customs Union Issue" in which the distinction between trade-creation and trade-diversion as it relates to RTA formation was laid out (OECD, 2001). RTAs can take on a variety of forms, such as a simple agreement on tariff reduction (preferential trade agreement), free trade area with common external tariff (customs union), free trade area with factor movements (common market), and a much more harmonized system of regulatory and fiscal policies (economic union). On the basis of this definition, the North American Free Trade Agreement (NAFTA) may be considered a preferential trade agreement that extends reduced tariffs to members.

While there were a few regional trade agreements during the GATT era, it was not until the 1990s that a lot of countries understood the importance of RTAs. There has, since the early 1990s, been a proliferation of RTAs across the globe. According to WTO statistics, there are currently 227 RTAs in force. Of these RTAs, 93 were signed in the 1990-1999 decade compared to 16 and 8 in the prior two decades (Davey, 2005). The United States has entered into 16 FTA and RTA partnerships with 17 countries in different regions of the world[2]. Other than NAFTA, the U.S. has RTAs with Central American countries (DR-CAFTA)[3], as well as with the Caribbean Basin countries. The U.S. is also involved in trade talks to form a trade agreement known as Trans-Pacific Partnership (TPP) with countries in the Asia-Pacific region. Most recently, negotiations fora proposed Transatlantic Trade and Investment Partnership (TTIP) agreement between the U.S. and the E.U. has been launched.

Regional Trade Agreements (RTAs) are important to creating economic integration and thereby promoting trade among the members of the RTA. RTAs are multilateral agreements involving several countries that may or may not share any geographical boundaries. A number of free trade areas exist throughout the world, a few of which are the European Union, Southern Common Market (MERCOSUR), Common Market for Eastern and Southern Africa (COMESA), and Association of Southeast Asian Nations (ASEAN). Bilateral trade agreements are also quite common and play a significant role in promoting trade between countries. The Canada-U.S. Trade Agreement (CUSTA), a precursor of NAFTA, was a bilateral trade agreement between Canada and the U.S., which came into effect January 1, 1989. This agreement gradually eliminated tariffs between the two countries while non-tariff barriers were gradually reduced. By January 1, 1998, all tariffs on goods traded between U.S. and Canada, with the exception of a few tariff rate quotas (TRQs), had been eliminated.

The provisions under CUSTA were absorbed into the North American Free Trade Agreement (NAFTA) which was implemented on January 1, 1994. In addition to the reduction of trade barriers already provided for under CUSTA, NAFTA agreement

[2] Examples of concluded RTAs are Israel (1986), Canada (1989), Mexico (1994), Jordan (2001), Chile (2004), Morocco (2004), South Korea (2012).The FTA agreement with Panama has been implemented (2012) while the U.S.-Colombia Trade Promotion Agreement (TPA) is going through the ratification phase.

[3] DR-CAFTA members include: Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, and Nicaragua

eliminated most non-tariff barriers and a gradual reduction of tariffs between the U.S. and Mexico (Koo and Kennedy, 2005). While many tariffs were to be eliminated immediately following the implementation of the NAFTA agreement, others were to be phased out gradually over a 4-, 9-, or 14-year period. Under the agreement, all other tariffs and quotas were to be eliminated by January 1, 2008. NAFTA also provided guidelines on Sanitary and Phytosanitary (SPS) measures as a way for each member country to maintain and protect the lives or health of humans, animals, or plants in its territory.

A lot of controversy surrounds the impacts of RTAs on trade. While some view RTAs as trading diverting, others hail such treaties as instruments of trade creation. Trade creation takes place when higher-cost domestic production of a commodity is displaced by imports from lower-cost RTA member countries. According to Burfisher and Jones (1998) «an RTA is trade-diverting if members shift their imports from efficient non-member producers to less efficient member producers within the RTA to take advantage of reduced tariffs provided by the preferential treatment. Consequently, consumers will have to pay higher prices because they are now importing from higher-cost RTA member countries.» In light of this, trade diversion is inefficient, insofar as it contradicts the tenets of comparative advantage espoused by economists. Previous studies have outlined the benefits of regional integration, both between members on the one hand, and between members and non-members on the other (Hejazi and Safarian, 2005). In their study, Hejazi and Safarian found that NAFTA has brought significant trade gains to members, particularly Mexico, as well as non-members such as Japan.

In a review of the impact of RTAs, the OECD (2001) found mixed results. The OECD review concluded that RTAs increase intra-bloc trade in some cases, but they found little evidence of trade diversion. Burfisher and Jones (1998) analyzed the agricultural trade impacts of RTAs noting that most of these RTAs, such as Canada-U.S. Trade Agreement (CUSTA) and Australia-New Zealand Closer Economic Relations, have led to increased agricultural trade among members and non-members.

Data from the USDA Foreign Agricultural Service indicate that since the signing of the agreement, U.S. total agricultural commodity trade with NAFTA members has increased more than three-fold from $18 billion in 1994 to $76 billion in 2012 (USDA-FAS, 2012). While all of this increased volume of trade cannot be attributed to NAFTA alone, evidence from other researchers has shown that the effect of NAFTA has generally been positive (Zahniser and Link, 2002; Zahniser and Roe, 2011). Other events pre- and post-NAFTA, such as Mexico's unilateral trade liberalization and exchange rate devaluation, the establishment of the WTO in 1995, and other bilateral trade agreements, could have accounted for some of the growth in trade (Agama and McDaniel, 2002).

The objective of the present study is to analyze the impact of NAFTA on agricultural trade between the three partners in a partial equilibrium framework. To this end, we use extensive data on eight of the leading agricultural commodities traded between NAFTA partners. The rest of the paper is organized as follows: Section 2 discusses materials and methods of the study, Section 3 presents the empirical findings, and Section 4 offers the concluding remarks.

2. Research Methodology and Data

2.1 Impacts of NAFTA on Trade

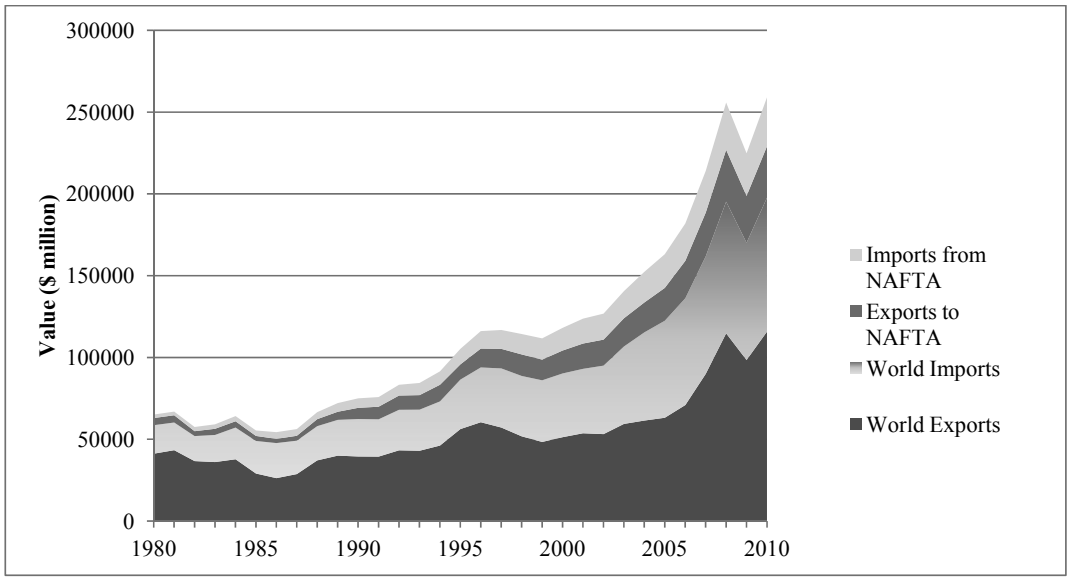
U.S. trade with NAFTA partners has seen a remarkable growth since the implementation of the NAFTA agreement. Estimates show that U.S. Trade with NAFTA partners has increased by 78% in real terms since 1993, and trade with Mexico alone has increased by 141%, compared to an average trade growth of 43% with the rest of the world during the same period (Hillberry and McDaniel, 2002). Using a decomposition analysis of trade growth offered by Hummels and Klenow (2002), Hillberry and McDaniel (2002) found that U.S. trade has increased both at the extensive and intensive margins. Their results show that post-NAFTA changes in U.S. trade with partners saw larger increases in quantities of goods traded in HTS[4] lines that were already traded as of 1993. This suggests that trade growth at the extensive margin was less than the intensive margin. Thus, U.S. industries that were exporting goods to NAFTA members before the Agreement are exporting more of those same goods, as opposed to more of new goods, post-implementation of the Agreement.

Since NAFTA implementation, U.S. agricultural trade with Canada and Mexico has more than tripled, even after accounting for recent economic downtown (Zahniser and Roe, 2011). NAFTA's effect on trade in the region varies by commodity and trading partner, with commodities that enjoyed the largest tariff reductions having the greatest increases in trade under the agreement (Zahniser and Roe, 2011). Zahniser and Link (2002) estimated that U.S. agricultural exports to Canada and Mexico combined increased by 59% between 1993 and 2000, while exports to the rest of the world grew by just 10% within the same period. Likewise, U.S. agricultural imports from Canada and Mexico increased by 86% compared to an increase of 42% from the rest of the world. Many agricultural commodities have seen increases in trade volumes following the implementation of NAFTA. Zahniser and Link (2002) and ERS (1999) found that the effect of NAFTA on U.S. agricultural commodity trade varies by commodity and trading partner, with the biggest increases occurring for those commodities that had the largest declines in tariff and non-tariff barriers.

The economic downturn of 2008/2009 affected agricultural trade in the NAFTA region, much like for other commodities in the region and globally. Figure 1 indicates the pattern of growth in U.S. agricultural trade within the NAFTA region and the rest of the world. Agricultural trade, both within NAFTA area and worldwide, took a hit during the recession but has since recovered at the beginning of 2010.

[4] Harmonized Tariff Schedule

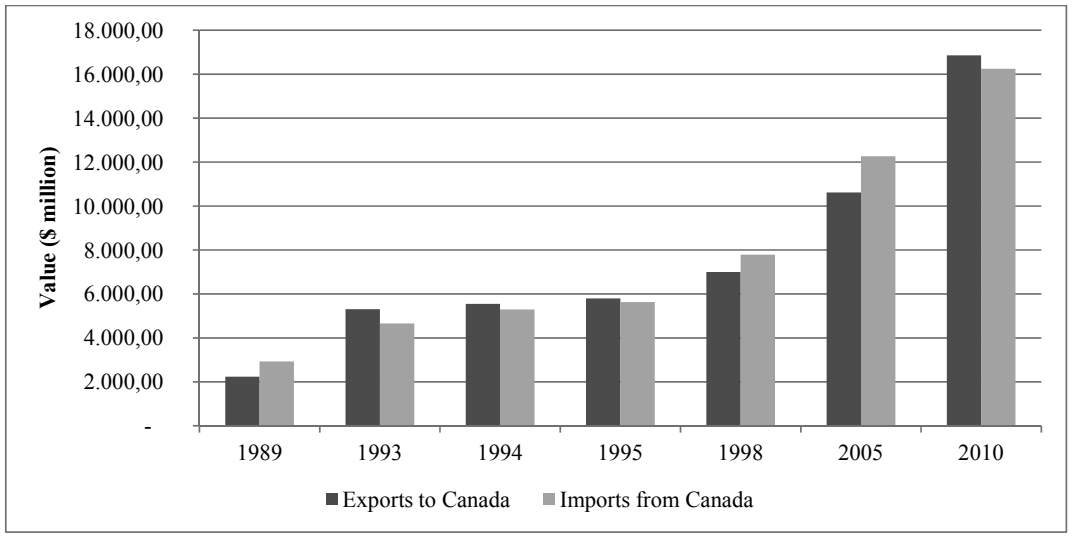
Figure 1: U.S. Agricultural Trade with NAFTA and world



Data Source: Foreign Agricultural Service, USDA

Figure 2 indicates that U.S. agricultural trade with Canada held steady following implementation of the Agreement before rapidly increasing in the late 1990s. The fact that agricultural trade with Canada did not immediately increase is attributable to the CUSTA Agreement which had already been in effect since 1989, and the rapid increase in the late 1990s was due to the complete elimination of all tariffs with Canada in 1998. Essentially, NAFTA merely replaced CUSTA Agreement which had already made provisions for tariff reduction on most agricultural commodities; as such NAFTA's immediate effect on agricultural trade between U.S. and Canada was modest. As U.S. agricultural exports to Canada increased, so did imports from Canada, which implies that both countries have benefited from the implementation of the Agreement. What does seemapparent in the immediate aftermath of CUSTA implementation was that U.S. agricultural trade deficit with Canada gave way to surpluses, at least until 1996 (see Figure 2).

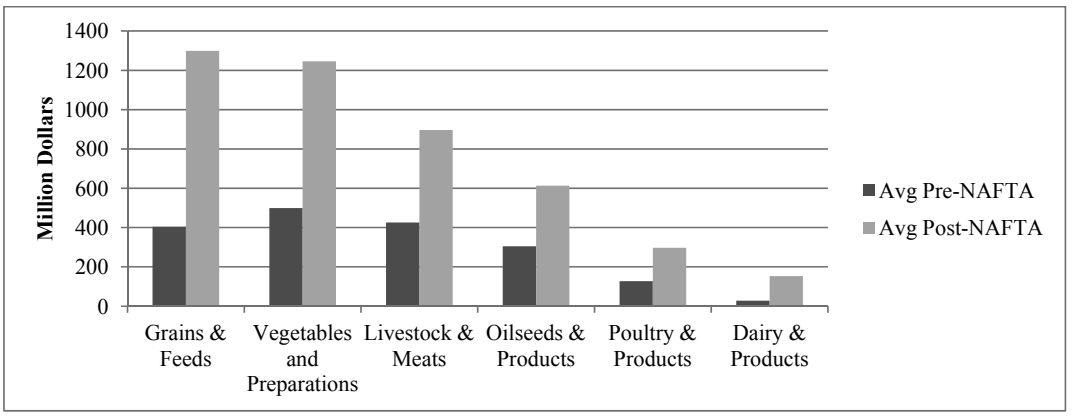
Figure 2: U.S. Agricultural Trade with Canada: All Commodities



Data Source: Foreign Agricultural Service, USDA

A simple analysis of the impact of NAFTA on agricultural trade can be carried out by analyzin gthe pre-and post-NAFTA pattern of trade. Figure 3 presents the annual average values of exports of various agricultural commodities to Canada in the decade preceding and after NAFTA. Generally, post-NAFTA values are greater than their pre-NAFTA equivalent values. The commodities that have seen the most significant increases are grains, vegetables, and livestock and meats. The top three agricultural commodities with the greatest increases in value of exports to Canada are grains/feeds, vegetables, and livestock/meats.

Figure 3: U.S. Agricultural Exports to Canada, Pre- and Post-NAFTA

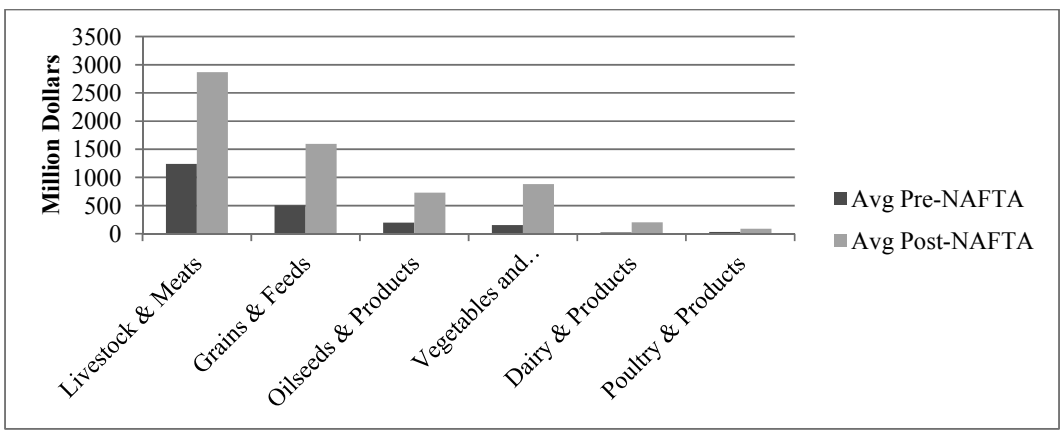


Data Source: Foreign Agricultural Service, USDA

Similar to exports, the imports of these agricultural commodities have significantly increased during the implementation phase of the Agreement. Figure 4 presents the comparison of average values of imports of selected commodities pre- and post-NAFTA. Annual average imports of vegetables, grains and oilseeds have increased by 473%, 215% and 268% respectively since 1994. By the same token, importation of dairy products, and livestock/meats from Canada increased by 760% and 131%,respectively, since NAFTA was signed.

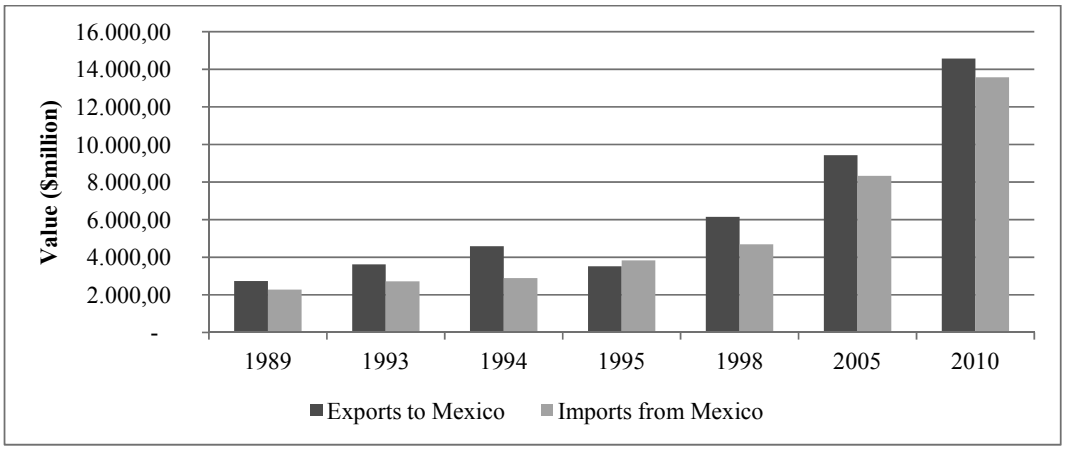
Figure 5 shows that U.S. agricultural trade with Mexico has enjoyed an increasing trend since the signing of the Agreement, buoyed by rapid increases in exports of grains and oilseeds. As a result of increased demand for meat in Mexico, poultry and hog producers rely heavily on importation of feed grains from the U.S. as feedstuffs. U.S. exports of feed grains and oilseeds to Mexico increased by 134% during NAFTA compared to the periods immediately before the Agreement came into force. Corn, wheat and rice exports to Mexico have quadrupled in the NAFTA era, which largely reflects the enhanced liberalization of agricultural trade provided by the NAFTA framework. With the exception of 1995, the U.S. maintains a trade surplus in agricultural commodities with Mexico both before and after NAFTA was implemented (Figure 5). Both partners appear to have gained from NAFTA; as U.S. increased its exports to Mexico, imports from Mexico increased by about the same margins.

Figure 4: U.S. Agricultural Imports from Canada, Pre- and Post-NAFTA



Data Source: Foreign Agricultural Service, USDA

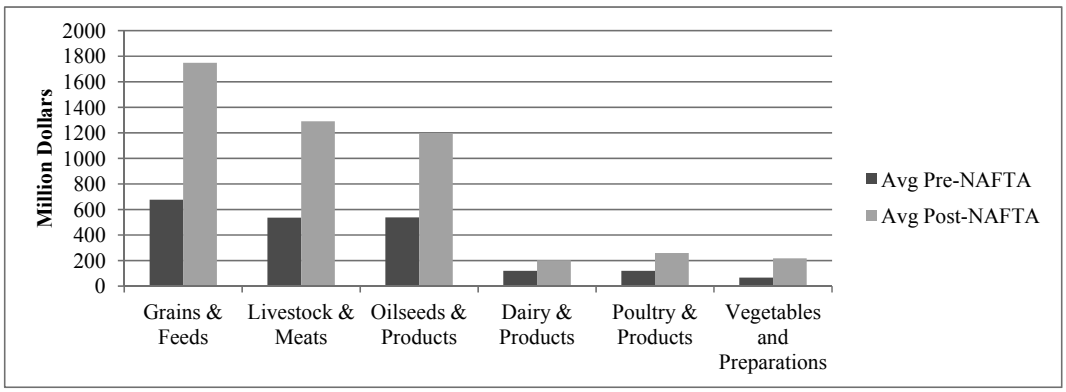
Figure 5: U.S. Agricultural Trade with Mexico: All Commodities



Data Source: Foreign Agricultural Service, USDA

Three of the agricultural commodities that saw significant increases in exports to Mexico are grains and feeds, livestock and meats, and oilseeds and products (see Figure 6).

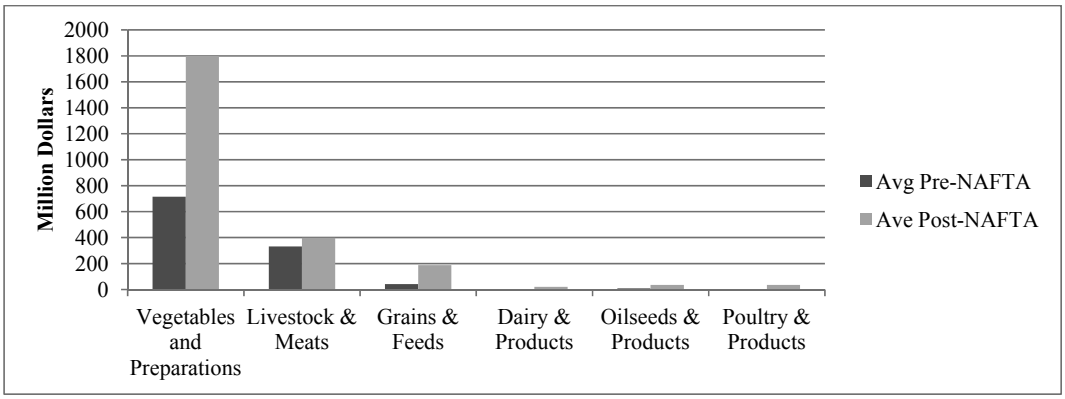
Figure 6: U.S. Agricultural Exports to Mexico, Pre- and Post-NAFTA



Data Source: Foreign Agricultural Service, USDA

Importation of vegetables from Mexico has significantly increased in the post-NAFTA period (Figure 7). Average annual value of vegetables imported into the U.S. from Mexico stands at $1.8 billion compared to $700 million in the period before NAFTA took effect. The amounts of oilseeds, dairy and poultry products coming into the U.S. from Mexico, although insignificant, are higher in the post-NAFTA period compared to the period before.

Figure 7: U.S. Agricultural Imports from Mexico, Pre- and Post-NAFTA



Data Source: Foreign Agricultural Service, USDA

2.2 Partial Equilibrium Analysis of U.S. Trade with NAFTA partners

To study the effect of NAFTA on US trade with other NAFTA partners, a partial equilibrium model is posited. Partial equilibrium, as opposed to general equilibrium, allows the study of the impact of a trade policy on one sector of the economy. Koo and Kennedy (2005) used partial equilibrium analysis to derive the import demand and export supply functions for a particular commodity or sector of the economy. The information derived from partial equilibrium analysis can be used by policy makers to estimate welfare effects (consumer and producer surpluses) associated with certain trade policies.

2.3 Import Demand Function

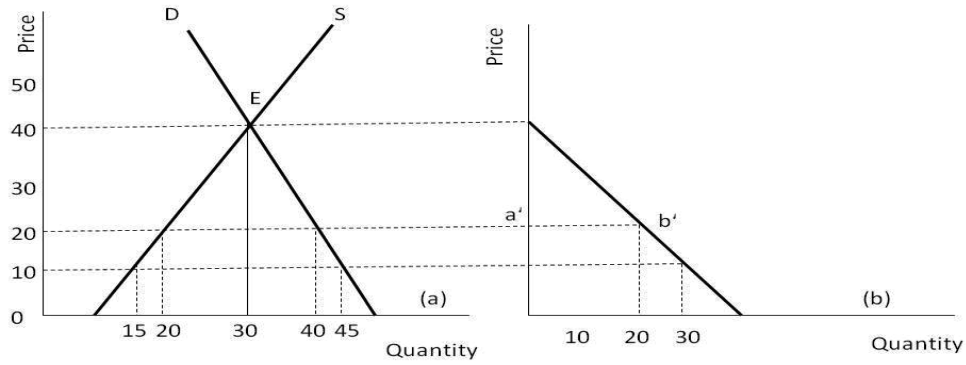
The import demand function can be derived as the excess domestic demand for a good. In this context, import demand for a particular commodity is defined at the points where the domestic quantity demanded of the good is greater than the domestic supply, as in Figure 8 below (Koo and Kennedy, 2005).

Algebraically, import demand is defined as;

$$Q_m(P,Y) = Q_d(P, Y(P)) - Q_s(P) = Q_m(P, Y) \quad (1)$$

where $Q_m(.)$ is the quantity of the commodity imported as a function of domestic price P and income Y, $Q_d(.)$ is the domestic quantity demanded as a function of price P, and income Y, and $Q_s(P)$ is the quantity of the good supplied domestically at each price level. It can be proved that the import demand is inversely related to domestic price level, as derived in Figure 8 below.

Figure 8: Derivation of import Demand curve



This inverse relationship between import demand and price can also be derived algebraically as;

$$\frac{\partial Q_m}{\partial P} = \frac{\partial Q_d}{\partial P} + \frac{\partial Q_d}{\partial Y} * \frac{\partial Y}{\partial P} - \frac{\partial Q_s}{\partial P} < 0 \qquad (2)$$

where the first term on the right is negative by the law of demand, the second term is negative by assumption that the imported good in question is a normal good, such that $\partial Q_d/\partial Y>0$ and $\partial Y/\partial P< 0$ because higher prices reduce the consumers real income. Lastly, $\partial Q_s/\partial P$ is positive by the law of supply.

From Figure 8, when the domestic price is \$40 per unit, domestic quantity demanded is equal to domestic supply of 30 units, thus, the domestic market clears and import demand is zero. As the price falls to \$20 per unit, domestic producers have less incentive to produce and therefore cut supply to 20 units while domestic demand increases to 40 units. The domestic excess demand of 20 units (40-20) is the import demand at the price of \$20. As price further decreases to \$10, import demand increases to 30 units (45-15).

2.4 Export Supply Function

The export supply function is derived as the horizontal difference between the domestic quantity supplied and domestic quantity demanded of a commodity at any given price. Export supply is positive when the domestic quantity supplied exceeds domestic quantity demanded, and this occurs at price levels at which the domestic price is higher than the international price, thus creating a surplus (excess supply) on the domestic market. The export supply (or excess supply) is zero at the point where the domestic and international prices of the commodity are equalized.

Export supply may be derived as;

$$Q_x(P) = Q_s(P) - Q_d(P) \qquad (3)$$

where $Q_x(P)$ is the quantity of exports of the commodity as a function of price, Q_s and Q_d are domestic quantity supplied and domestic quantity demanded, respectively.

2.5 Empirical Models

Following Khan and Ross (1977) and Boylan et al. (1980), the import demand is specified as

$$M_t^* = f(Y_t, P_{mt}/P_{dt}); \tag{4}$$

Which can be linearized as;

$$M_t^* = \alpha_0 + \alpha_1 Y_t + \alpha_2 P_t + e_t \tag{5}$$

Where M_t^* is the desired quantity of imports, $Y_t$is the gross domestic product (or income), P_t is the relative price defined as the ratio of import price (P_{mt}) to domestic price (P_{dt}). A partial adjustment mechanism may be introduced into the model in equation 5 above (Doroodian, 1994). This is expressed as;

$$\Delta M_t = M_t - M_{t-1} = \delta(M_t^* - M_{t-1}) \tag{6}$$

Where M_t and M_{t-1} are actual quantities imported at time t and t-1 respectively, and δ is the coefficient of adjustment, such that; $0 \le \delta \le 1$. Substituting equation 5 into equation 6, and rearranging the terms yields the following dynamic import demand equation;

$$M_t = \delta\alpha_0 + \delta\alpha_1 Y_t + \delta\alpha_2 P_t + (1-\delta)M_{t-1} + \delta e_t \tag{7}$$

Partial equilibrium analysis is used to model U.S. import demand for agricultural commodities. The following equations represent the domestic market clearing conditions for each commodity;

$$Q_d = Q_d(P, Y, e) \tag{8}$$

$$Q_s = Q_s(P, e, W) \tag{9}$$

$$Q_d = Q_s \tag{10}$$

Assuming that there is a negative price differential between the domestic and international markets, the estimated excess demand or import demand is given as;

$$M_t = Q_d - Q_s = M(P/P_t^*, e_t, Y_t, M_{t-i}, W_t) \tag{11}$$

This is estimated econometrically as;

$$lnM_t = \alpha_0 + \alpha_1 ln(P/P_t^*) + \alpha_2 lne_t + \alpha_3 lnY_t + \alpha_4 lnM_{t-i} + \alpha_5 NAFTA + \alpha_6 W_t + \varepsilon_t \tag{12}$$

Where *ln* is the natural logarithm and t indexes time, *M* is the value of imports, *P/P** is the relative price (ratio of domestic to foreign prices), e is the real exchange rate defined as the price of foreign currency, *Y* is per capita income level, NAFTA is a dummy variable (=1 if year ≥ 1994), and *W* is a vector of other factors that may affect imports. It is important to mention that the use of a dummy variable to measure NAFTA effects on trade has certain limitations: The obvious being that the dummy variable may well capture some other exogenous effects on trade other than NAFTA. One example of an exogenous effect is supply management in Canada that effectively restricts importation of dairy and poultry products. Thus, in the case of Canada-U.S. trade, declining exports to Canada of certain poultry and meat products may be due to supply management system, rather than NAFTA. The second is that the NAFTA dummy variable has different interpretations in the case of regressions involving U.S.-Canada trade than U.S.-Mexico trade. The Canada-U.S. trade agreement (CUSTA) took effect from 1989 while U.S-Mexico trade agreement became fully effective 1994. Thus, the dummy variable for NAFTA in the case of U.S-Canada trade is constructed as NAFTA =1 if year ≥ 1988, and zero otherwise.

Following similar procedure as for the import demand, the estimated export supply function is derived as;

$$X = Q_s - Q_d = X\,(P/P_t^*,\ e_t,\ X_{t-i},\ Y_t^*,\ Z_t) \tag{13}$$

This is estimated as;

$$lnX_t = \beta_0 + \beta_1 ln(P/P_t^*) + \beta_2 lne_t + \beta_3 lnY_t^* + \beta_4 lnX_{t-i} + \beta_5 NAFTA + \beta_6 Zt + u_t \tag{14}$$

Where *ln* is the natural logarithm and t indexes time, X_t is the quantity of exports, Y_t^* is foreign country per capita income level,NAFTA is a dummy variable (=1 if year ≥ 1988) for U.S. - Canada trade regressions, and (=1 if year ≥ 1994) for U.S. - Mexico trade regressions, Z_t is a vector of other factors, and Q_s, Q_d, P and e are as previously defined. Relative prices and exchange rates are included in all the regressions to determine their impact on trade flows as per Oyinlola et al. (2010).

2.6 Data and Unit Root Tests

Quarterly trade data (1989Q1:2010Q4) for U.S.-Canada and U.S.-Mexico are obtained from the Global Agricultural Trade System (GATS) maintained by the Foreign Agricultural Services (FAS) of the United States Department of Agriculture (USDA). The data comprise import and export values (measured in thousands of dollars) of major agricultural commodities traded between NAFTA partners: these include corn, cotton, wheat, sugar, soybeans, poultry products, dairy products, red meats, and vegetables. Gross national income per capita for the U.S., Canada, and Mexico are obtained from the Organization for Economic Cooperation and Development (OECD). Other data, including price indices, and exchange rates, are obtained from the Federal Reserve Bank of St. Louis (FRED II).

Time series data used in regression analysis should be stationary (Enders, 2004). A stationary time series is one that has a constant mean and variance over time (covariance stationary process). A violation of the stationarity assumption results in a spurious regression, in which the R^2 is high and t ratios appear to be significant but the output results have no economic meaning (Granger and Newbold, 1974). The Augmented Dickey-Fuller test, equation (15) below, proposed by Dickey and Fuller (Dickey and Fuller, 1979;Dickey and Fuller, 1981), was performed to check presence of unit roots. The null hypothesis for the ADF unit root test consists of testing $\gamma = 0$. Failure to reject this null hypothesis signifies the presence of a unit root. By this definition, the tests show that all variables are unit root processes, or integrated of order one, $I(1)$. First differencing the variables, thus, achieves required stationary series, or $I(0)$ processes.

$$\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{j=1}^{p} \beta_j \Delta y_{t-j} + \varepsilon_t \tag{15}$$

3. Results and Discussion

3.1 Regression Analysis

The analysis covers top agricultural commodities traded in the NAFTA area including corn, wheat, cotton, soy bean, poultry products, dairy products, red meats, sugar, and vegetables. Tables 1 and 2 compare the pre-NAFTA and post-NAFTA average values of trade between the U.S. and Canada for the commodities covered in the regression analysis. The post-NAFTA average values traded are significantly higher than pre-NAFTA values. Similar analysis (not shown for brevity) of pre- and post-NAFTA trade between the U.S. and Mexico reveal the same findings as for U.S. –Canada trade.

Table 1: Pre- and Post-NAFTA Analysis of U.S. Exports to Canada

Exports	Avg. Pre-NAFTA (Value $mil)	Avg. Post-NAFTA (Value $mil)	Difference (Value $mil)
Corn	15635.75	57461.74	41825.99*
Cotton	14888.15	16616.7	1728.55*
Wheat	507.1	1110.5	603.4*
Soya bean	10574	23004.39	12430.39*
Vegetables (fresh)	142125.3	271677.8	129552.5*
Dairy Products	11392.9	65656.48	54263.58*
Poultry Products	46813.5	97236.56	50423.06*
Red Meats	92702.75	194819.8	102117.05*

*=Difference statistically significant at the 5% level

Table 2: Pre- and Post-NAFTA Analysis of U.S. Imports from Canada

Imports	Avg. Pre-NAFTA (Value $mil)	Avg. Post-NAFTA (Value $mil)	Difference (Value $mil)
Corn	4297.6	8802.03	4504.43*
Wheat	30067.7	88222.53	58154.83*
Soya bean	4983	12430.59	7447.59*
Vegetables (fresh)	24313	144306.5	119993.5*
Dairy Products	7963.45	68261.18	60297.73*
Poultry Products	9167.9	36694.14	27526.24*
Red Meats	160764.9	416805.8	256040.9*

*=Difference statistically significant at the 5% level

Regression analyses show mixed findings regarding the direction of NAFTA effects on agricultural commodity trade between NAFTA partners. A number of econometric specifications were tried to determine if the mixed sign effects of NAFTA could be due to a misspecification, but all turned up almost similar results. Autocorrelation and heteroskedasticity were identified as potential issues that could be causing this mixed signs. Estimating the models in first differences did not change the signs. Consequently, we employed Prais-Winsten and Cochrane-Orcutt transformations to deal with the time series issues relating to autocorrelation.

In Tables 3A and 3B, the results of regression analyses of U.S. agricultural commodity trade with Canada are presented, while Tables 4A and 4B present similar regression analyses for U.S. – Mexico trade. Tables 3A and 4A show estimates of the export supply functions for U.S. exports to Canada and Mexico, respectively. The regression results show that since NAFTA's inception, U.S. corn and poultry product exports to Canada have significantly declined, while U.S. exports of corn to Mexico has significantly increased. Before NAFTA, Mexico strictly regulated the importation of corn from U.S. and Canada using import licensing requirements. Under NAFTA, tariffs were replaced with duty-free tariff rate quotas during the period of 1994-1997 and eventually eliminated by 2008. The increased trade in corn is a reflection of the removal of these trade barriers. The impact of NAFTA on U.S. exports of cotton to Canada is positive but not significant. NAFTA's effect on the exports of U.S. soy bean to Canada is negative but statistically insignificant. The regression results also show that the effect of NAFTA on U.S. exports of wheat, soy bean, and poultry products to Mexico is not statistically significant.

U.S. dollar depreciation against the Canadian dollar increases U.S. exports of cotton to Canada, and in the same vein U.S. dollar depreciation against the Mexican Peso increases U.S. exports of poultry products to Mexico. The exchange rate effect is however negative in the export of poultry products to Canada, but insignificant with regard to U.S. exports of corn, soy bean and wheat to Mexico. Increases in gross national income per

capita in Canada lead to increases in U.S. exports, while U.S. exports of corn to Mexico increases with increasing per capita incomes in Mexico. Similar findings of the effect of GDP on trade flows have been reported for trade between the E.U. and the Western Balkans (Botrić, 2013). Matchaya et al. (2013) found evidence that GDP (income) growth leads to increased trade in the case of imports to Malawi. Other explanatory variables, namely, relative prices, average tariffs, and lending rates are shown to have mixed effects on U.S. exports to Canada and Mexico.

Similarly, Tables 3B and 4B show the estimated import demand functions for U.S. imports from Canada and Mexico, respectively. In Table 3B we present the estimated import demand functions for U.S. imports of dairy products, poultry products, red meats, and wheat from Canada. The effect of NAFTA on the exports of all these products is negative but statistically significant only for wheat imports from Canada and insignificant for dairy, poultry and read meats. Further results from Table 3B show the income effect is positive and significant for U.S. imports of poultry and red meats from Canada, while the exchange rate is insignificant, except for red meats, in which case it has a positive effect, opposite of what we would expect for imports. The relative price effect is negative and significant for dairy products and wheat imports from Canada, indicating that lower domestic prices of these commodities result in an increased excess demand, and consequently increased importation.

In Table 4B we present regression results of U.S. imports of dairy products, sugar and related products, red meats, and vegetables from Mexico. The results show that U.S. imports of dairy products and sugar have significantly increased under NAFTA than in the period preceding the agreement. There is no significant impact of NAFTA on the importation of red meats and vegetables in general from Mexico. The income and relative price effects are significant in the dairy and sugar equations with the expected signs: Increase in U.S. per capita income increases the amounts of each commodity imported, which conform to the assumption that these are normal goods. Also, lower domestic prices lead to increased domestic demand, and hence higher import demand. The exchange rate effect is negative as expected but statistically insignificant. All things remaining constant, it is expected that an appreciation of the dollar increases the purchasing power of U.S. consumers; as such we would expect an increase in imports. In other words, a depreciation of the peso increases Mexican exports (i.e. increases in U.S. imports). The average tariff rate does have a marginal effect on U.S. imports but the lending rate does not significantly affect the imports of dairy products, sugar products, red meats, and vegetables from Mexico.

The regression results also show mixed effects with regard to the tariff revenues (a proxy for tariff rates) in most of the models estimated. The effect of Canada's tariffs is positive and significant in the case of U.S. exports of corn to Canada (Table 3A). On the other hand U.S. tariff has a negative effect on imports of poultry and red meats from Canada and positively related to imports of wheat (Table 3B). Mexico's tariff rate negatively impacted U.S. exports of corn, soy bean and wheat to Mexico (Table 4A). In the same vein, Table 4B shows that U.S. tariff rate negatively affected imports of dairy, sugar, and red meats from Mexico.

Table 3A: Regression Analysis of U.S. Exports to Canada

Variable	lncorn	lncotton	lnsoyb	lnpoultry
Nafta	–.844** (0.384)	0.425 (0.369)	–0.818 (0.608)	–0.202** (0.098)
excaus	0.963 (0.592)	1.947*** (0.667)	1.44 (0.916)	–0.389** (0.157)
GNI^{can}	5.673*** (1.842)	2.75* (1.635)	6.61** (2.52)	–0.156 (0.409)
$lendrate^{can}$	–0.537* (0.285)	0.815*** (0.277)	–0.634 (0.401)	–0.012 (0.067)
$tariffrev^{can}$	2.067*** (0.551)	0.293 (0.489)	0.311 (0.742)	0.169 (0.133)
relpr	–20.88*** (7.02)	20.42*** (7.26)	–4.847 (9.878)	–3.407* (1.739)
trend	–0.054 (0.323)	0.623* (0.321)	–0.44 (0.376)	0.309*** (0.059)
$corn_{t-1}$	0.486*** (0.110)			
$corn_{t-2}$	–0.327*** (0.106)			
$cotton_{t-1}$		0.552*** (0.110)		
$cotton_{t-2}$		–0.018 (0.104)		
$soyb_{t-1}$			0.416*** (0.111)	
Constant	–49.47*** (17.93)	–28.72* (16.44)	–58.02** (24.91)	12.40*** (4.204)
Observations	85	85	85	87
R-squared	0.75	0.75	0.63	0.89
DW[a]	1.94	1.95	2.04	1.83
DW[b]	1.97	1.95	1.98	1.95

[a] Original DW statistic, [b] DW statistic after Prais-Winsten/Cochrane-Orcutt transformation, *** p<0.01, ** p<0.05, * p<0.1, Standard errors in parentheses

All variables are in natural logarithmic scale

Table 3B: Regression Analysis of U.S. Imports from Canada

Variable	lndairyp	lnpoultry	lnrmeats	lnwheat
Nafta	–0.168 (0.163)	–0.056 (0.075)	–0.055 (0.066)	–0.604*** (0.217)
excaus	–0.002 (0.543)	–0.226 (0.146)	0.485*** (0.145)	–0.227 (0.346)
GNI^{us}	–1.98 (1.846)	1.358* (0.749)	1.536** (0.732)	–3.11* (1.81)
$lendrate^{us}$	0.197 (0.141)	–0.063 (0.057)	0.038 (0.045)	0.057 (0.144)
$tariffrev^{us}$	0.718 (0692)	–0.718* (0.349)	–0.262 (0.290)	2.458** (0.994)
relpr	–8.584** (3.637)	–0.173 (1.374)	1.129 (1.333)	–27.12*** (5.616)
trend	0.186 (0.155)	0.061 (0.053)	0.055 (0.049)	0.311* (0.156)
$poultry_{t-1}$		0.654*** (0.092)		
$rmeats_{t-1}$			0.555*** (0.105)	
$wheat_{t-1}$				0.403*** (0.095)
Constant		–9.311 –10.43 (9.725) (7.142)	35.76* (20.02)	
Observations	87	86	86	86
R-squared	0.08	0.98	0.98	0.83
DW[a]	1.16	2.16	2.15	2.11
DW[b]	2.28	2.09	2.01	2.01

[a] Original DW statistic, [b] DW statistic after Prais-Winsten/Cochrane-Orcutt transformation,
*** p<0.01, ** p<0.05, * p<0.1, Standard errors in parentheses

All variables are in natural logarithmic scale

Table 4A: Regression Analysis of U.S. Exports to Mexico

Variable	lncorn	lnsoyb	lnwheat	lnpoultry
Nafta	1.244*** (0.239)	0.288 (0.351)	–0.501 (0.552)	0.007 (0.184)
exmeus	0.340 (0.426)	–0.798 (0.719)	–1.856 (1.122)	1.059*** (0.286)
GNI^{mex}	3.111** (1.346)	1.515 (2.349)	0.394 (3.704)	–1.558 (1.272)
relpr	1.096*** (4.08)	0.996** (0.499)	0.497 (0.799)	–0.602 (0.642)
$tariffrev^{mex}$	–0.699*** (0.211)	–0.590** (0.28)	–0.542 (0.445)	0.364* (0.213)
$lendrate^{mex}$	0.133 (0.116)	$-9.3E-06$ (0.201)	–0.205 (0.315)	0.122 (0.086)
trend	–1.317*** (0.312)	–0.344 (0.313)	1.035** (0.512)	0.455** (0.204)
$corn_{t-1}$	0.783*** (0.105)			
$corn_{t-2}$	–0.251** (0.099)			
Constant	–16.51 (11.71)	3.683 (20.31)	10.51 (31.97)	
Observations	85	87	87	87
R-squared	0.91	0.56	0.65	0.18
Dw[a]	2.13	2.19	2.22	1.06
Dw[b]	1.93	2.06	2.58	2.3

[a] Original DW statistic, [b] DW statistic after Prais-Winsten/Cochrane-Orcutt transformation,
*** p<0.01, ** p<0.05, * p<0.1, Standard errors in parentheses

All variables are in natural logarithmic scale

Table 4B: Regression Analysis of U.S. Imports from Mexico

Variable	lndairyp	lnsugar	lrmeats	lnveggies
Nafta	0.492**	0.262**	–0.761	0.241
	(0.188)	(0.108)	(0.582)	(0.242)
GNI^{us}	5.349**	2.387*	–6.384	4.300*
	(2.04)	(1.400)	(6.414)	(2.324)
exmexus	–0.009	–0.023	1.436	–0.670
	(0.342)	(0.256)	(1.646)	(2.44)
relpr	–1.140***	–0.576**	–1.582	–0.546
	(0.347)	(0.267)	(1.209)	(0.363)
$tariffrev^{us}$	–2.148*	–1.521*	–4.926	–2.098
	(1.214)	(0.846)	(2.967)	(1.210)
$lendrate^{us}$	–0.011	–0.072	0.612	–0.347*
	(0.162)	(0.165)	(0.533)	(0.187)
trend	–0.103	0.287	3.515***	–0.186
	(0.197)	(0.197)	(0.893)	(0.142)
$dairyp_{t-1}$	0.567***			
	(0.083)			
$sugar_{t-1}$		0.517***		
		(0.091)		
Constant	–49.69**	–19.038**	66.4	–27.010
	(21.53)	(14.916)	(67.66)	(24.679)
Observations	87	87	87	87
R-squared	0.57	0.68	0.66	0.84
Dw[a]	1.92	2.10	1.31	0.964
DW[b]	2.04	2.12	1.38	1.74

[a] Original DW statistic, [b] DW statistic after Prais-Winsten/Cochrane-Orcutt transformation,
*** p<0.01, ** p<0.05, * p<0.1, Standard errors in parentheses

All variables are in natural logarithmic scale

Table 5: Description of Variables Used in the Models

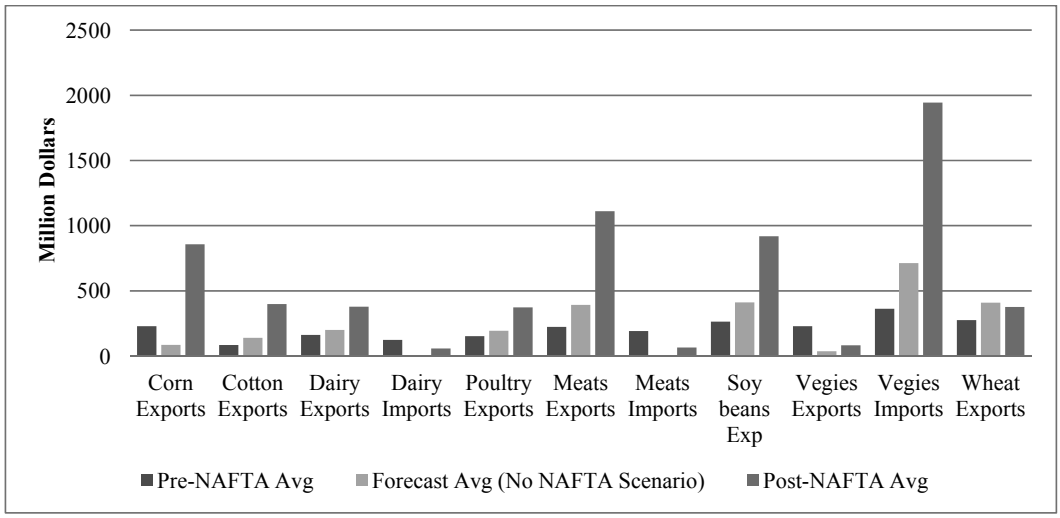
Variable	Description	Data Source
Excaus	U.S.-Canada real exchange rate ($US/$can)	Federal Reserve Bank
Exmeus	U.S.-Mexico real exchange rate ($US/peso)	Federal Reserve Bank
GNI	Gross national income per capita	OECD
Lendrate	Domestic lending rate (cost of borrowing)	OECD
Tariffrev	Average tariff revenues collected	OECD
Relpr	Relative price (domestic/foreign price ratio)	Federal Reserve Bank
Trend	Time trend	N/A
Dairyp	Quantity of Dairy products	GATS-FAS
Rmeats	Quantity of Red meats products	GATS-FAS
Veggies	Quantity of Vegetables	GATS-FAS
Corn	Quantity of corn	GATS-FAS
Sugar	Quantity of sugar	GATS-FAS
Soyb	Quantity of soy beans	GATS-FAS

3.2 Counterfactual Analysis

The mixed findings from the regression analyses contrast with the all-positive effects of NAFTA shown in Tables 1 and 2, as well as in the preceding graphical analyses. A plausible explanation for this could be the failure of the dummy variable (NAFTA=1 for years>1994) to pick up the true effect of NAFTA on traded commodities in a regression analytic framework. An alternative to the regression analyses, then, is to perform counterfactual analyses, whereby, we compare the realized trade values (for each commodity) to what would have obtained, had NAFTA not come into existence.

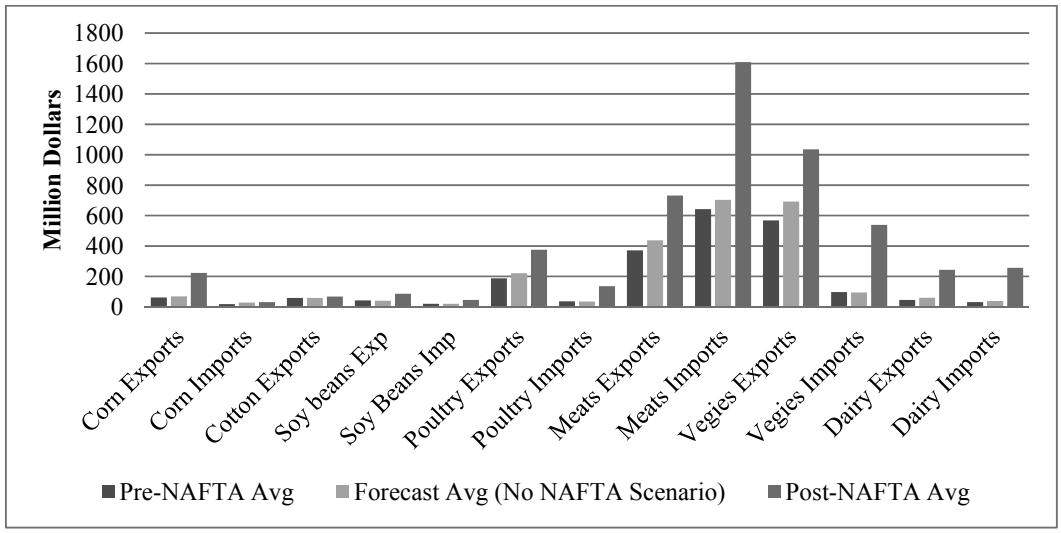
Essentially, with counterfactual analyses, we aim to answer the question: What would have been the path of U.S. agricultural trade with Canada and Mexico had NAFTA not existed? To do this, we would have to assume that NAFTA did not exist at all, and then, using the historical trade data up until 1993, forecast the trend that trade in each commodity would have taken without the NAFTA agreement. This is implemented by conducting a three-period moving average forecast of trade for ten years beyond 1993. Comparing these forecasted no-NAFTA trade data to the actual (or realized) data post-NAFTA reveals that NAFTA indeed had a positive effect on the trade of most of these commodities. Figures 9 and 10 present a graphical summary of the counterfactual analyses for different commodities. These graphs compare the pre-NAFTA, forecast (No NAFTA), and the post-NAFTA averages for each commodity. What is clear from these graphs is that for almost all the commodities, post-NAFTA averages are higher than both the pre-NAFTA and forecasted values.

Figure 9: Counterfactual Analyses of U.S.-Mexico Trade (With and Without NAFTA)



Data Source: Foreign Agricultural Service, USDA

Figure 10: Counterfactual Analyses of U.S.- Canada Trade (With and Without NAFTA)



Data Source: Foreign Agricultural Service, USDA

The no-NAFTA (or forecasted) scenario averages show that some commodities would have seen increases in trade, but by fewer margins than what was realized after

NAFTA's implementation. For example, U.S. trade in poultry products, meats and vegetables with Canada is forecasted to be higher than the case before NAFTA came into existence. Similarly, U.S. trade in cotton, wheat, meats, soybeans, and vegetables with Mexico are higher in the forecasted scenario than pre-NAFTA case, indicating that trade in these commodities would have continued an upward trend whether or not NAFTA existed. Overall, however, post-NAFTA averages are significantly higher than pre-NAFTA or forecasted averages, an indication of the positive effect that NAFTA had on trade between the U.S. and NAFTA partners.

4. Conclusion

This paper presents an empirical analysis of the effects of the North American Free trade Agreement (NAFTA) on agricultural commodity trade between U.S.-Canada on the one hand, and U.S.-Mexico on the other hand. Using quarterly data from 1989 to 2010, we explore, using different approaches, the trends in agricultural commodity trade between NAFTA partners. Overall agricultural trade has been increasing since the inception of the agreement, as tariff and non-tariff barriers were gradually reduced. By 2008, all tariff and non-tariff barriers on agricultural commodities were eliminated, thus, allowing unfettered trade among the signatories of the agreement.

Graphical analyses of the trends in trade indicate that most of the agricultural commodities have seen increased trade, with post-NAFTA average quantities traded far exceeding pre-NAFTA averages. Regression analysis, however, show mixed effects of NAFTA on trade, which is attributed to the inability of the dummy variable for NAFTA to pick up the true effect of the agreement. The regression results show that since NAFTA's implementation, U.S. exports of corn and poultry products to Canada significantly decreased, while U.S. exports of corn to Mexico significantly increased. At the same time, while U.S. importation of sugar and dairy products from Mexico significantly increased following NAFTA, imports of wheat and poultry products from Canada significantly decreased.

More robust estimation approaches, other than the dummy-variable approach, might accurately capture the positive effects observed in the graphical analyses. For this reason, a counterfactual approach, using pre-NAFTA data to forecast the trends in trade, assuming NAFTA had not existed, is used to augment the regression analysis. We find that increases in trade would have been far less than what we observed in the actual data after NAFTA came into existence.

Acknowledgement

The paper has benefitted immensely from the constructive suggestions of two anonymous reviewers, to whom we gracefully acknowledge.

References

Botrić, V., 2013, Determinants of Intra-industry Trade between Western Balkans and EU-15: Evidence from Bilateral Data, *International Journal of Economic Sciences and Applied Research*, 6, 2, pp. 7-23.

Boylan,T., Cuddy, M. and O'Muircheartaigh, I., 1980, 'The Functional Form of the Aggregate Import Demand Equation: A Comparison of Three European Economies', *Journal of International Economics*, 10, 4, pp. 561-566.

Burfisher, M.E. and Jones, E.A. (eds.), 1998, 'Regional Trade Agreements and U.S. Agriculture', Market and Trade Economics Division, Economic Research Service, U.S. Department of Agriculture, *Agricultural Information Bulletin* No. 745.

Burfisher, M.E., Robinson, S. and Thierfelder. K., 2001, 'The Impact of NAFTA on the United States', *Journal of Economic Perspectives*, 15, 1, pp. 125-144.

Davey, W.J., 2005, 'Regional Trade Agreements and the WTO: General Observations and NAFTA Lessons for Asia'*, Illinois Public Law and Legal Theory Research Paper Series,* Research Paper No. 05-18.

Dickey, D.A. and Fuller, W.A., 1979, 'Distributions of the Estimators for Autoregressive Time Series with a Unit Root', *Journal of the American Statistical Association*, 74, pp. 427-431.

Dickey, D.A. and Fuller, W.A., 1981, 'Likelihood ratio statistics for autoregressive time series with a unit root', *Econometrica*, 49, pp. 1057-1072.

Doroodian, K., Koshal, R.K. and Al-Muhanna S., 1994, 'An Examination of the Traditional Aggregate Import Demand Function for Saudi Arabia', *Applied Economics*, 26, 9, pp. 909-915.

Enders, W., 2004, *Applied Econometric Time Series*, 2nd ed. John Wiley & Sons Inc., pp. 171.

ERS (Economic Research Service of the USDA), 1999. 'NAFTA: The Record to Date', World Agriculture and Trade, Agricultural Outlook, September, 1999.

Granger, C. and Newbold, P., 1974, 'Spurious Regressions in Econometrics', *Journal of Econometrics,* 2, pp. 111-120.

Hejazi, W. and Safarian, A.E., 2005, 'NAFTA Effects and the Level of Development', *Journal of Business Research,* 58, 12, pp. 1741-1749.

Hillberry, R.H. and McDaniel, C.A., 2002, 'A Decomposition of North American Trade Growth since NAFTA', *International Trade Commission.Office of Economics Working Paper*, No. 2002-12-A.

Hinojosa-Ojeda, R., Runsten, D., De Paolis, F. and Kamel, N., 2000, 'The U.S. Employment Impacts of North American Integration after NAFTA: A Partial Equilibrium Approach', *Unpublished manuscript*, North American Integration and Development Center, School of Public Policy and Social Research, UCLA.

Hummels, D. and Klenow, P.J., 2002, 'The Variety and Quality of a Nation's Trade', *National Bureau of Economic Research* (NBER) Working Paper 8712.

Khan, M.S. & Ross, K., 1977, 'The Functional form of the Aggregate Import Demand Equation', *Journal of International Economics*, 7, 2, pp. 149-160.

Koo, W.W. and Kennedy, P.L., 2005, *International Trade and Agriculture*, Blackwell Publishing.

Matchaya, G. C., Chilonda, P. and Nhelengethwa, S., 2013, 'International Trade and Income in Malawi: A Co-integration and Causality Approach', *International Journal of Economic Sciences and Applied Research*, 6, 2, pp. 125-147.

McDaniel, C.A. and Agama, L-A., 2003, 'The NAFTA Preference and U.S. - Mexico Trade: Aggregate-Level Analysis', *The World Economy*, 26, 7, pp. 939-955.

OECD (Organization for Economic Co-operation and Development), 2001, 'Regional Integration: Observed Trade and other Economic Effects', OECD Doc, TD/TC/WP (2001)19/Final.

Oyinlola, M. A., Adeniyi, O. and Omisakin, O., 2010, Responsiveness of Trade Flows to Changes in Exchange rate and Relative prices: Evidence from Nigeria, *International Journal of Economic Sciences and Applied Research*, 3, 2, pp. 123-141.

USDA (U.S. Department of Agriculture), 1997, NAFTA. WRS-97-2, Washington, DC.

USDA-FAS (Foreign Agricultural Service of the U.S. Department of Agriculture), 2012, Global Agricultural Trade System (GATS Database), http://www.fas.usda.gov/gats/default.aspx.

Viner, J., 1950,*The Customs Union Issue, New York*, Carnegie Endowment for International Peace.

Zahniser, S. and Link, J. (eds.), 2002, 'Effects of North American Free Trade Agreement on Agriculture and the Rural Economy', *A Report from the Economic Research Service*, ERS/USDA, WRS (02-01).

Zahniser, S. and Roe A. (eds.), 2011, 'NAFTA at 17: Full Implementation leads to Increased Trade and Integration', *A Report from the Economic Research Service*, ERS/USDA, WRS (11-01).

Modelling nonlinear behavior of labor force participation rate by STAR: An application for Turkey

Sibel Cengiz[1] and Afsin Sahin[2]

Abstract

The aim of this paper is to contribute to the understanding of the behavior of participation rates in terms of gender differences. We employed smooth autoregressive transition models for the quarterly Turkish labor force participation rates (LFPR) data between 2000: Q1 – 2011: Q4 to present an asymmetric participation behavior. The smoothness parameter indicates a gradual transition from low to high regimes. It is higher for female workers compared to the male workers. Participation rates diminish during a recession but they increase smoothly during the periods of expansion. The estimation results of Enders et al. (1998) also verified the asymmetry and nonlinearity in participation rates. During periods of economic expansion, they are higher than the threshold but the low regime indicator function takes the value zero. The results of the paper have economic implications for policy makers. Due to the discouraged worker and added worker effects, LFPR should be observed with the unemployment rates while evaluating the tightness of the labor market.

Keywords: Labor Force Participation Rate, Asymmetry, Nonlinear Behavior, STAR Model

JEL Classification: J21, E24, CO1

1. Introduction

Concerning labor market analysis, when economic activity declines, workers become discouraged and tend to leave the job market. During these times, inflow of additional workers and outflow of discouraged workers may create an equilibrium and leave LFPR unchanged, according to Strand et al. (1964). Because of discouraged and additional worker

[1] Associate Professor of Economics, Department of Economics, Mugla Sitki Kocman University, Mugla, Turkey, scengiz@mu.edu.tr. Sibel Cengiz was a visiting scholar at the University of California, Berkeley Center for Labor Economics, USA between 01 October 2013 and 30 December 2013.

[2] Associate Professor of Economics, Department of Banking, Gazi University, Ankara, Turkey, afsinsahin@gazi.edu.tr.

effects, LFPR[1] may be a better indicator concerning the labor market if economic activity declines compared to unemployment rates (see Mincer, 1962, Benati, 2001, Gustavsson et al., 2012). Therefore considering LFPR in addition to the unemployment rate may help policy makers to evaluate the tightness of the labor market (Gustavsson et al., 2007).

LFPR is related to unemployment and employment rates, and it is usually compared with these indicators to see if it is a more efficient indicator or not[2]. There are several papers trying to investigate the relationship between LFPR and unemployment rates. For instance, Emerson (2011) finds a long-run relationship between LFPR and the unemployment rate for the United States. Kakinaka et al. (2012) explore a cointegration relationship between LFPR and the unemployment rate for the male and fail to reject the null hypothesis for female workers in the Japanese economy. They emphasize the discouraged worker effect and claim if the unemployment rate increases at the same time, the LFPR may diminish. Besides, according to them, because of the added worker effect, young males are keen to be involved in the labor market when the unemployment rate is high. Especially during recessions, additional workers may enter the market to compensate for the diminishment in their household income due to being unemployed (see Lundberg, 1985 for the added worker effect). Due to these adverse conditions, households may decide to increase their labor supply (Hernandez et al., 2009). At the same time, the presence of a high unemployment rate during a recession period may lead unemployed workers to be withdrawn from the labor force whom are known as discouraged workers. Job searching costs may outweigh employment benefits during times of recession (Hartley et al., 1974). In this case, unemployment may be a significant variable negatively affecting the decision of entering the labor force (Mincer, 1966).

During business cycles, increasing unemployment also increases LFPR, but in the longer run, the relationship between LFPR and unemployment disappears according to Nickell (1995). Taking these factors into account, during macroeconomic shocks, it is also claimed that the unemployment rate does not reflect the actual situation in the labor market. One of the reasons is related with the discouraged workers effect. Thus LFPR should also be considered in those times (Koop et al., 1999).

This paper employs smooth autoregressive transition models for the quarterly Turkish LFPR data between 2000: Q1 – 2011: Q4 to present an asymmetric participation behavior. That seems plausible because when the shocks widen asymmetrically, the linear models may not be adequate for the nature of participation rates. Capturing the nonlinearity and asymmetry in LFPR is meaningful because the unemployment rate does not involve

[1] It is defined as the ratio of employment and unemployment to active population.

[2] Fatih Ozatay who is the former vice president of the Central Bank of the Republic of Turkey claims that unemployment may decline because of a diminishment in LFPR. Thus, it should be considered while evaluating unemployment rate. (Ozatay, 2012). On the other hand, according to Elmeskov et al. (1993), there is a negative relationship between unemployment rates and LFPR for the OECD countries.

the discouraged workers[3]. The paper is structured as follows. The second part reviews the literature briefly and discusses the macroeconomic variables for some countries including Turkey, and the data and the methodology are given. The third section is devoted to discussion and the concluding remarks. We included the Appendices within the web address[4].

2. Data and Methodology

We used the Turkish quarterly data spanning from 2000:Q1 to 2011:Q4. The graphs of the variables are presented in Appendix-A1. Data was gathered from the Turkish Statistical Institute (TurkStat). The stationarity properties of the data may offer some insight on the informative level of the variables. As seen in Appendix – A0, the unit root tests give mixed results. The Dickey Fuller tests tend to reject the null of non-stationarity but all of the ADF specifications fail to reject the unit root hypothesis. KPSS with trend and intercept values also tends to provide stationary results. When we look at the literature for other countries, the variables in question may give mixed results or non-stationary evidence. For instance, Gustavsson et al. (2006) claim that the LFPR in Australia, Canada and US are not stationary. If LFPR is stationary, then the unemployment rate may be transferred to the employment rate in the long-run (Gustavsson et al., 2006, p. 429). They tell us that if LFPR is non-stationary, then the unemployment rate cannot be used as an indicator of the labor market. The mean reversion is not valid also for the disaggregated LFPRs of sub-populations of the US economy according to Gustavsson et al., (2012). If the LFPR is not stationary, then the effectiveness of unemployment rates for measurement purposes would be problematic (Madsen et al., 2008, p. 167). The response of labor may change depending on employment prospects. It diminishes quickly but increases slowly (Madsen et al., 2008, p. 168). There is a case of mixed evidence for the LFPR concerning mean reverting properties (Madsen et al., 2008). Consequently they find mixed evidence for unemployment being a good indicator of joblessness. If there is a case of mean reverting in an unemployment rate, the probability of it being a good indicator of joblessness increases. They argue that the unemployment series in US are stationary nonlinear TAR processes (Caner et al., 2001). Salamaliki and Venetis (2014) use seasonally adjusted quarterly data for the US economy. They apply ADF unit root tests with constants and trends and explore the possibility that the participation rates are not stationary[5].

Ozdemir et al. (2011) analyse the total, male and female participation rates for Australia, Canada and USA by multiple structural breaks. They claim that the structural

[3] Ozdemir et al. (2011, p 1) claim that unemployment rates are not informative during business cycles. Similarly Murphy et al. (1997) maintain that the unemployment rate is not a good informative rate for evaluating the job market.

[4] http://websitem.gazi.edu.tr/site/afsinsahin/files.

[5] Following the suggestions of the papers on the subject, we did not seasonally adjust the data, since the effects of seasonally adjusting on the nonlinear structure are not clear in the literature.

breaks hinder the stationarity nature of the series. Gustavsson et al. (2006) and Madsen et al. (2008) claim that LFPR is not stationary, therefore the unemployment rate is not informative. However they claim that by the fractionally integrated method, the series are mean reverting and have structural breaks. They also mention that the unemployment rate is informative and may explain the movements in employment rates.

LFPR is the univariate variable we tried to model on smooth autoregressive models (STAR). STAR is one of the nonlinear econometric models based on the linear autoregressive model of Terasvirta (2004). Balcilar et al. (2011, p. 893) claim that because of the smooth transition consideration property of the STAR models, they are preferable compared to the threshold autoregressive models[6] or the Markov switching models[7]. There is a sharp and discrete transition in threshold autoregressive models (TAR) and Markov switching models, but the transition is smooth with STAR or smooth transition regression (STR) models (Bonga, 2009). To do so, we applied the methodology defined in Terasvirta (2004) and the estimation steps as explained particularly in Kratzig (2005). Rather than using *Jmulti* to estimate the STAR or STR models, there are also programs such as *R, Ox, Matlab* and to some extent, RATS. In this paper we preferred to use *Jmulti* essentially which is much simpler and make the work easier and more systematic[8]. On the other hand, *JMulti* has some restrictions and we should emphasize them. First of all, *JMulti* only allows for the logistic transition function, say the Logistic Smooth Transition Regression (LSTR1 or LSTR2), for modelling nonlinearity. - One can refer for the LSTAR versus ESTAR for Terasvirta (1994) and its replication for the *RATS* example files. The shape of the transition function is an essential distinction between the ESTAR and LSTAR models (see Ocal et al., 2000, p. 5).

In this paper, the LSTAR form defined in Terasvirta (2004) and Kratzig (2005) is given by the equation (1). See also Lundbergh and Terasvirta (2004) for the STAR model definitions. According to Sarantis (2001), the dynamics between the high and low regimes are not the same considering the LSTAR model.

$$y_t = \left\{\phi_t + \theta G\left(\gamma, c, s_t\right)\right\}' w_t + \varepsilon_t; \quad \varepsilon_t \sim iii(0,\sigma^2); \quad t = 1,...,T. \tag{1}$$

The first piece of the equation (1) with a parameter $\phi = \left(\phi_0, \phi_1, ..., \phi_p\right)'$ inherits the linear part of the system, but the second piece of the equation represents the nonlinear part with the parameter $\theta = \left(\theta_0, \theta_1, ..., \theta_p\right)'$. These parameter vectors are $(p+1)x1$. $w_t' = \left(1, y_{t-1}, ..., y_{t-p}\right)'$ including the intercept and the first p lagged values of the y_t. Note that if the model was a STR model, then there would be $z_t = \left(w_t', x_t'\right)$ as a $(p+1)x1$ vector of explanatory variables (parameter vectors) with intercept and $x_t' = \left(x_{1t}, ..., x_{kt}\right)'$.

[6] See Tsay (1989).

[7] See Hamilton (1989).

[8] We used RATS for the estimations in the Appendix.

This is the difference between univariate models (STAR) and the multivariate model (STR). Since our model is univariate, we model the labor participation rate with STAR. The general logistic function in (2) represents the transition function and determines the behavior of the nonlinear part.

$$G(\gamma, c, s_t) = \left(1 + \exp\left\{-\gamma \prod_{k=1}^{K} (s_t - c_k)\right\}\right)^{-1} \tag{2}$$

There are three parameters in the transition function. These are slope parameter (γ), vector of location parameters ($c = (c_1, ...c_K)'$) representing the threshold among the regimes and the time varying transition parameter (s_t). Note that the location parameter is increasing and the slope parameter is positive. - See Lundbergh et al. (2004, p. 486). If K = 1, then the specification (1) and (2) are called logistic smooth transition functions (LSTAR1) and if K = 2, it is called LSTAR2 (Terasvirta, 2004, p. 223). The model allows for an extreme transition between 0 and 1 and can be handled as a regime-switching model according to van Dijk et al. (2000, p. 2). LSTAR models had been extended as multiple regimes STAR (MRSTAR) models[9].

Since our analysis is univariate, we do not have explanatory variables; therefore we estimated a STAR model rather than a STR model. So the maximum lag determined for the dependent variable (y) is the LFPR. However we included seasonal dummy variables and a constant in the model as the deterministic part of the equation. First, we applied common linearity tests and selected the appropriate LSTAR specification. Table 1 presents the linearity test results for the LFPR of the total, male and female workers. The null hypothesis is to test linearity against non-linearity. At various lag lengths for all the variables, we rejected the null with the F- statistics. We started from the lag length of 8 for the AR part and estimated the equations. The lags for 8 and 7 provided matrix inversion problem for the p-values of F-tests. We chose the appropriate model from several alternatives.

Table 1: Linearity Test Results

Variables	Transition Variable	F	F4	F3	F2	Suggested Model	Optimal Lag Length
Total	Trend	0.0003	0.4088	0.0228	0.0000	LSTAR1	2
Male	Trend	0.0364	0.6637	0.4884	0.0004	LSTAR1	2
Female	Trend	0.0002	0.0308	0.0651	0.0005	LSTAR1	1

For all the lags by the linearity tests the transition variable is chosen as the trend for total, male and female values. The LSTAR1 type model was chosen as the transition function for all the variables and lags. The meaning of LSTAR1 is that there is a monotonic

[9] See van Dijk et al. (1999) for the argumentation on the unemployment rate of the US economy.

change of parameters through the linear to nonlinear part as a function of the trend in this case. Since the linearity tests indicate the case for LSTAR1 within the document, we also present the results for LSTAR2 in the Appendix-A2 where the parameters move symmetrically around the middle of the two location parameters. Terasvirta (2004, p. 224) claims that LSTAR1 may characterize the asymmetric behavior. Since the aim of the paper is to characterize the nature of asymmetry in participation rates, we evaluated the results for LSTAR1 model.

The initial values had been gathered by the grid search. Table 2 gives the initial values for the slope and location parameters. Next we determined the suggested LSTAR1 model by the *p*-values of the F4, F3 and F2 tests which has similar structures to the linearity test. For all the lags, the LSTAR1 type nonlinearity had been chosen. However it is interesting to note that when the trend as a transition variable is utilized, the value of SSR, gamma (slope) and *c1* increase if we diminish the lag.

Table 2: STR Grid Search

	Total	**Male**	**Female**
Transition variable	Trend	Trend	Trend
Transition function	LSTAR1	LSTAR1	LSTAR1
Grid *c*	{ 1.00, 46.00, 30}	{ 1.00, 46.00, 30}	{ 1.00, 47.00, 30}
Grid *gamma*	{ 0.50, 10.00, 30}	{ 0.50, 10.00, 30}	{ 0.50, 10.00, 30}
SSR	13.4019	14.2355	26.7248
Gamma	0.9293	1.7271	2.1235
c1	1.0000	16.5172	13.6897

Since the grid is constructed over c_1, γ because of choosing LSTAR1, the panel (a) of Figure 2a is drawn by surface over these parameters. The panel (b) of Figure 2a is the contour plot of these. These figures are provided in Appendix - A3. The sum of residual square (SSR) is plotted as a function of c, γ. The initial one is the maximum SSR and the latter is the minimum SSR. *str_resids*[2] is the square of the estimated residuals. A cross plot *G* (Trend) is the graph of the transition function $G(\gamma, c, s_t) = \left(1 + \exp\left\{-\gamma\left(s_t - c\right)\right\}\right)^{-1}$ for the LSTAR versus the transition variable (trend). The linear part ($\phi' z_t$), nonlinear part ($\theta' z_t G(\gamma, c, s_t)$), fitted series ($\phi' z_t + \theta' z_t G(\gamma, c, s_t)$), original series ($y_t$), transition function ($G(\gamma, c, s_t)$) and the transition variable (s_t) are graphed at the bottom of Figure 2a. The fitted series are the sum of the linear and nonlinear series. The average of the difference between fitted series and the original series is nearly zero.

Table 3: STAR Estimation Results

	TOTAL			MALE			FEMALE		
Variables	**Start**	**Estimate**	***p*-value**	**Start**	**Estimate**	***p*-value**	**Start**	**Estimate**	***p*-value**
	Linear Part								
Constant	22.3750	91.3337	[0.9528]	14.1729	14.0890	[0.3528]	8.4350	8.1327	[0.5010]
Seas1	-4.0457	-26.5723	[0.9582]	-1.8728	-1.9181	[0.3376]	1.0225	1.0239	[0.4767]
Seas2	8.5181	26.0472	[0.9470]	4.8109	4.8298**	[0.0143]	7.0345	6.9971***	[0.0017]
Seas3	12.1940	56.4346	[0.9547]	4.9769	5.0356	[0.0443]	6.5435	6.4677**	[0.0213]
$LFPR_{t-1}$	-1.0923	-11.3776	[0.9607]	0.4599	0.4516	[0.2899]	0.5414	0.5540	[0.2401]
$LFPR_{t-2}$	1.5524	10.2466	[0.9580]	0.3137	0.3232	[0.5023]			
	Nonlinear Part								
Constant	-22.8334	-92.4791	[0.9522]	4.6908	5.2539	[0.8340]	-11.0820	-10.7469	[0.4395]
Seas1	6.1355	29.0213	[0.9544]	2.6863	2.6972	[0.3082]	-0.4901	-0.4905	[0.7799]
Seas2	-4.9923	-22.7658	[0.9538]	-2.4812	-2.4978	[0.2945]	-3.3491	-3.3103	[0.1777]
Seas3	-12.2964	-57.1991	[0.9542]	-3.6908	-3.7300	[0.2266]	-4.9626	-4.8841	[0.1136]
$LFPR_{t-1}$	2.8787	13.3213	[0.9540]	0.5729	0.5676	[0.3941]	0.5078	0.4939	[0.3576]
$LFPR_{t-2}$	-2.3606	-11.1956	[0.9543]	-0.6300	-0.6326	[0.3755]			
$LFPR_{t-3}$									
$LFPR_{t-4}$									
Gamma	0.9293	0.5944	[0.5465]	1.7271	1.7422	[0.3531]	2.1235	2.1702	[0.2721]
C1	1.0000	-43.1529	[0.9331]	16.5172	16.0242*	[0.0848]	13.6897	13.9693	[0.1223]

Note: ***, ** and * indicate significance of the coefficients at 1%, 5% and 10% levels.

The parameters c, γ, θ, ϕ are estimated by maximizing the conditional likelihood function automatically by the Newton-Raphson algorithm through benefiting the specification in *JMulti*. Smoothness parameter (gamma) is insignificantly positive and satisfies the restriction, and indicates a smooth transition from low to high periods of LFPR. The value of the gamma is higher for the female than the male workers indicating a sharper transition for the initial. The smoothness depends on or is controlled by the transition variable[10]. The location parameter (*c*) indicates that LFPR switches into the second regime. Location parameter is the threshold between regimes and may take different signs. This signals to us that the different magnitudes of the shocks may cause a shift among the regimes. Table 3 presents the results and Table 4 is for the diagnostic statistics. The null of no error autocorrelation failed to be rejected for Total (2 lags), Male (2, 4, 6, 8 lags) and Female (2, 4, 6, 8 lags). The parameter constancy is satisfied for Total (H1), Male (H1, H2) and Female (H1, H3). The ARCH-LM test with eight lags does not reject the null

[10] According to Balcilar et al. (2011, p. 894) if gamma is not significant, then the model should be interpreted as autoregressive model which is linear.

of no conditional heteroskedasticity. In addition, the Jarque-Bera test of non-normality is rejected for total and female workers. The misspecification tests indicate the adequacy of the specifications.

Table 4: Diagnostic Statistics

	Total	Male	Female
AIC	-0.6286	-0.5643	-0.0539
R^2	0.9304	0.9011	0.9079
Variance of transition variable	180.1667	180.1667	188.0000
Standard deviation of transition variable	13.4226	13.4226	13.7113
Variance of residuals	0.4171	0.4448	0.7635
SD of residuals	0.6459	0.6669	0.8738

Table 5: Test of No Error Autocorrelation

Total	***F*-value**	**df1**	**df2**	***p*-value**
2	0.3537	2	28	0.7052
4	8.6628	4	24	0.0002
6	5.0395	6	20	0.0027
8	5.3737	8	16	0.0021
Male	***F*-value**	**df1**	**df2**	***p*-value**
2	0.4677	2	28	0.6313
4	1.9215	4	24	0.1394
6	1.4141	6	20	0.2580
8	1.8222	8	16	0.1461
Female	***F*-value**	**df1**	**df2**	***p*-value**
2	3.9041	2	31	0.0307
4	1.4766	4	27	0.2369
6	1.7192	6	23	0.1616
8	1.6010	8	19	0.1900

Note: The null is no error autocorrelation

Table 6: Test of No Remaining Nonlinearity

Transition variable	F	F4	F3	F2
$Total_{t-1}$	0.3210	0.2811	0.6970	0.1612
$Male_{t-1}$	0.0021	0.0082	0.0749	0.1052
$Female_{t-1}$	0.3351	0.2907	0.3804	0.3793

Note: Null is no remaining linearity.

Table 7: Parameter Constancy Test

Total	***F*-value**	***p*-value**
H1	1.6427	0.1655
H2	NaN	NaN
H3	NaN	NaN
Male	***F*-value**	***p*-value**
H1	0.9197	0.5478
H2	0.4948	0.8979
H3	NaN	NaN
Female	***F*-value**	***p*-value**
H1	3.1310	0.0114
H2	1.8768	0.1232
H3	3.0467	0.1951

Note: Null is parameter constancy.

Table 8: Other Tests

	Total	***Male***	***Female***
ARCH-LM test statistics with 8 lags	9.8293	3.8185	7.178
p-value	[0.2772]	[0.8731]	[0.5176]
F- statistic:	1.6574	0.5306	1.0996
p-value	[0.1519]	[0.8236]	[0.3908]
	Total	***Male***	***Female***
Jarque-Bera Test Statistic	1.3875	20.5764***	1.6988
p-Value	[0.4997]	[0.0000]	[0.4277]
Skewness	-0.3942	0.9667	-0.2971
Kurtosis	3.3198	5.6452	3.7172

Note: ***, ** and * indicate significance of the coefficients at 1%, 5% and 10% levels.

3. Discussion and Concluding Remarks

During the last ten years of the Turkish economy, although there were high economic growth rates, the unemployment rate did not diminish sufficiently, LFPR remained low and the registered number of people employed could not be increased, as stated by Papps (2011, p. 1). According to TurkStat (2012), as of February, 2012, the civilian labor force reached nearly 54.37 million people. Within the same period, the employed people were nearly 23.34 million and the number of unemployed people was 2.72 million. Besides, the

employment rates were not high sufficiently and the unemployment rate was not lower in Turkey compared to growth rate (Table 9)[11].

Participation behavior during the economic crisis is an essential research agenda among economists. When the time series data exhibits asymmetry and nonlinearity during the recessions, LFPR diminishes. The unemployment rate may decrease because of diminishing LFPR or it may not reflect the real situation of the market. So when considering the unemployment rates we should also observe LFPR. During the post economic crisis period, the LFPR diminishes for female workers[12]. The participation decision of the labor in the course of macroeconomic shocks is connected to the coherence of the labor market to the fluctuations. However, during economic expansions, LFPR increases gradually. The shocks in the labor market spread asymmetrically in most of the theoretical and empirical papers. There are a variety of papers considering the asymmetric adjustment costs in labor market. When the economy shrinks, there is a high outflow of labor but when the economy expands, LFPR does not return to its old level quickly and there is an asymmetric situation (Madsen, et al., 2008).

The asymmteric behavior of the labor market is also supported in the literature for a variety of countries. The unemployment rates experienced by these countries may exhibit asymmetry and nonlinearity. Silvapulle et al. (2004) explain asymmetry, which means that the reaction of unemployment rate to output is not similar across different regimes of the economy. Pissarides and Mortenson (1993) measure asymmetry during the job creation and destruction periods. They claim that the job creation process takes more time compared to the job destruction one. According to McHugh (2002), there is an asymmetric behavior in unemployment rate. When the total demand diminishes, the unemployment rate does not diminish as quickly as the first case because of the rigidities in the labor market. Neftçi (1984) denotes that the unemployment data of the US economy exhibits asymmetric behavior. Delong et al. (1986) provide an emprical evidence that US unemployment is asymmetric during the business cycles. They claim that as a result of the rational expectations theory, if there is a case of asymmetry, the linear forecasts would not be optimal.

The asymmetry and nonlinearity are also supported for LFPR. For instance, Darby et al. (1998) estimate LFPR for US, Japan, France and Sweden in terms of age and sex for the period 1970 to 1995. They conclude that the adaptation of LFPR to the shocks may be asymmetric during the high and low regimes. Gustavson et al. (2006) analyse the features

[11] Especially during the post crisis period in countries such as the US, the work hours per family have increased because the women are also included in the job market more frequently (Stiglitz, 2012, p. 14). We also observed a similar case for Turkey. Following the economic crises of 2000 and 2008, the women tended to get involved in the job market with a lag and by the increasing education level of women, LFPR tends to increase for women. See also the discussions in Gozgor (2013).

[12] The LFPR of women is historically low in Turkey and the non-farm activities should be increased by rural development programmes in rural areas. However, women in rural areas do not involve non-farm activities compared to men as mentioned by Rijkers et al. (2012, p. 1) and it is not an easy task for development programmes.

Table 9: Descriptive Statistics of the Basic Macroeconomic Variables (2000-2011)

Countries	Statistics	GDP Growth Rate	Inflation Rate	Unemployment Rate	Employment Rate	LFPR
Czech Republic	Mean	3.0619	2.4333	7.1333	65.2667	59.3636
	Std. Dev.	3.3500	1.7839	1.2383	0.6457	0.5045
Estonia	Mean	7.0296	4.2750	10.2833	64.2167	60.0000
	Std. Dev.	4.5917	2.6619	3.7755	3.2730	1.6733
Germany	Mean	2.4797	1.6833	8.6250	67.7083	58.6364
	Std. Dev.	1.3167	0.7056	1.5806	2.7268	0.9244
Greece	Mean	4.0655	3.3333	10.5250	59.1000	53.3636
	Std. Dev.	1.5583	0.8370	2.4208	2.1755	0.9244
Spain	Mean	2.4054	2.9083	12.7500	60.6333	56.2727
	Std. Dev.	2.2333	1.1115	4.5476	3.1376	2.6492
Latvia	Mean	8.1261	5.1167	11.6750	62.4250	58.7273
	Std. Dev.	4.3500	4.3373	4.0748	3.6219	2.0538
Turkey	Mean	5.1777	20.8667	9.7714	69.4364	60.8182
	Std. Dev.	4.6167	19.7166	1.3949	0.9014	0.7508
Japan	Mean	2.4715	-0.3000	4.2917	45.5167	48.3636
	Std. Dev.	0.7917	0.7403	0.4944	1.5791	1.2863
US	Mean	2.0365	2.4727	6.0750	71.0909	65.0909
	Std. Dev.	1.8000	1.1867	1.9987	2.1626	0.7006

Source: Eurostat.

of LFPR for Australia, Canada and US for the monthly data of 1951-2004. They claim that LFPR series are not stationary by using the panel and univariate unit root tests.

We also estimated the Enders et al. (1998) methodology for Turkey to replicate the original paper. The test results also verified that there is an asymmetry and nonlinearity in LFPR. Participation rates behave differently for periods of recession and expansion in the economy. During the expansion LFPR is higher than the value of the threshold. The indicator function takes the value one. However in a reverse economic condition, the indicator function takes the value zero. And it can be claimed that the LFPR is lower than the threshold level. - Similar interpretation has been conducted of the unemployment rate by Enders (2006, p. 16). - See Appendix-B for the details of the test results.

Government subsidies would be beneficial to increasing the efficiency of the labor market. Betcherman et al. (2010) claim that the employment subsidies which aim to diminish the burden of employers in Turkey lower the informal employment levels, and encourage the registered employment and jobs in poor regions of Turkey. Moreover, the World Bank (2006) also claims that the reason for not creating sufficient employment was because of the cost for employers of severance pay.

Acknowledgements

The previous version of the paper had been presented at the *6th Annual International Conference on Mediterranean Studies*, 26-29 March 2013, Athens, Greece. We would like to thank anonymous two referees for their valuable comments and suggestions.

References

Balcilar, M., Gupta, R. and Shah, Z.B., 2011, 'An in-sample and out-of-sample empirical investigation of the nonlinearity in house prices of South Africa', *Economic Modeling,* 28, 3, pp. 891-899.

Benati, L. 2001, 'Some empirical evidence on the discouraged worker effect', *Economics Letters,* 70, 3, pp. 387-395.

Betcherman, G., Daysal, M. and Pages, C., 2010, 'Do employment subsidies work? Evidence from regionally targeted subsidies in Turkey', *Labour Economics,* 17, 4, pp. 710-722.

Bonga, L.B., 2009, 'Forward exchange rate puzzle: Joining the missing pieces in the rand-US dollar exchange market', *University of Johannesburg, Working Paper* No. 122, http://www.econrsa.org/node/146, (accessed 5/1/2011).

Caner, M. and Hansen, B.E., 2001, 'Threshold autoregression with a unit root', *Econometrica,* 69, 6, pp. 1555-1596.

Chan, K.S., 1993, 'Consistency and limiting distribution of the least squares estimator of a threshold autoregressive model', *The Annals of Statistics*, 21, 1, pp. 520-533.

Darby, J., Hart, R.A. and Vecchi, M., 1998, 'Labour force participation and the business cycle: A comparative analysis of Europe, Japan and the United States', https://dspace.gla.ac.uk/bitstream/1905/577/1/9802.pdf, (accessed 29/1/2012).

Elmeskov, J. and Pichelmann, K., 1993, 'Interpreting unemployment: The role of labour force participation', *OECD Economic Studies,* 21(Winter), pp. 139-159.

Emerson, J., 2011, 'Unemployment and labor force participation in the United States', *Economics Letters*, 111, 3, pp. 203-206.

Enders, W. and Granger, C.W.J., 1998, 'Unit root tests and asymmetric adjustment with an example using the term structure of interest rates', *Journal of Business and Economic Statistics*, 16, 3, pp. 304-311.

Enders, W., Liu, Y. and Prodan, R., 2009, 'Forecasting series containing offsetting breaks: Old school and new school methods of forecasting transnational terrorism', *Defense and Peace Economics*, 20, 6, pp. 441-463.

Enders, W., 2010, *Applied time series analysis,* 3rd Edition, Wiley Publication Incorporation, USA.

Enders, W., 2006, 'Forecasting persistent data with possible structural breaks: Old school and new school lessons using OECD unemployment rates', Working Paper, November, http://cba.unomaha.edu/faculty/mwohar/web/Frontiers-of-Forecasting/Enders_Prodan.pdf, (accessed 3/2012).

Gozgor, G., 2013, 'The New Keynesian Phillips Curve in an inflation targeting country: The case of Turkey', *International Journal of Economic Sciences and Applied Research*, 6, 1, pp. 7-18.

Granger, C.W.J. and Terasvirta, T., 1993, *Modelling nonlinear economic relationships,* Oxford University Press, Oxford.

Gustavsson, M. and Österholm, P., 2012, 'Labor-force participation rates and the informational value of unemployment rates: Evidence from disaggregated US data', *Economics Letters*, 116, 3, pp. 408-410.

Gustavsson, M. and Österholm, P., 2007, 'Does unemployment hysteresis equal employment hysteresis?', *The Economic Record,* 83, 261, pp. 159-173.

Gustavsson, M. and Österholm, P., 2006, 'The informational value of unemployment statistics: A note on the time series properties of participation rates', *Economics Letters*, 92, 3, pp. 428-433.

Hamilton, J.D., 1989, 'A new approach to the economic analysis of nonstationary time series and the business cycle', *Econometrica*, 57, 2, pp. 357-384.

Hartley, M.J. and Revankar, N.S., 1974, 'Labor supply under uncertainty and the rate of unemployment', *The American Economic Review*, 64, 1, pp. 170-175.

Hernandez, R.D. and Romano, P.O., 2009, 'A cohort analysis of labor participation in Mexico 1987-2009', *IZA Working Paper* No. 4371, http://www.iza.org/en/webcontent/publications/papers/viewAbstract?dp_id=4371, (accessed 3/2011).

Kanika, M. and Miyamoto, H., 2012, 'Unemployment and labour force participation in Japan', *Applied Economics Letters*, 19, 11, pp. 1039-1043.

Koop, G. and Potter, S.M., 1999, 'Dynamic asymmetries in US unemployment', *Journal of Business and Economic Statistics*, 17, 3, pp. 298-312.

Kratzig, M., 2005, 'STR Analysis in Jmulti', *Jmulti Documentation*, http://www.jmulti.de/download/help/str.pdf, (accessed 18/6/2011).

Ludberg, S., 1985, 'The added worker effect', *Journal of Labor Economics*, 3, 1, pp. 11-37.

Lundbergh, S. and Terasvirta, T., 2004, 'Forecasting with Smooth Transition Autoregressive Models', In: M.P. Celments and D.F. Hendry (eds.), *A Companion to Economic Forecasting*, Blackwell Publishing, USA, pp. 432-453.

Madsen, J., Mishra, V. and Smyth, R., 2008, 'Are labour force participation rates non-stationary? Evidence from 130 years for G7 countries', *Australian Economic Papers*, 47, 2, pp. 166-189.

Mchugh, Z., G. Bardsen and Hurn, S., 2002, 'A smooth-transition model of the Australian unemployment rate', *Norwegian University of Science and Technology*, Working Paper, No. 10, 2002, http://www.svt.ntnu.no/iso/wp/2002/10ausu.pdf, (accessed 10/7/2011).

Mincer, J, 1962, 'Labor force participation of married women: A study of labor supply', *NBER*, http://www.nber.org/chapters/c0603.pdf, (accessed 04/05/2012).

Mincer, J., 1966, 'Labor-force participation and unemployment: A review of recent evidence', In: R.A. Gordon and Gordon, H.S. (eds.), *Prosperity and Unemployment*, Wiley Publication, New York.

Murphy, K.M. and Topel, R., 1997, 'Unemployment and nonemployment', *American Economic Review*, 87, 2, pp. 295-300.

Neftçi, S.N., 1984, 'Are economic time series asymmetric over the business cycle?', *Journal of Political Economy*, 92, 2, pp. 307-328.

Nickell, S., 1995, 'Wages, unemployment and population change', L. Christophides, E.

Grant and Swidinsky, R. (eds.), *Aspects of Labour Market Behavior: Essays in Honor of John Vanderkamp*, University of Toronto Press, Canada, pp. 71-102.

Ocal, N. and Osborn, D.R., 2000, 'Business cycle nonlinearities in UK consumption and production', *Journal of Applied Econometrics*, 15, 1, pp. 27-43.

Ozatay, F., 2012, 'Unemployment is sticky again', *Radikal Gazetesi*, June, 16. [In Turkish].

Ozdemir, Z.A., M. Balcilar and Tansel, A., 2011, 'International labour force participation rates by gender: Unit root or structural breaks?' *Koç University-TUSIAD Economic Research Forum Working Paper Series*, No. 1130.

Papps, K.L., 2011, 'The effects of social security taxes and minimum wages on employment: Evidence from Turkey', *IZA* Discussion Paper, No. 6214, December, http://ftp.iza.org/dp6214.pdf, (accessed 10/1/2012).

Rijers, B. and Costa, R., 2012, 'Gender and rural non-farm entrepreneurship', *World Bank Policy Research Working Paper* No. 6066, 2012, http://elibrary.worldbank.org/content/workingpaper/10.1596/1813-9450-6066, (accessed 12/2012).

Salamaliki, P.K. and Venetis, I.A., 2014, 'Smooth Transition Trends and Labor Force Participation Rates in the United States', *Empirical Economics*, 46, 2, pp. 629-652.

Silvapulle, P., Moosa, I. and Silvapulle, M.J., 2004, 'Asymmetry in Okun's Law', *Canadian Journal of Economics*, 37, 2, pp. 353-374.

Stiglitz, J. E., 2012, *The price of inequality.* USA: Norton Publications.

Strand, K. and Dernburg, T., 1964, 'Cyclical variation in civilian labor force participation', *The Review of Economics and Statistics*, 46, 4, pp. 378-391.

Terasvirta, T., 2004, 'Smooth Transition Regression Modeling'. In: Lutkepohl, H. and Kratzidg, M. (eds.) *Applied Time Series Econometrics*, Cambridge University Press, Cambridge.

Terasvirta, T., 1994, 'Specification, estimation, and evaluation of smooth transition autoregressive models', *Journal of the American Statistical Association*, 89, 425, pp. 208-218.

Tsay, R., 1989, 'Testing and modeling threshold autoregressive processes', *Journal of the American Statistical Association*, 84, 405, pp. 231-240.

TurkStat, 2012, 'Household labor force press release', *TurkStat,* Ankara, Turkey.

van Dijk, D., Terasvirta, T. and Franses, P.H., 2000, 'Smooth transition autoregressive models: A survey of recent developments', *Econometric Institute Research Report* No. 23/A, http://repub.eur.nl/res/pub/1656/feweco20000609141913.pdf, (accessed 4/2012).

van Dijk, D. and Franses, P.H., 1999, 'Modeling multiple regimes in the business cycle', *Macroeconomic Dynamics*, 3, 3, pp. 311-340.

How accounting information and macroeconomic environment determine credit risk? Evidence from Greece

Vasiliki Makri[1], Konstantinos Papadatos[2]

Abstract

In this paper, we study the determinants of credit risk in the Greek banking sector. Credit risk is related to bank asset quality and considered responsible for bank failures. In this context, we investigate how loan quality can be explained by accounting and macroeconomic factors. Aggregate loans loss provisions (LLP) are used as a proxy for measuring credit risk. Using quarterly aggregate data that span from 2001Q1 to 2012Q4, we examine a period that covers the recent financial crisis in Greece. The results of Generalized Method of Moments (GMM) estimations indicate that LLP is positively affected by unemployment, public debt, loans loss provisions of previous quarter and negatively by capital adequacy ratio. Therefore, our findings support the hypotheses that both macroeconomic environment and accounting information exert significant influence on the credit risk of Greek banking system.

Keywords: Credit risk, loan loss provisions, Greek banking system, accounting information and macroeconomic environment, GMM

JEL Classification: E44, G20, G21

1. Introduction

It is widely accepted that financial institutions play a vital role to the economy by allocating credit from surplus economic units to deficit economic units in various economic sectors, i.e. mobilising savings and allocating resources to productive economic activities (Fukuda and Dahalan, 2012). A sound banking system is prerequisite for economic growth (Rajaraman and Vasishtha, 2002) and welfare (Kristo, 2013). Moreover, Bairamli and Kostoglou (2010) highlight that economic growth ensures macroeconomic stability, develops strong financial institutions in order to transform savings into investments. However, banks have to confront credit risk. According to Saunders and Cornet (2008), credit risk can be defined as the risk that the promised cash flows from loans and securities,

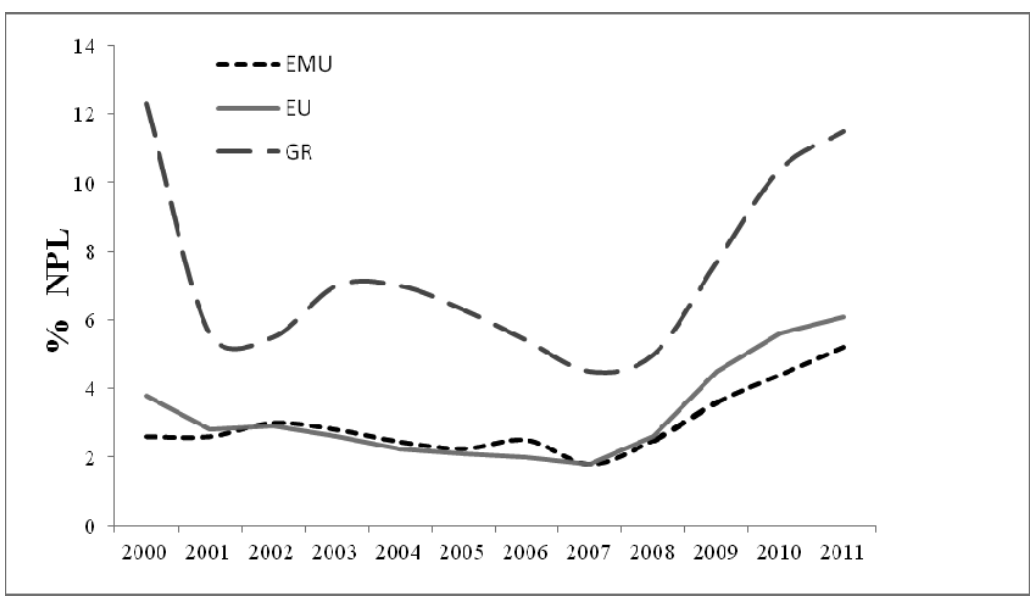
[1] Corresponding author, PhD Candidate, Department of Business Administration, University of Patras, Greece, 26500, vmakri@upatras.gr

[2] Research Associate, Department of Business Administration, University of Patras, Greece, 26500, kostaspp8@yahoo.gr

held by financial institutions, may not be paid in full. Consequently, credit risk is linked to bank asset quality and considered responsible for bank failures (eg. Gup and Kolari,2005, Samad, 2012). Since 1990s, the issue of bank asset quality has gained much attention revealing important insights about the financial fragility of banking institutions. Banks' loans portfolio quality is measured through various indicators drawn from their balance sheet. The most commonly used indicators are the Non Performing Loans to Total Loans (NPL) and Loan Loss Provision to total loans (LLP).

The paper contributes to the literature by exploring the determinants of the aggregate bank loan quality in Greece, using loan loss provisions to total loans (LLP) as indicator of credit quality. We consider Greece to be in the core of our investigation due to several reasons. Firstly, Greece is in the middle of a severe, still ongoing, sovereign debt crisis. Consequently, this economic instability might have jeopardized the fragility of the Greek banking system. Additionally, during last decade (2000 – 2011) the levels of NPLs in Greece (GR) are constantly above the average of European Monetary Union (EMU) and European Union (EU). More precisely, since 2008, the year of the beginning of the global financial crisis, the levels of NPL have increased 108% and 135% for EMU and EU respectively, although in Greece the NPL growth reached 130% (see Graph 1).

Graph 1: Non Performing Loans Ratio, World Bank



During last three decades, the Greek banking industry has faced important structural reforms. Numerous mergers and acquisitions have taken place, state owned banks were privatized and Greek banks expanded their activities to Balkan countries[1]. Regarding their

[1] For more details about the evolution of Greek banking industry see, Athanasoglou et al. 2009, Dimitropoulos et al. 2010, etc.

performance, Greek banks were quite profitable, since 2007, ROE reached at 15%. However, the recent financial crisis has influenced significantly the Greek banking profitability, as ROE, was ranged from -8% to -34%, in 2010 and 2011 respectively (Financial Soundness Indicators, IMF) after Greek Private Sector Involvement (PSI), on 2012, Greek banks must face and accept a new reality by focusing on their recapitalization and restructuring procedures[2].

In our study, we focus on aggregate LLP for the period 2001-2012. More precisely, we examined the impact of both accounting specific and macroeconomic factors to aggregate bank loan quality. The examination of aggregate banking data is widely used in credit quality literature (e.g. Brookes, Dicks and Pradhan, 1994, Ghosh, 2005, Chase, Greenidge, Moore and Worrell, 2005, Rinaldi and Sanchis-Arellano, 2006, Marcucci and Quagliariello, 2008, Boudriga et al. 2009, Pederzoli, Torricelli and Castellani, 2010, Nkusu, 2011, Fainstein and Novikov, 2011b, Bofondi and Ropele, 2011, Vogiazas and Nikolaidou, 2011, Jakubik and Reininger, 2013). According to Boudriga et al. (2009), aggregate data (for the aggregate banking system), in contrast to individual data for each bank, are considered preferable as the risk of non-representativeness of the sample is reduced. Also, Rinaldi and Sanchis-Arellano (2006) argued that aggregate data seem to be appropriate, where individual data unavailability exists. In this context, our study, based on aggregate accounting data extracted from Bank of Greece, takes into consideration not only the major listed commercial banks but the total of monetary financial institutions operating in Greece (cooperative banks, small commercial banks etc).

Several studies examined the determinants of loan portfolio quality in many countries around the world (e.g. Arpa et al. 2001, Boudriga et al. 2009, Espinoza and Prasad, 2010, Chase, Greenidge, Moore and Worrell, 2005, Nikolaidou and Vogiazas 2013). However, the examination of the Greek banking system is at a very early stage, as only the study of Louzis et al. (2010) focused on the determinants of loan portfolio quality. Our research extends the existing literature and differentiates from the analysis of Louzis et al. (2010) in many ways. Firstly, Balás (2009) argue that although NPL can reflect trends in changes in portfolio quality, shows weaker correlation with loan losses. Therefore, in order to investigate the loan portfolio quality, we used LLP instead of NPL. Secondly, we processed aggregate instead of individual banking data, hence our empirical results based on the total of monetary financial institutions operating in Greece. Moreover, given that since 2009 Greece is in a very deep crisis, we decided to include in our sample data covering this period. Thus, contrary to Louzis et al. (2010), so as to include the impact of prolonged recession in our results, we analyzed data from 2001 to 2012. Finally, taking into account the Greek fiscal problems, we decided to differentiate by examining public debt as possible macroeconomic determinant of loan losses. In general, our findings record that both accounting specific and macroeconomic variables seem to exert a powerful influence on LLP.

The structure of the paper is as follows. Section 2 reviews the relevant empirical literature. Section 3 provides the data and the methodology framework. Section 4 presents

[2] Bank of Greece (2012). Report on the recapitalisation and restructuring of the Greek banking sector.

the empirical findings followed by their discussion on section 5. Finally, section 6 demonstrates a brief summary and our concluding remarks.

2. Literature Review

During the 90's, many banking crises were linked to problems loans. Additionally, the availability of published data regarding baking sector was increased significantly. These facts gave the opportunity to many researchers to focus on loan portfolio quality (NPL, LLP and loans losses). In this context, several studies considered NPL as "financial pollution" with harmful effects for both economic development and social welfare (e.g. Zeng 2011, Gonzales-Hermosillo, 1999, Barseghyan, 2010).

One of the first studies that focused on the determinants of asset quality was the investigation of Keeton and Morris (1987), which examined a sample of 2,470 insured commercial banks in the United States (US) for the period 1978-1985. More presicely, they used NPL as indicator of loan quality and found that local economic conditions and low performance of various economic sectors are responsible for the differences in loan losses across banks. Moving to the same direction, Sinkey and Greenawlat (1991) were focused on loan losses in US commercial banks for the period 1984-1987. They also confirmed that both internal and external factors play a decisive impact on loan quality. Moreover, McGoven (1993) found that banks (in US) suffer from loan losses due to lax credit standards, unsecured loans and borrowers' attitudes. Berger and De Young (1997) studied the relationship between loan quality, capital adequacy and efficiency through Granger causality techniques to US commercial banks during 1985-1994. By formulating four hypothesis, regarding bank efficiency and capital adequacy (namely bad luck', 'bad management', 'skimping' and 'moral hazard'), they concluded that a decreased cost efficiency is associated with increased bad loans.

The analysis of Lis, Pages and Saurina (2000) examined Spanish commercial and savings banks and investigated the bank specific and macroeconomic factors that define their loan losses from 1985 to 1997. Specifically, via the implementation of dynamic estimations, they found that the level of problem loans is influenced by GDP growth rate and bank size negatively. On the contrary, loan growth, collateral loans, net interest margin and market power were found to deteriorate bank asset quality. Arpa, Giulini, Ittner and Pauer (2001) examined the impact of various macroeconomic variables on loans loss provisions and revenues in Austria. For their analysis, they used quarterly data from Austrian banks for the period 1990-1999. Their results recorded that banks make higher provisions when GDP falls. Futhermore, Arpa et al. (2001) found a positive relationship between LLP and banks' earnings. Finally, they concluded that when banks implement good management practices, unfavorable macroeconomic conditions should not cause important financial problems. Similarly, Laeven and Majnoni (2003) collected data from 45 countries and 1419 banks, during 1988-1999. Based on cross-country comparisons, they provide evidence that LLP is related to loan growth, earnings and GDP growth. According to the authors, the positive relationship between LLP and earnings indicates that banks follow income-smoothing practices.

Quagliariello (2007) described the influence of both micro and macroeconomic factors on LLP and new bad debts. His analysis based on data extracted from 207 Italian banks for 1985-2002. The econometric findings revealed that LLP and new bad debts are moving cyclically with GDP. Moreover, he concluded that various bank specific (capital ratio, credit growth, interest income, etc.) and macro factors (loan-deposit rates spread, stock market indices) seem to be associated with LLP. Das and Ghosh (2007) studied the (micro and macro) factors affecting the level of problem loans in Indian public banks, for the period 1994-2005. They concluded that GDP growth, loan growth and bank size determine problem loans. The empirical analysis of Fonseca and Gonzalez (2008) examined a panel dataset for 40 countries from 1995-2002. In particularly, they pointed out that loans loss provisions are used for income smoothing. Furthermore, they recorded significant relationships between LLP and various variables like GDP growth, the reserves for loan losses to total assets, capital ratios, etc.

Boudriga et al. (2009), using aggregate banking, financial, institutional and legal environment data of 59 countries for the period 2002-2006, explored the determinants of NPL. They showed that NPL is affected mainly by bank-specific factors, such as capital adequacy, provisions, and bank ownership, while credit exposure is reduced in countries where legal and institutional conditions are improved. The main research objective of Festić, Kavkler and Repina (2011) was to examine the interaction between NPL and various banking and macroeconomic indices in five new members of the EU (Estonia, Latvia, Lithuania, Bulgaria and Romania). Credit growth, FDI and loans to total assets are positively related to NPL. On the contrary, loans to deposits, exports, gross capital fixed formation, net foreign assets to net assets ratio, compensation of employees relative to domestic demand of households and the compliance with Basel principles seem to improve loan quality. The empirical analysis of Nkusu (2011) was focused on 26 advanced economies from 1998 to 2009. Her findings unveiled that poor macroeconomic performance (e.g. slower GDP growth, higher unemployment, decreasing asset prices etc) is related to increased non-performing loans. The Eurozone's banking fragility was under investigation by Makri, Tsagkanos and Bellas (2011). They investigated bank specific and macroeconomic determinants, on aggregate level, in 13 countries for 2000-2008. Their findings revealed that loans to deposits rate, capital adequacy ratio, NPL of the previous year, unemployment and public debt influence bank asset quality.

Nikolaidou and Vogiazas (2013) analyzed possible factors influencing Romanian bank asset quality, as well as the contagion effect of the Greek crisis. In this context, they collected and processed monthly data spanning from December 2001 to November 2010. Their findings suggest that unemployment, money supply, loan growth and the Greek loan loss provisions influence loan portfolio quality significantly. Finally, Louzis, Vouldis and Metaxas (2010) explored the Greek banking industry. They presented results for the pre-crisis period 2003Q1-2009Q3 and extracted data from nine commercial banks. They discovered that the GDP growth rate, unemployment and lending rates have a strong negative impact on NPL. Additionally, they found that ROE and ROA are negatively related NPL, indicating poor bank management practices.

Based on the aforementioned studies, macroeconomic and accounting specific factors seem to define bank asset quality. However, it is obvious that there is a large gap in the literature, regarding the determinants of loan quality in Greece, which our empirical investigation hopes to fill in. Specifically, the present study extends the existing literature by recording results, which cover the period of the prolonged recession in Greece, using LLP as indicator of loan quality (instead of NPL). In addition, it is examined the financial fragility of aggregate Greek banking system and not a specific category of banks (e.g. commercial or cooperative banks). Finally, in order to capture the impact of Greek fiscal problems on loan quality, we include public debt to our research as possible determinant of LLPs.

3. Data & Methodology

3.1 Data

As mentioned above, the aim of our study is to investigate the possible factors that influence aggregate loan quality of the Greek banking industry. For the completion of our empirical research, we chose to collect aggregate data. According to Boudriga et al. (2009), aggregate data (for the aggregate banking system), in contrast to individual data for each bank, are considered preferable as the risk of non-representativeness of the sample is reduced. In addition, as Rinaldi and Sanchis-Arellano (2006), we used aggregate data in order to tackle possible problems of disaggregate data unavailability. Considering this, aggregate accounting data were extracted from Bank of Greece and macroeconomic data were drawn from the Hellenic Statistical Authority (ELSTAT) and Eurostat databases, both in quarterly basis. Our final sample consisted of 48 quarterly observations extended from 2001Q1 to 2012Q4.

3.2 Methodology

Taking into consideration the studies that investigated bank asset quality, we examined a set of explanatory variables that are commonly used in similar investigations. Although Louzis et al. (2010) examined NPL with individual banking data, we also implemented a dynamic regression method for our analysis. More precisely, we implemented the Generalised Method of the Moments (GMM) estimation instead of OLS techniques. We investigated the effect of accounting and macroeconomic factors on LLPs for two separate periods, t and t-1[3]. Our fist econometric estimation is expressed as follows:

$$LLP_t = a_0 + a_1 ACC_t + a_2 MAC_t + \varepsilon_t \quad (1)$$

[3] We used first and second period lagged variables as instruments for the explanatory variables of GMM estimations for period t and t-1, respectively. The validity of the instruments is in line with the results of Sargan test).

Where LLP is the aggregate Loans Loss Provisions to total gross loans and accounts for loan losses estimations. ACC denotes the accounting specific variables and MAC the macroeconomic factors. Note that t corresponds to the examined quarter. Moreover, in order to capture the dynamics of explanatory variables over previous quarters, we extend our empirical research by including one additional lag for both accounting and macroeconomic factors. Hence, our second econometric model is expressed as follows:

$$LLP_t = a_1 + a_3 ACC_{t-1} + a_3 MAC_{t-1} + \varepsilon_{t-1} \quad (2)$$

All the investigated independent variables along with their expected signs are briefly presented on Table 1.

Table 1: Presentation of variables

	Symbol	Explanation	Expected Sign
Accounting Variables	LLP	Loans Loss Provisions to total gross loans	(+)
	CAP	Bank capital and reserves to total assets	(-)/(+)
	LtA	Loans to total assets ratio	(+)
Macroeconomic variables	DEBT	Quarterly Public debt as % of GDP	(+)
	GDP	Quarterly percentage growth rate of GDP	(-)
	INFL	Quarterly average inflation rate	(+)/(-)
	UNEMP	Quarterly percentage of Unemployment	(+)

One of the investigated independent accounting variables is the previous quarter's loan loss provisions (LLP_{t-1}). Given the dynamic persistence of loans provisions, we expect a positive correlation with the dependant variable (Laeven and Majnoni 2003, Fonseca and Gonzalez, 2008). According to Quagliariello (2007), the inclusion of lagged terms of the dependent variable on the right hand side of the equation violates the exogeneity assumption for regressors, thus more sophisticated dynamic econometric techniques are required to provide unbiased estimations. Therefore, "when the lagged depended variable is added as explanatory variable, OLS becomes inconsistent since regressors are correlated with the error term". In this context, the implementation of GMM technique is considered more appropriate than other static techniques (Quagliariello, 2007). Capital ratio (CAP) is the second accounting variable included to our model and measures the risk that a financial institution can undertake. Losses from bank assets can have negative impact on bank capital (Cambazoğlu and Karaalp, 2013). Generally, capital indices are commonly used in the literature. However, they are recorded ambiguous results regarding the sign of their

impact on banks asset quality (Boudriga et al., 2009; Fiordelisi et al., 2010). On one hand, it is considered that low capital indices deteriorate bank asset quality (Berger and De Young, 1997, Vogiazas and Nikolaidou, 2011). On the other hand, it is argued that high capital ratios are linked to more risky banking activities (Rime, 2001). Banking liquidity is measured by LtA index, which demonstrates the funds that a financial institution has utilized into loans from its assets. LtA is expected to exert a positive effect on LLP, since high values of the ratio might signal higher defaults (Sinkey and Greenwalt,1991, Khemraj and Pasha, 2009, Dash and Kabra, 2010, Festić and Repina, 2009 and Cotugno, Stefanelli, Torluccio,2010). Based on the aforementioned discussion we state the following hypothesis:

***H_1**: Accounting information affect LLP significantly*

Given the fact that the current financial crisis revealed the importance of linking macroeconomic variables to the financial stability's banking system (Espinoza and Prasad, 2010), we investigated the impact of macroeconomic environment on loans loss provisions. Therefore, GDP growth rate (GDP), inflation rate (INFL), unemployment (UNEMP) and public debt (DEBT) were also included to our model in order to capture the economic conditions in Greece for the period 2000-2012 and how they affected the LLP index. GDP and UNEMP account for the existing economic activity and highlighting the effect of business cycle to loan quality (Quagliariello, 2007 and Salas and Saurina, 2002). Consequently, we expect a positive relation between LLP and unemployment and negative with GDP. Moreover, INFL affects borrower's ability paying their loans. However, its impact on loan quality can be either negative or positive. On one hand, it is argued that high inflation rates decrease the real value of loans and therefore improve the payment capacity of borrowers. On the other hand, it is considered that a high inflation rate deteriorates the payment capacity of borrowers when salaries are stable. The positive impact of inflation is also supported from the fact when lending interest rates are floating, banks adjust the interest rates in order to maintain their interest income (Nkusu, 2011, Rinaldi and Sanchis-Arellano, 2006). Finally, variable DEBT was included to our investigation, since the current crisis in Greece firstly affected fiscal indices and then extended to the banks. Considering this point, we anticipate a positive association between loan quality and public debt. The positive relationship between NPL and public debt in Eurozone was also confirmed by the study of Makri et al. (2011). Given the above discussion, we formulate the following hypothesis:

***H_2**: Macroeconomic environment affect LLP significantly*

4. Empirical Results

4.1 Descriptive Statistics

Table 2 reports the descriptive statistics of the examined variables over the period 2001-2012. Regarding loan quality, the mean value of LLP reaches the 4,2% and 4,1% of total loans on t and t-1 respectively. Capital ratio, records a minimum of 6,1% across all

time lags and a maximum of 11,5% on period t. Variable LtA demonstrates, a maximum of 0,582 and a minimum of 0,337. The mean value of GDP growth rate ranges from -0,602% to -0,747%. The negative values indicate that over the period 2001-2012 Greece marked with negative economic growth. Additionally, for the same period unemployment presents a minimum of 7,47% and a maximum of 26,43%. The mean value of inflation rate is 0,26 approximately. Finally, public debt as percentage of GDP ranged from 97,3% to 170,6%.

Table 2: Descriptive Statistics of the examined variables

Variables	Mean	Median	Max	Min	SD
LLP_t	0,042	0,036	0,113	0,025	0,020
LLP_{t-1}	0,041	0,036	0,103	0,025	0,018
CAP_t	0,082	0,079	0,115	0,061	0,011
CAP_{t-1}	0,081	0,079	0,105	0,061	0,009
LtA_t	0,491	0,509	0,582	0,348	0,057
LtA_{t-1}	0,490	0,508	0,582	0,337	0,060
$DEBT_t$	116,941	107,950	170,600	97,300	20,793
$DEBT_{t-1}$	116,653	107,900	170,600	97,300	20,660
GDP_t	-0,747	0,386	3,791	-8,000	3,091
GDP_{t-1}	-0,602	0,397	3,791	-8,000	2,953
$INFL_t$	0,255	0,267	0,667	-0,167	0,189
$INFL_{t-1}$	0,260	0,267	0,667	-0,167	0,188
$UNEMP_t$	11,669	10,117	26,433	7,467	4,673
$UNEMP_{t-1}$	11,355	10,000	25,467	7,467	4,180

Note: Where LLP is the aggregate of loans loss provilsion to total gross loans, CAP is the capital ratio defined as bank capital and reserves to total assets, LtA is the loans to total assets ratio, DEBT is the public debt as a percentage of GDP, GDP is the annual percentage growth rate of GDP, INF is the annual average inflation rate and UNEMP is the unemployment rate. t corresponds to the examined year.

4.2 Econometric Results

The results of GMM estimations for equations (1) and (2) are presented on Table 3, where the coefficients of the independent variables, their corresponding p-values, the R^2 and the adjusted R^2 for all the examined specifications are recorded. Starting with the adjusted R^2 indicator, it is noted that the explanatory power of both models is very high, since it ranges from 97,6% to 98,3%. The use of LLP as indicator of loan quality unveiled interesting results. Starting with model (1), it is observed that UNEMP and LLP of the previous quarter records positive and statistically significant relationship with LLP. Additionally, CAP exerts negative and significant impact on LLP. Model (2) demonstrates

similar results. Specifically, variables DEBT, UNEMP and LLP of previous quarter, seem to affect positively loan quality, while CAP negatively. However, it has to be mentioned that INFL, GDP and LtA do not exert significant impact on bank asset quality.

Table 3: Econometric Results of Equations (1) & (2)

Variables	Model (1)	Model (2)
C	0,006 (0,444)	-0,003 (0,703)
LLP_{t-1}	**0,809***** **(0,000)**	**0,768***** **(0,000)**
CAP_t	**-0,116**** **(0,021)**	
CAP_{t-1}		**-0,107*** **(0,090)**
LtA_t	-0,002 (0,874)	
LtA_{t-1}		-0,001 (0,901)
$DEBT_t$	-0,001 (0,845)	
$DEBT_{t-1}$		**0,001*** **(0,068)**
GDP_t	-0,005 (0,141)	
GDP_{t-1}		-0,003 (0,511)
$INFL_t$	0,001 (0,810)	
$INFL_{t-1}$		-0,005 (0,794)
$UNEMP_t$	**0,001***** **(0,001)**	
$UNEMP_{t-1}$		**0,001***** **(0,000)**
R^2	0,980	0,985
Adjusted R^2	0,976	0,983
N obs	48	47

Note: Table shows the coefficients estimates (coefficients in boldface are significant), and p-values of the GMM regression model..* Significance at the 10% level **Significance at the 5% level, ***Significance at the 1% level. Where LLP is the aggregate of loans loss provilsion to total gross loans, CAP is the capital ratio defined as bank capital and reserves to total assets, LtA is the loans to total assets ratio, DEBT is the public debt as a percentage of GDP, GDP is the annual percentage growth rate of GDP, INF is the annual average inflation rate and UNEMP is the unemployment rate. t corresponds to the examined year

5. Discussion

The results of our econometric analysis, provide strong evidence that hypothesis 1 and 2 are confirmed, since both accounting specific and macroeconomic factors seem to determine the loan quality, as literature review proposed.

Firstly, past loans' experience, proxied by LLP of previous quarters, proved to be significantly related with the loan quality of current period. This result highlights the dynamic persistence of problem loans through periods. This finding is also confirmed by Laeven and Majnoni (2001), Jimenez and Saurina (2006), Fonseca and Gonzalez (2008), Louzis et al. (2010) etc. Capital ratio is an indicator that can determine the risk behaviour of banks. However, prior studies have documented mixed results regarding its impact on loan quality (Ahmed et al., 1999, Boudriga et al., 2009 and Fiordelisi et al., 2010). On one hand, positive relationship between LLP and CAP illustrate that banks probably use LLP as a tool of income smoothing and create risky portfolios. On the other hand, negative relationship can be associated with Moral hazard Hypothesis, revealing that bank managers increase the riskiness of bank asset portfolio when low capital ratios are recorded. In the case of the Greek banking system, contrary to Louzis et al. (2010), it is confirmed Moral Hazard Hypothesis. Similar results are also recorded by Berger and DeYoung (1997), Ahmed et al. (1999), Salas and Saurina (2002) and Espinoza and Prasad (2010). Apart from the aforementioned accounting ratios, profitability indices (ROA and ROE) are also employed in similar studies. However, data constraints prevented the calculation of ROA and ROE.

Regarding macroeconomic indicators, it was confirmed that in Greece economic conditions have significant impact on loan quality. Specifically, it was observed a positive relationship between LLP and unemployment, supporting the view that unemployment reduces households' disposable income and weakens borrower's ability to pay their loan installments. Similar results were recorded to Brookes et al. (1994), Louzis et al. (2010), Nkusu (2011) and Vogiazas and Nikolaidou (2011) etc. Finally, sovereign debt problems were proved to determine loan quality, since public debt as percentage of GDP was found to be positively related to LLP. According to Reinhart and Rogoff (2010), sovereign debt crises proceed or occur at the same time with banking crises. This can be explained from the fact that when governments stop financing national banks, the latter reduce their lending activities (Reinhart and Rogoff, 2010). Therefore, debtors cannot refinance their loans and pay their loan installments. Additionally, when public debt increases, governments take fiscal measures by reducing social expenditure and salaries, influencing negatively the disposable household income (Perotti, 1996). This finding is line with Makri et al. (2011) who found that debt problems define the level of NPL in EMU countries.

6. Conclusion

In the present study, we provide strong evidence about the factors influencing aggregate loan quality in Greece over period 2001-2012. Main goal of our study was to record results covering the period of the prolonged recession in Greece. Implementing

GMM estimation on aggregate banking data, we found that both accounting specific and macroeconomic factors seem to define credit risk. It is worth mentioning that is the first study in Greece, which investigates the impact of various accounting and macroeconomic ratios to LLP. Based on the existing literature, aggregate data could provide valid findings for the total stability of a country's banking system. Our conclusions are in line with previous empirical studies, as capital ratio, loan loss provision of previous quarter, unemployment and public debt influence significantly bank asset quality.

Acknowledgements

The authors would like to acknowledge and thank Dr. Athanasios Bellas for his continued encouragement and support.

References

Ahmed, A.S., Takeda, D., Thomas, S., 1999, 'Bank LLP: A reexamination of capital management, earnings management and signaling effects', *Journal of Accounting and Economics,* 28, pp. 1-25.

Arpa, M., Giulini, I. Ittner, A. and Pauer, F., 2001, 'The influence of macroeconomic developments on Austrian banks: implications for banking supervision', *BIS Papers*, no. 1, pp. 91-116.

Athanasoglou, P.P., Georgiou, E.A. and Staikouras, C.C., 2009, 'Assessing output and productivity growth in the banking industry', *The Quarterly Review of Economics and Finance*, 49, pp. 1317-1340.

Bairamli, N. and Kostoglou, V., 2010, 'The Role of Savings in the Economic Development of the Republic of Azerbaijan', *International Journal of Economic Sciences and Applied Research*, 3, 2, pp. 99-110.

Balás, T. (2009). Comparison of the indicators describing the loan portfolio quality of the banking sector, *Report on financial stability, Magyar Nemzeti Bank*.

Barseghyan, L., 2010, 'Non-Performing Loans, Prospective Bailouts, and Japan's Slowdown', *Journal of Monetary Economics*, 57, 7, pp. 873-890.

Berger, A.N., and De Young, R., 1997, 'Problem loans and cost efficiency in commercial banks', *Journal of Banking & Finance*, 21, pp. 849-870.

Chase, K., Greenidge, K., Moore, W. and Worrell, D., 2005, 'Quantitative Assessment of a Financial System – Barbados', IMF Working Paper, 05/76.

Bank of Greece, 2012, 'Report on the recapitalization and restructuring of the Greek banking sector', Athens, Greece, ISBN: 978 - 960 - 7032 - 55 - 3, *www.bankofgreece.gr/BogEkdoseis/Report_on_the_recapitalisation_and_restructuring.pdf*

Bofondi, M. and Ropele, T., 2011, 'Macroeconomic determinants of bad loans: evidence from Italian banks', Bank of Italy, Occasional Paper No. 89.

Boudriga, A., Taktak, N. and Jellouli, S., 2009, 'Banking supervision and nonperforming

loans: a cross-country analysis', *Journal of Financial Economic Policy,* 1, 4, pp. 286-318.

Brookes M., Dicks M. and Pradhan M., 1994, 'An empirical model of mortgage arrears and repossessions', *Economic Modelling*, 11, 2, pp. 134-144.

Cambazoğlu, B. and Karaalp, H.S., 2013, 'The External Finance Premium and the Financial Accelerator: The Case of Turkey', *International Journal of Economic Sciences and Applied Research,* 6, 1, pp. 103-121.

Cotugno, M., Stefanelli, V. and Torluccio, G., 2010, 'Bank intermediation models and portfolio default rates: what's the relation?', *Proceedings of 23rd Australasian Finance and Banking Conf. Sydney.*

Dash, M. K. and Kabra, G., 2010, 'The determinants of non-performing assets in Indian commercial bank: an econometric study', *Middle Eastern Finance and Economics,*7, pp. 94-106.

Dimitropoulos, P.E., Asteriou, D. and Koumanakos, E., 2010, 'The relevance of earnings and cash flows in a heavily regulated industry: Evidence from the Greek banking sector', *Advances in Accounting, incorporating Advances in International Accounting,* 26, pp. 290-303.

Fainstein, G. and Novikov, I., 2011, 'The role of macroeconomic determninants in credit risk measurement in transition country: Estonian example', *International Journal of Transitions and Innovation Systems*, 1, 2, pp. 117-137.

Festić, M., Kavkler, A. and Repina, S., 2011, 'The macroeconomic sources of systemic risk in the banking sectors of five new EU member states', *Journal of Banking and Finance*, 35, pp. 310-322.

Festić, M. and Repina, S., 2009, 'Financial stability in the Baltics', *Czech Journal of Economics and Finance*, 59, 6, pp. 554-576.

Fiordelisi, F., Marques-Ibanez, D. and Molyneux, P., 2010, 'Efficiency and risk in European banking', *Working paper series, European Central Bank*, no. 1211.

Fonseca, A.R. and Gonzalez, F., 2008, 'Cross-country determinants of bank income smoothing by managing loan-loss provisions', *Journal of Banking and Finance,* 32, pp. 217-228.

Fukuda, T. and Dahalan, J., 2012, 'Finance - growth-crisis nexus in Asian emerging economies: evidence from VECM and ADRDL assessment', *International Journal of Economic Sciences and Applied Research*, 5, 2, pp. 69-100.

Ghosh, S., 2005, 'Does leverage influence banks' non-performing loans? Evidence from India', Applied Economics Letters, 12, pp. 913-918.

Gonzales-Hermosillo, Brenda, 1999, 'Developing Indicators to Provide Early Warnings of Banking Crises', *Finance & Development, (Financial Markets)*, 36, pp. 36-39.

Gup, B.E. and Kolari, J.W., 2005, *Commercial Banking: The Management of Risk*, 3rd Edition, John Wiley and Sons Ltd, Australia.

Jakubík, P. and Reininger, Th., 2013, 'Determinants of Nonperforming Loans in Central, Eastern and Southeastern Europe, Oesterreichische Nationalbank', Focus on European Economic integration, Q3/13, pp. 48-66.

Jimenez, G. and Saurina, J., 2006, 'Credit Cycles, Credit Risk, and Prudential Regulation', *International Journal of Central Banking*, 2, 2, pp. 65-98.

Keeton, W. R. and Morris, C. S., 1987, 'Why do banks' loan losses differ?', *Federal Reserve Bank of Kansas City, Economic Review*, pp. 3-21.

Khemraj, T. and Pasha, S., 2009, 'The Determinants of Non-performing Loans: An Econometric Case Study of Guyana', *Proceedings of 3rd Biennial on Banking and Finance 27-29 May 2009.*

Kristo, S., 2013, 'Efficiency of the Albanian banking system: Traditional approach and Stochastic Frontier Analysis', *International Journal of Economic Sciences and Applied Research*, 6, 3, pp. 61-78.

Laeven, L. and Majnoni, G., 2003, 'Loan loss provisioning and economic slowdowns: Too much, too late?', *Journal of Financial Intermediation,* 12, pp. 178-197.

Louzis, D. P., Vouldis, A.T. and Metaxas, V.L., 2010, 'Macroeconomic and bank-specific determinants of non-performing loans in Greece: a comparative study of mortgage, business and consumer loan portfolios', *Working Paper, 118*, Bank of Greece.

McGoven, J., 1993, 'Why bad loans happen to good banks', *The Journal of Commercial Lending, Philadelphia,* 75, 6.

Makri, V., Tsaganos, Ath. and Bellas, Ath., 2011, 'A cross-country study: Determinants of Non-Performing Loans in the Eurozone', *Annual International Conference on Accounting and Finance (AF 2011), 23-24 May, Singapore.*

Marcucci, J. and Quagliariello, M., 2008, 'Is bank portfolio riskiness procyclical: Evidence from Italy using a vector autoregression', *Journal of International Financial Markets, Institutions and Money*, 18, 1, pp. 46-63.

Nikolaidou, E. and Vogiazas, S.D., 2013, *Credit Risk in the Romanian Banking System: Evidence from an ARDL Model, Balkan and Eastern European Countries in the Midst of the Global Economic Crisis Contributions to Economics,* Springer Editions, 87-101, ISBN: 978-3-7908-2872-6.

Nkusu, M., 2011, 'Nonperforming Loans and Macrofinancial Vulnerabilities in Advanced Economies', *IMF Working Paper* 11/161.

Pederzoli, C., Torricelli, C. and Castellani, S., 2010, 'The Interaction of Financial Fragility and the Business Cycle in Determining Banks' Loan Losses: An Investigation of the Italian Case', *Economic Notes by Banca Monte dei Paschi di Siena SpA*, 39, 3, pp. 129-146.

Perotti, R., 1996, 'Fiscal consolidation in Europe: composition matters', *American Economic Review*, 86, pp. 105-110.

Quagliariello, M., 2007, 'Banks' riskiness over the business cycle: a panel analysis on Italian intermediaries', *Applied Financial Economics,* 17, pp. 119-138.

Rajaraman, I. and Vasishtha G., 2002, Non-Performing Loans of PSU Banks: Some Panel Results, *Economic and Political Weekly*, 37, 5, pp. 429-435.

Rinaldi, L. and Sanchis-Arellano, A., 2006, 'Household Debt Sustainability: What Explains Household Non-Performing Loans?', An Empirical Analysis, *ECB Working Paper No. 570.*

Salas, V. and Saurina, J., 2002, 'Credit risk in two institutional regimes: Spanish commercial and savings banks', *Journal of Financial Services Research*, 22, 3, pp. 203-224.

Samad, A., 2012, 'Credit Risk Determinants of Bank Failure: Evidence from US Bank Failure', *International Business Research*, 5, 9, pp. 10-15.

Saunders, A. and Cornet, M.M., 2008, *Financial institutions Management*, *A Risk Management Approach (6th edition)*, McGraw-Hill Irwin.

Sinkey, J. F. and Greenawalt, M. B., 1991, 'Loan-loss experience and risk-taking behaviour at large commercial banks', *Journal of Financial Services Research*, 5, pp. 43-59.

Reinhart, C., Rogoff, K., 2010, 'From Financial Crash to Debt Crisis', *NBER Working Paper 15795*.

Vogiazas, S.D. and Nikolaidou, E., 2011, 'Investigating the determinants of non-performing loans in the Romanian banking system: an empirical study with reference to the Greek crisis', *Economics Research International*, Article ID 214689, doi:10.1155/2011/214689.

Zeng, S., 2011, Bank Non-Performing Loans (NPLS): A Dynamic Model and Analysis in China. *Modern Economy*, 2, pp. 100-110.

About IJESAR

The **International Journal of Economic Sciences and Applied Research** is a blind peer-reviewed, scholarly journal devoted to publishing high-quality papers and sharing original economics research worldwide. It intends to serve as an outlet for theoretical and empirical research in all areas of economics. These include, but are not limited to the following:

- Economic Theory and Policy
- Micro- and Macro-economics
- International economics
- European economics
- Regional economics
- Public economics
- Financial economics
- Business Management
- Business Informatics
- Accounting and
- Mathematical methods for economics.

Papers in other sub-disciplines of economics (e.g., labour, public, money, industrial organization, health, environment and history) are also welcome if they contain international or cross-national dimensions in their scope and/or implications. The Journal especially encourages the submission of articles, which are empirical in nature, or deal with issues of open economy macroeconomics and international finance. Theoretical work submitted to the Journal should be original in its motivation or modelling structure. Empirical analysis should be based on a theoretical framework, and should be capable of replication. It is expected that all materials required for replication (including computer programs and data sets) should be available upon request to the authors.

Instructions for Authors

1. Submission of Papers

Please submit papers by e-mail to editassist@ijesar.org. If electronic submission is not possible, papers (and any other correspondence) should be sent to the IJESAR Editorial Manager:

Address: TEI of EMTh,
Agios Loukas,
PC 65404, Kavala, GREECE
Phone: (+30) 2510 462193
Fax: (+30) 2510 462193
E-mail: editassist@ijesar.org

2. Format of Papers

IJESAR accepts submissions in English only. The submission should include a cover page showing the author's name and affiliation(s), an address for correspondence (including email), and any acknowledgements. The title but not the author's name should appear on the first page of the manuscript, as IJESAR uses a blind peer-review process. Therefore, all information revealing the author's identity will be removed before we send the paper to the referees. Papers should be submitted in Microsoft Word electronically by e-mail as attachments to the Editor, to the e-mail address: editassist@ijesar.org.

A template is a set of styles and page layout settings that determine the appearance of a document. The use of the template is mandatory (see the webpage for the template file format).

3. Copyright