Assessing NAFTA and EU's Optimum Currency Areas: A SVAR Approach

João Leitão[1]
University of Beira Interior, NECE, Research Center in Business Sciences & CEG-IST, Centre for Management Studies of Instituto Superior Técnico, University of Lisbon.

Joaquim Ferreira
University of Beira Interior, NECE, Research Center in Business Sciences.

Abstract

With the motivation of determining the applicability of an Optimum Currency Area (OCA) in three groups of countries (NAFTA, PIIGS and European Block of Rich Countries), a selected specification of a SVAR model by Blanchard & Quah (1989) is considered, following the technique of Chow & Kim (2003) and Zhao & Kim (2009). Use of the variance decomposition of forecast error reveals that in the three groups of countries, domestic production is explained above all by domestic shocks. However, regional shocks also show a certain importance in determining the performance of domestic production. Global shocks do not generally show any importance in determining the performance of domestic production. Analysis of the amplitude of shocks and the speed of adjustment (Bayoumi & Eichengreen, 1993) confirms that the NAFTA block and the European Block of Rich Countries (EBRC) show a greater speed of adjustment with regard to regional shocks than to global shocks and domestic shocks. The PIIGS group is seen to have a greater speed of adjustment to domestic shocks. From the results obtained, the NAFTA block and the European Block of Rich Countries are shown to be candidates to the applicability of an OCA.

Key words: Optimum Currency Area; NAFTA Block; European Block; SVAR.

***JEL* Classification Codes:** C32; F36; F41; F44.

[1] Contacting author: jleitao@ubi.pt.

1. Introduction

The long economic-financial crisis experienced in Europe since 2008, especially in the Eurozone, has led political decision-makers and analysts to question the existence of the euro, as well as the possible exit from the group of countries using the single European currency of some member States in a more vulnerable economic and financial situation, namely, the so-called PIIGS.[2] In this context, the possibility arises of implementing two common currencies, one for rich countries and another for countries with more vulnerable economies, and also of whether the definition of an Optimum Currency Area (OCA) is effectively applicable to the Eurozone, compared to the NAFTA block.

Although this topic has been given close attention in recent years by European decision-makers, the theory of OCAs saw major advancements in the 1960s thanks to Mundell (1961), McKinnon (1963) and Kenen (1969).

Mundell (1961) proposes that the flexible exchange regime is best, in the case of adjustment of balance of payments, unemployment and inflation, when faced with an asymmetric shock between two countries with individual currencies. In this way, depreciation of the currency of the affected country in relation to the benefiting country leads to a reduction of unemployment in the affected country and control of inflation in the benefiting country.

For the same author, in the case of an asymmetrical shock between regions of a given country[3], the flexible regime is not the most appropriate, inasmuch as the increased supply by central banks would only solve one situation, i.e., unemployment or inflation, but not both. Therefore, the author recommends the fixed regime as suitable for regions. Nevertheless, he underlines that mobility of the labour production factor and flexibility of salaries and prices are important requirements for the formation of an OCA for the purpose off adjusting to asymmetric shocks.

[2] English acronym applied to the Eurozone economies (Portugal, Ireland, Italy, Greece and Spain) with serious problems in public finance and with greater weight of Public Debt expressed by the ratio: Public Debt/GDP.
[3] The author presents the case of USA and Canada as an example.

McKinnon (1963) defends assessment of the measure of openness of a given economy, determined by the ratio of transactional to non-transactional goods, as a criterion for the applicability of an OCA, i.e., finding a high level of commercial flows between economies can increase the probability of forming an OCA. For economies with a high degree of openness, the preferential regime to apply is the fixed exchange one, inasmuch as it does not let external prices contribute to increased inflation, nor influence salaries, as would happen if applying a flexible exchange regime. In this line of analysis, the same author proposes that for a small open economy, it is better to seek integration in a large OCA, as the former is not able to be self-sustaining.

In turn, Kenen (1969) indicates diversification of production as a requirement for forming an OCA. In addition, he argues that a fixed exchange regime is based on an economy with a high degree of product diversification (or on a common currency) and that a flexible exchange regime is based on an economy with limited diversification. The author reveals that, on one hand, in economies with high product diversification, an asymmetric shock in products of certain industries leads to increased demand for products of other industries, and therefore, the economy will remain stable without the need to float the exchange rate. On the other hand, the same author underlines that economies with limited product diversification need a flexible exchange rate with the double aim of devaluing their currency and increasing demand. In the case of possible implementation of a fixed exchange regime, there would be the need to carry out a reduction of prices and salaries, which would bring about increased unemployment.

For Corden (1972), the formation of an OCA leads to the loss of the monetary policy instrument, which amounts to effectively losing the possibility to control the exchange rate. Referring to Mundell (1961), the same author argues that for there to be an OCA, it is necessary to ensure high flexibility of prices and salaries. Ishiyama (1975) and Tower & Willett (1976) specify their theory in assessing the pros and cons of forming an OCA. Ishiyama (1975) reveals that the costs and benefits should be analyzed considering each country's well-being, while Tower & Willett (1976) present their theory based on trade-offs, considering the relationship between costs and benefits associated with the options of a fixed exchange rate regime or flexible exchange rate regime.

More recently, the literature of reference highlights the trade-off between benefits and costs arising from the option of integration in a monetary union (Tavlas, 1993). In this connection, Mélitz (1995) reveals that in the monetary union context, in which monetary power is distributed among the members of that union, any country wanting to be included should, nevertheless, calculate the difference between the monetary power before and after joining.

Krugman (1993) points out that a high level of integration and the existence of a common currency can lead to certain circumstances that originate regional crises. Regions' specialization leads to instability concerning their exports due to asymmetric technological shocks caused by that same specialization. Consequently, movement of capital frequently emerges by means of monetary integration, leading to asymmetric economic growth. In the domain of managing a hypothetical adjustment process, the author underlines two main mechanisms, namely migration and adjustment of real salaries. The same author also argues that, in the context of a monetary union, stabilization policies should be oriented towards use of so-called fiscal federalism.

The studies by Bayoumi & Eichengreen (1997), proposing the construction of an OCA index, and by Frankel & Rose (1998), contribute to solidifying the argument that a currency union can improve and increase market integration.

Frankel & Rose (1998) also propose that the greater the proximity of countries with commercial links, the greater the probability of correlated economic cycles occurring.
Enders & Hurn (1997) present the concept of Generalized Purchasing Power Parity[4]. This conception shows that macroeconomic shocks tend not to be stationary, and so ensure that exchange rates are not stationary. However, to identify at least one co-integration relationship, it is necessary to confirm the existence of a linear combination that is significant and represents the emergence of a currency union (Mishra & Sharma, 2010).

Goldberg (1999) asks whether OCA theory is important in transition economies. The author reveals that the interest rate does not have an impact on either employment or

[4] The GPPP concept is expressed as follows: $q_{12t}=\alpha_0+ \alpha_{13}\, q_{13t}+ \alpha_{14}\, q_{14t}+\ldots+ \alpha_{1m}\, q_{1mt}+\varepsilon_t$, where q_{1it} is the logarithm of the bilateral rate of exchange between country *1* and country *i* in period *t*, α_{1i} the parameters of co-integration vectors and ε_t the term of stochastic disturbance.

production in this type of economy[5]. This question may be connected to the fact of having industrial links due to economies' integration, as well as to monopolist behaviour resulting from a weak distribution system. However, the author claims that the choice of exchange rate regime should depend on the reformist objectives defined by the governments of transition economies.

Then again, Dellas & Tavlas (2009) state that the exchange rate regime to apply should take the level of economic development into account, inasmuch as this is shown to be determinant for growth and inflation. They point out, nevertheless, that the choice of exchange rate regime can be determined by a function of well-being with macroeconomic objectives, considering the degree of salary flexibility.

This article aims to determine the applicability of an OCA in the NAFTA block and in the European block, divided in two groups, designated as PIIGS and European Block of Rich Countries (EBRC). To do so, a Structural VAR model (SVAR) is used as developed by Blanchard & Quah (1989), as well as the methodology of Chow & Kim (2003) and Zhao & Kim (2009). In addition, the amplitude of shocks and speed of adjustment is assessed according to the procedure proposed by Bayoumi & Eichengreen (1993).

Through analysis of the variance decomposition of forecast error, domestic production in the three groups is found to be explained above all by domestic shocks. Therefore, global shocks have very little importance in determining the performance of domestic production. In turn, regional shocks also show some importance in determining domestic production performance.

By analyzing the amplitude of shocks and speed of adjustment, the NAFTA block and the EBRC group are seen to present a greater speed of adjustment to regional shocks than to global and domestic shocks. The PIIGS group presents greater speed in relation to domestic shocks. The NAFTA block and EBRC group therefore show prospects for the formation of an OCA, unlike the PIIGS group.

[5] The author concentrates her analysis on countries included in, and satellites of the former URSS, which correspond to transition economies.

The article is structured as follows. In item 2, a review is made of the literature on the theoretical and empirical construction of the subject of Optimum Currency Areas. Item 3 presents a brief explanation of the econometric model used and its corresponding specification. Item 4 presents the results of variance decomposition of the forecast error, of the amplitude of turbulence and speed of adjustment, followed by the corresponding discussion. Item 5 deals with the conclusions, providing the main evidence and implications for political decision-makers, the limitations of the study and guidelines for future research.

2. Literature review and research hypotheses

In the literature on OCAs, issues concerning the uncertainty associated with the Eurozone structure, as well as the proposed possibility of creating new currency areas, for example in Asia, have been gaining importance, given the instability of macroeconomic fundamentals, highly volatile financial markets and growing uncertainty.

Using a SVAR model, Kwack (2004) reveals that for Asia in general, some contingencies arise as regards the formation of an OCA, for example, the lack of inter-commercial agreements, policies to attract foreign direct investment (FDI) and foreign exchange swaps. From this perspective, there is a possibility of forming a "quasi-currency" block, as some regions present the same sector position (Bacha, 2008) and with a high degree of openness (Kwack, 2004).

For the case of the USA, Beckworth (2010) analyzes the response to a monetary shock, finding asymmetry in those responses (the US dollar does not constitute an OCA), since States specializing in manufacturing industries, compared to those specializing in extraction industries, show less sensitivity to a currency shock.

Besides testing shock impulses, Alesina *et al.* (2003) assess the applicability of a standard-currency, as a platform to generate economic blocks, calculating the square root of the mean squared prediction error, in order to determine the existence of co-movements. The main results point towards the US dollar and the euro (the yen was also tested) being the international standard currencies, finding no evidence of the applicability of an OCA in the NAFTA economic block.

As regards analysis of responses to exogenous structural shocks, Lee & Koh (2012) use a vector auto-regressive approach of the structural type (SVAR), applied to the Asian context, revealing the importance of economies such as China, Japan and South Korea for the hypothetical acceptance of an OCA, inasmuch as these economies present high economic growth and major foreign exchange reserves.

Still in the Asian context, the strong adjustment to shocks and the diminishing amplitude of shocks are also important factors for admitting a hypothetical OCA (Zhang *et al.*, 2004; Zhang *et al.*, 2008). In addition, Saxena (2005) highlights the importance that can be attributed to intensification of bilateral exchanges as a determinant factor of hypothetical formation of an OCA, as strong commercial integration provides greater synchrony between economic cycles of different economies.

Chow & Kim (2003) show that Asian economies respond symmetrically to domestic shocks, and so do not form an OCA. In the African context, formation of a possible OCA is not found (Buigut & Valev, 2005; Zhao & Kim, 2009), due to weak commercial integration in regional terms and bilateral negotiations at the international level aiming to overcome the arguments of Saxena (2005), applied to the Asian context. In the context of the NAFTA block, the response to structural shocks (supply, demand and monetary), in the general computation, is found to be symmetrical between the USA and Canada, but asymmetrical between the USA and Mexico[6] (Louis *et al.*, 2011). Indeed, an OCA in the European context[7], is more feasible, compared to what is described in the literature in relation to NAFTA, in that productive structures are more similar, contributing to minimizing the possibility of industrial specialization, although in the European context, peripheral countries do not form an OCA (Bayoumi & Eichengreen, 1993).

Using estimations based on the ordinary least squares method, various studies focusing on bilateral commercial exchanges between countries forming a given region, as well as intra-industrial commerce (in the European and Asian context) show a positive relationship between the degree of intensity of bilateral commercial exchanges and the

[6] One of the main causes of the asymmetric response lies in the Mexican "Tequilla" crisis of 1994, and in the symmetric growth and inflationary behaviour of the North American countries.
[7] Referring to the countries neighbouring Germany (France, the Netherlands, Belgium, Luxembourg and Denmark).

expansion stage of economic cycles (Frankel & Rose, 1997; Fidrmuc, 2004; Silvestre & Mendonça, 2007; Shirono, 2008), which is revealed as important in determining the synchronization of those cycles.

In turn, when it is possible to ensure the formation of an OCA (particularly in the Asian context) with industrialized economies, the contribution to social well-being will be greater (Shirono, 2008). In the North American context, Carr & Floyd (2002) reveal that the movement of the exchange rate is significantly influenced by real shocks, suggesting the continuity of a flexible exchange system.

From the perspective of endogeneity, Mendonça *et al*. (2011), using a beta regression, conclude that commercial exchanges, in the Eurozone, have lost importance in the synchronization of economic cycles.

Concerning study of exchange rates as a focus for formation of an OCA, the theory of Generalized Parity of Purchasing Power (GPPP) emerges as an indicator of the degree of monetary integration, resorting to the use of co-integration models. If there is, at least, a common stochastic tendency (co-integration) between the pairs of exchange rates of a region and the adjustment towards a long-term balance is symmetrical, an OCA may be applicable. Empirical evidence indicates that for the European and G-7 context, there is the possibility of forming an OCA (Enders & Hurn,1997; Beirne, 2008), while in the Asian context (Beirne 2008; Mishra & Sharma, 2010) and in that of Latin America, some asymmetries are found, in terms of adjustment towards long-term balance (Neves *et al.*, 2008; Beirne, 2008) and so despite finding co-integration, admission of an OCA becomes less possible. Not including the GPPP theory, Lim (2005) and Coulibaly & Gnimassoun (2013) conclude in the East Asian and West African context that only certain economies tend to form an OCA, i.e., in global terms those regions do not show homogeneity for an OCA to be admitted. In turn, Haug *et al.* (2000), in the Eurozone context, exclude southern countries for the Eurozone to be an OCA, inasmuch as co-integration is not found between exchange rates and interest rates.

Concerning the use of correlation tests, Karras (2005)[8] shows that a "yenization" is only applicable to North Korea due to the correlation or synchronization of its economic cycles with the Japanese cycle, in line with the results obtained in the study by Kwan (1998)[9], which reveals that the yen does not form a monetary block, in that Asian economies are heterogeneous and the corresponding currencies show less volatility in relation to the dollar. Then presenting China as an OCA, applicability is admitted, except for Hong Kong and Macau, as the correlations between product growth and inflation are different in the other Chinese regions (Kwan, 1998).

Banik *et al.* (2009) point out that European and North American industrial production is influenced mostly by global factors, while industrial production in East Asia is influenced by intrinsic factors.

For Grüner (2010), a common monetary policy emerges as an important instrument for stabilizing inflation, reducing unemployment and synchronizing economic cycles.

Using estimations by the generalized method of moments, Lee & Azali (2010) reveal that in the East Asian context, financial integration results in less synchronization of economic cycles and an increase in the industrial specialization index. In addition, they conclude that bilateral commercial exchanges produce a positive effect in terms of synchronization of cycles.

Through non-parametric tests, Binner *et al.* (2011) find the concept of an OCA is admissible in different contexts, namely Africa, Asia and the Eurozone.

Due to the existence of non-observable factors in industrial production, Banik *et al.* (2009) and Lee & Azali (2012), in the case of South Asia, and in the European, North American and East Asian cases, use a spatial econometric model which allowed them to conclude on symmetry in the response to exogenous shocks, through geographical proximity and commercial similarities.

[8] Karras uses *Band–Pass* and *Hodrick–Prescott* filters to retain cyclical frequencies.
[9] The work by Kwan (1998) is based on statistical compilations from the *Nomura Research Institute*.

Other related studies resort to alternative methodologies, namely correlation tests and linear regressions (Torres & Vela, 2003; Hugger, 2008), as well as neo-classical growth models (Bejan, 2011), in order to confirm the synchronization of economic cycles between economies in the NAFTA block, given the greater commercial and industrial integration, which should mean greater reduction of transaction costs. Viable implementation of a single currency in that economic block can therefore contribute to a fall in interest rates and the end of inflationary cycles (Grubel, 2000).

Using meta-analysis, Fidrmuc & Korhonen (2006) reveal a synchrony of economic cycles between EU economies and those of Central and Eastern Europe, defending that based on this criterion, it would be desirable for countries in that region to join the Economic and Monetary Union.

Summarizing, considering the review carried out, it is retained that empirical evidence points towards the greater probability of an OCA being admissible in Europe and North America, compared to Asian, African and South American regions. This is justified by the fact that the first two regions show greater commercial and industrial integration, as well as a higher degree of openness in their economies.

From the previous empirical evidence found by Grubel (2000), Carr & Floyd (2002), Torres & Vela (2003), Hugger (2008), Louis *et al.* (2011) and Bejan (2011), indicating symmetry in responses to exogenous shocks and synchronization of economic cycles, and despite the greater incidence in the USA-Canada relationship incorporating the predominance of the US dollar in the economic block, the following research hypothesis is considered:

H_1: The NAFTA block forms an Optimum Currency Area (OCA).

The studies by Bayoumi & Eichengreen (1993), Frankel & Rose (1997), Haug *et al.* (2000), Fidrmuc (2004), Fidrmuc & Korhonen (2006), Silvestre & Mendonça (2007), Grüner (2010) and Binner *et al.* (2011), besides finding a positive correlation between commercial exchanges, prices and industrial production, also confirm a limited amplitude of demand and supply shocks, endogeneity, co-integration of foreign exchange rates and industrial integration between members of the EBRC block. Therefore, the following hypothesis is formulated:

H_2: The European block of rich countries (EBRC) forms an OCA.

Taking as a reference the results obtained by Haug *et al.* (2000) in their application to Southern European countries, it should be highlighted there are no co-integration relationships between interest rates and exchange rates in those countries in relation to the other EU countries.

Added to the evidence reported above is the relatively slow adjustment to supply and demand shocks, as well as the weak correlation between prices and industrial production (Bayoumi & Eichengreen, 1993), together with the evidence provided by Mendonça *et al*. (2011) showing that bilateral exchanges contribute less to synchronization of economic cycles. Therefore, the following research hypothesis is considered:

H_3: The set of European countries designated as PIIGS do not form an OCA.

3. Methodology and data

3.1. The Model

To determine whether an Optimum Currency Area (OCA) is admissible in the NAFTA economic block and in the European block, the Blanchard & Quah (1989) methodology is used. This study analyzes different types of shocks, using the methodology to measure the amplitude of shocks and speed of adjustment proposed by Bayoumi & Eichengreen (1993). Therefore, the structural model can be described as follows:

$$X_t = A_0\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + \cdots = A(L)\varepsilon_t (1)$$

where, X_t= (ΔY^G, ΔY^R, ΔY^D) and Y^G, Y^R and Y^D represent: global production (output); regional production; and the specific production of each country. It is also considered that: ε_t=(ε_t^G, ε_t^R, ε_t^D); represent three structural shocks that can affect the variables contained in X_t. So the 3×3 matrix of polynomial functions with a lagged factor of L, is expressed as follows:

$$\begin{bmatrix} \Delta Y_t^G \\ \Delta Y_t^R \\ \Delta Y_t^D \end{bmatrix} = \begin{bmatrix} A_{11}(L) & A_{12}(L) & A_{13}(L) \\ A_{21}(L) & A_{22}(L) & A_{23}(L) \\ A_{31}(L) & A_{32}(L) & A_{33}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_t^G \\ \varepsilon_t^R \\ \varepsilon_t^D \end{bmatrix} \quad (2)$$

In (2) it is assumed that structural shocks have a unit variance and that they are not correlated, i.e., $Var(\varepsilon_t) = I$. Since the structural shocks in (1) are non-observable components, long-term restrictions are imposed so as to identify those shocks from innovations in a limited way. So the reduced form of VAR can be estimated through:

$$\Delta X_t = B(L)X_{t-1} + \mu_t \quad (3)$$

where μ_t represents the disturbance vector in the reduced form, for which a representation of the moving average of equation (3) can be expressed as follows:

$$X_t = C(L)\mu_t \quad (4)$$

where: $C(L) = (1\text{-}B(L)L)^{-1}$; and $C_0 = I$. Consequently, conjugation between structural shocks and disturbances in the reduced form can be expressed as follows:

$$\mu_t = A_0\varepsilon_t \quad (5)$$

Supposing that structural shocks are orthogonal and of unit variance, the long-term covariance matrix is expressed by $\Lambda = A(L)A(L)'$. If $A(L)$ is a lower triangle, $A(L)$ can be calculated as the factor of the Choleski lower triangular matrix of Λ.

3.2. Data description and model specification

This article aims to investigate the applicability of the OCA theory in two economic blocks, the NAFTA block and the European Block. The NAFTA block is formed of the following countries: USA; Canada; and Mexico. The European block is divided in two groups: European Block of Rich Countries (EBRC); and PIIGS countries. Firstly, rich countries included in the Eurozone and European Union are considered, namely Germany, France, United Kingdom, Sweden and Denmark. Secondly, European countries with weaker economies are considered, namely Portugal, Italy, Ireland, Greece and Spain. With this aim, time series data with a monthly frequency are used, referring to the period 2000:M1-2012:M12. The limit of the period studied corresponds to the creation of the first group of European Union member-States to adopt the euro, giving rise to the Eurozone.

As a proxy for the production variable, the seasonally adjusted Industrial Production Index is used (2005=100), provided by the OECD. In addition, two dummy variables were considered as exogenous variables, these being named Subprime Crisis[10] and Debt Crisis[11]. To identify global and regional shocks on the endogenous variable of production, average weights of transactions in the period 2008-2010 were considered[12].

In order to identify the structural parameters, the structural VAR model proposed by Blanchard & Quah (1989) is used, as well as the methodology proposed by Chow & Kim (2003) and Zhao & Kim (2009).

Consequently, *n(n-1)/2* long-term restrictions are imposed on a lower triangular matrix, considering that some structural shocks do not have permanent impacts on some variables.

Therefore, according to Chow & Kim (2003) and Zhao & Kim (2009), regional and domestic shocks are found not to produce long-term effects on global production. In turn, domestic shocks are considered not to have long-term effects on regional production, respecting the following matrix formulation:

[10] The dummy variable of Subprime Crisis is equal to 0 from 2000M1 to 2007M3 and equal to 1 from 2007M4 to 2012M12.
[11] The dummy variable of Debt Crisis is equal to 0 from 2000M1 to 2010M3 and equal to 1 from 2010M4 to 2012M12
[12] Average weights of transactions are based on imports and exports (2008-2010 obtained from the *Bank of International Settlements*. However, average weights of transactions of Eurozone countries on countries that define Global Shocks and Regional Shocks were calculated, by the authors, based on total imports and exports in the period 2008-2010.

$$\begin{bmatrix} \Delta Y_t^G \\ \Delta Y_t^R \\ \Delta Y_t^D \end{bmatrix} = \begin{bmatrix} A_{11} & 0 & 0 \\ A_{21} & A_{22} & 0 \\ A_{31} & A_{32} & A_{33} \end{bmatrix} \begin{bmatrix} \varepsilon_t^G \\ \varepsilon_t^R \\ \varepsilon_t^D \end{bmatrix} \quad (6)$$

For a more robust analysis of an OCA in the two blocks, various "models" are used[13].

In the context of the NAFTA block, the Benchmark Model (BM) presents as a global shock: the average weight of production transactions (output) of the Eurozone; and as a regional shock: the average weight of production transactions of the USA[14]. For Model 1 (M1), a global shock is defined as: the average weight of production transactions of the Eurozone and China; while a regional shock is defined as: the average weight of production transactions of countries included in the block[15]. For Models 2 (M2), 3 (M3) and 4 (M4), global shock is defined as: the average weight of production transactions of the Eurozone, China and Japan; average weight of production transactions of the BRIC[16] and Japan; and the average weight of production transactions of the BRIC, Japan and the Eurozone.

In the context of the European Block, the Benchmark Model presents as a global shock the average weight of production transactions of the USA and defines regional shock as the average weight of production transactions of Germany[17]. For Model 1, global shock represents the average weight of production transactions of USA and China, while the regional shock corresponds to the average weight of production transactions of countries included in each group. For Model 2 the global shock shows the average weight of production transactions of USA, China and Japan, while the regional shock represents the average weight of production transactions of the three biggest commercial partners included in the UE-15, not belonging to the group[18]. In Model 3, the global shock shows the average weight of production transactions of the BRIC and Japan, with the regional shock being defined as the average weight of production transactions of the two major commercial partners of the EU-15, not incorporated in the group, and two emerging countries included in the EU-27 (Poland and the Czech Republic). In Model 4, the global

[13] In the same line proposed by Zhao & Kim (2009), there are various definitions of global shocks and regional shocks and for that reason various definitions (models) are incorporated in this analysis.
[14] In the case of USA, the regional shock is presented as the average weight of Canada's production transactions.
[15] Since NAFTA only includes three countries, the regional shock will be the same in the four models.
[16] Acronym to refer to the four large emerging economies: Brazil; Russia; India; and China.
[17] In the German case, the regional shock is defined as the average weight of France's production transactions.
[18] Concerning the PIIGS group, the commercial partners defining the regional shock are Germany, France and the United Kingdom. In turn, the commercial partners defining the regional shock for the EBRC group are Italy, Spain and the Netherlands.

shock is defined as the average weight of production transactions of the BRIC, Japan and USA, while the regional shock is defined as the average weight of production transactions of each country included in the opposite group and one rich country outside the EU-27 (i.e., Norway).

3. Results

3.2.1. Variance decomposition of domestic ouput

Estimation of a SVAR model, aiming to determine whether OCA Theory is admissible in the blocks analyzed, requires firstly checking the stationarity of time series. To do so, three tests are used: Augmented Dickey-Fuller (1979); Phillips Perron (1988); and Kwaiatkowski-Phillips-Schmidt-Shin (1992). The results are presented in Tables 1, 2 and 3.

Concerning NAFTA, in the USA context, for all models the variables are found to be integrated of order *1*, except the domestic production variable (Y^D), which is stationary at levels, i.e., it is *I(0)*. In the Canadian and Mexican contexts, only the regional production variable (Y^R) is stationary at levels, while global production (Y^G) and domestic production are integrated of order 1.

As for the PIIGS group, the variable representing regional production is stationary at levels in the benchmark model, but integrated of order 1, for the other models. The other variables are integrated of order 1, except in the Irish case where domestic production is *I(0)*, for the benchmark model and for the other models.

For the EBRC group, global production is stationary at levels, in the benchmark model, being integrated of order 1 in the other models. Regional production and the country's specific production are *I(1)* in the benchmark and in the other models, except in the Swedish case, where regional production is integrated of order 2 in Model 4.

Consequently, to estimate the model, the test to select the optimal number of lags is used. In this way, each model is estimated based on the Akaike Information Criterion (AIC)[19], following the process used in the studies by Lim (2005) and Zhang *et al*. (2008).

Following the work of Chow & Kim (2003) and Zhao & Kim (2009), the results of the variance decomposition of forecast error of domestic production (or specific production of each country) are presented, in order to assess the admissibility of forming an OCA in the blocks studied. Therefore, if there is a predominance of regional shocks (key variable) on domestic production, an OCA can be admitted in the region considered, while with a predominance of global shocks, it will be possible to form global agreements (Zhao & Kim, 2009).

Given the results of variance decomposition of forecast error for the NAFTA block (see Table 4), for the American context, short-term (one period) global shocks are found to explain domestic production by 3.5%, 49.76%, 67.49%, 30.80% and 28.84%, for the benchmark model and for the alternative models, in corresponding terms. For the long-term time horizon (24 periods), global shocks show less influence on domestic production, finding 0.63% (MB), 29% (M1), 27.26% (M2), 1.85% (M3) and 1.11% (M4). Concerning regional shocks, domestic production is explained by around 21.11%, 13.77%, 5.01%, 18.46% and 19.33%, in a short-term perspective. In the long-term, only regional shocks show increased explanation of the performance of domestic production of 45.19%, referring to the benchmark model.

In the other models, diminished explanatory power is found as regards the performance of domestic production, in the short-term time-span. In turn, domestic shocks are shown to have the greatest influence on the performance of domestic production in the USA, except for models M1 and M2, in a short-term time-scale, where the performance of the domestic production variable is explained by 36.47% and 27.50%, respectively.

In the Canadian case, global shocks show a greater influence on domestic production in a long-term time-scale, compared to what is found in the short-term, except in models M3

[19] Due to the great number of tables for the results of the test to calculate the optimal number of lags for each model of each country, these are available on request.

and M4, which show a reduction from 26.97% to 25.84%, and from 26.62% to 25.85% respectively.

Consequently, regional shocks in a short-term perspective, present residual values (between 0.11% and 2.15%) concerning explanation of Canadian domestic production performance, while in the long-term regional shocks have an influence of around 12.75%, 10.22%, 16.80%, 13.95% and 13.64% in the benchmark model and models M1, M2, M3 and M4 respectively.

Regarding domestic shocks, as in the case of the USA, these mostly influence domestic production, presenting in the short-term an influence between 69.73% and 87.65, whereas in the long-term, regional shocks influence Canadian production by between 59.41% and 71.55%.

In the Mexican case, global shocks are the ones with least influence on domestic production, finding in a short-term time-scale an influence of about 1.30%, 9.11%, 6.24%, 11.32% and 0.68%, and in the long-term, about 7.48%, 10.12%, 6.93%, 12.02% and 1.38%, for the benchmark model and for the alternative models (M1, M2, M3 and M4), respectively. In the short-term, regional shocks influence domestic production by 20.69%, 30.84%, 25.57%, 15.63% and 23.70%, while in the long-term the results are 25.86%, 29.09%, 25.56%, 22.07% and 26.32% for the benchmark model and the alternative models (M1, M2, M3 and M4), in corresponding terms. Concerning domestic shocks, these are found mostly to influence domestic production, in both the short and long-term. In the short-term time-scale, domestic shocks have an influence of between 60.05% and 78%, and in the long-term the figure is between 60.80% and 72.1%.

Considering the European block (see Table 5), and the PIIGS group, in the Portuguese case global shocks are found to provide limited explanation of the performance of domestic production, in both the short and long-term. In the short-term, the explanation provided by global shocks is set between 0.06% and 2.11%, while in the long-term this varies between 3.84% and 7.58%. Regional shocks, similarly to global shocks, show little influence on the performance of domestic production, except in the benchmark model where regional shocks have an influence of about 30.33% (short-term) and 27% (long-term) on Portuguese production. Domestic shocks mostly influence domestic production both in the short-term (domestic shocks vary between 69.61% and 97.76%), and in the long-term (domestic shocks vary between 68.66% and 89.59%).

In the Italian context, global shocks in the short-term show some influence on Italian production, explaining 25.79%, 9.73%, 29.98%, 32.64% and 21.24% for the BM, M1, M2, M3 and M4, respectively, and only in Model M1 is that influence minimal. In a long-term perspective, global shocks show explanatory capacity of 31.90%, 26.21%, 40.53%, 41.93% and 36.30% for BM, M1, M2, M3 and M4 respectively. In turn, regional shocks similarly show some influence on domestic production. In a short-term perspective, regional shocks explain 38.12%, 36.62%, 7.25%, 21.57% and 24.54%, respectively, of the behaviour of domestic production for the benchmark model and alternative models respectively. In the long-term, regional shocks have an influence of 26.77%, 33.03%, 11.36%, 14.67% and 18.53% in BM, M1, M2, M3 and M4, in corresponding terms. Regarding domestic shocks, it is of note that these are the ones influencing domestic production most. Nevertheless, they do not present, in majority terms, an influence in the long-term. In the short-term, domestic shocks influence the behaviour of domestic production by 36.09%, 53.64%, 62.78%, 45.79% and 54.22%, while in the long-term, they influence that production by 41.32%, 40.76%, 48.11%, 43.40% and 45.17% for the benchmark and alternative models.

In the Irish case, global shocks, in both the short and long-term, except in the benchmark model, have a limited influence on domestic production, varying between 0.03% and 5.68% and between 0.78% and 8.57% respectively. In the benchmark model, the behaviour of domestic production is explained by 28.07% and 49.59%, for a short and long-term time-scale. Regional shocks have a limited influence on domestic production, showing for the short-term results of 1.04% (BM), 2.57% (M1), 20.46% (M2), 0.50% (M3) and 4.11% (M4). For the long-term, the figures are 2.99% (BM), 4.23%, (M1), 15.74% (M2), 1.57% (M3) and 3.05% (M4). Concerning domestic shocks, they have a majority influence on domestic production, except in the benchmark model in the long-term. Therefore, the influence of domestic shocks in the short-term is set between 70.90% and 97.39%, while in the long-term this is between 47.42% (BM) and 94.99%[20].

[20]Excluding the value of the benchmark model in the long-term time-scale, regional shocks influence production performance starting from 79,06% (M2).

In the case of Greece, global shocks show limited influence on production performance, in both the short and long-term. In the short-term, global shocks influence domestic production between 0.49% and 3.33% and in the long-term between 2.73% and 11.99%. As for regional shocks, in the short-term an influence on domestic production of between 2.88% and 7.31% is found, while in the long-term, the figures are 4.99% (BM), 13.05% (M1), 22.83% (M2), 7.31% (M3) and 4.95% (M4). Domestic shocks, in the short-term, influence domestic production between 92.20% and 95.33%, and in the long-term between 74.96% and 92.32%.

In the case of Spain, global shocks present a certain influence on the performance of domestic production, which in the short-term varies between 28.20% and 51.56%, and in the long-term between 26.19% and 49.19%. Regarding regional shocks, an influence of 20.80% (BM), 18.03% (M1), 8.05% (M2), 12.03% (M3) and 13.65% (M4) is found in the short-term. In the long-term, regional shocks have an influence of 16.26% (BM), 18.03% (M1), 8.05% (M2), 12.03% (M3) and 13.65% (M4). Regarding domestic shocks, in the short-term these shocks have an influence of 36.40% to 55.46%, while in the long-term that influence is set between 39.26% and 57.70%.

In relation to the European block (see Table 6), for the EBRC group, in the case of Germany, global shocks in the short-term are seen to have an influence of 0.11% in the M2 model and for the other models the influence of global shock lies between 8.01% and 10.95%. In the long-term, the behaviour of domestic production is explained by between 21.86% and 31.04%. In relation to regional shocks, an influence of 39.14% (BM), 29.72% (M1), 5.19% (M2), 25.09% (M3) and 11.08% (M4) is found in the short-term context. However, in the long-term, regional shocks influence the behaviour of domestic production by 31.74% (BM), 27.25% (M1), 10.83% (M2), 19.39% (M3) and 8.25% (M4). As for domestic shocks, a majority influence on the performance of domestic production is found, especially in the short term, where this influence lies between 52.27% and 94.70%. In the long-term time-scale, the performance of German production is explained by 46.40% (BM), 49.32% (M1), 61.49% (M2), 49.57% (M3) and 60.92% (M4).

In the French context, in the short and long term, global shocks have a majority influence on the performance of domestic production of 58.41% and 53.68%, respectively.

Regarding the other models, global shocks present a short-term influence of between 12.63% and 32.55%, while in the long-term the figure lies between 16.67% and 33.53%. Regional shocks only present some influence on domestic production performance in the benchmark model, observing an influence of 34.59% in the short-term and 28.08% in the long-term. However, in the other models, the influence of regional shocks varies between 0.10% and 11.74%, in the short-term, and between 5.58% and 13.97%, in the long-term. As for domestic shocks, their influence on domestic production performance is seen to be 52.79% (BM), 41.48% (M1), 70.93% (M2), 63.99% (M3) and 55.71% (M4), in the short-term, and 55.25% (BM), 40.74% (M1), 66.14% (M2), 62.90% (M3) and 52.50% (M4) in the long-term.

In the case of the United Kingdom, global shocks are found to have a moderate effect on domestic production performance, observing in the short-term that domestic production behaviour is explained by 16.46% (BM), 10.09% (M1), 5.10% (M2), 20.74% (M3) and 27.23% (M4). In the long-term, global shocks have an influence on domestic production of between 12.29% and 24.76%. Regarding regional shocks, their influence is found to be 27.87% (BM), 41.08% (M1), 2.33% (M2), 11.30% (M3) and 5.53% (M4) in the short-term. In the long-term, the performance of domestic production is explained through regional shocks by 21.27% (BM), 33.86% (M1), 7.68% (M2), 16.77% (M3) and 6.94% (M4). Domestic shocks have a majority influence on production performance in the United Kingdom, except for Model M2 where an influence of 48.83% and 46.98% is found in the short and long-term respectively. For the other models, domestic shocks have an influence of between 67.23% and 92.57% in the short-term, and between 63.3% e 79.82%, in the long-term.

Regarding the case of Sweden, in the short-term, global shocks are found to influence Swedish production by between 5.37% and 16.63%, while in the long-term their influence is between 12.15% and 21.64%. Concerning regional shocks, their influence on domestic production in the short-term is 29.56% (BM), 38.24% (M1), 15.98% (M2), 3.28% (M3) and 0% (M4). In the long-term, their influence is 23.96% (BM), 35.33% (M1), 13.66% (M2), 6.84% (M3) and 9.38% (M4) on domestic production performance. In relation to domestic shocks, their influence is dominant on domestic production, since these shocks have an influence on Swedish production performance of between 62.94% and 86.25% in the short-term and between 52.51% and 75.07% in the long-term.

In the Danish case, global shocks have a minimal influence on domestic production performance, finding in the short-term an influence of between 0% and 0.19%, in the alternative models and of 8.66%, in the benchmark model. In the long-term, global shocks have an influence on Danish production of between 1.45% and 4.47% in the alternative models, and of 19.16% in the benchmark model. Regional shocks present a limited influence, observing in the short-term an influence of between 0.04% and 4.74%, and in the long-term between 2.22% and 7,18%. Domestic shocks are the ones with the greatest influence on domestic production performance. In the short-term, their influence varies between 91.30% and 99.22%, while in the long-term it varies between 77.44% and 95.46%.

3.2.2. Size of disturbances and speed of adjustment

According to Bayoumi & Eichengreen (1993), Zhang *et al.* (2004) and Lee & Koh (2012), the lesser the adjacent shocks the greater the possibility of a region or country becoming a suitable candidate for the formation of an OCA. Similarly, the greater the adjustment the lower the cost of adopting a fixed exchange rate regime, and the greater the probability of losing monetary sovereignty and political autonomy.

Following this line of analysis, turbulence is quantified based on the long-term effect (24 periods), while calculating the speed of adjustment takes into consideration the ratio between the value of the impulse-response function coefficient of the third year[21] and that corresponding to the long-term period. These calculations are based on supply shocks.

The results obtained for the NAFTA block (see Table 7) show that the size of disturbance of a global shock is relatively less than that of regional and domestic shocks. It is nevertheless observed that the size of regional shocks is the greatest of the three adjacent shocks. It is of note that the speed of adjustment to these shocks is greater in relation to global and regional shocks[22]. Therefore, the NAFTA block is presented as a strong candidate to the state of applicability of OCA formation.

[21] The suggestion of Bayoumi & Eichengreen (1993) and Lee & Koh (2012) is followed.

[22] In some models, the speed of adjustment of global shocks is greater than in relation to regional shocks. However, the speed of adjustment in the face of regional shocks is greater in three of the five models estimated.

For the PIIGS group (see Table 8), the size of regional shocks is found to be less than global and domestic shocks. In turn, the speed of adjustment is greater in relation to domestic shocks than to regional and global ones. Therefore, the PIIGS group does not present itself as a strong candidate for an admissible OCA.

Regarding the EBRC group (see Table 9), the size of regional and domestic shocks is seen to be limited, but that of domestic shocks is smaller. However, despite the speed of adjustment to regional and domestic shocks being similar, the speed of adjustment to regional shocks is greater in two models. In turn, the speed of adjustment of domestic shocks is greater in only one model. In the others, the speed of adjustment is identical. Therefore, the EBRC group is a strong candidate for an admissible OCA.

4.Discussion

Considering H_1, which tests the hypothesis of the NAFTA block forming an OCA, the empirical evidence obtained points towards the admissibility of countries in this block forming an OCA, i.e., the hypothesis is not rejected, which contrasts with the contrary results obtained by Bayoumi & Eichengreen (1994), Carr & Floyd (2002) and Louis *et al.* (2011), but are in line with Grubel (2000), Torres & Vela (2003), Hugger (2008) and Bejan (2011).

The results obtained can be justified by the high level of commercial integration, characterized by a substantial number of commercial partnerships formed between countries in the NAFTA block, with similar productive structures (Torres & Vela, 2003; Hugger, 2008; Bejan, 2011), namely in manufacturing and oil-derivative industries, justifying synchronization of economic cycles. Indeed, Louis *et al.* (2011) show that faced with an American monetary shock, production growth in both Canada and Mexico has a symmetrical response, which is in line with the results obtained, through the greater predominance of the US dollar, in the context of the NAFTA block.

As for H_2, which tests the admissibility of an OCA in relation to the European block (EBRC group), the empirical evidence obtained does not allow rejection of the hypothesis, contrasting with the previous results of Bayoumi & Eichengreen (1993), Bayoumi & Eichengreen (1994), Frankel & Rose (1997), Haug *et al.* (2000), Fidrmuc (2004), Fidrmuc & Korhonen (2006), Silvestre & Mendonça (2007), Grüner (2010) and Binner *et al.* (2011).

Therefore, the countries belonging to this group show themselves to be apparently more homogenous economies, since they are developed economies revealing strong industrial integration (Bayoumi & Eichengreen, 1994), with high indices of dynamics and economic activity, added to which are commercial partnerships between a great number of these economies. So, as happens in the NAFTA block, synchronization in terms of economic cycles can be detected.

Concerning H_3, which tests the hypothesis of the European block (PIIGS group) forming an OCA, the empirical evidence obtained reveals that the countries in this group do not form an OCA. Therefore, the evidence means rejection of the hypothesis, which is in agreement with Bayoumi & Eichengreen (1993), Haug *et al.* (2000) and Mendonça *et al.* (2011).

This result can be justified by the fact of countries' economic activity presenting great heterogeneity, with Spain and Italy being among the major European economies, contrasting with the economic weight of the more peripheral economies of Portugal, Ireland and Greece. Moreover, the result obtained can be explained by the limited labour flexibility and reduced mobility of the labour production factor (Bayoumi & Eichengreen, 1993). Added to this is the fact that in these last economies, bilateral relations are no longer determinant for synchronization of economic cycles, given the diversification of commercial transactions, which contribute to reducing the effective level of economic (industrial and commercial) integration of neighbouring geographical areas, in the European context (Mendonça *et al.*, 2011).

5. Conclusions

From the results obtained for the different blocks (and groups), the NAFTA economic block forming an OCA is found to be admissible (H_1 is not rejected), while for the European block, evidence is not found of the PIIGS group forming an OCA (H_2 is rejected). In turn, for the EBRC group formation of an OCA is found to be admissible (H_3 is not rejected).

So the prospects of admissibility of an OCA in both the NAFTA block and the EBRC group are due to the strong commercial integration and the economies' similar productive structures. Concerning the PIIGS group, strong commercial or industrial integration between countries is not found. Considering the significant weights of public debt in relation to the real product of PIIGS countries, commercial exchanges between the five countries involved are not of great significance, underlining however that the economies are of different sizes and present structural problems regarding the sustainability of public finances, due to various origins, namely institutional factors (for example, corruption) and excessive and lagged public expenditure (e.g. public-private partnership contracts).

The evidence obtained here suggests different implications for political decision-makers. Concerning European decision-makers, it is recommended that they should dare to rethink the current structure of the European economic and monetary union, considering the possibility of an OCA including the richest or most developed countries in the EU. For decision-makers in North and Central America, the admissibility of an OCA is found in this economic block's area of direct influence, finding that the speed of adjustment to a regional shock is greater than the speed of adjustment to a regional shock by the two groups of the European block. The strong bilateral commercial relations between countries in the NAFTA block sustain the admissibility of an OCA. That scenario can benefit the American investor (inasmuch as there is major American investment in the Mexican economy) and in turn stimulate Mexican investment in the USA, in this way contributing to reducing transaction costs and eliminating the exchange rate risk.

This article presents some limitations, arising from the analysis, in exclusive terms, of the economic integration (i.e., commercial and industrial) of the economies studied. An analysis of the level of financial integration would be important, considering the warning issued by Mendonça *et al.* (2011), who argue that commercial integration may not be a determinant factor of synchronization of economic cycles. The limitations identified are recognized and incorporated in carrying out this study, given the unavoidable difficulties in access to data, which made alternative analyses impossible.

Bearing in mind those limitations, suggestions for future lines of research could be, firstly, to carry out tests of OCA theory in the groups included in this article, but using alternative variables, namely the consumer price index, exchange rates and a tax variable aiming to analyze the possible convergence provided by tax policy. Secondly, analysis of an admissible OCA in the Benelux and Scandinavia is suggested, in order to produce a comparative analysis with other regions or groups of countries in Europe and America.

References

Alesina, A., Barro R., & Tenreyro, S. (2003). Optimal Currency Area. In M. Gertler & K. Rogoff (Eds.), NBER Macroeconomics Annual 2002 17 (pp. 301-345). Cambridge, MA: MIT Press.

Bayoumi, T., & Eichengreen, B. (1993). Shocking aspects of European Monetary Integration. In F. Toress, & F. Giavazzi (Eds.), Adjustment and growth in the European Monetary Union (pp. 193-229). Cambridge: Cambridge University Press.

Bayoumi, T., & Eichengreen, B. (1994). Monetary and exchange rate arrangements for NAFTA. *Journal of Development Economics*, 43(1), 125-165.

Bayoumi, T., & Eichengreen, B. (1997). Ever closer to heaven? An optimum-currency-area index for European countries. *European Economic Review*, 41(3-5), 761-770.

Bacha, O. (2008). A Common Currency Area for MENA Countries? A VAR Analysis of viability. *International Journal of Emerging Markets*, 3(2), 197-215.

Banik, N., Biswas, B., & Criddle, K. (2009). Optimum currency area in South Asia: A state space approach. *International Review of Economics and Finance*, 18(3), 502-510.

Beckworth, D. (2010). One nation under the fed? The asymmetric effects of US monetary policy and its implications for the United States as an optimal currency area. *Journal of Macroeconomics*, 32(3), 732-746.

Beirne, J. (2008). Real Exchange Rate Dynamics and Monetary Integration in Crisis-Affected Regions. *Journal of International and Global Economic Studies*, 1(2), 1-25.

Bejan, M. (2011). Trade agreements and international comovements: The case of NAFTA (North American Free Trade Agreement). *Review of Economics Dyamics*, 14(4), 667-685.

Binner, J., Chen, S-H., Lai, K-H., Mullineux, A., & Swafford, J. (2011). Do the ASEAN countries and Taiwan form a common currency area. *Journal of International Money and Finance*, 30(7), 1429-1435.

Blanchard, O., & Quah, D. (1989). The Dynamic Effects of Aggregate Demand and Supply Disturbances. *American Economic Review*, 79(4), 655-673.

Buigut, S., & Valev, B. (2005). Is the Proposed East African Monetary Union an Optimal Currency Area? A Structural Vector Autoregression analysis. *World Development*, 33(12), 2119-2133.

Carr, J., & Floyd, J. (2002). Real and monetary shocks to the Canadian dollar: Do Canada and the United States form an optimal currency area?. *North American Journal of Economics and Finance*, 13(1), 21-39.

Chow, H., & Kim, Y. (2003). A common currency peg in East Asia? Perspectives from Western Europe. *Journal of Macroeconomics*, 25(3), 331-350.

Corden, W., 1972. Monetary Integration. Essays in International Finance. no. 93, International Finance Section: Princeton University, NJ.

Coulibaly, I., & Gnimassoun, B. (2013). Optimality of a monetary union: New evidence from exchange rate misalignments in West Africa. *Economic Modelling*, 32, 463-482.

Dellas, H., & Tavlas, G. (2009). An optimum-currency-area odyssey. *Journal of International Money and Finance*, 28(7), 1117-1137.

Dickey, D., & Fuller, W. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of American Statistical Association*, 74(366),427-431.

Enders, W., & Hurn, S. (1997). Common trends and Generealized Purchasing Power Parity. *Mathematics and Computers in Simulation*, 43(3-6), 437-443.

Fidrmuc, J. (2004). The Endogeneity of optimum currency area criteria, intraindustry trade and EMU enlargement. *Contemporary Economic Policy*, 22(1), 1-12.

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

Frankel, J., & Rose, A. (1997). Is EMU more justifiable ex post than ex ante?. *European Economic Review*, 41(3-5), 753-760.

Frankel, J., & Rose, A. (1998). The Endogeneity of the Optimum Currency Area Criteria. *Economic Journal*, 108(449), 1009-1025.

Goldberg, L. (1999). Is Optimum Currency Area Theory Irrelevant for Economies in Transition?. In: R. Sweeney, C. Wihlborg & T. Willet (Eds.), Exchange Rate Policies for Emerging Markets Economies (pp. 45-60). Westview Press.

Grubel, H. (2000). The merit of a Canada-US monetary union. *North American Journal of Economics and Finance*, 11(1), 19-40.

Grüner, H. (2010). Why EMU is not a failure. *European Journal of Political Economy*, 26(1), 1-11.

Haug, A., MacKinnon, A., & Michelis, L. (2000). European Monetary Union: a cointegration analysis. *Journal of International Money and Finance*, 19(3), 419-432.

Hugger, K. (2008). NAFTA toward a common currency: an economic feasibility study. *Undergraduate Economic Review*, 4(1), 1-40.

Ishiyama, Y. (1975). The Theory of Optimum Currency Areas: a Survey. *Staff Papers – IMF*, 22(2), 344-383.

Karras, G. (2005). Is there a yen optimum currency area? Evidence from 18 Asian and Pacific economies. *Japan and the World Economy*,17(4), 456-469.

Kenen, P. (1969). The Theory of Optimum Currency Areas: An Eclectic View. In Mundell & Swoboda (Eds.), Monetary Problems in the International Economy (pp. 41-60.). Chicago: University of Chicago Press.

Krugman, P. (1993). Lessons from Massachusetts for EMU. In F. Torres & F. Giavazzi (Eds.), Adjustment and Growth in the European Monetary Union (pp. 241-266). Cambridge: Cambridge University Press.

Kwack, S. (2004). An optimum currency area in East Asia: feasibility, coordination, and leadership role. *Journal of Asian Economics*, 15(1), 153-169.

Kwan, C. (1998). The Theory of Optimum Currency Areas and the Possibility of Forming a Yen Bloc in Asia. . *Journal of Asian Economics*, 9(4), 555-580.

Kwiatkowski D., Phillips P., Schmidt P., & Shin Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root?. *Journal of Econometrics* 54(1-3):159-178

Lee, G., & Azali, M. (2010). The endogeneity of the Optimum Currency Area criteria in East Asia. *Economic Modelling*, 27(1), 165-170.

Lee, G., & Azali, M. (2012). Is East Asia an optimum currency area?. *Economic Modelling*, 29(2), 87-95.

Lee, G., & Koh, S. (2012). The prospects of a monetary union in East Asia. *Economic Modelling*, 29(2), 96-102.

Lim, L. (2005). A dollar or yen currency union in East Asia. *Mathematics and Computers in Simulation*, 68(5-6), 507-516.

Louis, R., Brown, R., & Balli, F. (2011). On the feasibility of monetary union: Does it make sense to look for shocks symmetry across countries when none of the countries constitutes an optimum currency area?. *Economic Modelling*, 28(6), 2701-2718.

Mélitz, J. (1995). The current impasse in research on optimum currency areas. *European Economic Review*, 39(3-4), 492-500.

Mendonça, A., Silvestre J., & Passos, J. (2011). One nation under the fed? The asymmetric effects of US monetary policy and its implications for the United States as an optimal currency area. *Economics Letters*, 113(1), 65-69.

Mishra, R., & Sharma, C. (2010). Real exchange rate behavior and optimum currency area in East Asia: Evidence from Generalized Purchasing Power Parity. *International Review of Financial Analysis*, 19(3), 205-213.

Mundell, R. (1961). A Theory of Optimum Currency Areas. *American Economic Review*, 51(4), 657-665.

McKinnon, R. (1963). Optimum Currency Area. *American Economic Review*, 53(4), 717-725.

Neves, J.A., Stocco, L., & da Silva, S. (2008). Is Mercosur an optimum currency area? An assessment using generalized purchasing power parity. *Economics Bulletin*, 6(29), 1-13.

Phillips, P., & Perron, P. (1988). Testing for unit root in time series regression. *Biometrika*, 75(2), 335–346.

Saxena, S. (2005). Can South Asia adopt a common currency?. *Journal of Asian Economics*, 16(4), 635-662.

Shirono, K. (2008). Real effects of common currencies in East Asia. *Journal of Asian Economics*, 19(3), 199-212.

Silvestre, J., & Mendonça, A. (2007). The Endogeneity of Optimum Currency Areas Criteria: Some Evidence from the European Union and Portugal. *International Advances in Economic Research*, 13(1), 1-18.

Tavlas, G. (1993). The 'New' Theory of Optimum Currency Areas. *World Economy*, 16(6), 663-685.

Torres, A. & Vela, O. (2003). Trade integration and synchronization between the business cycles of Mexico and the United States. *North American Journal of Economics and Finance*, 14(3), 319-342.

Tower, E. & Willet T. (1976). The Theory of Optimum Currency Areas and Exchange Rate Flexibility: A More General Framework. Special Papers in International Economics, 11, Princeton University.

Zhang, Z., Sato K., & McAleer, M. (2004). Is a monetary union feasible for East Asia?. *Applied Economics*, 36(10), 1031-1043.

Zhang, Z., Sato, K., & McAleer, M. (2008). Is Greater China a currency union? A tale of the Chinese trio. *Mathematics and Computers in Simulation*, 78 (2-3), 319–327.

Zhao, X., & Kim Y. (2009). Is the CFA Franc Zone an Optimum Currency Area?. *World Development*, 37(12), 1877-1886.

Tables

Table 1 – Unit Root Tests with constant and trend: NAFTA

	Level			1st Difference			2nd Difference		
BM									
	ADF			**ADF**			**ADF**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	-2.923	-2.582	-2.974	-3.940**	-4.691*	-3.012	-	-	-12.924*
Canada	-2.923	-2.974	-2.582	-3.940**	-3.012	-4.691*	-	-12.924*	-
Mexico	-2.923	-2.974	-1.995	-3.940**	-3.012	-13.964*	-	-12.924*	-
	PP			**PP**			**PP**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	-2.200	-2.172	-1.881	-11.786*	-12.016*	-10.710*	-	-	-
Canada	-2.200	-1.881	-2.172	-11.786*	-10.710*	-12.016*	-	-	-
Mexico	-2.200	-1.881	-2.236	-11.786*	-10.710*	-13.984*	-	-	-
	KPSS			**KPSS**			**KPSS**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	0.156**	0.144	0.131	0.048	-	-	-	-	-
Canada	0.156**	0.131	0.144	0.048	-	-	-	-	-
Mexico	0.156**	0.131	0.091	0.048	-	-	-	-	-
M1									
	Level			1st Difference			2nd Difference		
	ADF			**ADF**			**ADF**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	-2.257	-2.646	-2.974	-20.705*	-4.521*	-3.012	-	-	-12.924*
Canada	-2.403	-3.191	-2.582	-13.058*	-3.041	-4.691*	-	-12.350*	-
Mexico	-2.427	-3.089	-1.995	-13.104*	-3.024	-13.964	-	-12.874*	-
	PP			**PP**			**PP**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	-3.902**	-2.127	-1.881	-	-11.746*	-10.710*	-	-	-
Canada	-4.256***	-1.932	-2.172	-	-10.758*	-12.016*	-	-	-
Mexico	-4.315***	-1.904	-2.236	-	-9.987*	-13.984*	-	-	-
	KPSS			**KPSS**			**KPSS**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	0.218***	0.105	0.131	0.034	-	-	-	-	-
Canada	0.222***	0.118	0.144	0.028	-	-	-	-	-
Mexico	0.223***	0.134	0.091	0.028	-	-	-	-	-
M2									
	Level			1st Difference			2nd Difference		
	ADF			**ADF**			**ADF**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	-2.233	-2.646	-2.974	-15.669*	-4.521*	-3.012	-	-	-12.924*
Canada	-1.724	-3.191	-2.582	-16.993*	-3.041	-4.691*	-	-12.350*	-
Mexico	-1.733	-3.089	-1.995	-17.127*	-3.024	-13.964*	-	-12.874*	-
	PP			**PP**			**PP**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	-2.496	-2.127	-1.881	-15.246*	-11.746*	-10.710*	-	-	-
Canada	-2.624	-1.932	-2.172	-16.242*	-10.758*	-12.016*	-	-	-
Mexico	-2.642	-1.904	-2.236	-16.349*	-9.987*	-13.984*	-	-	-
	KPSS			**KPSS**			**KPSS**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	0.195**	0.105	0.131	0.036	-	-	-	-	-
Canada	0.200**	0.118	0.144	0.035	-	-	-	-	-
Mexico	0.200**	0.134	0.091	0.035	-	-	-	-	-

M3									
	Level			1st Difference			2nd Difference		
	ADF			**ADF**			**ADF**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	-1.909	-2.646	-2.974	-13.108*	-4.521*	-3.012	-	-	-12.924*
Canada	-2.083	-3.191	-2.582	-14.335*	-3.041	-4.691*	-	-12.350*	-
Mexico	-2.142	-3.089	-1.995	-13.275*	-3.024	-13.964*	-	-12.874*	-
	PP			**PP**			**PP**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	-2.407	-2.127	-1.881	-13.226*	-11.746*	-10.710*	-	-	-
Canada	-2.459	-1.932	-2.172	-14.215*	-10.758*	-12.016*	-	-	-
Mexico	-2.556	-1.904	-2.236	-13.302*	-9.987*	-13.984*	-	-	-
	KPSS			**KPSS**			**KPSS**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	0.184**	0.105	0.131	0.037	-	-	-	-	-
Canada	0.187**	0.118	0.144	0.037	-	-	-	-	-
Mexico	0.193**	0.134	0.091	0.033	-	-	-	-	-
M4									
	Level			1st Difference			2nd Difference		
	ADF			**ADF**			**ADF**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	-2.797	-2.646	-2.974	-12.356*	-4.521*	-3.012	-	-	-12.924*
Canada	-2.662	-3.191	-2.582	-13.449*	-3.041	-4.691*	-	-12.350*	-
Mexico	-1.942	-3.089	-1.995	-12.613*	-3.024	-13.964*	-	-12.874*	-
	PP			**PP**			**PP**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	-2.332	-2.127	-1.881	-12.684*	-11.746*	-10.710*	-	-	-
Canada	-2.356	-1.932	-2.172	-13.576*	-10.758*	-12.016*	-	-	-
Mexico	-2.450	-1.904	-2.236	-12.788*	-9.987*	-13.984*	-	-	-
	KPSS			**KPSS**			**KPSS**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
USA	0.180**	0.105	0.131	0.037	-	-	-	-	-
Canada	0.182**	0.118	0.144	0.037	-	-	-	-	-
Mexico	0.180**	0.134	0.091	0.034	-	-	-	-	-

Note: * Indicate rejection of null hypothesis at 1% level; ** Indicate rejection of null hypothesis at 5% level.

Table 2 - Unit Root Tests with constant and trend: PIIGS

BM									
	Level			1st Difference			2nd Difference		
	ADF			**ADF**			**ADF**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	-2.974	-2.913	-2.726	-3.012	-4.702*	-9.284*	-12.924*	-	-
Italy	-2.974	-2.913	-2.379	-3.012	-4.702*	-4.573*	-12.924*	-	-
Ireland	-2.975	-2.913	-4.413*	-3.012	-4.702*	-	-12.924*	-	-
Greece	-2.975	-2.913	-1.429	-3.012	-4.702*	-22.699*	-12.924*	-	-
Spain	-2.974	-2.913	-1.174	-3.012	-4.702*	-5.433*	-12.924*	-	-
	PP			**PP**			**PP**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	-1.881	-2.392	-4.476*	-10.710*	-12.790*	-	-	-	-
Italy	-1.881	-2.392	-2.053	-10.710*	-12.790*	-13.328*	-	-	-
Ireland	-1.881	-2.392	-6.105*	-10.710*	-12.790*	-	-	-	-
Greece	-1.881	-2.392	-1.836	-10.710*	-12.790*	-30.329*	-	-	-
Spain	-1.881	-2.392	-1.117	-10.710*	-12.790*	-15.547*	-	-	-
	KPSS			**KPSS**			**KPSS**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	0.131	0.081	0.264*	-	-	0.127	-	-	-
Italy	0.131	0.081	0.195**	-	-	0.044	-	-	-
Ireland	0.131	0.081	0.343*	-	-	0.115	-	-	-
Greece	0.131	0.081	0.351*	-	-	0.081	-	-	-
Spain	0.131	0.081	0.301*	-	-	0.078	-	-	-

M1									
	Level			1st Difference			2nd Difference		
	ADF			ADF			ADF		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	-2.259	-1.218	-2.726	-20.682*	-5.273*	-9.284*	-	-	-
Italy	-2.259	-1.146	-2.379	-20.682*	-19.900*	-4.573*	-	-	-
Ireland	-2.259	-1.355	-4.413*	-20.682*	-5.439*	-	-	-	-
Greece	-2.259	-1.666	-1.429	-20.682*	-17.410*	-22.699*	-	-	-
Spain	-2.259	-2.131	-1.174	-20.682*	-13.076*	-5.433*	-	-	-
	PP			PP			PP		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	-3.671**	-1.186	-4.476*	-	-15.632*	-	-	-	-
Italy	-3.671**	-1.410	-2.053	-	-20.790*	-13.328*	-	-	-
Ireland	-3.671**	-1.071	-6.105*	-	-16.854*	-	-	-	-
Greece	-3.671**	-1.779	-1.836	-	-16.457*	-30.329*	-	-	-
Spain	-3.671**	-2.914	-1.117	-	-23.827*	-15.547*	-	-	-
	KPSS			KPSS			KPSS		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	0.194**	0.302*	0.264*	0.041	0.073	0.127	-	-	-
Italy	0.194**	0.343*	0.195**	0.041	0.057	0.044	-	-	-
Ireland	0.194**	0.306*	0.343*	0.041	0.061	0.115	-	-	-
Greece	0.194**	0.259*	0.351*	0.041	0.051	0.081	-	-	-
Spain	0.194**	0.305*	0.301*	0.041	0.500*	0.078	-	0.077	-
M2									
	Level			1st Difference			2nd Difference		
	ADF			ADF			ADF		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	-1.686	-2.104	-2.726	-16.564*	-4.848*	-9.284*	-	-	-
Italy	-1.686	-2.176	-2.379	-16.564*	-4.730*	-4.573*	-	-	-
Ireland	-1.686	-2.052	-4.413*	-16.564*	-4.930*	-	-	-	-
Greece	-1.686	-1.817	-1.429	-16.564*	-5.382*	-22.699*	-	-	-
Spain	-1.686	-2.194	-1.174	-16.564*	-4.713*	-5.433*	-	-	-
	PP			PP			PP		
	Y^G	Y^R	Y^C	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	-2.488	-1.916	-4.476*	-15.893*	-15.015*	-	-	-	-
Italy	-2.488	-1.930	-2.053	-15.893*	-14.901*	-13.328*	-	-	-
Ireland	-2.488	-1.902	-6.105*	-15.893*	-15.027*	-	-	-	-
Greece	-2.488	-1.771	-1.836	-15.893*	-15.353*	-30.329*	-	-	-
Spain	-2.488	-1.940	-1.117	-15.893*	-14.969*	-15.547*	-	-	-
	KPSS			KPSS			KPSS		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	0.184**	0.162**	0.264	0.043	0.060	0.127	-	-	-
Italy	0.184**	0.158**	0.195**	0.043	0.060	0.044	-		-
Ireland	0.184**	0.164**	0.343	0.043	0.060	0.115	-	-	-
Greece	0.184**	0.178**	0.351	0.043	0.066	0.081	-	-	-
Spain	0.184**	0.159**	0.301	0.043	0.060	0.078	-	-	-
M3									
	Level			1st Difference			2nd Difference		
	ADF			ADF			ADF		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	-1.572	-2.588	-2.726	-12.257*	-6.633*	-9.284*	-	-	-
Italy	-1.572	-2.590	-2.379	-12.257*	-4.794*	-4.573*	-	-	-
Ireland	-1.572	-2.591	-4.413*	-12.257*	-6.524*	-	-	-	-
Greece	-1.572	-2.107	-1.429	-12.257*	-6.678*	-22.699*	-	-	-
Spain	-1.572	-2.590	-1.174	-12.257*	-4.794*	-5.433*	-	-	-
	PP			PP			PP		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	-2.063	-2.223	-4.476*	-12.517*	-11.611*	-	-	-	-
Italy	-2.063	-2.224	-2.053	-12.517*	-11.912*	-13.328*	-	-	-
Ireland	-2.063	-2.226	-6.105*	-12.517*	-11.420*	-	-	-	-
Greece	-2.063	-2.204	-1.836	-12.517*	-11.687*	-30.329*	-	-	-
Spain	-2.063	-2.224	-1.117	-12.517*	-11.912*	-15.547*	-		-
	KPSS			KPSS			KPSS		
	Y^G	Y^R	Y^C	Y^G	Y^R	Y^C	Y^G	Y^R	Y^C
Portugal	0.214**	0.136	0.264*	0.044	-	0.127	-	-	-
Italy	0.214**	0.140	0.195**	0.044	-	0.044	-	-	-
Ireland	0.214**	0.133	0.343*	0.044	-	0.115	-	-	-
Greece	0.214**	0.143	0.351*	0.044	-	0.081	-	-	-
Spain	0.214**	0.140	0.301*	0.044	-	0.078	-	-	-

M4									
	Level			1st Difference			2nd Difference		
	ADF			**ADF**			**ADF**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	-2.613	-1.804	-2.726	-4.807*	-13.599*	-9.284*	-	-	-
Italy	-2.613	-1.859	-2.379	-4.807*	-13.838*	-4.573*	-	-	-
Ireland	-2.613	-1.811	-4.413*	-4.807*	-13.608*	-	-	-	-
Greece	-2.613	-1.894	-1.429	-4.807*	-14.236*	-22.699*	-	-	-
Spain	-2.613	-1.790	-1.174	-4.807*	-13.539*	-5.433*	-	-	-
	PP			**PP**			**PP**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	-2.084	-2.128	-4.476*	-12.114*	-13.736*	-	-	-	-
Italy	-2.084	-2.106	-2.053	-12.114*	-13.877*	-13.328*	-	-	-
Ireland	-2.084	-2.131	-6.105*	-12.114*	-13.732*	-	-	-	-
Greece	-2.084	-2.091	-1.836	-12.114*	-14.160*	-30.329*	-	-	-
Spain	-2.084	-2.127	-1.117	-12.114*	-13.709*	-15.547*	-	-	-
	KPSS			**KPSS**			**KPSS**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Portugal	0.203**	0.193**	0.264*	0.046	0.060	0.127	-	-	-
Italy	0.203**	0.193**	0.195**	0.046	0.059	0.044	-	-	-
Ireland	0.203**	0.193**	0.343*	0.046	0.060	0.115	-	-	-
Greece	0.203**	0.205**	0.351*	0.046	0.061	0.081	-	-	-
Spain	0.203**	0.191**	0.301*	0.046	0.060	0.078	-	-	-

Note: * Indicate rejection of null hypothesis at 1% level; ** Indicate rejection of null hypothesis at 5% level.

Table 3 - Unit Root Tests with constant and trend: EBRC

BM									
	Level			1st Difference			2nd Difference		
	ADF			**ADF**			**ADF**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	-2.974	-2.385	-2.913	-3.012	-5.434*	-4.702*	-12.924*	-	-
France	-2.974	-2.913	-2.385	-3.012	-4.702*	-5.434*	-12.924*	-	-
UK	-2.974	-2.913	-1.657	-3.012	-4.702*	-15.498*	-12.924*	-	-
Sweden	-2.974	-2.913	-2.207	-3.012	-4.702*	-14.342*	-12.924*	-	-
Denmark	-2.974	-2.913	-1.786	-3.012	-4.702*	-12.680*	-12.924*	-	-
	PP			**PP**			**PP**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	-1.881	-2.220	-2.392	-10.710*	-15.056*	-12.790*	-	-	-
France	-1.881	-2.392	-2.220	-10.710*	-12.790*	-15.056*	-	-	-
UK	-1.881	-2.392	-2.030	-10.710*	-12.790*	-15.449*	-	-	-
Sweden	-1.881	-2.392	-2.469	-10.710*	-12.790*	-14.184*	-	-	-
Denmark	-1.881	-2.392	-2.498	-10.710*	-12.790*	-18.020*	-	-	-
	KPSS			**KPSS**			**KPSS**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	0.131	0.166**	0.081	-	0.058	-	-	-	-
France	0.131	0.081	0.166**	-	-	0.058	-	-	-
UK	0.131	0.081	0.219*	-	-	0.055	-	-	-
Sweden	0.131	0.081	0.171**	-	-	0.056	-	-	-
Denmark	0.131	0.081	0.245*	-	-	0.053	-	-	-

	Level			1st Difference			2nd Difference		
M1									
	ADF			**ADF**			**ADF**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	-2.259	-2.110	-2.913	-20.682*	-5.039*	-4.702*	-	-	-
France	-2.259	-1.788	-2.385	-20.682*	-13.497*	-5.434*	-	-	-
UK	-1.967	-2.667	-1.657	-20.002*	-4.160*	-15.498*	-	-	-
Sweden	-2.151	-1.827	-2.207	-20.465*	-16.059*	-14.342*	-	-	-
Denmark	-2.368	-1.845	-1.786	-20.868*	-5.151*	-12.680*	-	-	-
	PP			**PP**			**PP**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	-3.671**	-2.076	-2.392	-	-14.014*	-12.790*	-	-	-
France	-3.671**	-2.116	-2.220	-	-13.596*	-15.056*	-	-	-
UK	-3.033	-2.168	-2.030	-19.961*	-12.712*	-15.449*	-	-	-
Sweden	-3.426	-2.154	-2.469	-20.996*	-15.882*	-14.184*	-	-	-
Denmark	-3.927	-2.345	-2.498	-	-12.920*	-18.020*	-	-	-
	KPSS			**KPSS**			**KPSS**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	0.194**	0.203**	0.081	0.041	0.060	-	-	-	-
France	0.194**	0.172**	0.166**	0.041	0.058	0.058	-	-	-
UK	0.183**	0.156**	0.219*	0.045	0.056	0.055	-	-	-
Sweden	0.190**	0.212**	0.171**	0.037	0.061	0.056	-	-	-
Denmark	0.198**	0.154**	0.245*	0.041	0.052	0.053	-	-	-
M2									
	Level			1st Difference			2nd Difference		
	ADF			**ADF**			**ADF**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	-1.686	-1.737	-2.913	-16.564*	-4.963*	-4.702*	-	-	-
France	-1.686	-1.746	-2.385	-16.564*	-4.383*	-5.434*	-	-	-
UK	-2.664	-1.881	-1.657	-15.786*	-4.308*	-15.498*	-	-	-
Sweden	-1.659	-1.744	-2.207	-16.192*	-4.817*	-14.342*	-	-	-
Denmark	-1.736	-1.736	-1.786	-17.497*	-4.760*	-12.680*	-	-	-
	PP			**PP**			**PP**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	-2.488	-1.651	-2.392	-15.893*	-14.974*	-12.790*	-	-	-
France	-2.488	-1.604	-2.220	-15.893*	-14.655*	-15.056*	-	-	-
UK	-2.371	-1.625	-2.030	-15.347*	-14.318*	-15.449*	-	-	-
Sweden	-2.439	-1.638	-2.469	-15.624*	-14.873*	-14.184*	-	-	-
Denmark	-2.595	-1.613	-2.498	-16.610*	-14.802*	-18.020*	-	-	-
	KPSS			**KPSS**			**KPSS**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	0.184**	0.204**	0.081	0.043	0.059	-	-	-	-
France	0.184**	0.243*	0.166**	0.043	0.054	0.058	-	-	-
UK	0.179**	0.219*	0.219*	0.046	0.056	0.055	-	-	-
Sweden	0.182**	0.211**	0.171**	0.044	0.058	0.056	-	-	-
Denmark	0.188**	0.215**	0.245*	0.043	0.058	0.053	-	-	-
M3									
	Level			1st Difference			2nd Difference		
	ADF			**ADF**			**ADF**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	-1.572	-2.238	-2.913	-12.257*	-4.295*	-4.702*	-	-	-
France	-1.572	-1.863	-2.385	-12.257*	-4.774*	-5.434*	-	-	-
UK	-2.591	-2.100	-1.657	-5.120*	-14.566*	-15.498*	-	-	-
Sweden	-2.554	-2.095	-2.207	-5.041*	-14.922*	-14.342*	-	-	-
Denmark	-1.661	-1.736	-1.786	-13.085*	-4.760*	-12.680*	-	-	-
	PP			**PP**			**PP**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	-2.063	-2.026	-2.392	-12.517*	-14.098*	-12.790*	-	-	-
France	-2.063	-1.748	-2.220	-12.517*	-13.595*	-15.056*	-	-	-
UK	-2.201	-1.981	-2.030	-13.577*	-14.388*	-15.449*	-	-	-
Sweden	-2.098	-2.219	-2.469	-12.680*	-14.684*	-14.184*	-	-	-
Denmark	-2.088	-1.613	-2.498	-13.226*	-14.802*	-18.020*	-	-	-
	KPSS			**KPSS**			**KPSS**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	0.214**	0.226*	0.081	0.044	0.045	-	-	-	-
France	0.214**	0.249*	0.166**	0.044	0.051	0.058	-	-	-
UK	0.201**	0.234*	0.219*	0.044	0.046	0.055	-	-	-
Sweden	0.213**	0.215**	0.171**	0.045	0.042	0.056	-	-	-
Denmark	0.214**	0.215**	0.245*	0.043	0.058	0.053	-	-	-

M4									
	Level			1st Difference			2nd Difference		
	ADF			**ADF**			**ADF**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	-2.613	-1.364	-2.913	-4.807	-18.469	-4.702	-	-	-
France	-2.613	-1.225	-2.385	-4.807	-18.301	-5.434	-	-	-
UK	-2.734	-2.375	-1.657	-4.680	-20.302	-15.498	-	-	-
Sweden	-2.654	-2.269	-2.207	-4.750	-11.219	-14.342	-	-	-
Denmark	-2.557	-1.963	-1.786	-4.911	-10.946	-12.680	-	-	-
	PP			**PP**			**PP**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	-2.084	-1.655	-2.392	-12.114	-18.643	-12.790	-	-	-
France	-2.084	-1.559	-2.220	-12.114	-18.348	-15.056	-	-	-
UK	-2.160	-2.955	-2.030	-13.030	-23.725	-15.449	-	-	-
Sweden	-2.087	-4.301	-2.469	-12.355	-	-14.184	-	-	-
Denmark	-2.104	-3.407	-2.498	-12.712	-31.591	-18.020	-	-	-
	KPSS			**KPSS**			**KPSS**		
	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D	Y^G	Y^R	Y^D
Germany	0.203**	0.321	0.081	0.046	0.046	-	-	-	-
France	0.203**	0.313	0.166**	0.046	0.051	0.058	-	-	-
UK	0.189**	0.331	0.219	0.045	0.054	0.055	-	-	-
Sweden	0.202**	0.355	0.171**	0.045	0.153**	0.056	-	0.114	-
Denmark	0.201**	0.367	0.245	0.045	0.083	0.053	-	-	-

Note: * Indicate rejection of null hypothesis at 1% level; ** Indicate rejection of null hypothesis at 5% level.

Table 4 - Variance Decomposition of Forecast Error of Domestic Output: NAFTA

		Months	**BM**	**M1**	**M2**	**M3**	**M4**
USA	Global Shock	1	3.52	49.76	67.49	30.80	28.84
		24	0.63	29.00	27.26	1.85	1.11
	Regional Shock	1	**21.11**	**13.77**	**5.01**	**18.46**	**19.33**
		24	**45.19**	**3.49**	**2.24**	**11.32**	**13.05**
	Domestic Shock	1	75.37	36.47	27.50	50.73	51.82
		24	54.18	67.51	70.50	86.83	85.84
CAN	Global Shock	1	12.09	30.16	21.41	26.97	26.62
		24	15.71	30.37	22.45	25.84	25.85
	Regional Shock	1	**0.26**	**0.11**	**2.15**	**0.33**	**0.38**
		24	**12.74**	**10.22**	**16.80**	**13.95**	**13.64**
	Domestic Shock	1	87.65	69.73	76.44	72.70	73.00
		24	71.55	59.41	60.75	60.21	60.51
MEX	Global Shock	1	1.30	9.11	6.24	11.32	0.68
		24	7.48	10.12	6.93	12.02	1.38
	Regional Shock	1	**20.69**	**30.84**	**25.57**	**15.63**	**23.70**
		24	**25.86**	**29.09**	**25.56**	**22.07**	**26.32**
	Domestic Shock	1	78.00	60.05	68.19	73.05	75.62
		24	66.66	60.80	67.52	65.90	72.31

Table 5 - Variance Decomposition of Forecast Error of Domestic Output: PIIGS

		Months	**BM**	**M1**	**M2**	**M3**	**M4**
PT	Global Shock	1	0.06	0.07	0.34	1.57	2.11
		24	4.34	3.84	7.58	5.91	6.25
	Regional Shock	**1**	**30.33**	**9.56**	**8.09**	**2.70**	**0.13**
		24	**27.00**	**7.59**	**9.65**	**4.87**	**4.15**
	Domestic Shock	1	69.61	90.37	91.57	95.73	97.76
		24	68.66	88.57	82.77	89.22	89.59
IT	Global Shock	1	25.79	9.73	29.98	32.64	21.24
		24	31.90	26.21	40.53	41.93	36.30
	Regional Shock	1	**38.12**	**36.62**	**7.25**	**21.57**	**24.54**
		24	**26.77**	**33.03**	**11.36**	**14.67**	**18.53**
	Domestic Shock	1	36.09	53.64	62.78	45.79	54.22
		24	41.32	40.76	48.11	43.40	45.17
IR	Global Shock	1	28.07	0.03	5.68	3.33	5.59
		24	49.59	0.78	5.20	5.60	8.57
	Regional Shock	1	**1.04**	**2.57**	**20.46**	**0.50**	**4.11**
		24	**2.99**	**4.23**	**15.74**	**1.57**	**3.05**
	Domestic Shock	1	70.90	97.39	73.86	96.17	90.31
		24	47.42	94.99	79.06	92.83	88.38
GR	Global Shock	1	1.80	0.49	1.23	3.33	2.87
		24	6.69	11.99	4.61	2.95	2.73
	Regional Shock	1	**2.88**	**7.31**	**5.35**	**4.36**	**3.68**
		24	**4.99**	**13.05**	**22.83**	**7.31**	**4.95**
	Domestic Shock	1	95.33	92.20	93.42	92.32	93.46
		24	88.32	74.96	72.56	89.75	92.32
SP	Global Shock	1	28.80	36.55	36.49	51.56	49.07
		24	26.19	34.58	34.37	49.19	48.09
	Regional Shock	1	**20.80**	**18.03**	**8.05**	**12.03**	**13.65**
		24	**16.26**	**25.69**	**7.93**	**10.04**	**12.65**
	Domestic Shock	1	50.40	45.42	55.46	36.40	37.28
		24	57.55	39.73	57.70	40.77	39.26

Table 6 - Variance Decomposition of Forecast Error of Domestic Output: EBRC

		Months	**BM**	**M1**	**M2**	**M3**	**M4**
GE	Global Shock	1	8.59	8.09	0.11	10.95	8.01
		24	21.86	23.43	27.68	31.04	30.83
	Regional Shock	1	**39.14**	**29.72**	**5.19**	**25.09**	**11.08**
		24	**31.74**	**27.25**	**10.83**	**19.39**	**8.25**
	Domestic Shock	1	52.27	62.19	94.70	63.96	80.91
		24	46.40	49.32	61.49	49.57	60.92
FR	Global Shock	1	12.63	58.41	23.87	26.08	32.55
		24	16.67	53.68	24.18	28.73	33.53
	Regional Shock	1	**34.59**	**0.10**	**5.21**	**9.93**	**11.74**
		24	**28.08**	**5.58**	**9.67**	**8.37**	**13.97**
	Domestic Shock	1	52.79	41.48	70.93	63.99	55.71
		24	55.25	40.74	66.14	62.90	52.50
UK	Global Shock	1	16.46	10.09	5.10	20.74	27.23
		24	12.29	19.15	12.50	19.90	24.76
	Regional Shock	1	**27.87**	**41.08**	**2.33**	**11.30**	**5.53**
		24	**21.27**	**33.86**	**7.68**	**16.77**	**6.94**
	Domestic Shock	1	70.49	48.83	92.57	67.96	67.23
		24	66.44	46.98	79.82	63.33	68.30
SW	Global Shock	1	5.37	8.64	9.04	10.47	16.63
		24	13.11	12.15	16.24	18.09	21.64
	Regional Shock	1	**29.56**	**38.24**	**15.98**	**3.28**	**0.00**
		24	**23.96**	**35.33**	**13.66**	**6.84**	**9.38**
	Domestic Shock	1	65.08	53.13	74.99	86.25	83.36
		24	62.94	52.51	70.10	75.07	68.98
DK	Global Shock	1	8.66	0.19	0.00	0.08	0.12
		24	19.16	1.45	2.32	4.47	3.87
	Regional Shock	1	**0.04**	**0.60**	**1.13**	**3.73**	**4.74**
		24	**3.40**	**7.16**	**2.22**	**5.05**	**7.18**
	Domestic Shock	1	91.30	99.22	98.87	96.19	95.14
		24	77.44	91.40	95.46	90.48	88.95

Table 7 - Size of Disturbances and Speed of Adjustment: NAFTA

BM						
	Global Shock		Regional Shock		Domestic Shock	
	Size	Speed	Size	Speed	Size	Speed
USA	0.006	1.147	0.005	1.837	0.163	1.076
Canada	0.006	1.147	0.220	1.096	0.006	1.124
Mexico	0.008	0.906	0.219	1.026	0.005	0.984
Average	**0.007**	**1.067**	**0.148**	**1.320**	**0.058**	**1.061**
M1						
	Global Shock		Regional Shock		Domestic Shock	
	Size	Speed	Size	Speed	Size	Speed
USA	0.004	1.458	0.005	1.149	0.180	1.116
Canada	0.004	1.698	0.159	1.244	0.008	1.016
Mexico	0.005	1.337	0.156	1.321	0.005	0.985
Average	**0.005**	**1.498**	**0.107**	**1.238**	**0.064**	**1.039**
M2						
	Global Shock		Regional Shock		Domestic Shock	
	Size	Speed	Size	Speed	Size	Speed
USA	0.004	1.783	0.005	1.192	0.186	1.149
Canada	0.003	2.827	0.155	1.250	0.007	1.033
Mexico	0.005	1.517	0.161	1.313	0.005	0.989
Average	**0.004**	**2.043**	**0.107**	**1.252**	**0.066**	**1.057**
M3						
	Global Shock		Regional Shock		Domestic Shock	
	Size	Speed	Size	Speed	Size	Speed
USA	0.006	1.044	0.004	1.485	0.207	1.101
Canada	0.005	1.218	0.209	1.281	0.007	1.037
Mexico	0.008	1.028	0.191	0.970	0.006	0.965
Average	**0.006**	**1.097**	**0.135**	**1.245**	**0.073**	**1.034**
M4						
	Global Shock		Regional Shock		Domestic Shock	
	Size	Speed	Size	Speed	Size	Speed
USA	0.006	1.002	0.004	1.549	0.206	1.105
Canada	0.005	1.138	0.211	1.274	0.007	1.042
Mexico	0.008	1.083	0.171	1.555	0.006	0.996
Average	**0.007**	**1.074**	**0.129**	**1.459**	**0.073**	**1.048**

Table 8 - Size of Disturbances and Speed of Adjustment: PIIGS

	Global Shock		Regional Shock		Domestic Shock	
BM						
	Size	Speed	Size	Speed	Size	Speed
Portugal	0.222	0.933	0.010	1.013	0.007	1.007
Italy	0.224	0.988	0.010	1.004	0.005	0.941
Ireland	0.198	0.944	0.008	1.154	0.163	1.353
Greece	0.228	0.822	0.009	0.822	0.006	1.008
Spain	0.215	0.984	0.010	1.013	0.005	0.904
Average	**0.218**	**0.934**	**0.010**	**1.001**	**0.037**	**1.042**
M1						
	Size	Speed	Size	Speed	Size	Speed
Portugal	0.012	1.000	0.008	1.000	0.008	0.996
Italy	0.012	1.000	0.006	0.985	0.007	0.995
Ireland	0.010	1.001	0.009	0.996	0.273	1.112
Greece	0.012	1.001	0.010	1.001	0.008	1.000
Spain	0.011	1.000	0.009	1.000	0.007	1.001
Average	**0.011**	**1.000**	**0.008**	**0.997**	**0.061**	**1.021**
M2						
	Size	Speed	Size	Speed	Size	Speed
Portugal	0.018	1.001	0.009	1.000	0.008	0.998
Italy	0.019	1.006	0.009	1.005	0.008	1.003
Ireland	0.016	1.001	0.010	1.013	0.246	1.113
Greece	0.016	1.000	0.010	1.000	0.010	1.000
Spain	0.017	1.001	0.009	1.001	0.006	1.001
Average	**0.017**	**1.002**	**0.009**	**1.004**	**0.056**	**1.023**
M3						
	Size	Speed	Size	Speed	Size	Speed
Portugal	0.015	1.000	0.004	1.000	0.008	0.994
Italy	0.017	1.000	0.004	1.000	0.005	1.000
Ireland	0.017	1.003	0.004	1.005	0.272	1.117
Greece	0.017	1.000	0.005	1.000	0.010	1.000
Spain	0.017	1.000	0.005	1.000	0.005	1.000
Average	**0.017**	**1.001**	**0.004**	**1.001**	**0.060**	**1.022**
M4						
	Size	Speed	Size	Speed	Size	Speed
Portugal	0.016	1.000	0.005	1.000	0.008	0.994
Italy	0.019	1.004	0.005	1.000	0.006	1.002
Ireland	0.017	1.009	0.005	0.998	0.267	1.116
Greece	0.016	1.000	0.006	1.000	0.009	1.000
Spain	0.017	1.000	0.005	1.000	0.005	1.000
Average	**0.017**	**1.003**	**0.005**	**1.000**	**0.059**	**1.023**

Table 9 - Size of Disturbances and Speed of Adjustment: EBRC

	Global Shock		Regional Shock		Domestic Shock	
BM						
	Size	Speed	Size	Speed	Size	Speed
Germany	0.224	0.999	0.006	1.002	0.006	1.015
France	0.224	0.999	0.010	1.006	0.004	0.990
UK	0.226	0.996	0.010	1.003	0.003	1.013
Sweden	0.226	1.006	0.010	1.015	0.007	1.020
Denmark	0.229	1.024	0.009	1.059	0.007	1.036
Average	**0.226**	**1.005**	**0.009**	**1.017**	**0.005**	**1.015**
M1						
	Global Shock		Regional Shock		Domestic Shock	
	Size	Speed	Size	Speed	Size	Speed
Germany	0.011	1.004	0.008	1.008	0.006	1.010
France	0.013	0.998	0.004	1.002	0.005	1.002
UK	0.012	1.001	0.011	1.001	0.003	1.000
Sweden	0.010	1.000	0.011	1.000	0.011	1.000
Denmark	0.010	1.000	0.015	1.000	0.010	1.000
Average	**0.011**	**1.000**	**0.010**	**1.002**	**0.007**	**1.002**
M2						
	Global Shock		Regional Shock		Domestic Shock	
	Size	Speed	Size	Speed	Size	Speed
Germany	0.016	1.007	0.008	1.010	0.005	1.017
France	0.017	1.001	0.009	1.001	0.005	1.000
UK	0.017	1.001	0.009	1.001	0.004	1.000
Sweden	0.018	1.003	0.009	1.002	0.009	1.001
Denmark	0.016	1.000	0.009	1.000	0.011	1.000
Average	**0.017**	**1.002**	**0.009**	**1.003**	**0.007**	**1.004**
M3						
	Global Shock		Regional Shock		Domestic Shock	
	Size	Speed	Size	Speed	Size	Speed
Germany	0.017	1.000	0.005	1.000	0.007	1.000
France	0.017	1.000	0.005	1.000	0.003	1.000
UK	0.016	1.000	0.005	1.000	0.004	1.000
Sweden	0.018	1.000	0.006	1.000	0.009	1.000
Denmark	0.017	1.000	0.007	1.000	0.011	1.000
Average	**0.017**	**1.000**	**0.006**	**1.000**	**0.007**	**1.000**
M4						
	Global Shock		Regional Shock		Domestic Shock	
	Size	Speed	Size	Speed	Size	Speed
Germany	0.016	1.000	0.007	1.000	0.007	1.000
France	0.017	1.000	0.006	1.000	0.005	1.000
UK	0.017	1.000	0.011	1.000	0.004	1.000
Sweden	0.015	0.995	0.003	1.014	0.007	1.009
Denmark	0.016	1.000	0.009	1.000	0.010	1.000
Average	**0.016**	**0.999**	**0.007**	**1.003**	**0.007**	**1.002**