UNIVERSITY OF NICE - SOPHIA ANTIPOLIS
FACULTY OF LAW, POLITICAL SCIENCE, ECONOMIC AND OF MANAGEMENT
C.E.M.A.F.I
Macroeconomics and International Finance Center

International Conference on Policy Modeling

EcoMod2008

2-4 July, Berlin

Analysis of shocks affecting Europe: EMU and some Central and Eastern acceding countries

Nabil Ben Arfa *

Nabil_ar@yahoo.fr

* Le CEMAFI, University of Nice Sophia-Antipolis.
Le Malibu, 1/3 Impasse Amaro 06200 Nice - France.
Phone: +33 (0) 6 88 13 10 46

Title: Analysis of shocks affecting Europe: EMU and some Central and Eastern acceding countries

Abstract:

This paper deals with the synchronization of business cycles and economics shocks between euro area and acceding countries. We therefore extract the business cycle component of output by using Hodrick-Prescot filter. Supply and demand shocks are recovered from estimated structural VAR models of output growth and inflation using long run restriction (Blanchard and Quah). We then check the (A) symmetry of these shocks by calculating the correlation between euro area shocks and those of the different acceding countries.

We find that several acceding countries have a quite high correlation of demand shocks with the euro area however supply shocks are asymmetric; the correlation between euro area and CEECs is negative. We therefore conclude that joining the European Monetary Union is not yet possible, central and eastern countries have to make structural changes to join the European Monetary Union.

Keys Words: *Central and Eastern countries, euro area, SVAR models, Hodrick- Prescott filter, symmetric-asymmetric shocks.*

Résumé :

Cet article traite de la corrélation des cycles et des chocs entre la zone euro et les petits pays européen en cours d'adhésion. Dans un premier temps, nous comparons les composantes cycliques des différents pays de notre échantillon en se servant du filtre d'Hodrick-Prescot, une meilleure synchronisation des cycles signifie que les pays en cours d'adhésion sont convergents et donc une possible intégration à l'UEM serait envisageable. Dans un second temps et dans le but d'identifier les chocs subis par les pays en question, nous mobilisons un modèle VAR structurel dont les variables sont la production et les prix. Le calcul de la corrélation entre les chocs nous enseigne sur la nature symétrique ou asymétrique de ces derniers. L'analyse des fonctions d'impulsions et de la décomposition de la variance de l'erreur de prévision stipule que les chocs de demande sont positivement corrélés entre la zone euro et les pays candidats. En revanche, les chocs d'offre sont asymétriques, ce qui nous laisse supposer que l'intégration de l'UEM est loin d'être envisageable pour une grande partie des pays candidats à l'adhésion. Enfin l'article s'achève par l'interprétation des résultats trouvés et les différentes recommandations qu'on puisse en tirer.

Mots-clés : *Choc d'offre et choc de demande, Zone euro, Pays du Centre et de l'Est candidats à l'adhésion, Synchronisation des cycles, Zone monétaire optimale, VAR structurel, Filtre d'Hodrick-Prescott.*

Introduction:

Our main objective is to evaluate the correlation of business cycles within the Euro area, between the euro area and acceding countries. We want to assess whether the European countries are confronted to symmetrical shocks (if an area, a zone or a country are hit by similar shocks) or rather asymmetrical (i.e. if the shocks and/or their impacts are not similar).
Our investigation on the nature of business cycles and shocks correlation within Europe leads us to the optimal currency areas theory.
The main contributions on optimal currency areas theory are those of Mundell (1961), followed by Mckinnon (1963) and Kenen (1969), which were considered as the base to later studies. Their objective was to identify the main criteria of a possible integration of a country to a monetary area. The strategy consists in identifying benefit and costs which a given country can try out by joining the monetary area. If benefits for each country wishing integration are positive and higher than costs, monetary area is called as optimal. In addition, if a consensus exists on the positive benefit effects of integration at a microeconomic level, like transaction costs fall or also more transparency. On the other hand, there is more skepticism about costs; the main cost is certainly the loss of the monetary policy instrument at a national level (for example foreign exchange rate) as mechanism of stabilization against macroeconomic fluctuations which affect only one country of the zone or the whole of its countries in different ways (asymmetrical shocks). This kind of shock cannot be absorbed by a common policy, an alternative adjustment mechanism is necessary to stabilize the economy.
Our paper is placed in this context; one of our goals is to see whether Europe can form an optimal currency area. To answer this, we will check the way business cycles evolve/move in euro area, and in CEECs countries. The aim is to asses if a synchronization of business cycles between euro area and small acceding economies in course of integration does really exist, because a better synchronization means that European countries become increasingly convergent, and thus a loss of monetary instrument does not constitute a danger to the economy. To conclude this comparative analysis of business cycles, we will use Hodrick-Presscott filtering method.
Thereafter, to improve our results, and to be able to clarify synchronization or differences in business cycles evolution found before, we estimate a structural VAR model (SVAR), in order to discover supply and demand shocks affecting European countries, and especially to see whether these countries are affected by symmetric or asymmetric shocks which is essential in determination of the optimality of the euro area.

The methodology suggested by Bayoumi and Einchengreen (1992), placed in the line of Blanchard and Quah work, constitutes our base of work. Indeed, the principal assumption of their model is there were two kinds of shocks: shocks affecting the demand curve (for example those due to monetary policy changes) and shocks affecting supply curve (like technological changes). As for Blanchard and Quah model, it is clear that demand and supply shocks have different effects on output and prices. If supply shocks have permanent effects on production, demand shocks have only temporary one; on the other hand the two shocks have permanent effects on price.

One then can be able to introduce these assumptions into a structural VAR model whose variables are production and prices in order to check supply and demand shocks, and their effects on economic variables (through impulse response function and variance decomposition).

Finally this paper will be ended by mentioning results and declaring recommendations.

1. Business cycle and optimal currency areas theory

The optimal currency areas theory appears with the original work of Mundell (1961)[1]. Mundell estimated that a country could find it advantageous to peg the external value of its currency to another country when the two countries business cycles are strongly correlated. In practice, a perfect correlation does not exist, but the problem of asymmetrical shocks will be alleviated if there were factors of production mobility between countries and areas. The fiscal policy and labour market flexibility can also replace the traditional mechanisms of adjustment.

After the breakdown of the Bretton Woods systems, optimal currency area analysis became a regular tool to evaluate the desirability of a particular country to adopt a fixed exchange rate. In the European case, currency area analysis revealed that mobility on labour market is rather low.

Important empirical works was carried out to evaluate optimal currency area theory before the introduction of European Monetary Union. The main objective of these empirical studies was the evaluation of business cycle correlation between the German economy and other potential countries.

[1] Mundell, R.1961. “A Theory of Optimum Currency Areas ”. American Economic Review. 51 (1). pp. 657-665.

An influential contribution by Bayoumi and Eichengreen (1992)[2], consists in discovering demand and supply shocks in the prospective members of the monetary union, using the technique developed by Blanchard and Quah (1989). The starting point of their analysis is that an economy can be hit by either supply or demand shocks. These shocks are identified using long run restrictions; long term impact of demand shocks on production is zero, only supply shocks can have long term effects on production. In addition, Bayoumi and Einchengreen designate another kind of restriction on identification - (Over-identifying), which stipulates that accumulated effects of supply and demand shocks on prices are respectively negative and positive.

In this section, we try to survey the literature treating on the evaluation of the criteria of the optimal currency area, in particular those related to the newest members of the monetary union and to the potential candidates to adhesion.

We then apply business cycle correlation criterion to euro area and to Eastern and central European countries candidates to join the Euro area.

1.1. Review of the literature on business cycles correlation within Europe

Table 1. Review of the literature on business cycles correlation between Euro area and acceding countries

Authors, year	Country	Method	Frequency	Country of reference
Boone, Maurel (1998)	CZ, HU, PL, SSL	Hodrick-prescot Filter	Monthly data	Germany
Frenkel (1999)	CE5, BG, EE, LV	Demand and supply shocks	Quarterly data	Germany
Horvath (2000)	CE5, B3	Demand and supply shocks	Quarterly data	Germany
Korhonen (2001,2003)	CE5, B3 , RO	VAR	Monthly data	Euro area
Fidrmuc (2001, 2004)	CE10	Correlation of GDP and of IPC	Quarterly data	Germany
Frenkel, Nickel (2002)	CE5, BG, EE, LV	Demand and supply shocks	Quarterly data	Euro area
Babetski et al. (2002, 2004)	CE5, EE, LV, RO	Demand and supply shocks	Quarterly data	European Union

[2] Bayoumi, T. and Eichengreen, B.1992. « Shocking Aspects of European Monetary Integration". NBER Working paper.N°3949.

Maurel (2002)	IS, CZE, HU, PL, RO	Demand and supply shocks	Quarterly data	Germany
Fidrmuc, Korhonen (2004)	CE10	Demand and supply shocks	Quarterly data	Euro area
Artis et al. (2004)	CE5, B3	Band Pas Filter	Monthly data	Euro area
Demanyk, Volosovych (2004)	CE5, B3	Correlation of GDP growth rate	Quarterly data	Europe of the 25
Darvas, Szapary (2004)	CE5, B3	HP and BP Filter	Quarterly data	Euro area
Ramos, Surinach (2004)	CE5, B3	Demand and supply shocks	Quarterly data	Euro area
IMF (2000)	CE10	Correlation of the GDP and of the IPC	Annual data	Germany
Boreiko (2002)	CE10	Hodrick-Prescot filter (IP)	Monthly data	Germany
Luikmel, Randveer (2003)	EE	Hodrick-Prescot Filter (GDP)	Quarterly data	Euro area

Source: Fidrmuc and Korhonen .2004. "The Euro goes East: Implications of the 2000-2002 Economic Slowdown for Synchronization of Business cycles between the Euro-area and CEECs".

Ind: CE4: Czech Republic, Hungary, Poland and Slovakia, CE5: CE4 plus Slovenia, B3: Estonia, Latvia and Lithuania, BG: Bulgaria, CZ- Czech Republic, EE - Estonia, HU - Hungary, LV - Latvia, LT-Lithuania, PL-Poland, RO-Romania, SSL-Slovenia, CE10- all countries.

The table above lists the studies related to the evaluation of business cycles correlation between the euro area and the countries applying for accession. We immediately notice the diversity of the used methods; while several studies take the simplest method, consisting in filtering the series around their trends to be able to determine business cycles (through several techniques like Hodrick-Prescott filter), only few contributions use the VAR methodology.

To summarize these studies, we can identify three categories of approaches in the literature treating on cyclical correlation between euro areas and acceding countries. In the first category, work has focused on a simple correlation of an indicator of the incorporated product, the GDP or the inflation rate for example.

In the second category, business cycles correlation is analyzed mainly through the use of various filters (including Hodrick-Prescot filter, Band-Pass filter…).

In the third category, structural VAR models were used to identify shocks affecting various countries.

While the first approach prevails in older analyses, the last two ones dominate recent discussions.

For this reason, we propose, in what follows, a review of the literature working under these last two recent analyses.

In a first group of studies, one used various measurements of business cycles correlation between euro area (European Union) and CEECs.

Boone and Maurel (1998)[3] calculate the coefficients of correlation between cyclical components of industrial production and unemployment rates for a selection of country applying for accession compared to those of Germany and European Union. Cyclical component of business cycle indicator is obtained with the help of Hodrick-Prescott filter. They generally find a higher degree of business cycles correlation between acceding countries and Germany. This implies a relatively low cost in case of giving up monetary sovereignty and joining a monetary union with Germany.

They find a similar result in their study of 1999[4] by using a different method: this one consists in determining the share of the variation in the unemployment rate which can be explained by a shock accured in Germany or within European Union.

Artis and Al (2004)[5] and Darvas and Szapary (2004)[6] describe business cycle of acceding countries by using the Band-Pass filter. The purpose of Artis and Al (2004) was to identify business cycles for each country individually. They find that business cycles of Hungary and Poland are generally more similar to those of euro area.

Darvas and Szapary work is considerably different from other investigations. Indeed, they were interested in the expenditure behaviour and on the various components of GDP. They find that GDP, industrial production and exports of Hungary, of Poland and Slovenia had started a high degree of correlation with those of the euro area. However, private consumption and services are not correlated, even within these three countries. Darvas and Szapary were

[3] Boone, L. and Maurel, M.1998. "Economic Convergence of the CEECs with the EU". CEPR Discussion Paper. N°2018. London 1998.

[4] Boone, L. and Maurel, M. 1999. "An Optimal Currency Area Perspective of the EU Enlargement to the CEECs". CEPR Working Paper. N°2119.

[5] Artis, M., Marcellino, M. and Proietti, T.2004. « Characterizing the Business Cycle for Accession Countries ». CEPR Discussion Papers. N° 4457. Centre for Economic Policy Research. June.

[6] Darvas, Z. et Szapary, G. 2004. « Business Cycle Synchronization in the Enlarged EU: Comovements in the New and Old Members ». CEPR Discussion Paper. N°5179. Centre for Economic Policy Research.

also interested in the evolution of correlation of acceding countries with euro area through time. Their results are not very conclusive since the correlation of GDP business cycle increased roughly in half of the studied countries whereas it dropped in the other half.

Other studies like those of Frenkel al. (1999)[7], Frenkel and Nickel (2002)[8], Fidrmuc and Korhonen (2001, 2003,2004), use an approach similar to that of Bayoumi and Eichengreen in order to identify supply and demand shocks of various States including the majority of countries applying for accession.

Frenkel and Al (1999), find that the correlation of shocks is quite high between the euro area and in the non participating EU member states. However, this correlation is weaker between euro area (represented by Germany and France) and the acceding countries.

Unfortunately result taking from these studies is difficult to interpret, probably because of the data used for estimation. Indeed, Frenkel et al. use quarterly data extending from the first quarter of 1992 to the second quarters of 1998, the time period is quite short to draw robust conclusions. Therefore Frenkel and Nickel (2002) had used a longer sample for the same group of country. However their conclusions are not very different from those resulting from their basic study.

Fidrmuc and Korhonen (2001)[9] assess supply and demand shocks correlation between ten acceding countries and the EMU countries for a period extending from1994 to 2000. They find divergent results between acceding countries. While some countries, like Hungary and Estonia are positively correlated with the euro area, other countries like Lithuania, Slovakia and the Czech Republic present a negative correlation with the euro area. They also claim that demand shock correlation is in general less strong than that of supply shocks. Fidrmuc and Korhonen conclude their analysis by an interesting remark: they find that supply shocks in some acceding countries are at least as well correlated with euro area shocks as in much of some smaller members of the EMU (like Portugal, and Greece).

Korhonen (2003)[10] examines the monthly indicators of industrial production in euro area and nine countries applying for accession. To analyze the correlation, he uses a separate VAR models on production of the euro area and production in each of the acceding countries.

[7] Frenkel, M., Nickel, C. et Schmidt, G.1999. « Some shocking Aspects of EMU Enlargement ». Research Note. N°99-4. Deutsche Bank. Frankfurt.

[8] Frenkel, M., Nickel, C. 2002. « How Symmetric are the Shocks and the Shock Adjustment Dynamics between the Euro Area and Central and Eastern European Countries? ». Working Paper. N° 02/222, IMF.Washington D.C.

[9] Fidrmuc, J. et Korhonen, I. 2001. « Similarity of Supply and Demand Shocks between the Euro Area and the CEECs ». BOFIT Discussion Paper. N°14. Bank of Finland. Institute for Economies in Transition.Helsinki.

[10] Korhonen, Iikka.2003. « Some Empirical Tests on the Integration of Economic Activity between the Euro Area and the Accession Countries: A note ». Economics of Transition. N°11(1). pp. 1-20.

Positive correlation of impulse function with these of euro area is considered as an evidence of business cycle symmetry. Korhonen finds that some applicant countries (particularly Hungary) show a high degree of correlation with the euro area business cycle. In addition, correlation seems to be at least as high as in some smaller EMU members like Portugal and Greece for example.

Recently, Ramos and Surinach (2004)[11] introduced monetary shocks as an additional variable on structural VAR models. They suggest two possibilities of introduction of these shocks into their structural VAR model; either through real interest rate as in Artis (2003b)[12], or through effective foreign exchange rate as in Clarida and Gali (1994)[13].

Thus in a first step, they estimate a structural VAR model for growth rate of GDP and for inflation rate in order to identify supply and demand shocks. In the second step, they introduce the monetary shocks by considering two different models; the first is composed of growth rate of the GDP, inflation rate and real interest rate, in the second models real interest rate is replaced by the effective exchange rate.

The result of their studies is surprising enough especially for monetary shocks resulting from Artis decomposition. Indeed, they find that correlation of these monetary shocks is similar between the euro area and acceding countries.

In summary, empirical works seem to indicate that business cycles in the most advanced acceding countries are strongly correlated with those of the euro area. This is particularly true for Hungary and to a lesser extent for Slovenia.

1.2. Business cycles synchronization within Europe: correlation of GDP

In order to check if the countries chosen for our analysis are affected by common fluctuations, it is possible relating on the cyclical behaviour of economic aggregates, GDP in particular, to evaluate how these countries evolve/move through time. Business cycles synchronization is therefore regarded as a sign of convergence between a monetary Union and countries applying for its adhesion.

---

[11] Ramos, R. et Surinach, J.2004. « Shocking Aspects of European Enlargement ». Eastern European Economics. N°42 (5). pp. 36-57.

[12] Artis, M. 2003 b. « Analysis of European and United Kingdom Business Cycles and Shocks ».[available at].URL: http://www.hm-treasury.go.uk. HM Treasury.

[13] Clarida, R. et Gali, J.1994. « Sources of Real Exchange Fluctuations: How Important are Nominal Shocks ». NBER Working Paper. N°4658. NBER. Cambridge.

Economies tend to fluctuate around a long term trend. Fluctuations around this trend correspond to the cyclical fluctuations. One of the most used methods in the literature to assess business cycles is the Hodrick-Prescott technique of decomposition (1980). Based on this method we try to determine the nature of the relation between euro area business cycle and acceding countries, results drawing from this analysis teach us about optimality (or not) of a potential monetary union extended to CEECs.

Hodrick-Prescot filtering method has been very successful in empirical literature, real business cycle theory used this method to carry out empirical applications. Hodrick and Prescott propose to decompose a series y_t in a cyclical component and in a trend by the help of this programme of minimization:

$$\underset{\tau}{Min} \sum_{i=1}^{T}(y_i - \tau_i)^2 + \lambda \sum_{i=2}^{T-1}(\Delta\tau_{i+1} - \Delta\tau_i)^2$$

τ_i measure the trend component and λ is an ad- hoc term.

Hodrick-Prescott filter look then in minimizing this equation. The First term of this program measures the adequacy of the trend τ_i with y_i, in other words the adequacy to the cyclical component deviation; the second corresponds to the trend deviation. The parameter λ represents the weight granted to the second objective relative to the first, it measures the relative importance that one can attaches to the trend flexibility compared to the business cycles extend. It plays a crucial role in the decomposition. The lower the value of this coefficient is, more flexible the trend will be. The higher the value is, the less flexible the trend will be.

Thus if the value $\lambda = \infty$, the program is summarized to minimize the second term of the equation. If the value of λ is zero, the trend is identified to the initial series ($y_i = \tau_i$).

This filter is considered as a flexible method, because the choice of the parameter λ depends on the data chronology. For quarterly data, which is the case of our data, we retains a value of $\lambda = 1600$.

The data used in our analysis are quarterly data extracted from several databases; Eurostat, IFS. After filtering the data and their decompositions into trend components - cyclical components, according to HP method (Hodrick-Prescott) previously defined, we make comparisons between the euro area cyclical components and those of the Central and Eastern countries of Europe. Our results are showed in the table below.

Table 2. Correlation with euro area business cycle

Country	Correlation
Bulgaria	0.13 *
Croatia	0.15 *
Estonia	0.08 *
Hungary	0.59
Latvia	0.58
Lithuania	0.37
Malta	0.32
Poland	0.58
Czech Republic	0.13 *
Romania	0.57
Slovakia	0.13 *
Slovenia	0.51

* These values are not significant (prob of 5%)[14]

Source: our estimations

- *Results:*

Results teach us that all countries have a positive correlation with the euro area business cycle. Republic Czech, Slovakia, Bulgaria, Estonia and Croatia represent the weakest correlations. The values of correlation coefficients are also not significant. It is clear that, there is no correlation between these countries and the euro area business cycle.

Business cycle seems to be well correlated with that of the euro area for Hungary, Poland, and Slovenia[15]. These countries present the highest correlation coefficients.

The remainder countries also seem to present a positive and significant correlation with the euro area. These countries are characterized by an economic cycle close to that of the euro area member; joining the European monetary union will undoubtedly accelerate business cycle synchronization with that of the euro area.

To sum, our results seem to be encouraging since synchronization is quite engaged for the most studied countries. Even, if business cycle of some countries remains always rather divergent from that of the euro area.

[14] A coefficient of correlation lies between -1 and 1. However, this coefficient is rarely close to these limit values that's why we often carries out tests of significativity (test of Student) to be able to draw a reliable interpretations.

[15] The accession of Slovenia to the euro area consolidates our result.

To confirm or discuss cyclical tendencies results, we adopt in the following section a different method (approach). Our purpose is to assess the cyclical fluctuations sources, in other words we will identify the sources of disturbances (shocks), and the economic policies responses to these shocks.

2. Structural VAR model: (A) Symmetry of demand and supply shocks

In order to see if differences observed in cyclical tendencies between euro area and acceding countries come from shocks differences or from economic policies responses differences to these shocks, an alternative econometric method will be applied in this section. It is the structural VAR methodology which main objective is to identify shocks, their nature (symmetrical or asymmetrical) and economic aggregates response to these disturbances.

We began by exposing the model of Bayoumi and Eichengreen (1992), which is considered in this context as a standard. We then apply this structural VAR methodology to the euro area and to acceding countries.

2 .1. Model of Bayoumi and Eichengreen (1992)

This influential contribution falls in a large empirical literature whose objective is to test the validity of the optimal currency areas theory. Its starting point is the fact that an economy can be hit either by demand shocks or by supply shocks. Demand and supply shocks are identified by using restrictions on the long run impact of demand shocks on production. Indeed, demand shocks are supposed to have zero effect on the long-term production, only supply shocks are supposed to have permanent effect on output.

After identifying the nature and the effects of the various shocks on economy, Bayoumi and Eichengreen estimate a VAR model on GNP and price of European Community (the Twelve minus Luxembourg). In order to transform the residuals of each estimated VAR into demand and supply shock, they apply the decomposition procedure of Blanchard and Quah (1989). This procedure makes possible the distinction between temporary and permanent shocks. Shocks correlation calculated between countries provide information on the degree of the asymmetry of real shocks, while impulse response functions associated to structural VAR make possible the evaluation of the speed adjustment of each economy to these various shocks.

In order to evaluate the relative weight of these shocks, the same econometric procedure is applied to the United States. In addition, Europe and United States are divided into a “center”

of countries or States, characterized by symmetrical behaviour, and a “periphery”, in which shocks are less correlated with those of the center.

The starting point of the model is the following:

$$\begin{bmatrix} \Delta Y_t \\ \Delta P_t \end{bmatrix} = \sum_{i=0}^{\infty} \begin{pmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{pmatrix} . \begin{bmatrix} e_{dt} \\ e_{st} \end{bmatrix} \qquad (1)$$

Where ΔY_t and ΔP_t respectively represent the logarithm of the GNP growth rate and that of prices in time *T*, e_{dt} and e_{st} represent demand and supply shocks. Identifying constraints are based on the assumptions already mentioned, related to the nature of the effects of shocks on variables. As the product (output) is represented on first difference, the constraints on demand shocks imply that the cumulated effects of demand shocks must be equal to zero:

$$\sum_{i=0}^{\infty} a_{11i} = 0 \qquad (2)$$

The model defined by equations (1) and (2) also implies that endogenous variables of the VAR model can be explained by various lag variables. If we suppose that B_i represent the coefficients values of the model, the model can be estimated as follows:

$$\begin{bmatrix} \Delta Y_t \\ \Delta P_T \end{bmatrix} = B_1 . \begin{bmatrix} \Delta Y_{t-1} \\ \Delta P_{t-1} \end{bmatrix} + B_2 . \begin{bmatrix} \Delta Y_{t-2} \\ \Delta P_{t-2} \end{bmatrix} + ... + \begin{bmatrix} e_{yt} \\ e_{pt} \end{bmatrix} \qquad (3)$$

Or e_{yt} and e_{pt} are the residuals of the VAR model equations.

Equation (3) can also be expressed as:

$$\begin{bmatrix} \Delta Y_t \\ \Delta P_t \end{bmatrix} = (I - B(L)^{-1}) . \begin{bmatrix} e_{yt} \\ e_{pt} \end{bmatrix} = (I + B(L) + B(L)^2 + ...) . \begin{bmatrix} e_{yt} \\ e_{Pt} \end{bmatrix} \qquad (4)$$

Or in an equivalent way:

$$\begin{bmatrix} \Delta Y_t \\ \Delta P_t \end{bmatrix} = \sum_{i=0}^{\infty} \begin{pmatrix} d_{11i} & d_{12i} \\ d_{21i} & d_{22i} \end{pmatrix} . \begin{bmatrix} e_{yt} \\ e_{pt} \end{bmatrix} \qquad (5)$$

Let put (1) and (5) together:

$$\sum_{i=0}^{\infty} \begin{pmatrix} d_{11i} & d_{12i} \\ d_{21i} & d_{22i} \end{pmatrix} . \begin{bmatrix} e_{yt} \\ e_{pt} \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{pmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{pmatrix} . \begin{bmatrix} e_{dt} \\ e_{st} \end{bmatrix} \qquad (6)$$

C, a matrix connecting demand and supply shocks of the VAR model to the residuals can thus be found.

$$\begin{bmatrix} e_{yt} \\ e_{pt} \end{bmatrix} = \left(\sum_{i=0}^{\infty} \begin{pmatrix} d_{11i} & d_{12i} \\ d_{21i} & d_{22i} \end{pmatrix}^{-1} . \sum_{i=0}^{\infty} L^i . \begin{pmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{pmatrix} \right) . \begin{bmatrix} e_{dt} \\ e_{st} \end{bmatrix} = c . \begin{bmatrix} e_{dt} \\ e_{st} \end{bmatrix} \qquad (7)$$

From equation (7), it is clear that in this model of order two, four restrictions are needed to identify the *C* matrix elements. Two of these restrictions are drawn from the assumption of normality of the variance of shocks e_{dt} and e_{st}. A general assumption retained within the framework of VAR model consists in imposing that the two variances are equal to *one*. These two assumptions combined with that of orthogonality define the third restriction, $c'c = S$, where *S* represents the covariance matrix of E_y and E_p.

The last restriction which will make the identification of the *C* matrix possible comes from the economic theory; it was previously defined in equation (2).

Introducing (2) in (7) yields the following model:

$$\sum_{i=0}^{\infty}\begin{pmatrix} d_{11i} & d_{12i} \\ d_{21i} & d_{22i} \end{pmatrix}\begin{pmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{pmatrix} = \begin{pmatrix} 0 & . \\ . & . \end{pmatrix}$$

And thus the resolution of this system will enable us to estimate the series of demand and supply shocks of the structural VAR model.

The analysis of Bayoumi and Eichengreen shows that supply shocks are larger and less correlated between countries (or areas) in Europe in comparison with the United States. In addition and through the impulses responses functions of the structural VAR model, they suggest that adjustment to supply shocks as well as to demand shocks is faster in the United States than in Europe.

Consequently, as the American monetary union constitutes a point of comparison, they consider that a possible EMU would be associated with significant adjustments costs.

Moreover, results of their model reveal the existence of a difference between two groups of Europe (the center and the periphery) with regard to supply shocks and to a lesser extent to demand shocks. Indeed, shocks affecting the economies of the center (Belgium, Denmark, France, Germany and Netherlands) are of less amplitude and more correlated with neighbours countries, while fluctuations in countries of the periphery seems to be asymmetrical. In addition, the two authors suppose that there are a few results in favour of convergence, the difference between the center and the periphery do not decrease during the studied period.

In what follows, we apply this model to our sample of countries.

2.2. Application to the Euro area and to acceding countries

If we consider an economy whose growth rate and inflation rate are affected each year, T, by two orders of shocks: supply impulses (ε_{st}) and demand impulses (ε_{dt}). The model resolution is the same as in Bayoumi and Eichengreen model.

We estimate a structural VAR model in first differences. Variable representing growth rate is the first difference of the GDP logarithm (ΔY_t), inflation rate is estimated through the logarithm of the consumer price index in the first difference (ΔP_t).

Data used are quarterly resulting from EUROSTAT database, IFS and OECD. The studied period extends from the first quarter of 1995 to the third quarter of 2005 (1995: Q1 ~2005: Q3)[16]. The data are related to the euro area as a group and to twelve central and Eastern European countries: Bulgaria, Romania, Slovenia, Slovakia, Republic Czech, Latvia, Lithuania, Malta, Estonia, Hungary, Poland and Croatia.

To our knowledge, the prevailing studies were never done based on a sample composed of so many countries. The studied period, even if it remains quite short, is larger than that of old investigations. This argument provides our work with a solid base and a significant advantage compared to works relating to the same subject.

Let's study the stationnarity of the variables.

2.2.1. Study of variables stationnarity

Table 3. Study of variables stationnarity of the model

Country	GDP	CPI
Euro area	Integrated of order 1	Integrated of order 2
Hungary	Integrated of order 2	Integrated of order 1
Slovenia	Integrated of order 1	Integrated of order 1
Slovakia	Integrated of order 1	Integrated of order 1
Poland	Integrated of order 1	Integrated of order 1
Malta	Integrated of order 1	Integrated of order 1
Lithuania	Integrated of order 1	Integrated of order 1
Latvia	Integrated of order 2	Integrated of order 1
Czech	Integrated of order 1	Integrated of order 2
Bulgaria	Integrated of order 1	Integrated of order 1
Estonia	Integrated of order 1	Integrated of order 1
Croatia	Integrated of order 2	Integrated of order 1
Roumania	Integrated of order 2	Integrated of order 1

Source: our estimations

[16] However, for Romania and Croatia the data extend from the first quarter 1997 to the third quarters 2005.

All variables are integrated of order one except for Latvia whose (log of) GDP is integrated of order *two*, the Czech Republic whose consumer price index is integrated of order *two* and Hungary whose (log of GDP) is also integrated of order *two*.

In all the cases the VAR lag length introduced is *four* as indicated by information criteria. Thus identification diagram will be homogeneous for each country.

After the VAR estimation for the euro area (as a reference) and for each acceding country, structural demand and supply shocks are identified. Our main aim is to check if these economic shocks are symmetrical (asymmetrical) and if the new candidates to adhesion, form or are able to form an optimal currency area with the euro area. To reach this objective, after models estimation (for each country) and shocks identification, we carry out the correlation analysis of these shocks. Knowing that, a positive correlation is supposed to be a favourable criterion for the constitution of a monetary union.

2.2.2. Symmetry or Asymmetry of shocks

Table 4. Correlation Coefficients between euro area and acceding countries: Shocks specification.

Country	Supply shocks	Demand shocks
Euro area	1.000	1.000
Estonia	0.280413	0.376883
Hungary	0.255249	0.366702
Latvia	0.238848	0.395844
Lithuania	0.127847*	0.361129
Malta	0.359200	0.182020*
Poland	0.033626*	0.439294
Romania	-0.125608	0.078744*
Czech Republic	-0.037494	0.509900
Slovenia	0.241872	0.408526
Bulgaria	-0.392937	-0.048359*
Slovakia	-0.057729	0.099131*
Croatia	-0.101964	0.389543

***** These values are statistically non significant (5% of probability).

Source: our estimations

The table above represents the coefficients correlation values which measure the relation between supply and demand shocks in euro area and acceding countries. The first column

relates correlation between euro area supply shocks and those of Eastern and central European countries. The second column relates demand shocks correlation.

Concerning demand shocks, only one country, Bulgaria, presents a negative correlation with the euro area. The remainder correlation coefficients are positive, which could be considered as a sign of shocks symmetry (demand) induced by the government acceding countries policies. However, these coefficients are statistically not significant for Romania, Malta, and Slovakia.

Estonia, Czech Republic, Hungary, Slovenia, Poland, Croatia, Lithuania, and Latvia present the highest correlation values (between 0.3 and 0.57). On the other hand, results related to supply shocks are contrasted. Five countries out of twelve present a negative correlation of their supply shocks with those of the euro area; they are Croatia, Slovakia, Romania, the Czech Republic and Bulgaria. Estonia and Hungary have the best results.

So, in contrast to demand shocks, supply shocks are rather asymmetrical between the euro area and acceding countries.

2.2.3. Shocks size and adjustment:

Table 5. Standard deviation (size) of supply and demand shocks

Country	Supply shocks	Demand shocks
Euro area	0.007204	0.001965
Poland	0.043846	0.007287
Romania	0.080451	0.017044
Estonia	0.024354	0.007095
Hungary	0.033221	0.006658
Latvia	0.030718	0.005150
Lithuania	0.049390	0.006288
Malta	0.036359	0.005541
Czech Republic	0.031445	0.008222
Slovenia	0.016287	0.005401
Bulgaria	0.161952	0.225138
Slovakia	0.032196	0.015565
Croatia	0.041250	0.006775

Source: Our estimations

In addition to the determination of correlation and the symmetry of shocks, our methodology can be used to estimate the relative size of shocks. The larger the shock size is, the more

difficult to keep a fixed foreign exchange rate would be and the more constraining the adhesion to a monetary union would be. This is particularly true for supply shocks since they require more rigorous adjustment.

Table above (table n°5) presents variation (standard deviation) of demand and supply shocks in the euro area and in acceding countries. By observing the results of our estimation, we notice that concerning supply shocks, Estonia, Hungary and Slovenia have the smallest supply shocks sizes (variation between 2 and 3 percent). However this shocks size remains far from being equal to those of euro area countries.

Both Bulgaria and Romania have the largest size. In fact, these two countries are the subject of more important shocks, and, thus economic policies responses will certainly be different from those of the euro area.

However, for demand shocks, results are more optimistic: size shocks are similar to those of the euro area, except for Bulgaria, Romania, and Slovakia.

In summary, our estimation presents contrasted results, acceding countries present divergent target. We deduce that Hungary, Estonia and perhaps Slovenia are converging towards the euro area.

One result could be considered as an important one; it is about the positive correlation of demand shocks in the most part of the acceding countries. This result can be interpreted as good news, in other words acceding countries are making considerable efforts to join the euro area by the alignment of their economic policies to those of the euro area members.

Finaly, and concerning supply shocks divergence, the endogeneity hypothesis of OCA can emerge. So, supply shock asymmetry emphasizes the diversity of the productive structures. However if we believe the defenders of the OCA endogeneity hypothesis, these divergences will disappear (will be attenuated) once these countries become euro area members.

Conclusion:

Compared to earlier studies, our results stipulate that economic shocks are asymmetrical in acceding countries in comparison with the euro area countries. However, some countries as Hungary, Poland, Czech Republic and Estonia seem to be ready to adopt the Euro. Indeed, their supply shocks correlation coefficients are the highest one. In terms of demand shock, the results of our estimation are in favour of a better harmonization of economic policies and for an alignment of these polices to those of the euro area.

A priori, taking in to consideration the average, correlations between acceding countries and euro area members are far from being close, other factors should be involved to constitute an optimal currency area. Mobility of the production factors would be essential to maintain the adhesion processes.

To make conclusions from an economic policy point of views, some remarks can be taken into account:

The First one is related to Lucas (1976) criticism. Indeed, according to Lucas, changes in economic policies can lead to changes in economic structure, which could make difficult *ex ante* interpretation of economic policies based on *ex post* data.

Moreover, and in the context of the optimal currency area literature, Frankel and Rose (1997) suggest that the OCA could be endogenous. Monetary Union amplifies the trade intensity and can increase the degree of business cycles synchronization between members. In other words acceding countries can satisfy OCA criteria *ex post* even if they do not satisfy them *ex ante*.

The second remark is a technical one, due to Artis (2003), it concerns the problem of "*sufficiency*". Most of our empirical results are resulting from shocks correlations between countries, however no economic theory informs us about the sufficient value of the correlation coefficients in order to draw reliable conclusions.

Finally, it is important to emphasize that our analysis concerns a part of the optimal currency area. So, we assess the shocks symmetry between the euro area and acceding countries. Nevertheless, these economies can meet other obstacles in their target of joining the Euro area. We quote financial crises risk due to capital surge for example; this problem was already met by countries whose banking system was not reliable.

Bibliography :

- Artis, M. and Marcellino, M. 2003a. «Characterising the Business Cycle for Accession Countries ». [available at].URL:http://efn.uni-bocconni.it.
- Artis, M. 2003b. « Analysis of European and United Kingdom Business Cycles and Shocks ». [available at].URL:http://hm-treasury.gov.uk/media/1/B/addevon03_316.pdf.
- Artis, M., Marcellino, M. and Proietti, T. 2004. « Characterizing the Business Cycle for Accession Countries ». CEPR Discussion Papers. N° 4457. Centre for Economic Policy.
- Artis, M. and Zhang, W. 1995. « International Business Cycles and the ERM: Is there an European Business Cycle? ». CEPR Discussion Paper. N°1191. August.
- Bayoumi, T. and Eichengreen, B.1992. «Shocking Aspects of European Monetary Unification ». NBER Working Paper. 1992: 3649.
- Blanchard, O.J. and Quah, D.1989. « The Dynamic effects of Aggregate demand and Supply Disturbances ». American Economic Review. September.79.pp.655-673.
- Boone, L. 1998. « Symétrie des chocs en Union Européenne: Une analyse dynamique». Economie Internationale». CEPII, 70(2). pp. 7-34.
- Boone, L. and Maurel, M. 1998. « Economic Convergence of the CEECs with the EU ». CEPR Discussion Papers. N°2018. London.
- Boone, L. and Maurel, M. 1999. « An Optimal Currency Area Perspective of the EU Enlargement to the CEECs ». CEPR Discussion Papers. N°2119.
- Clarida, R. and Gali, J.1994. « Sources of Real Exchange Fluctuations: How Important are Nominal Shocks ». NBER Working Paper. N°4658. Cambridge.
- Darvas, Z. and Szapary, G. 2004. « Business Cycle Synchronization in the Enlarged EU: Comovements in the New and Old Members ». CEPR Discussion Paper. N°5179. Centre for Economic Policy Research. August.
- Dupasquier, Ch. and Jacob, J. 1997. « L'Union Economique et Monétaire Européenne : Généralités et Implications ».Bank of Canada Review. Automne 1997.
- Fidrmuc, J. and Korhonen, I. 2003. « Similarity of Supply and Demand Shocks between the Euro Area and the CEECs ». Economics Systems. N°27. pp. 313-334.
- Fidrmuc, J.and Korhonen, I. 2004. « The Euro Goes East: Implications of the 2000-2002 Slowdown for Synchronization of Business Cycles between the Euro Area and CEECs ». Comparative Economic Studies. 46(1). pp. 45-62.

- Frankel, J.A. and Razin, A. 1987. « The Mundell-Fleming Model a Quarter Century Later: A Unified Exposition ». Staff Papers. International Monetary Fund. Vol 11(December). pp. 567-620.
- Frankel, J.A. and Rose, A.K. 1997. « The Endogeneity of the Optimum Currency Area Criteria ». The Economic Journal. 108. pp.1009-1025.
- Frenkel, M. and Nickel, C. 2002. « How Symmetric are the Shocks and the Shocks Adjustment Dynamics between the Euro Area and Central and Eastern Europe? ». IMF Working Paper. 2002: WP/02/222.
- Frenkel, M., Nickel, C. and Schmidt, G. 1999. « Some Shocking Aspects of EMU Enlargement ». Research Note. N°99-4. Deutsche Bank. Frankfurt.
- Funke, M.1997. « How Important are Demand and Supply Shocks in Explaining German Business Cycles? New evidence on an Old Debate ». Economic Modelling. N°14. pp. 11-37.
- Funke, M. 2000. « Macroeconomic Shocks in Euroland vs the UK: Supply, Demand, or Nominal ? ». Quantitative Macroeconomics Working Paper. Hamburg University. pp. 1-19.
- Hartely, P.R. and Whitt, j.2003. « Macroeconomic fluctuations: Demand or Supply, Permanent or Temporary? ». European Economic Review. 47(1). pp. 61-94.
- Horvath, J. and Ratfai, A. 2004. « Supply and Demand Shocks in Accession Countries to the Economic and Monetary Union ». Journal of Comparative Economics. 32(2). pp. 203-211.
- Kenen, P.B. 1969. « The Optimum Currency Area: An Electric View ». In Mundell R.A., Swoboda A. (Eds). *Monetary Problems of the International Economy*. University of Chicago Press. Chicago.
- Korhonen, I. 2003. « Some Empirical Tests on the Integration of Economic Activity between the Euro Area and the Accession Countries: A note ». Economics of Transition. 11(1). pp. 1-20.
- McKinnon, R. 1963. « Optimum Currency Areas ». American Economic Review. 53(4). pp. 717-725.
- Mundell, R. 1961. « A Theory of Optimum Currency Areas ». American Economic Review 51(4). pp. 657-665.
- Pamies, S. 2002. « Chocs asymétriques et variables d'ajustement au sein de l'UEM : Vers la mise en place d'instruments fédéraux ? ». Revue des Affaires Européennes. Vol 2001-2002(2).

- Ramos, R. and Surinach, J. 2004. « Shocking Aspects of European Enlargement ». Eastern European Economics. 42(5). pp. 36-57.
- Ratfia, A., Koren, M. and Benczur, P. 2004. « The Transmission of Euro Zone Shocks to CEECs ». [available at].URL:http://cerge-ei.cz /pdf/gdn/RRCIII_102_paper_03.pdf.
- Rondeau, F.2004. « Echanges Commerciaux et Transmission des chocs en Europe ». article présenté lors de la conférence intitulée Doctoriales en Economie et Finance Internationale. Paris le 18 et 19 Novembre 2004.
- Sarte, P.D.1997. « On the Identification of Structural Vector Auto regressions ». Federal Reserve Bank of Richmond. Economic Quarterly. Volume 83. pp. 45-68.
- Tavlas, G.S. 1993. « The New Theory of Optimum Currency Areas ». The World Economy. 16(6). pp. 663-685.