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Optimum Currency Area and the enlargement of the euro zone to the East

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Abstract

The 1st May 2004, ten countries entered in the European Union. These new member states are expected to adopt the euro when they will be ready to do so, but not immediately upon accession. In order to enter in the euro area, those countries will have to respect the convergence criteria that were applied to the current members of the euro area. The timing of the enlargement of the euro zone to those countries is thus a core policy issue.

The optimum currency area theory is a natural starting point to analyze this kind of issue. So the first part of the paper briefly recalls the main characteristics of optimum currency areas and outlines some stylized facts related to those criteria.

Among the characteristics of optimum currency areas, the similarity of shocks can be considered as a "meta-property" (i.e. when a group of countries is hit by a similar shock, this group of countries forms an optimum currency area even if the other characteristics usually required to be considered as an optimum currency area are not observed within this group of countries). Starting from this, in the second part of the paper, we measure not only the correlation and the variance of business cycles but also the correlation of demand and supply shocks in the western and eastern parts of Europe.

Finally, on the base of this analysis, we conclude that an early accession to the euro area seems plausible for some accession countries.

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1. Introduction

The 1st May 2004, ten countries entered in the European Union (EU). These new member states are expected to adopt the euro when they will be ready to do so, but not immediately upon accession. The timing of the enlargement of the euro zone to those countries is thus a core policy issue.

The optimum currency area theory (OCA) is a natural starting point to analyze this kind of issue. The first part of the paper describes the main characteristics of OCA and outlines stylized facts related to those criteria.

Among the characteristics of OCA, the similarity of shocks has often been presented as a "meta-property" (i.e. when this characteristic is observed in a group of countries, this group of countries forms an optimum currency area even if the other characteristics are not observed within this group of countries). Starting from this "meta-property", we use a simple AD-AS model to estimate demand and supply shocks in European countries. We also compare those results with a classic measure of business cycles correlation in the Western and Eastern parts of Europe and with results for the euro zone member countries based on longer time series.

2. The optimum currency area theory: a brief review

The optimum currency area theory has initially been developed during the sixties. This strand of literature highlighted the conditions under which various regions could share the same currency without problem. Those conditions are called OCA criteria. The most often cited OCA criteria are: mobility of labor, wage and price flexibility, fiscal integration, mobility of capital, integration of financial markets, degree of openness, diversification in production and consumption, similarities between inflation rates and the similarities between economic shocks.

Those criteria are briefly summarized below.

When a currency union is created, the exchange rate can no longer be used as a policy instrument to resolve a crisis. Hence, when a currency union is created other ways of adjustment have to be used.

- **Mobility of labor**: when labor mobility is effective, asymmetric shocks in one country included in a monetary union which bring about a higher rate of unemployment in this country can easily be softened. Unemployed workers will move from this country to other member countries. This movement of labor ensures the equilibrium of labor markets in the monetary union. The diversity of language in Europe could be an obstacle in labor mobility. Before the enlargement of Europe, the European Union had 11 official languages. Now, after the enlargement, there are 20 official languages in the EU.

But labor mobility is not the sole criteria. Wage and price flexibility could be an alternative way to adjust the labor market.

- **Wage and price flexibility**: another way to resolve the increase in unemployment in the country struck by an adverse asymmetric shock is a decrease in wages, which increases demand for labor at the new prevailing wage and reduces unemployment. Labor unions are very active in some European countries. The social safety net is well developed in some European countries and wages are regulated. As output prices depend on variable cost, wage and price flexibility could be quite limited in some European countries.

- **Fiscal integration**: if national automatic stabilizers work in the wake of adverse shocks, the need for other types of adjustments described in this survey of OCA criteria –such as mobility of factor of production, supranational fiscal transfers, international risk sharing through the financial system, changes in wages and prices- are somewhat reduced. But countries in the euro zone are now complying with the Stability and Growth Pact (SGP), which limits their deficit to 3% of their GDP. The recent crisis of the SGP last November shows that some countries find this ceiling too compelling. In Europe, supranational fiscal transfers are quite limited. The total EU budget approximately amounts to 100 milliards euro, which barely corresponds to 1% of the GNI in EU countries. Hence, in the euro zone, fiscal policy could be unable to resolve a crisis if countries were hit by an adverse shock.

- **Mobility of capital**: In theory, capital mobility will increase the supply of capital in countries with a higher marginal productivity of capital. Consequently, with decreasing marginal productivities, capital mobility will bring marginal productivities of capital to the same level and will lead those countries to the same level of economic development. In Europe, capital mobility is quite high; capital controls have progressively been removed.

- **Integration of financial markets**: financial market integration is often presented as a way to share risk. When economic agents hold financial assets from different countries, they hold more diversified portfolios, which reduced their risk exposure. Cross-countries ownership of assets increases when economies become more integrated and plays an insurance role.

Those criteria described the adjustments or the protective measures that can be used when the exchange rate instrument is not available. Nevertheless, when exchange rate adjustments are neither useful nor necessary, a currency union can also be created. The criteria described below belong to this group.

- **Degree of openness**: it has often been attested that the cost of relinquishing one's national currency declines with the degree of openness. The degree of openness can be measured by the ratio of foreign trade to GDP. This ratio is quite high in European countries. In open country, a depreciation of the national currency will increase the domestic price of foreign goods and services. This increase in the price of foreign goods will reduce the purchasing power of domestic residents and the latter will require an increase in wages. Moreover, in open country, foreign goods and services can be used as input. Hence, the depreciation of the national currency increases the firm costs and will quite quickly lead to price increases. In closed countries, the upward pressure on wages and domestic prices will be less important.

- **Diversification in production**: when the structure of production is quite similar, asymmetric shocks are less threatening because a shock in one sector will not be observed in a single country of the monetary union but the same sector will be hit in all countries. The following table shows the diversification in production in EU countries.

Countries, year 2001	Agriculture et fishing	Industry	Services
Austria	2.1	31.6	66.3
Belgium	1.4	26.6	72.0
Cyprus	4.0	19.9	76.1
Czech Republic	4.3	39.4	56.3
Denmark	2.5	25.3	72.2
Estonia	6.3	28.2	65.5
Euro zone 2001	2.4	27.7	69.9
Finland	3.5	33.3	63.1
France	2.8	25.4	71.7
Germany	1.2	30.4	68.5
Greece	7.3	20.4	72.3
Hungary	4.1	33.9	62.0
Ireland	4.2	42.4	53.4
Italy	2.8	28.3	68.9
Latvia	4.5	25.7	69.8
Lithuania	8.4	30.8	60.8
Luxembourg	0.7	19.4	79.9
Malta	2.8	33.3	63.9
Netherlands	2.6	26.2	71.1
Poland	3.7	35.0	61.3
Portugal	3.6	29.0	67.4
Slovak Republic	4.5	34.2	61.4
Slovenia	3.2	37.5	59.3
Spain	3.5	29.2	67.3
Sweden	1.7	27.3	70.9
United Kingdom	1.0	27.5	71.5

Source: IMF

- **Similarities in inflation rates**: when prices increase at the same pace in different countries, no exchange rate realignment is needed to preserve their competitiveness. Inflation rates in EU countries are presented in the following table. Inflation rates have declined but the rate of price increase is still high in some countries. This could be due to the Samuelson-Balassa effect. Those differences in inflation rates could thus reflect a "catching up" process.

COUNTRYNAME	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AUSTRIA	3.6	3.0	2.3	1.8	1.3	0.9	0.6	2.4	2.7	1.8	1.28
BELGIUM	2.8	2.4	1.5	2.1	1.6	1.0	1.1	2.5	2.5	1.6	1.71
CYPRUS	4.9	4.7	2.6	3.0	3.6	2.2	1.6	4.1	2.0	2.8	2.25
CZECH REPUBLIC	n.a.	10.0	9.2	8.8	8.5	10.6	2.1	3.9	4.7	1.8	0.99
DENMARK	1.3	2.0	2.1	2.1	2.2	1.9	2.5	2.9	2.4	n.a.	1.22
ESTONIA	89.8	47.7	28.8	23.1	10.6	8.2	3.3	4.0	5.7	3.6	1.22
EURO AREA	n.a.	n.a.	n.a.	n.a.	n.a.	1.1	1.1	2.3	2.5	2.3	2.1
FINLAND	2.1	1.1	1.0	0.6	1.2	1.4	1.2	3.4	2.6	1.8	1.2
FRANCE	2.1	1.7	1.8	2.0	1.2	0.7	0.5	1.7	1.6	1.9	2.4
GERMANY	4.4	2.8	1.7	1.4	1.9	0.9	0.6	1.9	2.5	1.3	1.1
GREECE	14.4	10.9	8.9	8.2	5.5	4.8	2.6	3.2	3.4	3.6	3.1
HUNGARY	22.5	18.9	28.3	23.4	18.3	14.2	10.0	9.8	9.1	n.a.	5.6
IRELAND	1.4	2.4	2.5	1.7	1.4	2.4	1.6	5.6	4.9	4.7	2.9
ITALY	4.5	4.0	5.2	4.0	2.0	2.0	1.7	2.5	2.8	2.5	2.5
LATVIA	108.8	35.9	25.0	17.6	8.4	4.7	2.4	2.7	2.5	1.9	3.5
LITHUANIA	410.2	72.2	39.7	24.6	8.9	5.1	0.8	1.0	1.2	0.3	-1.3
LUXEMBOURG	3.6	2.2	1.9	1.4	1.4	1.0	1.0	3.1	2.7	2.1	2.4
MALTA	4.1	4.1	4.0	2.5	3.1	2.4	2.1	2.4	2.9	n.a.	0.7
NETHERLANDS	2.6	2.8	1.9	2.0	2.2	2.0	2.2	2.5	4.5	3.5	1.6
NORWAY	2.3	1.4	2.5	1.3	2.6	2.3	2.3	3.1	3.0	1.3	0.1
POLAND	36.9	33.3	28.1	19.8	15.1	11.7	7.3	10.1	5.5	n.a.	1.6
PORTUGAL	6.8	4.9	4.1	3.1	2.2	2.8	2.3	2.9	4.4	3.6	2.3
SLOVAK REPUBLIC	n.a.	13.4	9.9	5.8	6.1	6.7	10.6	12.0	7.3	n.a.	9.3
SLOVENIA	31.7	21.0	13.5	9.9	8.4	7.9	6.2	8.9	8.4	n.a.	4.7
SPAIN	4.6	4.7	4.7	3.6	2.0	1.8	2.3	3.4	3.6	3.1	2.7
SWEDEN	4.6	2.2	2.5	0.5	0.5	-0.1	0.5	1.0	2.4	2.2	1.8
SWITZERLAND	3.3	0.9	1.8	0.8	0.5	0.1	0.7	1.6	1.0	0.6	0.6
UNITED KINGDOM	1.6	2.5	3.4	2.4	3.1	3.4	1.6	2.9	1.8	1.6	1.3

Source: IMF

o **Similarities in economic shocks**: Mongelli (2002) presents the similarity of shocks and policy responses to shocks as a meta-criterion, capturing interaction between several properties. This is due to the fact that differentiated and open economies are likely to endure more differentiated and, possibly, smaller unit shocks. Moreover, if countries are struck by identical shocks, exchange rate adjustment is not the appropriate response. In order to test this criterion, we have measured the similarity of shocks between some members of the European Union. This has been done with 2 methodologies. The first one relies on the similarities of the business cycles observed in those countries, the second one corresponds to the Blanchard and Quah – Svar approach.

3. Empirical analysis

3.1. Business cycles between EU countries

In order to determine whether countries are subjected to the same shocks, it is possible to measure how they growth over time. Economies tend to fluctuate around their long-run trend. The fluctuations around their trend growth correspond to their business cycle. The Hodrick-Prescott (HP) filter, proposed by Hodrick and Prescott (1997) is extensively used in the business-cycle literature. This method is described below.

Technically, the HP method computes a smoothed series $\bar{y}$ of y by minimizing the variance of y around $\bar{y}$, subject to a penalty that constrains the second difference of $\bar{y}$.

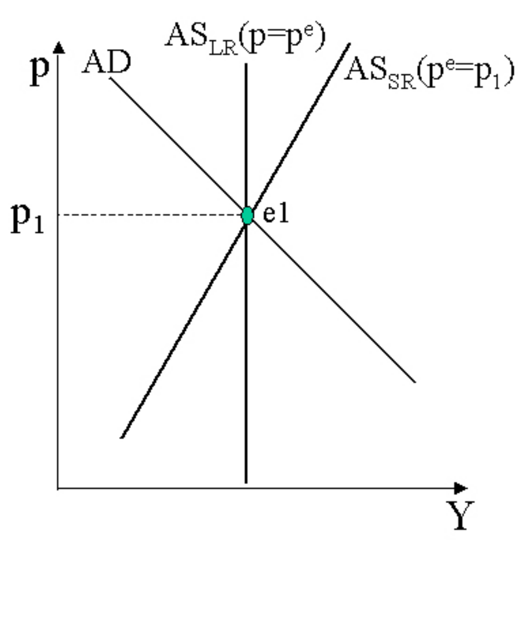
$$\underset{\bar{y}}{\text{Min}} \sum_{t=1}^{T}\left(y_{i,t}-\bar{y}_{i,t}\right)^{2}+\lambda\sum_{t=2}^{T-1}\left(\left(\bar{y}_{i,t+1}-\bar{y}_{i,t}\right)-\left(\bar{y}_{i,t}-\bar{y}_{i,t-1}\right)\right)^{2}$$

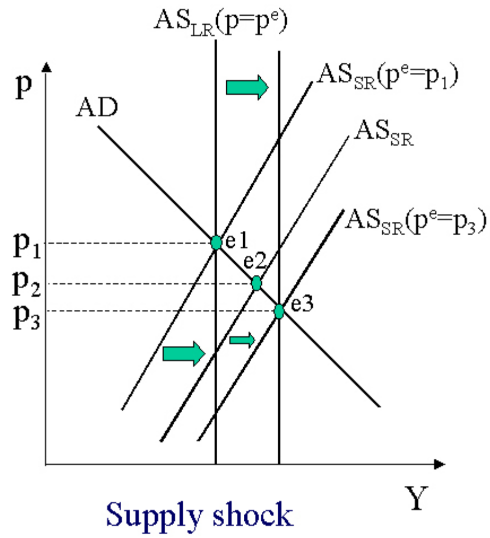
The penalty parameter λ controls the smoothness of the series $\bar{y}$. The larger the λ, the smoother the $\bar{y}$ and as λ tends to infinity, $\bar{y}$ approaches a linear trend. We choose $\lambda = 1600$ which is the recommended value for quarterly data. The business cyclical component is simply $\hat{y}_{i,t} = y_{i,t} - \bar{y}_{i,t}$.

3.2. Supply and demand shocks in EU countries

The asymmetry of shocks can also be measured by the methodology developed by Blanchard and Quah (1989) and Bayoumi and Eichengreen (1992). This methodology extracts from price and output data the underlying demand and supply shocks. Once those supply and demand shocks have been computed for each country, their correlation with the supply and demand of the euro zone can be measured.

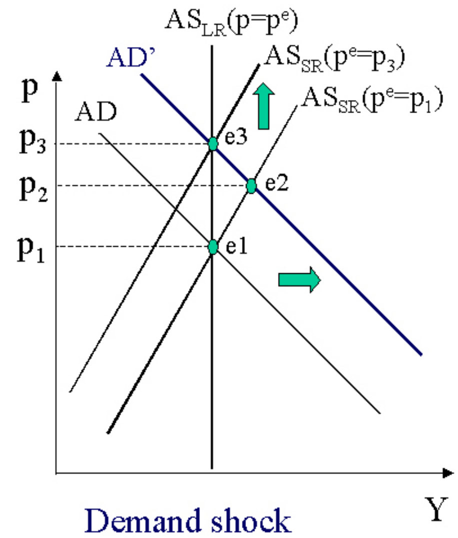
This methodology is based on the AD-AS model. The aggregate demand curve (labeled AD) is downward sloping in the price output plane, reflecting the fact that lower prices, by rising money balances, boost demand. The short run aggregate supply curve (SRAS) is upward sloping, reflecting that higher prices reduce real wages as wages are sticky. The long run supply curve (LRAS) is vertical, since real wages adjust to changes in prices in the long run. Economic textbooks usually offer a detailed description of this model. In this AD-AS model, supply shocks result in permanent changes in output while demand shocks have no long run effect on output. Moreover, demand and supply shocks have different effects on prices, positive demand shocks raise prices while positive supply shocks reduce them. Using a VAR, it is possible to decompose permanent and temporary shocks to a variable.





A favorable technology shock move rightwards long run and short run supply curve by the same amount. The short run effect raises output and reduces prices, shifting the equilibrium from e_1 to e_2. In e_2, prices have decreased and economic agents modify their price expectations taking the observed price increase into account. Consequently, the aggregate supply curve shifts down. The final equilibrium is e_3.

Figure 3



A shock to aggregate demand shits the aggregate demand curve from AD to AD', resulting in a move in the equilibrium from the initial point e_1 to e_2. In e_2, prices have risen and economic agents modify their price expectations taking the observed price increase into account. Consequently, the aggregate supply curve shifts up. The final equilibrium is e_3.

Figure 4

Supply shocks, $\varepsilon_{s,t}$, and demand shocks, $\varepsilon_{d,t}$, affect economic growth, Δy_t, (measured below as the GDP growth rate) and inflation, Δp_t, (measured below as the CPI growth rate). The Blanchard and Quah decomposition assume that this supply and demand model can be represented by an infinite moving average representation:

$$\begin{bmatrix}\Delta y_t\\ \Delta p_t\end{bmatrix}=\begin{bmatrix}b_{11,0} & b_{12,0}\\ b_{21,0} & b_{22,0}\end{bmatrix}\begin{bmatrix}\varepsilon_{d,t}\\ \varepsilon_{s,t}\end{bmatrix}+\begin{bmatrix}b_{11,1} & b_{12,1}\\ b_{21,1} & b_{22,1}\end{bmatrix}\begin{bmatrix}\varepsilon_{d,t-1}\\ \varepsilon_{s,t-1}\end{bmatrix}+\ldots+\begin{bmatrix}b_{11,n} & b_{12,n}\\ b_{21,n} & b_{22,n}\end{bmatrix}\begin{bmatrix}\varepsilon_{d,t-n}\\ \varepsilon_{s,t-n}\end{bmatrix}+\ldots$$

where Δy_t and Δp_t are stationary and where the variance-covariance matrix of shocks, Σ_ε, is

$$\Sigma_\varepsilon=\begin{bmatrix}\mathrm{var}(\varepsilon_{d,t}) & \mathrm{cov}(\varepsilon_{d,t},\varepsilon_{s,t})\\ \mathrm{cov}(\varepsilon_{d,t},\varepsilon_{s,t}) & \mathrm{var}(\varepsilon_{s,t})\end{bmatrix}=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$$

Using the lag operator L and assuming that $B_i=\begin{bmatrix}b_{11,i} & b_{12,i}\\ b_{21,i} & b_{22,i}\end{bmatrix}$, this infinite moving average process can be written as:

$$\begin{bmatrix}\Delta y_t \\ \Delta p_t\end{bmatrix} = \sum_{i=0}^{\infty} L^i B_i \begin{bmatrix}\varepsilon_{d,t} \\ \varepsilon_{s,t}\end{bmatrix}$$

As demand shocks have a temporary effect on output, we can consider that $\sum_{i=0}^{\infty} b_{11,i}\varepsilon_{d,t-i} = 0$

Since demand and supply shocks are not observed, the problem is to recover them from VAR estimation

$$\begin{bmatrix}\Delta y_t \\ \Delta p_t\end{bmatrix} = \begin{bmatrix}\chi_{11,1} & \chi_{12,1} \\ \chi_{21,1} & \chi_{22,1}\end{bmatrix}\begin{bmatrix}\Delta y_{t-1} \\ \Delta p_{t-1}\end{bmatrix} + \begin{bmatrix}\chi_{11,2} & \chi_{12,2} \\ \chi_{21,2} & \chi_{22,2}\end{bmatrix}\begin{bmatrix}\Delta y_{t-1} \\ \Delta p_{t-1}\end{bmatrix} + \ldots + \begin{bmatrix}\chi_{11,n} & \chi_{12,n} \\ \chi_{21,n} & \chi_{22,n}\end{bmatrix}\begin{bmatrix}\Delta y_{t-n} \\ \Delta p_{t-n}\end{bmatrix} + \begin{bmatrix}e_{d,t} \\ e_{s,t}\end{bmatrix}$$

But it can be shown that those VAR residuals are composites of the pure innovations. The VAR residuals are the one-step ahead forecast error of $y_{i,t}$:

$$\begin{bmatrix}e_{d,t} \\ e_{s,t}\end{bmatrix} = \begin{bmatrix}\Delta y_t \\ \Delta p_t\end{bmatrix} - E_{t-1}\begin{bmatrix}\Delta y_t \\ \Delta p_t\end{bmatrix}$$

From the Bivariate Moving Average process, this can be written:

$$\begin{bmatrix}e_{d,t} \\ e_{s,t}\end{bmatrix} = B_0 \begin{bmatrix}\varepsilon_{d,t} \\ \varepsilon_{s,t}\end{bmatrix}$$

If the 4 elements of B_0 can be identified, it is possible to recover the supply and demand shocks from the regression residuals. Blanchard and Quah showed that four component of the matrix B_0 could be identified by the following four restrictions:

The third first restrictions are based on the variance-covariance matrix of the shocks, Σ_ε, and on the variance-covariance matrix of the error term, Σ_e. The latter equation can be used to write:

$\Sigma_e = B_0' B_0 \Sigma_\varepsilon$

Hence,

Restriction 1: $\text{var}(e_{d,t}) = b_{11,0}^2 + b_{12,0}^2$

Restriction 2: $\text{var}(e_{s,t}) = b_{21,0}^2 + b_{22,0}^2$

Restriction 3: $\text{cov}(e_{d,t}, e_{s,t}) = b_{11,0}b_{21,0} + b_{12,0}b_{22,0}$

The fourth restriction comes from the absence of the impact of demand shocks on output in the long run. A detailed explanation is given in the appendix.

Restriction 4: $\left[1-\sum_{i=0}^{n}\chi_{22,i}\right]b_{11,0}+\sum_{i=0}^{n}\chi_{12,i}b_{21,0}=0$

3.3. Description of the data

Data are obtained from the IMF's International Financial Statistics and are quarterly for the period 1993:1-2001:4. The choice of the sample and of the selected countries has been determined by the availability of the data. The countries included in the analysis are: Austria, Belgium, Cyprus, The Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Netherlands, Norway, Portugal, Slovenia, The Slovak Republic, Spain, Sweden, Switzerland and the United Kingdom. This means that the analysis concern 23 countries, including the 15 initial members of the European Union, 2 members of the EFTA[1] (Switzerland and Norway) and 6 new EU members (Cyprus, The Czech republic, Hungary, Lithuania, Slovenia and The Slovak Republic).

Below, those data are abbreviated in the following way: Austria (AUS), Belgium (BEL), Cyprus (CYP), The Czech Republic (CZE), Denmark (DEN), Finland (FIN), France (FRA), Germany (GER), Greece (GRE), Hungary (HUN), Ireland (IRE), Italy (ITA), Lithuania (LIT), Luxembourg (LUX), Netherlands (NET), Norway (NOR), Portugal (POR), Slovenia (SLO), The Slovak Republic (SLR), Spain (SPA), Sweden (SWE), Switzerland (SWI) and the United Kingdom (UKI).

Price, denoted by P, is measured by the consumer price index. Output, denoted by Y, is measured by industrial production. An aggregate series has been constructed for the euro zone. This series corresponds to the weighted average of the industrial production index observed in the Euro zone member countries.

$$Y_{EU12,t}=\sum_{i=1}^{12}w_{i,t}Y_{i,t}\quad\text{where}\quad w_{i,t}=\frac{GDP_{i,t}}{\sum_{i=1}^{12}GDP_{i,t}}$$

It is important to note that the results presented in section 4 are based on the evolution of the industrial production which does not cover all the sectors of the economy. The industrial production (IP) index measures the real output of the manufacturing, mining, and electric and gas utilities industries. The sector of services which contributes for the most part of GPD is not included in this statistics, nor the sector of agriculture (even if the size of this sector is relatively larger in some new EU members). Consequently, the results presented in this paper only give the degree of similarities between the industrial sectors of the countries included in this analysis. Nevertheless, as mentioned by Lobo et al. (1999), this choice is pertinent because the industrial sector is highly exposed to international competition due to its greater openness. Although it represents a limited share of GDP, manufactured goods account for a considerable proportion of total export and import in EU countries (around

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[1] EFTA includes 4 members: Iceland, Liechtenstein, Norway and Switzerland (http://www.efta.int)

75%). Hence the process towards a future extension of the euro zone is likely to have more effect on this sector.

4. Empirical results

4.1. Similarities in business cycles

Since the influential work of Hodrick and Prescott (developed in 1980 and published in 1997), it has become increasingly popular to characterize the behavior of macroeconomic variables over the business cycle with their method.

Below, we measure the correlation of the business cycles in the 23 countries included in our sample with the average business cycle in the euro zone. This correlation is denoted by $\rho_{i€}$. We also compare the variance of the business cycles in those 23 countries with the variance of the business cycle in the euro zone. This measure of the relative variance is denoted by $\sigma_i^2 / \sigma_€^2$.

Results are presented in the following tables.

Countries	$\rho_{i€}$
GER	0.926238
SPA	0.879187
FRA	0.822083
ITA	0.814943
SWE	0.781729
DEN	0.725844
SLO	0.694975
FIN	0.685154
UKI	0.634284
AUS	0.559618
NET	0.505112
HUN	0.444697
CYP	0.434485
SWI	0.391477
LUX	0.357317
SLR	0.320903
NOR	0.280717
BEL	0.277071
GRE	0.265988
CZE	0.176734
IRE	0.132338
POR	0.014664
LIT	-0.20259

Countries	$\sigma_i^2 / \sigma_€^2$
UKI	0.404
NET	0.742
FRA	0.945
GER	1.295
ITA	1.628
SWI	1.667
SLO	2.004
SPA	2.016
AUS	2.036
DEN	2.069
NOR	2.100
FIN	2.292
GRE	2.632
SWE	2.788
LUX	3.692
POR	4.122
CYP	4.772
BEL	4.898
SLR	6.114
CZE	8.982
HUN	14.425
IRE	26.451
LIT	45.217

On the basis of those results, we can make some comments:

- Large euro zone member countries are highly correlated with the euro area. This is the case for Germany, Spain, France and Italy. This is not too surprising because those countries make up a significant part of the euro area.
- All countries show a positive correlation of their business cycles with the business cycle of the euro area, except Lithuania. This result is consistent with the finding of Korhonen and Fidrmuc (2001).
- The relative variance (i.e. the variance of the business cycles in those countries divided by the variance observed in the euro zone, denoted by $\sigma_i^2 / \sigma_€^2$) is very high in some countries. This could possibly be explained by the fact that those economies are less diversified[2].
- The business cycles in Slovenia, Hungary and Cyprus seem quite well correlated with the business cycles in the euro area.
- The correlations with the euro area could seem surprisingly low in some countries belonging to the euro zone, but our results are consistent with those found for those countries by Karras and Stokes (2001) on the same period. Those authors explain this phenomenon by the fact that countries as Ireland, Netherlands, Belgium and Luxembourg have probably experienced a drop in the correlation of their business cycles in the beginning of the nineties. This could be due to the ERM crisis or due to the German reunification.

As our sample was quite limited due to the availability of the data, we do not have tested whether those correlations vary over time[3].

4.2. Similarities in supply and demand shocks

In order to apply the Bayoumi and Eichengreen methodology, we first have computed the rate of growth in industrial production and prices. This has been done in order to work with stationary variable.

VAR have been estimated with two lags on the basis of the Schwarz information criteria.

In the picture below, each point represents the correlation coefficient of demand shock (vertical axis) and supply shocks (horizontal axis) with the average demand and supply shocks in the euro area.

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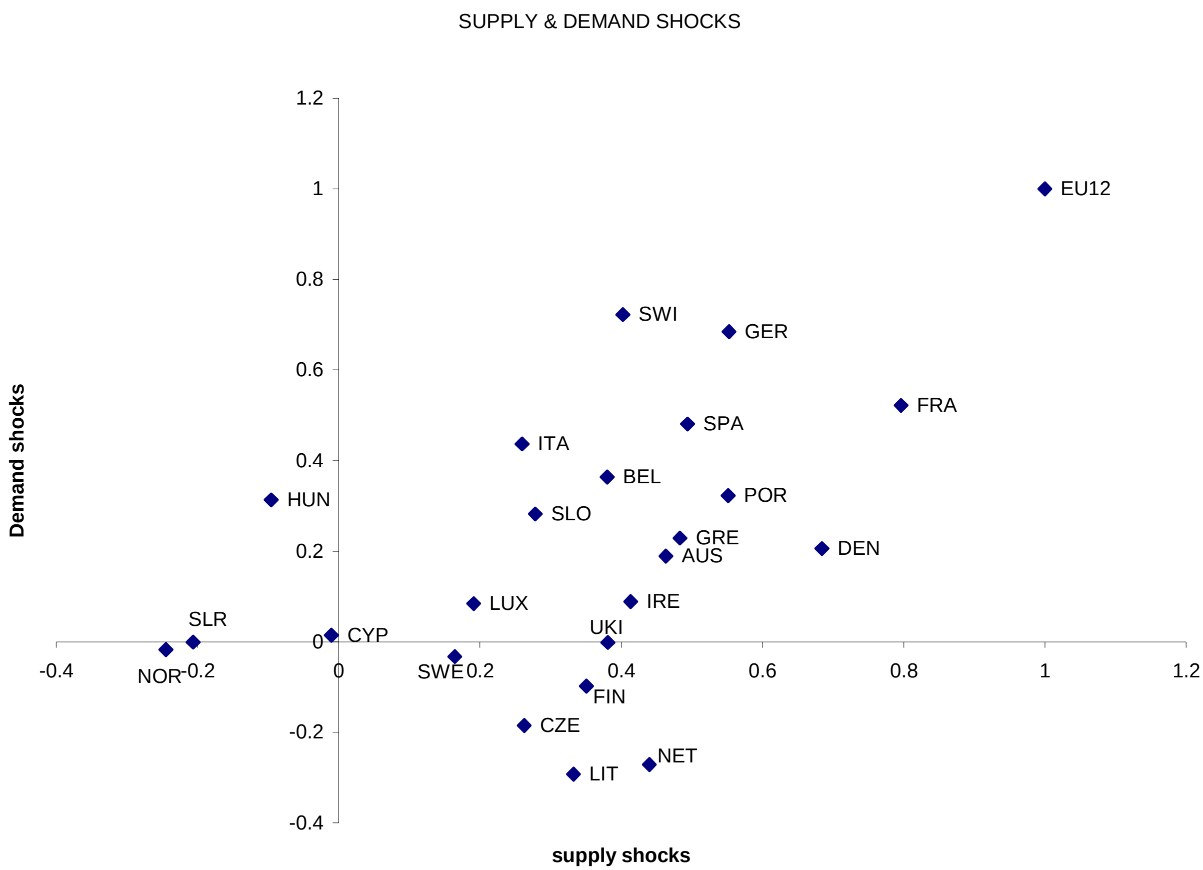
[2] Cf. Kose, Prasad and Terroness (2003), "How does Globalization affect the synchronization of business cycles", IZA DP, n°702, January.

[3] Nevertheless, the analysis of Karras and Stokes (2001) shows that this kind of criteria is not time invariant. They estimated time-varying parameters $\sigma_{i,t}^2, \sigma_{€,t}^2$, and $\rho_{i€,t}$, computing them for consecutive "rolling" windows of fixed length, k (they chosen k=48 quarters). This exercise allows an assessment of how those variances and correlations evolve over time. They results show that the correlations, $\rho_{i€,t}$ and the relative variances, $\sigma_{i,t}^2 / \sigma_{€,t}^2$, have exhibited significant variability over time.



This methodology permits to decompose the economic shocks, which could explain why the economic activity deviates from this long run trend, in supply and demand shocks. Hence, this model determines two kinds of perturbations: shocks that affect the demand curve (for example, due to monetary or fiscal policy changes, or even due to modifications in consumer behaviors) and shocks that affect the supply curve (for example, technological changes).

On the basis of those results, we can also make some comments:

- As previously, Lithuania seems to exhibit the lowest correlation with the euro zone, but here in terms of demand shocks. This could be due to the fact that, during the period analyzed, Lithuania changed its exchange rate regime from independent float to currency board in 1993. This change could explain the strong negative correlation found for this country. The Czech Republic made a change in the opposite direction: from fixed peg to float.[4]

- Lithuania and the Czech Republic seem also close to Finland and the Netherlands. The low correlation of demand shocks in the Netherlands and in Finland with demand shocks observed in the euro zone is a priori puzzling. Nevertheless, performing the Bayoumi-Eichengreen analysis on the initial 15 EU members for the period 1973-2002 on the basis of the annual growth rates of GDP and prices, we observe that those countries seem to exhibit a higher correlation of their supply shocks during the last 10 years than in the past; those results are presented in Gilson (2004). In contrast, their demand shocks seem less correlated than in the past. This could be explained by the restrictive budgetary policies followed by those countries in order to satisfy the Stability and Growth Pact. The graph presented in the appendix shows that countries like the Netherlands and Finland experienced strong restrictive budgetary policies.
- As previously, large member countries in the euro zone are highly correlated with the euro area, whatever the methodology applied to the data. This is the case for France, Germany, Italy and Spain. As mentioned above, this is not too surprising because those countries make up a significant part of the euro area.
- Finally, supply and demand shocks in Slovenia seem as well correlated with the average shocks in the euro zone as Ireland or Greece.

5. Conclusion

We can observe that the two methodologies presented here lead to similar conclusions: large member countries in the euro zone are highly correlated with the euro area and Slovenia seems quite well correlated with some members of the euro zone. This analysis shed some light on the similarities between new entrants and other EU countries, but some questions could be more deeply investigated. For example: What are the determinants of the business cycles correlation or of the correlation of shocks in Europe? How can we explain their evolution over time? If the costs of being member of a monetary union increase when economies are less correlated, those questions are important issues. This analysis will be extended in those directions and will also be enlarged in order to take into account a larger set of countries (actually Estonia, Latvia, Malta and Poland have not been included in this analysis because of the lack of data).

6. References

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[4] Hungary also changed its exchange rate regime during this period but the change was less radical. It moved from fixed peg to crawling bands. While the Slovak Republic changed its exchange rate regime from fixed peg to managed float.

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7. Appendix

SVAR approach: explanation of the 4th restriction:

We estimate the following VAR:

$$\begin{bmatrix}\Delta y_t\\ \Delta p_t\end{bmatrix}=\begin{bmatrix}\chi_{11,1} & \chi_{12,1}\\ \chi_{21,1} & \chi_{22,1}\end{bmatrix}\begin{bmatrix}\Delta y_{t-1}\\ \Delta p_{t-1}\end{bmatrix}+\begin{bmatrix}\chi_{11,2} & \chi_{12,2}\\ \chi_{21,2} & \chi_{22,2}\end{bmatrix}\begin{bmatrix}\Delta y_{t-1}\\ \Delta p_{t-1}\end{bmatrix}+\ldots+\begin{bmatrix}\chi_{11,n} & \chi_{12,n}\\ \chi_{21,n} & \chi_{22,n}\end{bmatrix}\begin{bmatrix}\Delta y_{t-n}\\ \Delta p_{t-n}\end{bmatrix}+\begin{bmatrix}e_{d,t}\\ e_{s,t}\end{bmatrix}$$

That can be rewritten as:

$$\begin{bmatrix}\Delta y_t\\ \Delta p_t\end{bmatrix}=\sum_{i=0}^{n}X_{i+1}L^{i+1}\begin{bmatrix}\Delta y_t\\ \Delta p_t\end{bmatrix}+\begin{bmatrix}e_{d,t}\\ e_{s,t}\end{bmatrix}$$

$$\left[I-\sum_{i=0}^{n}L^{i+1}X_{i+1}\right]\begin{bmatrix}\Delta y_t\\ \Delta p_t\end{bmatrix}=\begin{bmatrix}e_{d,t}\\ e_{s,t}\end{bmatrix}\Rightarrow\begin{bmatrix}\Delta y_t\\ \Delta p_t\end{bmatrix}=\left[I-\sum_{i=0}^{n}L^{i+1}X_{i+1}\right]^{-1}\begin{bmatrix}e_{d,t}\\ e_{s,t}\end{bmatrix}$$

Denoting by D the determinant of $\left[I-\sum_{i=0}^{n}L^{i+1}X_{i+1}\right]$, we can write,

$$\begin{bmatrix}\Delta y_t\\ \Delta p_t\end{bmatrix}=\frac{1}{D}\begin{bmatrix}1-\sum_{i=0}^{n}\chi_{22,i+1}L^{i+1} & \sum_{i=0}^{n}\chi_{12,i+1}L^{i+1}\\ \sum_{i=0}^{n}\chi_{21,i+1}L^{i+1} & 1-\sum_{i=0}^{n}\chi_{11,i+1}L^{i+1}\end{bmatrix}\begin{bmatrix}e_{d,t}\\ e_{s,t}\end{bmatrix}$$

Knowing that, in the long run, demand shocks have no effect on output, we can observe the impacts of shocks on output.

$$\Delta y_t=\frac{1}{D}\left(\left(1-\sum_{i=0}^{n}\chi_{22,i+1}L^{i+1}\right)e_{d,t}+\sum_{i=0}^{n}\chi_{12,i+1}L^{i+1}e_{s,t}\right)$$

Replacing the error terms by their equivalence in terms of demand shocks (assuming that supply shocks are zero in order to focus on the impact of demand shocks and modelize their insignificance in the long run), we get:

$$\left(1-\sum_{i=0}^{\infty}\chi_{22,i+1}L^{i+1}\right)b_{11,0}\varepsilon_{d,t}+\sum_{i=0}^{\infty}\chi_{12,i+1}L^{i+1}b_{21,0}\varepsilon_{d,t}=0$$

This equation is always true, whatever the realizations of the shocks $\varepsilon_{d,t}$ when

$\left(1-\sum_{i=0}^{n}\chi_{22,i+1}\right)b_{11,0}+\sum_{i=0}^{n}\chi_{12,i+1}b_{21,0}=0$, which corresponds to the fourth restriction.

Budgetary policies in the EU15

This graph shows the average public debt and the average cyclically adjusted primary balance during the period 1993-2001 in those countries. We can observe that Finland, Ireland and the Netherlands implemented budgetary policies that were more restrictive during this period than other EU countries with the same public debt level.