EMU Enlargement, Stabilisation Costs and Insurance Mechanisms*

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Abstract

This paper considers the determinants of the macroeconomic costs of joining EMU for the *new* EU Member Sates, and compares them with those of the EMU members. Specifically, we investigate two particular determinants of costs predicted by the theory of optimum currency areas: the business-cycle correlation between the candidate's economy and that of the euro area as a whole; and the ability of insurance mechanisms and fiscal policies to smooth income fluctuations. The results suggest that EMU membership would not be costly for some countries (Cyprus, Hungary and Malta) but for other countries it could have relevant costs, at least in the short-run. For some of these countries, business cycles are not yet well synchronized with the euro area's business cycle, and risk-sharing mechanisms do not provide enough insurance against shocks.

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1. Introduction

On 1 May 2004 the European Union (EU) welcomed ten new members: the Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovakia. In addition, two other countries, Bulgaria and Romania, joined the EU on January 2007, and other three countries are at various stages of candidacy for membership in the EU: Croatia, Turkey and the Former Yugoslav Republic of Macedonia.

As underlined during the accession negotiations, once these countries have achieved economic and budgetary results in line with the Maastricht Treaty, they are expected to join the single currency (Slovenia joined on January 2007). None of the countries requested a dispensation and no 'opt-out' options were granted. This means that the *new* (and, eventually, the *prospective*) EU countries should be considered candidates for the euro once they join the EU.

It is likely that all these countries will benefit from joining European and Monetary Union (EMU) in terms of inflation bias reduction, higher exchange rate stability, lower interest rates, and higher growth. Therefore, the main question is whether these economies should also expect to have high costs from EMU membership. To help answer this question we will also look at particular determinants of costs as predicted by the theory of optimum currency areas:[1] (i) the business-cycle correlation between the candidate's economy and that of the euro area as a whole; and (ii) the ability of insurance mechanisms, and fiscal policies to smooth income fluctuations.

The aim of this paper is to evaluate how important these determinants of the macroeconomic costs for the *new* and *prospective* EU member countries are, and compare them with those of the EMU members. We use annual data on real GDP, gross national product, national income, disposable national income, private consumption and public

[1] The theory was first developed by Mundell (1961) and extended by the classical contributions of McKinnon (1963) and Kenen (1969). For some more recent contributions see Alesina and Barro(2002), Alesina, Barro and Tenreyro (2002), Corsetti and Pesenti (2002).

consumption to evaluate business cycle synchronization and to identify channels of risk-sharing that exist in the EU25 and in EMU. We use fiscal data to evaluate the ability of fiscal policies to smooth shocks.

The results of the paper suggest that EMU membership could entail some costs for a number of EMU candidate countries. These countries' business cycles are not yet well synchronized with that of the Euro area, and risk-sharing mechanisms do not provide much insurance against shocks.

The remainder of the paper is organized as follows. In Section Two we outline a simple theoretical model, in order to illustrate how to derive the stabilisation costs from adopting the euro. In Section Three, we present the empirical methodology used to evaluate costs from entering in the EMU. Section Four reports the results obtained, and finally, Section Five summarises the paper's main findings.

2. Theoretical Model

The theory predicts that the more synchronized the business cycles among the member countries, the lower the probability of asymmetric shocks, and thus the less painful the loss of independent monetary policy and of a flexible exchange rate for the member country. Moreover, in the case of a high degree of business cycle correlation, it becomes more plausible to expect a single monetary authority to respond to aggregate shocks and to implement these interventions with greater ease.

The theoretical framework follows the monetary models proposed by Kydland and Prescott (1977), and Barro and Gordon (1983), applied by Alesina and Grilli (1992), Alesina and Wacziarg (1999), and Karras (2002) to evaluate the effects of monetary integration. In particular, we assume that the policymakers of each economy i minimize the following loss function:

$$L_i = \frac{1}{2}\left\{\beta_i (y_i - k_i)^2 + \pi_i^2\right\} \tag{1}$$

where *y* denotes output (in deviations from the trend), π is inflation, β is the relative weight of output deviations, from its target *k*. This target is assumed to be greater than zero because of distortions such as imperfect competition or taxes.

For each economy we assume that the aggregate supply is given by:

$$y_i = \theta_i(\pi_i - \pi_i^e) + v_i \tag{2}$$

where π_i^e is the expected inflation rate, and v_i is the country-specific shock which we assume to have zero mean and variance equal to σ_i^2.

2.1 Independent Monetary Policy

With differentiated monetary policies, policymakers independently choose the effective inflation rate, π_i, minimizing (1) subject to (2). The optimal time-consistent policy choice can be derived under standard assumptions of complete information and rational expectations $\left(E\pi_i = \pi_i^e\right)$. The "discretionary" time-consistent policy mix (denoted by a star superscript) for any economy *i* will be characterized as follows:

$$\pi_i^* = \beta_i \theta_i k_i - \frac{\beta_i \theta_i}{1 + \beta_i \theta_i^2} v_i \tag{3}$$

where $E\pi_i = \pi_i^e = \beta_i \theta_i k_i$.

Using the equilibrium values of the inflation rate and expected inflation rate in (2) and calculating output variance, we obtain that the business cycle volatility of output will be given by:

$$\mathrm{var}(y_i) = \frac{1}{\left(1 + \beta_i \theta_i^2\right)^2} \sigma_i^2 \ . \tag{4}$$

From (4), it emerges that output volatility is a decreasing function of both the relative weight (β_i) given by policymakers to output stabilisation, and of the slope of the aggregate supply (θ_i).

2.2 EMU Membership

In a monetary union, monetary policy is decided by the common central bank, which chooses the effective inflation rate to minimize its loss function. The loss function faced by the monetary central authority could be formalized as:

$$L_E = \frac{1}{2}\left\{\beta_E (y_E - k_E)^2 + \pi_E^2\right\} \tag{5}$$

where the "E" subscript refers to EMU-wide aggregates.

As in (2), the aggregate supply faced by the common central bank can be formulated as:

$$y_E = \theta_E\left(\pi_E - \pi_E^e\right) + v_E \tag{6}$$

where v_E is the EMU-wide shock with zero mean and variance equal to σ_E^2.

Thus, the monetary authority will optimally choose the inflation rate in order to minimize (5), subject to (6). The inflation rate in "discretionary" equilibrium is given by:

$$\pi_E^* = \beta_E \theta_E k_E - \frac{\beta_E \theta_E}{1 + \beta_E \theta_E^2} v_E \tag{7}$$

where $E\pi_E = \pi_E^e = \beta_E \theta_E k_E$.

In the EMU the inflation rate is set by the central monetary authority for each Member State: $\pi_E^* = \pi_i^{*Union} \quad \forall i$. Thus, substituting the optimal inflation rate in (2), we have that the output of each economy under EMU membership, y_i^{Union}, will be a function not only of

the country-specific shock, but also of the EMU-wide shock which is (negatively) exported through the single monetary policy:[2]

$$y_i^{Union} = -\frac{\beta_E \theta_E^2}{1+\beta_E \theta_E^2} v_E + v_i \tag{8}$$

Thus, business cycle volatility for country *i* in EMU will be given by:

$$\text{var}\left(y_i^{Union}\right) = \left(\frac{\beta_E \theta_E^2}{1+\beta_E \theta_E^2}\right)^2 \sigma_E^2 + \sigma_i^2 - 2\frac{\beta_E \theta_E^2}{1+\beta_E \theta_E^2} \rho_{i,E} \sigma_i \sigma_E \tag{9}$$

where $\rho_{i,E} = corr(v_i, v_E)$.

Looking at equation (9) and comparing it with equation (4), it emerges that each country's business cycle variability under the monetary union will tend to increase. In particular, the cost of joining EMU for each candidate country will be relevant if: a) there are no insurance mechanisms that are able to smooth shocks, and thus to reduce σ_E^2 and σ_i^2; b) business cycles are not well synchronized, so that $\rho_{i,E}$ is small or negative.

The intuition for the first result is that, if the business cycle of, say, Poland is very highly correlated with the EMU-wide cyclical income ($\rho_{i,E}$ close to 1), a countercyclical monetary policy conducted by the monetary authority will be a very close substitute for monetary policy conducted by the central bank of Poland. In this case, Poland's membership in the monetary union, even though it means relinquishing an independent monetary policy, will not be very costly.

[2] Asssuming that the EMU-wide aggregate shock is a weighted average of the country-specific shocks $\frac{\sum v_i n_i}{n} = v_E$, in equilibrium the EMU-wide aggregate output will be function only of the EMU-wide shock v_E, which is coherent with equations (6) and (7).

Moreover, insurance mechanisms and fiscal policies could smooth symmetric (v_E) and country-specific shocks (v_i), thus alleviating the cost of losing an independent monetary policy.

To sum up, the theoretical model has identified three different stabilisation cost factors: a) the country-specific income volatility (σ_i^2); b) the EMU-wide income volatility (σ_E^2); and c) the correlation between country-specific and EMU-wide shock ($\rho_{i,E}$). Thus, any mechanism able to reduce these sources of volatility can sensibly decrease the stabilisation cost associated with EMU membership. In particular, we can say that EMU membership would not be costly if i) business cycles are well synchronized; and ii) if insurance mechanisms and fiscal policies are able to smooth EMU-wide and country-specific shocks.

3. Empirical Methodology

In this section we describe the empirical methodology to investigate the three cost factors pointed out in the previous section.

3.1. Business Cycle Synchronization

Business cycle measures are obtained by detrending the series of real GDP. Four different methods are used to detrend the output series of each country *i* and estimate its cyclical component. Letting $y_{i,t} = \ln(Y_{i,t})$, the first measure is simple differencing (growth rate of the real GDP):

$$c_{i,t} = y_{i,t} - y_{i,t-1}. \qquad (10)$$

The second and the third method use the Hodrick-Prescott (HP) filter, proposed by Hodrick and Prescott (1980). The filter decomposes the series into a cyclical $(c_{i,t})$ and a

trend $(g_{i,t})$ component, by minimizing with respect to $g_{i,t}$, for the smoothness parameter $\lambda > 0$ the following quantity:

$$\sum_{t=1}^{T}\left(y_{i,t} - g_{i,t}\right)^2 + \lambda\sum_{t=2}^{T-1}\left(g_{i,t+1} - g_{i,t-1}\right)^2 . \qquad (11)$$

The methods differ because the second one consists of using the value recommended by Hodrick and Prescott for annual data for the smoothness parameter (λ) equal to 100, while the third method considers the smoothness parameter (λ) to be equal to 6.25. In this way, as pointed out by Ravn and Uhlig (2002), the Hodrick-Prescott filter produces cyclical components comparable to those obtained by the Band-Pass filter.

The fourth method makes use of the Band-Pass (BP) filter proposed by Baxter and King (1999), and evaluated by Stock and Watson (1999) and Christiano and Fitzgerald (2003) (who also compares its properties to those of the HP filter). The Low-Pass (LP) filter $\alpha(L)$, which forms the basis for the band pass filter, selects a finite number of moving average weights α_h to minimize:

$$Q = \int_{-\pi}^{\pi}\left|\delta(\omega)\right|^2 d\omega, \qquad (12)$$

where $\alpha(L) = \sum_{h=-K}^{K}\alpha_h L^h$ and $\alpha_K(\omega) = \sum_{h=-K}^{K}\alpha_h e^{-i\omega h}$.

The LP filter uses $\alpha_K(\omega)$ to approximate the infinite MA filter $\beta(\omega)$. Defining $\delta(\omega) \equiv \beta(\omega) - \alpha(\omega)$, and then minimizing *Q,* we minimize the discrepancy between the ideal LP filter $\beta(\omega)$ and its finite representation $\alpha_K(\omega)$ at frequency ω. The main objective of the BP filter as implemented by Baxter and King (1999) is to remove both the high frequency and low frequency component of a series, leaving the business-cycle frequencies. This is obtained by subtracting the weights of two low pass filters. We define ω_L and ω_H, the lower and upper frequencies of two low pass filters, as respectively eight

and two for annual data. We therefore remove all fluctuations shorter than two or longer than eight years. The frequency representation of the band pass weights becomes $\alpha_K(\omega_H) - \alpha_K(\omega_L)$, and forms the basis of the Baxter-King filter, which provides an alternative estimate of the trend and the cyclical component.

The three filters yield substantially similar results, with only minor differences (for example, differencing generally produces the most volatile series, while the BP the smoothest). This robustness will be formally assessed by the estimations of the empirical section.

Finally, we measure business cycle synchronization for each country as the correlation between the country's cyclical component and EMU's cyclical component, c_i:

$$corr(c_{EMU}, c_i). \tag{13}$$

3.2. Risk Sharing and Insurance Mechanisms

In order to quantify the grade of risk-sharing through different channels, we follow Asdrubali et al. (1996) and decompose GDP into different income national aggregates all closely tied to GDP: Gross National Product (GNP), Net National Income (NI), Disposable National Income (DNI), and Total (private and public) Consumption (C+G):

GDP-GNP = *international income transfers (factor income flows),* (14)

GNP-NI = *capital depreciation,*

NI-DNI = *net international tax and transfers,*

DNI-(C+G) = *total saving.*

If a shock hits the economy of one country, modifying the value of the GDP, the economic system will smooth the shock if some counter-cyclical factor can perform this task.

Let us consider the following chain equation between GDP and total consumption:

$$GDP_i = \frac{GDP_i}{GNP_i} \cdot \frac{GNP_i}{NI_i} \cdot \frac{NI_i}{DNI_i} \cdot \frac{DNI_i}{(C+G)_i} \cdot (C+G)_i . \qquad (15)$$

If only GDP varies after the shock, while the other aggregates are unchanged, then full stabilisation has been obtained. If GDP varies and GNP remains unchanged, on the other hand, then stabilisation is achieved in the first stage by the international net transfers of income factors. Conversely, if GNP varies and NI remains constant, then cyclical smoothing is provided by the capital depreciation. Finally, if the total consumption also changes, it means that a share of the shock is not smoothed.

In principle, all these factors (except capital depreciation) have a counter-cyclical smoothing effect. The first aggregate expresses the international transfers of the income that is earned by foreign entities in each country. The second aggregate is the capital depreciation, usually calculated as a constant part of the total amount of capital. Thus, since the capital-to-output ratio is typically counter-cyclical, depreciation will constitute a large fraction of output in recessions and a smaller fraction in boom periods, resulting in a higher cross-sectional variance of NI with respect to GNP. The third aggregate is based on the mutual insurance between the countries. Finally, the fourth aggregate represents consumption smoothing.

In particular, from equation (15) it is possible to derive[3] the following system of independent equations (with time fixed-effects):

$$\Delta \log GDP_{i,t} - \Delta \log GNP_{i,t} = \alpha_t^m + \beta^m \Delta \log GDP_{i,t} + \varepsilon_{i,t}^m$$

[3] See Asdrubali et al. (1996) and Arreaza et al. (1998).

$$\Delta \log GNP_{i,t} - \Delta \log NI_{i,t} = \alpha_t^d + \beta^d \Delta \log GDP_{i,t} + \varepsilon_{i,t}^d$$

$$\Delta \log NI_{i,t} - \Delta \log DNI_{i,t} = \alpha_t^g + \beta^g \Delta \log GDP_{i,t} + \varepsilon_{i,t}^g \qquad (16)$$

$$\Delta \log DNI_{i,t} - \Delta \log (C+G)_{i,t} = \alpha_t^s + \beta^s \Delta \log GDP_{i,t} + \varepsilon_{i,t}^s$$

$$\Delta \log (C+G)_{i,t} = \alpha_t^u + \beta^u \Delta \log GDP_{i,t} + \varepsilon_{i,t}^u$$

where the index i $(i = 1,...,N)$ denotes the country, the index t $(t = 1,...,T)$ indicates the period and α_t stands for time fixed-effects.

The β coefficients measure the incremental percentage amount of smoothing achieved at each level of the GDP decomposition, and $\sum \beta = 1$. In particular, β^u is the percentage of shock that remains unsmoothed; β^m is the percentage of shock smoothed by factor income flows; β^d represents capital depreciation smoothing (or dis-smoothing); β^g is the amount of shock smoothed by international transfers; β^s measures consumption smoothing. Thus, if β^u=0, then there is full risk-sharing. Moreover, each coefficient has no constraint, so it can be either larger than 1 or negative (dis-smoothing).

The time fixed-effect captures year-specific impacts on growth rates. To take into account autocorrelation in the residuals, we assume that the error terms in each equation and in each country follow an AR (1) process. We also allow for country-specific variance of the error terms, since GDP is typically more variable for small countries. In practice, we estimate the system (16) using a two-step General Least Squares (GLS) procedure.

3.3. Fiscal Policies

Considering equation (15) and decomposing $\frac{DNI_i}{(C+G)_i}$ into

$$\frac{DNI_i}{(C+G)_i} = \frac{DNI_i}{(DNI+f)_i} \cdot \frac{(DNI+f)_i}{(C+G)}, \qquad (17)$$

where *f* is the fiscal variable that we examine, we can differentiate between the effect of consumption smoothing through fiscal policy and the effect of consumption smoothing through private saving.

Using the same strategy proposed by Asdrubali et al. (1996) that we applied for equation (16), we measure the fraction of the shock smoothed via government consumption, transfer and taxes at EMU (or EU) level by estimating the coefficient in the following panel regression (with time fixed-effects):

$$\Delta \log DNI_{i,t} - \Delta \log(DNI + f)_{i,t} = \alpha_t^f + \beta^f \Delta \log GDP_{i,t} + \varepsilon_{i,t}^f \ . \qquad (18)$$

In particular, the sign in parenthesis would be positive if we consider government consumption, transfers or other government expenditures. In contrast, if we consider taxes the sign will be negative.

Again, we assume that the error terms in each equation and in each country follow an AR (1) process and we allow for country-specific variances. In practice, we estimate (18) using a two-step GLS.

4. Empirical Analysis

4.1. Data

We use data from the *Annual Macro-economic Database* (AMECO).[4] The dataset covers 28 countries (the 12 current EMU countries, the 3 existing EU countries which have not adopted the euro, the 10 *new* EU members, and 3 prospective members, Bulgaria, Romania and Turkey) from 1980 to 2005.

The income variable we use to determine business cycle synchronization is real GDP in 2000 constant prices. Data for real GNP, NI, DNI, C and G are also used to estimate the effectiveness of insurance mechanisms.

[4] See Annex for a description of data sources and availability.

Fiscal variables (namely, Direct Taxes, Indirect Taxes, Social Contributions, Capital Taxes, Subsidies, Social Benefits, Social Transfers, Government consumption, Compensation of Employees, Gross Fixed Capital Formation) are used to estimate the effect of fiscal policy on smoothing shocks.[5]

4.2. Business Cycle Synchronization

In Table 1, we calculate the correlation coefficient of each country's cyclical component of real GDP with that of EMU,[6] as a whole, using the HP filter with smoothness parameter equal to 6.25.[7] The table considers three different periods of analysis. The first is from 1980 to 1992 and considers the EU15 countries. The second is from 1993 to 2005 and applies to all 28 countries. The third is the overall period from 1980 to 2005.

In relation to the overall period, we can see that for most EMU countries business cycle is relatively well synchronized, and France is the country with the highest synchronization (0.786).

Looking at the period 1993-2005 it is clear that France shows an almost perfect correlation with the EMU economy as a whole. However, comparing the 12 euro area countries with the 3 (*old*) non-euro economies, it is difficult to establish a systematic relationship. In fact, Denmark, Sweden and the UK appear to be more synchronized with the EMU-wide cycle than some euro area members, such as Greece and Finland.

The *new* EU countries show a generally higher synchronization with the EMU than the candidate countries. In particular, there are some *new* EU countries (such as Cyprus,

[5] For consistency and since for most aggregates there is not a well defined deflator, we use the GDP deflator to express all the variables in 2000 constant prices.

[6] It is possible to argue that the results of this analysis could be mainly driven by the home bias, due to the fact that EMU countries unlike other countries in the sample are already part of the EMU. However, since the size of the new and candidate members is very small compared to the EMU members the home bias is very negligible.

[7] Even though the estimated correlations vary according to the detrending method used, the implied rankings are very similar, regarding the overall period, the highest Spearman's rank correlation coefficients is 0.936 (BP, HP6.25) and the lowest is 0.776 (Diff, HP100). For a detailed comparison see Appendix 1.

Hungary and Malta) already well synchronized with the EMU, and with correlations comparable to, or even higher than, those of some of the *old* members. On the other hand, several *new* EU countries (such as Estonia, Lithuania and Slovakia) exhibit negative correlations, as do two of the three prospective EU members (Romania and Turkey).

Focusing on the 1980-2005 period is again fully feasible only for the *old* EU members, but this can be used to indicate how the correlations have changed for these countries, and how they could change for the prospective Member States. The most striking fact to emerge from this exercise is that the degree of synchronization with EMU has remarkably increased for all countries (with the exception of Germany, where it remained broadly similar).[8] This can largely be attributed to the achievement of a more integrated market since 1992, and to an increase in trade as pointed out by Furceri and Karras (2006). But, perhaps more unexpectedly, the results show that the increased synchronization has been at least as large in the non-euro area as in the euro area economies. The UK's business cycle synchronization has seen the most dramatic change, rising from -0.137 to 0.594. The policy implication of this is obvious. Seen from the point of view of the whole period, the UK, Denmark, and Sweden are poor candidates for the euro, as stabilisation costs would be very high. However, from the perspective of the shorter period 1993-2005, the UK and Denmark appear to be highly correlated with the EMU, changing the cost calculus.

In Figures 1 and 2 we compute the rolling-windows estimation for business cycle synchronization. Looking at the figures, we can see that while a sort of convergence emerges among the EU15 members (even if not smoothly), there is no convergence among the *new* EU and candidate countries (for example, the stabilisation cost of joining EMU

[8] Similar results have been found by Angeloni and Dedola (1999), and by Fatás (1997), analyzing different time periods. In particular, Angeloni and Dedola (1999) found that output correlation between Germany and other European countries clearly increased during 1993-1997. Fatás (1997), using annual employment growth rates for regions of France, Germany, Italy and the UK, found that the average correlation with aggregate EU12 employment growth has increased from 1966-1979 to 1979-1992.

would be small for Cyprus, Hungary and Malta), and it could be negative for Estonia, Lithuania and Slovakia ex ante.

Additionally, it is worthwhile mentioning that this analysis can only provide a useful indication in terms of stabilisation costs in the short to medium term. In fact, as Frankel and Rose (1998) show, business cycle synchronization is likely to increase for the EU countries once they join EMU. Moreover, EU membership could increase intra-EMU trade allowing business cycle to become more synchronized[9]. Thus, the ex ante cost to join the EMU is likely to be larger than the ex post cost.

4.3. Insurance Mechanisms

In Table 2, we present the estimated percentages of shocks to GDP smoothed through each channel pointed out in the GDP decomposition in (14), among EMU and EU countries[10]. In particular, we consider two different sets of EU countries: the *old* EU countries (EU15) and the overall EU countries including also the *new* ones (EU25). We consider again three different periods of analysis. The first is from 1980 to 2005, the second is from 1992 to 2005, and the third is from 1998-2005. In this way, we can see how the ability of these channels to smooth income fluctuations evolves over time.

Analyzing the overall period from 1980 to 2005, it is immediately apparent that a large amount of the shocks to GDP are not smoothed both for the EMU (57 percent) and for the EU15 (61 percent) countries.[11] In particular, factor income flows and international transfers have a very negligible effect on income smoothing since they absorb respectively

[9] See, for example, Artis and Zhang (1997), Frankel and Rose (1998), Rose and Engel (2002), and Rose and Stanley (2005).

[10] In Appendix 1, Table A2, we also present the results obtained by OLS using a robust variance and covariance matrix. In this way, in fact whenever the panel is balanced, the estimated coefficients sum up to 100 percent.

[11] Using the same methodology for the US, Asdrubali et al. (1996) find that the amount of interstate risk-sharing not smoothed is only 25 percent of shocks to gross domestic product.

1 percent (-0.25 percent) and 2.14 percent (2.39 percent) of shocks to GDP among EMU (EU15) countries.

Capital depreciation provides dis-smoothing (around 6 percent for EMU and 8 percent for EU15 countries) since it generally constitutes a large fraction of output in recessions and a smaller fraction in boom.

The only operative smoothing mechanism is consumption smoothing through saving.[12] For the EMU countries, and still for the overall period, saving is able to reduce 39 percent of shocks to GDP, and it reduces 37 percent of the shock among EU15 countries. Overall, looking at the entire period, it seems that the current EMU is able to provide more income smoothing than an enlarged EMU at 15 members.

Looking at the period 1992-2005 we can see that income smoothing is increased among both EMU and the EU15 countries. In particular, saving is able to smooth a larger amount of shock to GDP (around 50 percent for both EMU and EU15 countries), and factor income flows provide a small and statistically significant contribution to the amount of shock smoothed (around 7 percent for EMU countries and 5 percent for EU15 countries). Comparing the results among the different sample of countries, we can see that overall insurance mechanisms work in the same way among EMU and EU15 countries. In contrast, they provide less income smoothing among the EU25. In fact, comparing the EMU and the EU25, we can see that while for the euro area countries 50 percent of the shock is not smoothed, for the EU25 countries 64 percent of income fluctuations are not absorbed. This implies that insurance mechanisms work better in the current EMU than in an enlarged EU at 25 members.

The same conclusions emerge if we repeat the same comparison for the period 1998-2005. Moreover, it is also true that for all subsets of countries, the amount of

[12] These results are consistent with those found by Sorensen and Yosha (1998).

consumption-smoothing through saving is remarkably reduced, thus implying a larger amount of unsmoothed shock.

It is important to notice that the period 1998-2005 provides more useful indications in terms of income smoothing comparison between the actual EMU and an enlarged EMU than the other periods. In fact, for this period our panel data set is fully balanced, which means that the amount of risk-sharing in each country enters with the same weight in the computation of the total amount of shock to GDP that is not smoothed. Thus, it would seem that, overall, in an enlarged EMU the ability to smooth country-specific shocks is softened, implying a relatively high stabilisation cost for the prospective members.

Again, it is also worthwhile mentioning that this analysis can only offer some useful indications in terms of stabilisation costs only in the short to medium term. In fact, as EMU and other EU countries become more homogenous in terms of the channels investigated in our analysis, the amount of cross-sectional smoothing may well increase.

4.4. Income Smoothing and Fiscal Policies

In Table 3 we present the estimated percentages of shocks to GDP smoothed through fiscal policies among EMU, EU15 and EU25 countries.[13] This table also considers the three different periods of analysis (1980-2005, 1992-2005, and 1998-2005). In this way, we can see how the ability of these channels to smooth income fluctuations evolves over time.

[13] For consistency we present in Appendix 1 the OLS results using a robust variance and covariance matrix. For related work on the ability of fiscal policy to smooth income fluctuations in federations or monetary unions see, for example, Bayoumi, and Prasad (1997), Goodhart and Smith (1993), Hammond and Von Hagen (1995), Masson and Taylor (1992), Obstfeld and Peri (1998), Sachs and Sala-i-Martin (1991), Von Hagen (1998), and Mélitz and Zumer (2002).

Analyzing the overall period from 1980 to 2005, we can see that both for EU15 and EMU countries, the largest amount of smoothing provided by fiscal variables is represented by social benefits (around 7 percent for the EMU countries and 9 percent for the EU15 countries). Government consumption tends to vary positively but less proportionally with GDP (particularly in EMU), which reduces the correlation of total consumption (private and public) with GDP, thereby contributing to consumption smoothing. Compensation of employees also contributes to smooth consumption, especially for the EU15 countries. In contrast, direct taxes, indirect taxes, capital taxes, gross fixed capital formation and social contributions provide dis-smoothing.

It is also interesting to note that the ability of the fiscal variables to smooth income is almost unchanged over time. In fact, both the amount of dis-smoothing provided by direct and indirect taxes, gross fixed capital formation and social contributions[14] and the amount of smoothing provided by social benefits and government consumption has slightly decreased over time.

More relevant to the point of this paper, we can see that comparing the three areas for the periods 1992-2005 and 1998-2005, fiscal policies seem overall to perform better in terms of income smoothing in the EU25 than in the EU15 and in EMU. Thus, at least in terms of the effectiveness of fiscal policies in providing income smoothing, an enlarged EMU at 25 members may represent a better alternative than the current one.[15] This result is consistent over the two different periods of analysis.

In conclusion, we can see that analyzing the result of this section with those previously obtained, the larger amount of un-smoothed shock in the EU area with respect to the EMU area, cannot certainly be imputed to fiscal policies. In contrast, fiscal policy

[14] In the period 1998-2005 social contributions were able to smooth 5 percent of the shock to GDP in EMU.
[15] It is worthwile noticing that Social Benefits and Government Consumption taken together contributed to approximately 50 percent of total consumption smoothing in the period 1998-2005.

seems to work better for stabilisation purpose in an enlarged EMU, thereby alleviating the possible stabilisation cost for the prospective EMU members.

5. Conclusion

It is likely that all the new Member Sates and the prospective EU countries will benefit from joining EMU, in terms of inflation bias reduction, higher exchange rate stability, lower interest rates, and higher growth. However, an open question is whether these economies should also expect to have to bear some costs from EMU membership. To help answer this question, in this paper we investigate two determinants of costs predicted by the theory of optimum currency areas: (i) the business cycle correlation between the candidate's economy and that of the euro area as a whole; (ii) and the ability of insurance mechanisms and fiscal policies to smooth shocks.

With regard to the first determinant, the results of the paper show that there are some *new* EU countries (such as Cyprus, Hungary and Malta) already well synchronized with the EMU, and with correlations comparable to, or even higher than, those of some of the *old* members. On the other hand, several *new* EU countries (such as Estonia, Lithuania and Slovakia) exhibit negative correlations, as do two of the three prospective EU members (Romania and Turkey).

With regard to the second determinant, our results show that, overall, in an enlarged EMU the ability to smooth country-specific shocks is softened, implying a relatively high stabilisation cost for the prospective members. In fact, while (for the last period 1998-2005) the amount of shock to GDP unsmoothed in the current EMU is 63 percent, in an *enlarged* EMU at 25 members it would be 69 percent. However, this result is not driven by the effectiveness of fiscal variables, since they seem to work better for stabilisation purposes in an *enlarged* EMU than in the current EMU.

Analyzing both results, we can conclude that, while the cost of joining EMU would be small for some countries (such as Cyprus, Hungary and Malta) with very highly synchronized business cycles, even in the absence of effective insurance mechanism at EU level, for other countries (such as Estonia, Lithuania and Slovakia) the negative business cycle correlation vis-à-vis the EMU-wide business cycle and the absence of effective insurance mechanisms to smooth income fluctuation could imply relevant stabilisation costs, at least in the short-run.

It should be noticed in this regard that this analysis can provide useful indications in terms of stabilisation costs only in the short to medium term. Moreover, the amount of cross-sectional smoothing would increase as EMU and other EU countries could become more homogenous in terms of risk-sharing channels. Thus, the ex ante cost of joining EMU is likely to be larger than the ex- post cost.

Annex – Data Sources

Table A1 – Data sources

Original series	AMECO codes *
Gross domestic product at 2000 market prices - National currency: Data at constant prices.	1.1.0.0.OVGD
Gross national income at 2000 market prices - National currency: Data at constant prices	1.1.0.0.OVGN
National income at current market prices - National currency: Data at current prices	1.0.0.0.UVNN
National disposable income - National currency: Data at current prices	1.0.0.0.UVNT
Total consumption at current prices - National currency: Data at current prices	1.0.0.0.UCTC
Price deflator gross domestic product at market prices - National currency; 2000 = 100.	3.1.0.0.PVGD
Current taxes on income and wealth (direct taxes); general government ESA 1995 - National currency: Data at current prices	1.0.0.0.UTYG
Taxes linked to imports and production (indirect taxes); general government ESA 1995 - National currency: Data at current prices	1.0.0.0.UTVG
Social contributions received; general government ESA 1995 - National currency: Data at current prices	1.0.0.0.UTSG
Capital taxes; general government ESA 1995 - National currency: Data at current prices	1.0.0.0.UTKG
Final consumption expenditure of general government ESA 1995 - National currency: Data at current prices	1.0.0.0.UCTG0
Subsidies; general government ESA 1995 - National currency: Data at current prices	1.0.0.0.UYVG
Social benefits other than social transfers in kind; general government ESA 1995 - National currency: Data at current prices	1.0.0.0.UYTGH
Compensation of employees; general government ESA 1995 - National currency: Data at current prices	1.0.0.0.UWCG
Gross fixed capital formation; general government ESA 1995 - National currency: Data at current prices	1.0.0.0.UIGG0

Note: * series from the EC AMECO database.

Table A2 – Data availability

	GDP	GNP	NI	DNI	C+G	DT	IT	SC	CT	S	SB	GC	CE	GFCF
BEL	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980
DEU	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980
GRC	1980	1980	1980	1980	1980	1988	1988	1988	1988	1988	1988	1988	1988	1988
ESP	1980	1980	1980	1980	1980	1995	1995	1995	1995	1995	1995	1995	1995	1995
FRA	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980
IRL	1980	1980	1980	1980	1980	1985	1985	1985	1985	1985	1985	1980	1985	1985
ITA	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980
LUX	1980	1980	1980	1980	1980	1990	1990	1990	1990	1990	1990	1990	1990	1990
NLD	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980
AUT	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980
PRT	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980
FIN	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980
CZE	1990	1992	1992	1992	1990	1992	1992	1992	1992	1992	1992	1992	1992	1992
DNK	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980
EST	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993
CYP	1990	1990	1980	1995	1995	1998	1998	1998	1998	1998	1998	1998	1998	1998
LVA	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990
LTU	1990	1993	1993	1993	1990	1993	1993	1995	1997	1993	1995	1990	1993	1993
HUN	1991	1993	-	-	-	1999	1999	1999	1999	1999	1999	1999	1999	1999
MLT	1991	1991	1998	1998	1980	1998	1998	1998	1998	1998	1998	1998	1998	1998
POL	1990	1991	-	-	1990	1990	1990	1990	1993	1990	1990	1990	1990	1990
SVN	1990	1990	1990	1990	1990	2000	2000	2000	2000	2000	2000	2000	2000	2000
SVK	1992	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993
SWE	1980	1980	1980	1980	1980	1993	1993	1993	1993	1993	1993	1993	1993	1993
GBR	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980
BGR	1991	1991	1991	1991	1991	-	-	-	-	-	-	-	-	-
ROM	1990	1990	-	-	1998	1995	1995	1995	1995	1995	1995	1995	1995	1995
TUR	1980	1980	1980	1980	-	-	-	-	-	-	-	-	-	-

Note: In the table is reported the first year where the data is available.
(-) means missing.
GDP=gross domestic product; GNP= gross national product; NI=national income; DNI=disposable national income; C+G=total (private and public) consumption; DT=direct taxes; It=indirect taxes; SC=social contributions; CT=capital taxes; S=subsidies; SB=social benefits; GC=government consumption; CE= compensation of employees; GFCF =gross fixed capital formation.

References

Alesina, A. and Barro, R. (2002). "Currency unions", *Quarterly Journal of Economics* 117, 409-436.

Alesina, A.; Barro, R. and Tenreyro, S. (2002). "Optimal currency areas", NBER Working Papers, 9072.

Alesina, A. and Wacziarg, R. (1999). "Is Europe Going too Far?" *Carnegie-Rochester Conference Series on Public Policy*, 51, 1-42.

Alesina, A. and Grilli, V. (1992). "The European Central Bank: Reshaping Monetary Politics in Europe," In M.B.Canzoneri, V.Grilli, and P.R.Masson (eds.) *Establishing a Central Bank: Issues in Europe and Lessons from the U.S.*, Cambridge.

Angeloni, I. and Dedola, L. (1999). "From the ERM to the Euro: nee evidence on economic and policy convergence among EU countries", European Central Bank Working Paper 4.

Arreaza, M; Sorensen, B. and Yosha, O. (1998). **"**Consumption Smoothing through Fiscal Policy in OECD and EU Countries," NBER Working Papers No. 6372.

Artis, M. and Zhang, W. (1997). "International business cycles and the ERM: Is there a European business cycle," *International Journal of Finance and Economics*, 2 (1), 1-16.

Asdrubali, P.; Sorensen, B. and Yosha, O. (1996). "Channels of Interstate Risk Sharing: United States 1963-90", *Quarterly Journal of Economics*, 111, 1081-1110.

Bayoumi, T. and Prasad, E. (1997) "Currency Unions, Economic Fluctuations, and Adjustment: Some New Empirical Evidence", *IMF Staff Papers*, 44 (1), 36-57.

Barro, R. and Gordon. D. (1983). "Rules, Discretion and Reputation in a Model of Monetary Policy". *Journal of Monetary Economics,* 12, 101-122.

Baxter, M. and King, R. (1999). "Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series", *Review of Economics and Statistics*, 81 (4), 575-593.

Christiano, L. and Fitzgerald, T. (2003). "The Band Pass Filter," *International Economic Review*, 4 (2), 435-465.

Corsetti, G. and Pesenti, P. (2002) "Self-validating optimum currency areas," NBER Working Papers, 8783.

Fatás, A. (1997). "EMU: countries or regions: lessons from the EMS experience," *European Economic Review*, 41 (3-5), 743-751.

Furceri, D. and Karras, G. (2006). "Business Cycle Synchronization in the EMU", *Applied Economics* (forthcoming).

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

Goodhart, C. and Smith, S. (1993) 'Stabilization', European Economy, Reports and Studies, 5, 417-56.

Hammond, J. and von Hagen, J. (1995) "Regional Insurance Against Asymmetric Shocks: An Empirical Study for The European Community," *Manchester School*, 66, 331-53.

Hodrick, R. and Prescott, E. (1980) "Postwar U.S. Business Cycles: An Empirical Investigations", Discussion Papers 451, Carnegie Mellon University.

Karras, G. (2002). "Costs and Benefits of Dollarization: Evidence from North, Central, and South America", *Journal of Economic Integration*, 17 (3), 502-516.

Kenen, R. (1969) "The theory of optimum currency area:an eclectic view," in: R. Mundell and A. Swoboda, (eds.), *Monetary problems of the international economy*, Chicago, Univeristy of Chicago Press.

Kydland, F. and Prescott. E. (1977). "Rules Rather Than Discretion: The Inconsistency of Optimal Plans," *Journal of Political Economy*, 85, 473-490.

Masson, P. and Taylor, M. (1992). "Common Currency Areas and Currency Unions: An Analysis of the Issues," CEPR Discussion Paper, 617.

McKinnon, R. (1963)."Optimum currency areas," *American Economic Review*, 53, 717-725.

Mélitz, J. and Zumer, F. (2002). "Regional Redistribution and Stabilization by the Central Governement in Canada, France, the UK and the US: A Reassessment and New Tests," *Journal of Public Economics*, 86 (2), 263-286.

Mundell, R. (1961) "A theory of optimum currency areas," *American Economic Review*, 82, 942-963.

Obstfeld, M. and Peri, G. (1998). "Regional Non-Adjustment and Fiscal Policy," *Economic Policy*, April, 207-59.

Ravn, M. and Uhlig, H. (2002). "On Adjusting the Hodrick-Prescott Filter for the Frequency of Observations". *Review of Economics and Statistics,* 84 (2), 371-380.

Rose, A. and Stanley, T. (2005) "A meta analysis of the effect of common currencies on international trade," *Journal of Economic Surveys*, 19 (3), 347-365.

Rose, A. and Engel, C. (2002). "Currency unions and international integration," *Journal of Money, Credit and Banking* 34, 1067-1089.

Sachs, J. and Sala-i-Martin, X. (1991). "Fiscal Federalism and Optimum Currency Areas: Evidence for Europe from The US," NBER Working Paper, 3885

Sorensen, B. and Yosha, O. (1998). "International Risk Sharing and European Monetary Unification", *Journal of International Economics*, 45, 211-238.

Stock, J. and Watson, M. (1999). "Business Cycle Fluctuations in U.S. Macroeconomic Time Series", in Taylor, J. and Woodford, M. (eds.), *Handbook of Macroeconomics*, vol 1, 3-64, Elsevier.

von Hagen, J. (1998) "Fiscal Policy and Intranational Risksharing," CEPR Discussion Paper, 126.

Tables and Figures

Table 1 – Business cycle synchronisation (vis-à-vis EMU)

HP6.25	1980-1992	1993-2005	1980-2005
		EMU	
Austria	0.534	0.793	0.647
Belgium	0.692	0.832	0.762
Finland	0.582*	0.478	0.509*
France	0.615	0.977	0.786
Germany	0.763	0.678	0.696
Greece	0.601	0.441	0.554
Ireland	0.285	0.645	0.465
Italy	0.539	0.810	0.674
Luxembourg	0.419	0.745	0.570
Netherlands	0.542	0.875	0.692
Portugal	0.341	0.733	0.507
Spain	0.506	0.871	0.662
		Other EMU	
Czech Republic		0.031	
Denmark	0.043	0.569	0.258
Estonia		-0.220	
Cyprus		0.541	
Latvia		0.238	
Lithuania		-0.032	
Hungary		0.789	
Malta		0.698	
Poland		0.247	
Slovenia		0.412	
Slovakia		-0.673	
Sweden	0.164	0.695	0.443
UK	-0.137	0.594	0.042
		Candidate countries	
Bulgaria		0.342	
Romania		-0.242	
Turkey		-0.273	

Note: HP6.25=Hodrick-Prescott Filter with smoothness parameter equal to 6.25.
* We did not consider the years 1991 and 1992 to take into account the Finland crisis in the early 1990s.

Table 2 – Channel of output smoothing (GLS)

	EMU			EU 15			EU 25^	
	1980-2005	1992-2005	1998-2005	1980-2005	1992-2005	1998-2005	1992-2005	1998-2005
Factor Income (β^m)	1.07	6.64**	13.64***	-0.25	4.98*	11.78***	-0.39	6.44
	(0.48)	(2.29)	(2.85)	(-0.13)	(1.88)	(2.58)	(-0.31)	-2.87
	[300]	[168]	[96]	[375]	[210]	[120]	[315]	[184]
Capital Depreciation (β^d)	-6.30***	-2.46*	-2.20	-7.58***	-3.05**	-2.81	-3.81	-9.26
	(-4.04)	(-1.85)	(-1.05)	(-5.67)	(-2.45)	(--1.47)	(-1.64)*	(-5.77)
	[300]	[168]	[96]	[375]	[210]	[120]	[308]	[183]
International Transfers (β^g)	2.14	-1.09	1.34	2.39**	-0.79	1.59	-2.7*	0.97
	(1.53)	(-0.47)	(0.54)	(2.13)	(-0.40)	(0.71)	(-1.93)	-0.75
	[300]	[168]	[96]	[368]	[210]	[120]	[303]	[183]
Saving (β^s)	39.01***	50.43***	24.79***	36.86***	50.71***	25.21***	38.12***	34.46***
	(6.50)	(6.21)	(2.62)	(6.97)	(6.83)	(2.86)	(5.74)	(5.36)
	[300]	[168]	[96]	[368]	[210]	[120]	[298]	[182]
Not Smoothed (β^u)	56.83***	49.93***	63.43***	61.12***	50.19***	62.72***	63.97***	69.37***
	(11.68)	(10.52)	(11.25)	(14.11)	(10.98)	(10.46)	(5.90)	(15.61)
	[300]	[168]	[96]	[375]	[210]	[120]	[302]	[182]

Notes: Fraction of shocks (percentage points) absorbed at each level of smoothing. T-statistics are in parenthesis and the number of observations in square brackets.
*, **, *** - statistically significant at the 10, 5, and 1 percent level respectively.

β^m is the two-step GLS estimate of the slope in the regression of $\Delta\log GDP - \Delta\log GNP$ on $\Delta\log GDP$, β^d is the slope in the regression of $\Delta\log GNP - \Delta\log NI$ on $\Delta\log GDP$, β^g is the slope in the regression of $\Delta\log NI - \Delta\log DNI$ on $\Delta\log GDP$, β^s is the slope in the regression of $\Delta\log DNI - \Delta\log(C+G)$ on $\Delta\log GDP$, and finally β^u is the slope in the regression of $\Delta\log DNI - \Delta\log(C+G)$ on $\Delta\log GDP$. We interpret the β coefficients as the incremental percentage amounts of smoothing achieved at each level. And thus β^u is the amount of shock not smoothed. The sum of the coefficient could not sum to 100 percent due to rounding, due the fact that for some regression we have an unbalanced panel and that our estimates are GLS.

^ It includes all the EU25 countries with the exception of Poland and Hungary for which data are not available. See the Annex for a detailed description of the data availability for each country with respect to the variables considered in the analysis.

Table 3 – Fiscal Channels of output smoothing (GLS)

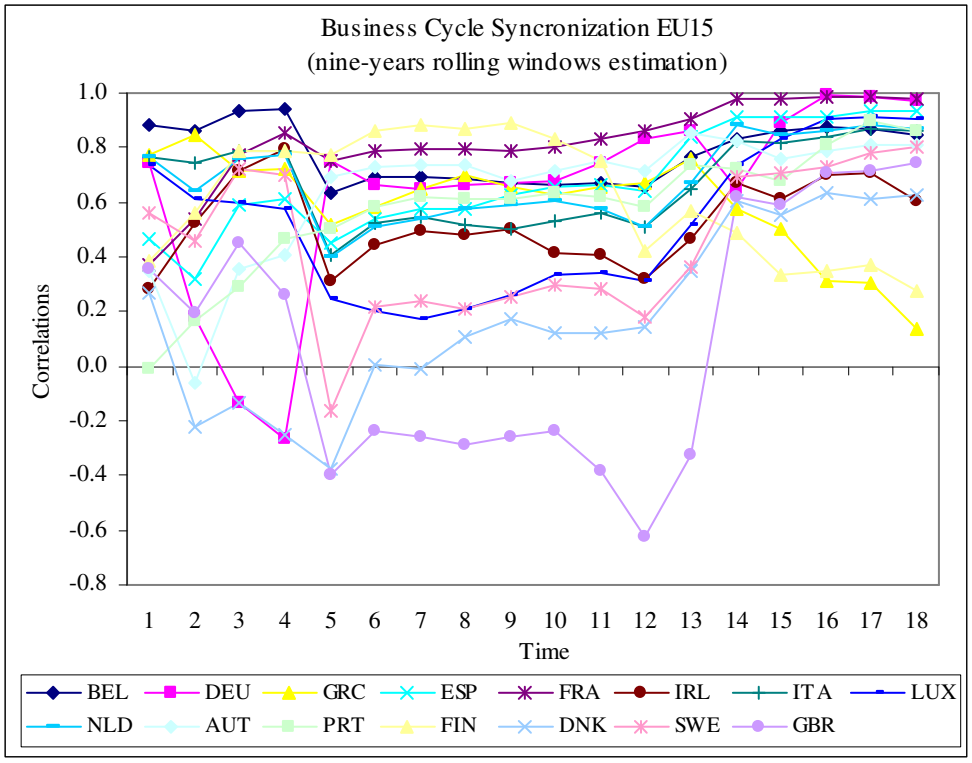
	EMU			EU 15			EU 25^	
	1980-2005	1992-2005	1998-2005	1980-2005	1992-2005	1998-2005	1992-2005	1998-2005
Direct Taxes	-4.21	-4.21	-3.16	-3.12	-3.72	-2.08	-4.27*	-0.21
	(-1.38)	(-1.37)	(-0.80)	(-1.04)	(-1.23)	(-0.54)	(-1.88)	(-0.08)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Indirect Taxes	-3.23*	-2.44	2.42	-2.62	-2.89	1.39	-3.10*	0.78
	(-1.71)	(-1.06)	(-0.71)	(-1.44)	(-1.32)	(0.41)	(-1.63)	(0.03)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Social Contributions	-5.49***	-4.69**	5.04**	-4.10***	-4.00**	3.52	-5.51***	-1.31
	(-3.15)	(-2.33)	(2.08)	(-2.64)	(-2.20)	(1.58)	(-3.60)	(-0.68)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Capital Taxes	-0.21	-0.14	-0.85	-0.01	-0.05	-0.07	-0.04	-0.17
	(-0.93)	(-0.44)	(-0.25)	(-0.75)	(-0.19)	(-0.26)	(-0.25)	(-0.49)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Subsides	0.94	-0.24	-0.21	0.11*	-0.31	-0.04	-0.74	1.37
	(1.21)	(-.042)	(-0.37)	(1.63)	(-0.53)	(-0.71)	(-1.51)	(0.26)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Social Benefits	7.39***	6.27***	6.31**	9.09***	6.98***	7.47***	7.81***	9.11***
	(4.02)	(3.07)	(2.47)	(5.11)	(3.42)	(3.03)	(5.16)	(4.27)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Government Consumption	3.42*	2.30	3.89	6.24***	4.35**	4.89*	8.31***	8.22***
	(1.82)	(1.13)	(1.25)	(3.50)	(2.14)	(1.63)	(3.82)	(3.29)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Compensation of Employees	2.09*	1.36	-0.64	3.59***	2.56**	0.07	5.91***	5.45***
	(1.91)	(1.25)	(-0.34)	(3.31)	(2.24)	(0.40)	(4.92)	(3.45)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Gross Fixed Capital Formation	-2.21**	-1.88	-5.72***	-2.29**	-1.82	-5.45***	0.15	-3.81***
	(-2.23)	(-1.61)	(-3.51)	(-2.39)	(-1.55)	(-3.27)	(0.19)	(-3.18)
	[262]	[164]	[96]	[401]	[204]	[120]	[287]	[182]

Notes: Fraction of shocks (percentage points) absorbed at each level of smoothing. T-statistics are in parenthesis and the number of observations in square brackets.

*, **, *** - statistically significant at the 10, 5, and 1 percent level respectively.

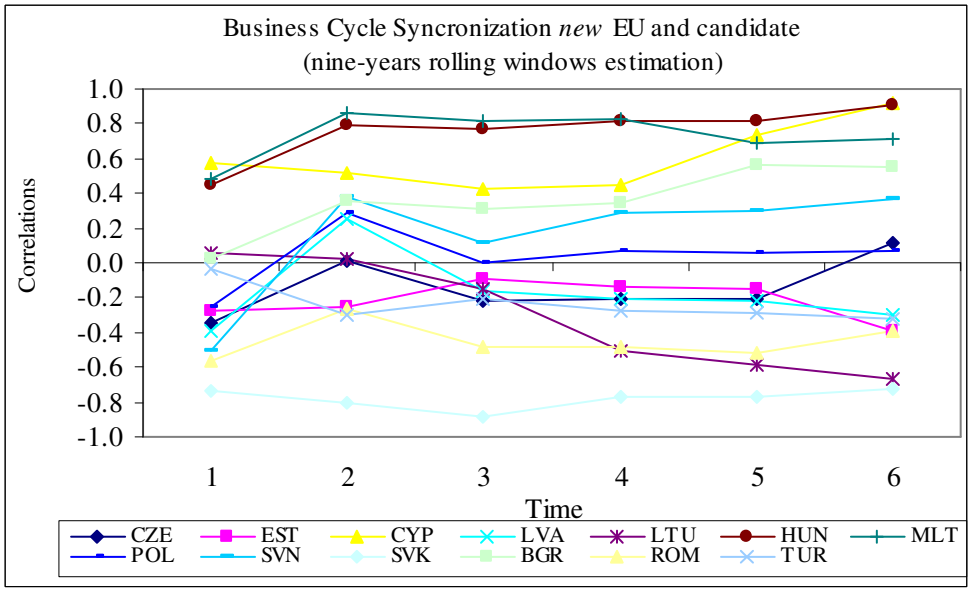
^ It includes all the EU25 countries with the exception of Poland and Hungary for which data are not available. See the Annex for a detailed description of the data availability for each country with respect to the variables considered in the analysis.

Figure 1 – Business Cycle Synchronization vis-à-vis the EMU (1980-2005)



Note: each period is nine years long. 1=1980-1988, 2=1981-1989,…, 18=1997-2005.

Figure 2 – Business Cycle Synchronization vis-à-vis the EMU (1992-2005)



Note: each period is nine years long. 1=1992-2000, 2=1993-2001,…, 6=1997-2005.

Appendix 1 – Additional Results

Table A1 – Spearman's rank correlation matrix

	HP6.25	HP100	BP	Diff
HP6.25	1.000			
HP100	0.936	1.000		
BP	0.847	0.855	1.000	
Diff	0.839	0.776	0.788	1.000

Table A2 - Channel of output smoothing (OLS)

	EMU			EU 15			EU 25^	
	1980-2005	1992-2005	1998-2005	1980-2005	1992-2005	1998-2005	1992-2005	1998-2005
Factor Income (β^m)	7.79	12.67*	23.46***	6.22	11.56*	23.68***	-1.16	10.64***
	(1.35)	(1.93)	(3.06)	1.20)	(1.81)	(3.25)	(-0.28)	(3.03)
	[300]	[168]	[96]	[375]	[210]	[120]	[315]	[184]
Capital Depreciation (β^d)	-6.85*	-1.95	-1.36	-7.39**	-2.33	-0.28	8.17	-12.25***
	(-1.93)	(-0.94)	(-0.09)	(-2.39)	(-1.07)	(-0.17)	0.51	(-3.05)
	[300]	[168]	[96]	[375]	[210]	[120]	[308]	[183]
International Transfers (β^g)	-3.49	-12.43	-10.55	-2.49	-11.75	-10.23	-8.17**	-3.68
	(-0.77)	(-1.39)	(-0.93)	(-0.65)	(-1.39)	(-0.93)	(-2.43)	(-0.95)
	[300]	[168]	[96]	[368]	[210]	[120]	[303]	[183]
Saving (β^s)	47.12***	51.75**	23.72**	44.38***	51.63***	22.96**	43.04	32.80***
	(6.23)	(2.88)	(2.60)	(6.34)	(2.90)	(2.60)	(1.00)	(5.63)
	[300]	[168]	[96]	[368]	[298]	[120]	[298]	[183]
Not Smoothed (β^u)	55.43***	49.96***	63.50***	59.68***	50.89***	63.87***	41.72	72.40***
	(11.89)	(7.57)	(12.28)	(10.68)	(7.83)	(13.45)	(0.59)	(16.06)
	[300]	[168]	[96]	[375]	[210]	[120]	[302]	[184]

Notes: Fraction of shocks (percentage points) absorbed at each level of smoothing. T-statistics are in parenthesis and the number of observations in square brackets. Robust standard errors for Heteroskedasticity and AR (1). *, **, *** - statistically significant at the 10, 5, and 1 percent level respectively.

β^m is the OLS estimate of the slope in the regression of $\Delta \log GDP - \Delta \log GNP$ on $\Delta \log GDP$, β^d is the slope in the regression of $\Delta \log GNP - \Delta \log NI$ on $\Delta \log GDP$, β^g is the slope in the regression of $\Delta \log NI - \Delta \log DNI$ on $\Delta \log GDP$, β^s is the slope in the regression of $\Delta \log DNI - \Delta \log(C+G)$ on $\Delta \log GDP$, and finally β^u is the slope in the regression of $\Delta \log DNI - \Delta \log(C+G)$ on $\Delta \log GDP$. We interpret the β coefficients as the incremental percentage amounts of smoothing achieved at each level. And thus β^u is the amount of shock not smoothed. The sum of the coefficient could not sum to 100 percent due to rounding, due the fact that for some regression we have an unbalanced panel.

^It includes all the EU25 countries with the exception of Poland and Hungary for which data are not available. See the Annex for a detailed description of the data availability for each country with respect to the variables considered in the analysis.

Table A3 – Fiscal Channels of output smoothing (OLS)

	EMU			EU 15			EU 25^	
	1980-2005	1992-2005	1998-2005	1980-2005	1992-2005	1998-2005	1992-2005	1998-2005
Direct Taxes	-4.94**	-2.76	-4.74	-3.49	-1.75	-2.02	-6.11**	-0.21
	(-2.23)	(-0.88)	(-0.91)	(-1.55)	(-0.57)	(-0.36)	(-2.75)	(-0.08)
	[270]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Indirect Taxes	-3.75*	-1.99	-3.19	-2.73	-2.07	-2.67	-4.27**	-2.55
	(-1.83)	(-0.60)	(-0.76)	(1..27)	(-0.66)	(-0.68)	(-2.21)	(-0.87)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Social Contributions	-5.95	-3.10	5.82	-5.59	-3.63	4.33	-8.96***	-3.73
	(-1.69)	(-1.24)	(1.86)	(-1.72)	(-1.47)	(1.51)	(-4.96)	(-1.51)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Capital Taxes	-0.33	-0.54	0.53	-0.18	0.01	0.44	0.14	0.05
	(-0.94)	(-0.11)	(0.64)	(-0.68)	(0.19)	(0.60)	(0.63)	(0.16)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Subsides	1.52	0.31	0.58	1.61	-0.01	0.23	-1.52	1.41**
	(1.21)	(0.46)	(0.94)	(1.47)	(-0.17)	(0.45)	(-1.40)	(2.48)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Social Benefits	10.90	8.09	4.38*	11.35*	7.44	3.91*	9.26***	9.91***
	(1.72)	(1.59)	(1.96)	(2.06)	(1.55)	(1.71)	(7.10)	(4.31)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Government Consumption	6.62	3.48	2.82	7.55*	4.28	3.31	14.91***	10.43***
	(1.65)	(1.34)	(0.77)	(2.08)	(1.65)	(0.99)	(4.87)	(3.62)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Compensation of Employees	3.85	1.38	-1.98	4.76	2.30	-0.94	8.38***	5.47***
	(1.23)	(1.13)	(-0.94)	(1.68)	(1.73)	(0.44)	(5.52)	(3.02)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]
Gross Fixed Capital Formation	-2.47**	-2.48	-4.69***	-2.78**	-2.67	-3.92**	1.09	-2.74***
	(-2.22)	(-1.51)	(-4.33)	(-2.49)	(-1.61)	(-2.64)	(0.86)	(-2.95)
	[262]	[164]	[96]	[317]	[204]	[120]	[287]	[182]

Notes: Fraction of shocks (percentage points) absorbed at each level of smoothing. T-statistics are in parenthesis and the number of observations in square brackets. Robust standard errors for Heteroskedasticity and AR (1).

*, **, *** - statistically significant at the 10, 5, and 1 percent level respectively.

^ It includes all the EU25 countries with the exception of Poland and Hungary for which data are not available. See the Annex for a detailed description of the data availability for each country with respect to the variables considered in the analysis.