An Enlarged Economic and Monetary Union: Effects and Policy Implications

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Abstract

We calculate an "enlarged" Phillips curve for a theoretical EMU with 12+8 Member States. Both the empirical evidence and the econometric analysis show the worsening of the trade-off between inflation and unemployment, and hence the need to revise, at least temporarily, the stance of the ECB monetary policy. Also, the estimates point to a modified responsiveness of the money-demand function to the changes of the interest rates, given, however, a greater stability of such a function in the long-run.

JEL classification: C3; E5

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1 Introduction

The enlargement process of the European Union (EU) has clearly become irreversible. However, the enlargement question interests European countries at a time in which the Eurozone is already facing the difficult task represented by the introduction of the new common currency, the Euro, and the management of the associated monetary policy in a period of sluggish economic growth. In particular, it is known that the ECB is not able to fine-tune its monetary policy in order to meet the particular economic challenges in every specific member country (De Grauwe, 2000). In fact, the presence of a single nominal interest rate set by the ECB and of different inflation rates across the member countries might create problematic responses both in the real economy and in the financial markets. In this respect, the Eurozone is likely to be still confronted with a difficult adjustment process in the future, the more so when recession fears will induce national policy makers to deliberately violate agreed-upon budgetary rules.

And yet, as the accession of the first ten Central and Eastern European Countries (CEECs)[1] into the EU starts to take place, the eastward enlargement of the Eurozone will only be a couple of years away. In fact, although membership of the EU does not imply participation in the Euro area at the very beginning[2], new Member States will nevertheless be under an obligation to adopt the acquis. This implies the participation in the Economic and Monetary Union (EMU), although an initial derogation from its Stage III[3] is allowed. All new Member States will therefore enjoy a period of transition, during which the EMU-related provisions will be implemented, and then they will end up in adopting the single currency, unless an "opt out" clause similar to those of Denmark or the UK is negotiated; neither the EU nor the applicants, however, are contemplating one at the moment[4].

As a result, a new Member State will be required to join the Euro area as soon as the entry criteria are met, with assessments made at least every two years under TEC article 109. Looking at the distance between the Maastricht criteria and the other EMU-related provisions (in particular Title VII - Economic and Monetary Policy of the Treaty, Chapters 1 and 2) reported in Table 1, it appears that the process of convergence is already under

[1] Czech Republic, Slovak Republic, Poland, Hungary, Latvia, Lithuania, Estonia, Slovenia, Malta and Cyprus.

[2] A period of at least two years, during which additional conditions regarding the stability of the exchange rate must be met, is required for an accession country to join the monetary union.

[3] TEC art. 109 refers to existing Member States still outside Stage III as "Member States with a derogation".

[4] It seems that no opt-out clauses have been arranged for new member states at the moment and any will be ever decided.

way: most of the candidate countries may be soon fulfilling the EMU criteria, and hence join the single currency.

[Table 1 about here]

The aim of this paper is an analysis of the ECB monetary policy once enlargement has taken place, in order to assess the requested (if any) policy changes, which should be undertaken in order to maintain an efficient management of the EMU, especially during the transition period. At this purpose, Section 2 presents an analysis of the degree of optimality of the EMU, under the viewpoint of the OCA theory, before and after the enlargement. It shows empirically how enlargement is likely to worsen the extent to which the EMU is an optimal currency area, hence giving rise to the presence of a long-run, negative-sloped Phillips curve. Section 3 attempts at measuring econometrically the Phillips curve of both the current and the enlarged EMU, while Section 4 performs a similar analysis as for the money demand function. Section 5 concludes with some policy implications and our general suggestions.

2 Is OCA-20 better than OCA-12?

A long debate over whether the countries that are currently members of the EMU constitute an Optimal Currency Area (OCA), as defined by Mundell (1961) in his seminal paper, characterized the years immediately before the formation of the monetary union itself. There was a general agreement about the fact that, according to the criteria of Mundell's theory, EMU-12 would not be an optimum currency area. Despite that, the monetary union was finally born in 1999, because economists and politicians thought that the benefits originating from the adoption of a common currency would be greater than the costs due to sub-optimality. Furthermore, the members themselves of the ECB's Executive Board now tend to look even at the process of monetary integration mainly as a direct consequence of the OCA theory and as its most important test-bed (Issing, 2001). But during the debate over what the inflation target in EMU should be, the issue of the non-optimality of the Euro currency area received very limited attention. The implicit theoretical (and practical) assumption was that, once a currency union is in place, monetary policy should be conducted with no regard to this question.

In policy terms, however, that means all the elements causing the sub-optimality have to be removed as soon as possible; this has led to the Maastricht criteria and the Growth and Stability Pact from the demand side; from the supply side, instead, this is the rationale currently driving the process of structural reforms initiated with the 2000 Spring Council in Lisbon (Altomonte and Secchi, 2002). Anyway, even though this approach is reasonable, when assessing the effects of the EU enlargement one has to take into consideration the short-term consequences of living in a non-OCA setup.

Consider a non-optimal currency union consisting of many countries, each one having its own degree of downward nominal wage rigidities. Moreover, let us assume each country to be also subject to random demand shocks. In those countries that have high unemployment, the nominal demand might be too low[5]. If a country wanted to restore full employment, price and nominal wage reductions would be necessary; but that is precisely one (if not even the main) reason of non-optimality of a currency area. Hence the sluggish supply adjustment would be such that unemployment would tend to persist. A clear alternative to country specific nominal wage reductions would be to increase aggregate nominal demand, a strategy that, however, would raise nominal demand in all the other countries[6]. As a final result, employment would increase in those countries with unemployment without producing significant inflationary pressures; on the contrary prices and nominal wages would rise in those countries already at full employment. The non-optimality, together with the imperfections in the labour market and an insufficient degree of flexibility, ultimately generates a short-term trade-off between inflation and unemployment, better known as the Phillips curve, and makes it more evident (Palley, 2000).

After its disappearance during the 1970s and the 1980s, a new negative relationship between the two economic variables has in fact emerged in the EU (European Commission, 2001). This obviously suggests further analysis (see Graph 1):

[Graph 1 about here]

It is interesting to note that, at the end of 2001, the Euro area seemed to be on a lower short-run Phillips curve than eight/ten years ago. This is an evidence of the fact that, like the US, EMU-12 has recently moved to a sustainable lower inflation path with reduced

[5] One might argue that the nominal demand, and even the aggregate supply, can instead be structurally low, as the case of Europe seems to be. However, in such a situation, a solution, which is additional to that suggested in the text, could consist of structural reforms capable of lowering the NAIRU in the area under consideration. Alternatively, stimulating the aggregate demand would constitute a first step to improve the situation of the labour market. In effect, both the roads may be pursued in Europe.

[6] Demand spillovers seem to be negligible in EMU, unless they come from monetary policy only. That is obviously the case treated in our context, in which we mainly try to examine the effects induced by monetary strategies.

inflationary expectations, very probably characterized by a higher level of productivity of both the labour and the capital stock. Furthermore, it is remarkable to note that the shift of the curve seems to have occurred between 1995 and 1996, that is when all the countries involved in the project of monetary integration started to converge towards the currency union's parameters.

By aggregating the data of EMU-12 with the data of the candidate countries, it is then possible to obtain the picture of a hypothetical EMU-20, composed of all the countries of EMU-12 and of the eight CEECs considered in this study (we left out Malta and Cyprus because of their negligible economic size):

[Graph 2 about here]

In this last case, Graph 2 clearly shows that not only does the short-run Phillips curve of EMU-20 maintain its negative slope, but it also seems to shift towards the right, hence worsening the trade-off between inflation and unemployment. Palley (2000) gives a theoretical explanation of the reason for which this might be the case: if, in a currency union, the variance of cross-country demand shocks is small, the demand curves of its countries will tend to be close together. So, a low growth of nominal demand induced by the policy authorities will be sufficient to offset negative country demand shocks and keep all the economies close to full employment. At the same time inflation will be low, because, if the growth of nominal demand is low, there will be a little additional inflation pressure in the economy when full employment is reached. Instead, if the variance of demand shocks is large, then an economy with high unemployment will continue presenting low levels of output, given that the low rate of nominal demand growth will not be enough to make the situation better. As a result, taking the cross-country variance of demand shocks as a proxy for the degree of optimality of a currency area (as suggested by Palley), the less optimal a monetary union is, the more the Phillips curve will be right-shifted, thus showing more unemployment for each rate of inflation. The policy implications are dramatic: monetary policy in a non-optimal currency area must differ significantly from that decided in an OCA context, particularly as for the inflation target, which should be set at a higher level, if high cyclical unemployment has to be avoided.

In order to assess the relevance of this conclusion, we first have to estimate whether the enlargement entails a worsening in the optimality of the Euro area. Secondly, we have to verify econometrically the existence of the Phillips curve. The former point can be easily checked using two "standard" indicators for the optimality of currency areas, already developed in the literature. The first measure is known as the *weighted dispersion of employment growth rates* taken at the country level, and can be interpreted as a proxy for the variability of economic shocks across the N countries constituting the currency union. The argument underlying the index is that the greater the degree of dispersion estimated for a group of countries, the less that group corresponds to an optimum currency area.

The index of dispersion of employment growth rates is given by the following formula:

$$\sigma_t = \sum_{i=1}^{N} [s_{i,t}(g_{i,t} - \overline{g}_t)^2]^{0.5}$$

where $s_{i,t}$ is country i's share of total employment in period t, $g_{i,t}$ is the growth of employment in country i in period t and $\overline{g}_t$ is the average growth of employment in the currency union area in period t. Performing such an analysis on annual data from 1995 to 2000 (see Table 2) shows how the values of σ_t for EMU-12 are lower than those calculated for EMU-20 in each period of time. This is a first element in support of what the empirical observations on the "enlarged Phillips curve" and the theory had already suggested: enlargement might cause the deterioration of the optimality of the union as a currency area.

[Table 2 about here]

Furthermore, the normalization of the values of σ_t, using EMU-12 as a benchmark, can provide a more precise and immediate understanding of this comparison, showing how the worsening of optimality appears to be dramatic[7]: on average, the employment growth dispersion in EMU-20 would be 2.2 times larger than the current one.

A second, more sophisticated, technique leads to similar results. It employs an econometric model, developed in a work by Bayoumi and Eichengreen (1992), capable of estimating demand and supply shocks in a country or, as in our case, a group of countries. Let us con-

[7] To be more precise, if the Phillips curve became less steep (and, in a certain sense, the inflation-unemployment trade-off improved) because of expectations in the countries currently belonging to EMU-12, the same might happen for the CEECs and our estimates would result inconsistent. However, ours is a completely backward-looking analysis, based on historical data and with no statistical inference. We are just presenting and comparing two different situations, which are valid now and have to be interpreted for the future on the basis of very general considerations. Additionally, without making any econometrical forecast, we try to depict a future scenario which is not much different from the current (and actual) one. Obviously, many things might change as time goes on and the worsening hypothesized for the period after the enlargement might not be as dramatic as it seems here.

struct a vector made up of the changes in output and of the changes in prices, and let ε_t be demand and supply shocks. Then, using the lag operator L, we can write the reduced-form model:

$$\begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} + \begin{bmatrix} k_1 \\ k_2 \end{bmatrix}$$

where y_t and p_t represent the logarithm of output and prices, ε_{dt} and ε_{st} are independent supply and demand shocks, a_{jji} represents element a_{jj} in the matrix A_i of the impulse response function and the k-vector is the constant term. The framework, based on the macroeconomic theory of shocks, implies that supply shocks have permanent effects on the level of output while demand shocks have only temporary effects. Both, instead, have permanent effects upon the level of prices. Since output is written in first differences on the left-hand side of the model above, this implies that the cumulative effect of demand shocks on the change of output must be zero, i.e. the model has to present the following restriction: $\sum_{i=1}^{\infty} a_{11i} = 0$.

The model can be estimated through a rigorous procedure that involves the use of parsimonious VAR(1) models on the quarterly time series regarding two different set of countries, namely EMU-12 (data starting from 1991) and EMU-20 (data starting, instead, from 1993). Table 3 reports the estimations for the two $\sum_{i=1}^{\infty} A_i$ matrices regarding EMU-12 and EMU-20; additionally, the correlation matrices of demand and supply shocks and, most importantly, their standard deviations[8].

[Table 3 about here]

Since EMU-12 series are longer than those of EMU-20, a direct comparison of their variability through their standard deviations would not be completely correct. A way to overcome this obstacle is to compare their standard deviations related to the same period of time, i.e. considering a common sample of observations. An even more precise result can be obtained by calculating and comparing the coefficients of variation of the series, which are adimensional comparable numbers, rather than their standard deviations. Paying attention to the demand shocks in particular, we can note that their coefficients of variation, in both the individual sample and the common sample, are greater in EMU-20 than in EMU-12. In other words, the variability of the demand shocks is likely to be higher in a monetary union

[8] Actually, we are not really interested in correlations between shocks in EMU-20 and shocks in EMU-12. We just presented this additional information to show how those shocks share the same patterns over time. In fact, we expected this result from the very beginning, given that we estimated shocks referring to two aggregates with the same "core". So, shocks covary strongly, as we can infere from the figures, but are more variable in EMU-20. What matters as for our conclusions is their standard deviations.

enlarged to Eastern countries. In Graph 3, we draw the time series of the estimated shocks:

[Graph 3 about here]

The result above confirms our intuition: being the variance of demand shocks one of the key elements to measure the degree of optimality of a currency union, the fact that the variance increases as the monetary union gets enlarged is another important proof of the possible worsening of the optimality conditions in EMU-20. A fortiori, provided that a significant Phillips curve exists in EMU-12, the change regarding the optimality conditions brought about by the enlargement should then worsen, according to the theory, the trade-off between unemployment and inflation, thus producing a shift towards the right of the "enlarged" Phillips curve. The empirical evidence reported in Graph 2 confirms this theoretical prior.

3 Phillips curves - EMU-12 vs. EMU-20

The following part focuses on one of the two elements on which the monetary policy in the Euro area is based, that is the so-called "two pillars". While the first one is defined as *"a prominent role for money"* and will be discussed carefully afterwards, the second one is a *"broadly based assessment of the outlook for future price developments"*. This part of the paper relies on the latter underlying basis.

Given our goals, it is then interesting to further strengthen our previous findings through an econometric analysis. As a first approach, we will be using a reduced-form specification of the Phillips curve in which the dependent variable is obviously the inflation rate. The first term on the right-hand side of the equation below is the constant; the second is the lagged inflation, a proxy for inflation inertia and expectations; the third is the output gap; the fourth and the fifth are proxies for supply shocks and the sixth is the error term. In particular, the fourth variable is added to avoid the serial correlation in the residuals of the regression and hence to improve the specification of the model. At this purpose, that is in order to make the specification better, it is common (Gordon, 1990) to exclude a fixed commodity basket from the price index and/or to add the relative price changes of a fixed commodity basket to the right-hand side of the equation, the latter being our chosen approach. As a result, our specification of the Phillips curve is the following[9]:

$$\dot{Cpi}_t = \alpha + \sum_{i=1}^{l} \beta_i \cdot \dot{Cpi}_{t-i} + \sum_{j=1}^{m} \gamma_j \cdot OpGap_{t-j} + \sum_{k=0}^{n} \theta_k \cdot \dot{RCpif}_{t-k} + \sum_{w=0}^{o} \varphi_w \cdot \dot{RCpie}_{t-w} + \varepsilon_t$$

where Cpi is the consumer price index, $OpGap$ the output gap, $RCpif$ the relative price of foods and $RCpie$ the relative price of energy-related goods. The parameters $l, m = 1, ..., 3$ and $n, o = 0, ..., 3$ indicate all the possible lags for the variables. The dots above the variables indicate year-to-year changes.

In order to fit the data with the assumed structure of the Phillips curve, we used a general-to-specific approach, starting from the most general specification, analyzing the results coming from the OLS regressions performed with various lag lengths for inflation, output gap and supply shock terms, and then selecting those specifications satisfying some required efficiency criteria. The structure of lags described above allows for 288 different models, out of which the 26 presenting a number of significant coefficients $\geq 70\%$ have been retained[10].

Within these models, several tests, capable of revealing departures from the general assumptions of OLS estimates (non-autocorrelation, normal distribution and homoskedasticity of the residuals), were performed. In particular, for each selected model we looked at the correlograms of the residuals and of the squared residuals in order to analyze their autocorrelation and capture any ARCH (Autoregressive Conditional Heteroskedasticity) effect; at the normality test underlying the Jarque-Bera statistic; at the LM test for serial correlation; at the LM test for ARCH effects and at the White's heteroskedasticity test. Moreover, in order to evaluate the stability of the estimations, we performed Chow breakpoint tests, Chow forecast tests and Ramsey's RESETs, general tests for several types of specification errors. Finally, we went through some recursive tests such as the CUSUM and the CUSUM of squares tests, in addition to the analisys of the graph showing the recursive residuals, in order to better assess the stability and the consistence of the estimated coefficients. We repeated this exercise for both the EMU-12 and EMU-20 sets of data.

[Tables 4 and 5 and Graph 4 about here]

[9] Note that we did not impose restrictions in the estimation of the model. We just let the data *"speak"* by themselves.

[10] We chose the 70% threshold arbitrarily, in order to have a finite and manageable number of regressions among which we could select the best, in other words the regression satisfying better some very specific statistical requirements.

The results reported in Table 4 show that just the first lagged value of the output gap has been estimated and found significant for both EMU-12 and EMU-20. The estimates have the same sign, too, so one can infere that the output gap has the same positively correlated effect on inflation; but the estimation in EMU-20 appears to be much greater than that in EMU-12. This means that the same marginal variation of real output is likely to affect inflation more prominently in an enlarged Europe than in a monetary union made of the present twelve countries, probably because of more binding capacity constraints and of a reduced average productivity of labour in a EMU-20 context.

This result confirms in some sense the deterioration of the trade-off under consideration: a larger Europe would be more sensitive to shocks capable of increasing or decreasing output, and the objective of the ECB of stabilizing prices (or, better, the changes of price levels) over time would be more difficult to achieve. Hence, since the risks of higher inflation rates as output increases (and of disinflation during the periods of recession) would become higher, the ECB would suddenly face the necessity of correcting its policy stance. Clearly, the theoretical explanation we adopt, linked to the worsening in the degree of optimality of the currency area (Palley, 2000), might be affected by several other factors, such as a greater rigidity of the labour market after the enlargement (there are, and will still be for some years, limitations in the mobility of workers from the CEECs to the EMU-12 countries, for instance) or the effects of Balassa-Samuelson inflation, which, in a few words, consists of higher inflation rates for those countries that are catching-up. However, econometric evidence still points to the existence of a right-shifted Phillips curve in an enlarged currency union.

The robustness of this evidence can however be challenged, being our estimates completely based on the restrictive assumptions of unrestricted OLS regressions. In addition, the model adopted does not consider variables directly related to the labour market, which, instead, should be included for a more detailed description of a possible relationship between unemployment and inflation, whose theoretical basis depends on a sluggish supply curve. As a check for robustness, we now turn to an estimation of the Phillips curve based on the so-called cointegration analysis, within which we decided to eliminate supply shocks and insert directly the productivity of labour, measured as real GDP per worker.

The estimation of a cointegrating vector explores the long-term relationship between the selected variables and, as such, might seem inappropriate to evaluate a Phillips curve whose existence is surely assessed only in the short-run. However, as for the long-run, the longheld tenet of mainstream macroeconomics, which claims that nominal aggregate demand shocks have no effect on real economic activity (the so-called classical dichotomy), has come under recent attack[11]. There is, in fact, the possibility that some form of hysteresis causes monetary shocks to have long-lasting effects on the real economy, opening the possibility of a non-unique long-run Phillips curve (Akerlof et al., 2000)[12].

At this purpose, it is then useful to start from the following VAR:

$$\begin{bmatrix} U_t \\ y_t \\ \pi_t \\ q_t \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \\ c_3 \\ c_4 \end{bmatrix} + \sum_{i=1}^{p} \Gamma_i \begin{bmatrix} U_{t-i} \\ y_{t-i} \\ \pi_{t-i} \\ q_{t-i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \end{bmatrix}$$

where U is the unemployment rate, y is the logarithm of the real GDP in 1995 constant prices, π is the rate of inflation as measured by the year-on-year changes of the consumer price index, q is the logarithm of the productivity of labour (measured as real output per employee), and the vector $\widehat{\varepsilon}$ represents the error term, which should be normally distributed with zero mean and non-autocorrelated. The value of p, i.e. the number of lagged values for the variables of the VAR, is chosen according to the joint results of the Schwarz criterion and the analysis of the residuals. This brought us to the selection of VAR(2) models for both EMU-12 and EMU-20, which turned out to be stable (all the inverse roots of the AR characteristic polynomials were inside the unit circle) and generating non-autocorrelated residuals. Through unit-root tests we found all the variables included in the VAR to be I(1), hence allowing us to safely adopt the cointegration approach.

In particular, the cointegration analysis has been performed with the Johansen's procedure and by considering the $\lambda - max$ and the *trace statistics* in order to check for the number of cointegrating relations among the variables involved. Among the possible deterministic specifications for the cointegrating vectors, we opted for the one allowing for a linear deterministic trend in the data, i.e. an intercept in the cointegrating equations and in the

[11] We tried to estimate a long-run relationship also to give an additional insight of what could happen when the role of expectations is completely ruled out (expectations would, instead, imply a moving Phillips curve in the short-run, coherently with the estimations performed using the Gordon method). We considered it as a necessary step to make some more significant *"guesses"* about the consequences of a process that will happen in not less than four years.

[12] In effect, as already stated, a long-run Phillips curve, expecially in the European case, might be a not easily defendable finding; but we just made an attempt. The ECB itself does not deny the existence of a Phillips curve in the short-run, so why not checking its existence in the long-run? We eventually found a stationary relationship among the variables, but, very probably, the link between unemployment and inflation is rather weak in equilibrium (jut check the size of the coefficient of inflation in the cointegrating vector!).

test VAR. Additionally, we specified 1 to 2 as the lag interval in first differences:

[Table 6 and Graph 5 about here]

As it can be seen in Table 6, we have been able to identify unique cointegrating equations for both EMU-12 and EMU-20, which also seem to fit pretty well the data (see Graph 5). In order to evaluate the impact of inflation on unemployment, we must now look at the coefficients estimated: combining the cointegration equation with the results of the VAR, they are found to be negative in both the cases[13]. So, as inflation increases, long-run unemployment is likely to decrease. The same is true as for the real GDP (the Okun law) and the reverse is, instead, true for labour productivity. And more, important for our purposes, the magnitude of the inflation coefficient, normalized with respect to unemployment, is greater in the case of EMU-12 than in the case of EMU-20. That means that the negative slope of the Phillips curve of EMU-20 is greater than that of EMU-12, indicating a worse trade-off: in EMU-20, little changes in unemployment are likely to cause larger oscillations of inflation or, said in another way, in order to reduce unemployment the EMU-20's Central Bank should allow inflation to rise more than in the current situation[14].

Another important element for the measurement of the worsening trade-off is given by the intercept, which is greater in the equation concerning EMU-20. This means that the Phillips curve of EMU-20 lies over that of EMU-12: *ceteris paribus*, in an enlarged currency union, the ECB would be forced to keep the inflation rate at a higher level, if it wanted to prevent unemployment from increasing too much.

Several theories and observations, completely different from the one regarding the variability of demand shocks analyzed above, may give possible explanations of the shift of the Phillips curve found for EMU-20. First of all, one can consider the behaviour of firms in fixing the prices: globalization has exacerbated competition in the markets, shrinking markups and prices. EMU-12, probably more influenced than EMU-20 by this phenomenon over the last decade, should then have experienced a Phillips curve closer to the vertical axis than the one that can be estimated for a theoretical EMU-20 (as done). Moreover, we must

[13] These and other non reported results are available upon request from the authors.

[14] According to some results obtained by Romer, Ball and Mankiw (1998), even Keynesian models with sticky prices predict the Phillips curve should be steeper in those countries with higher average rates of inflation. That is the case of the average rate of inflation in EMU-20 over the last decade, undoubtedly affected by the hyperinflations of the early '90s in the CEECs.

not undervalue the commitments of the Western National Central Banks after the currency crisis in 1992, first, and then of the ECB, which have probably influenced expectations. The Eastern Central Banks did a good job, too, managing to recover from the galloping inflation of their respective countries; however, as for the long-run estimates, the Phillips curve of EMU-20 is sistematically affected by the high rates of inflation of a decade ago. The obvious and consequent result is a right-shifted Phillips curve for EMU-20.

Furthermore, the recalled shift might also be linked to a possible increase of the NAIRU, or natural rate of unemployment, evident if we compare the same variable for EMU-20 with respect to the case of EMU-12 and also determined by the more significant structural incongruences between demand and supply in the CEECs (Staiger et al., 2001). Contrary to the CEECs, in EMU-12, the (still ongoing) reforms that started after the creation of the Single Market in 1992 have allowed some improvements in the labour market, lowering unemployment especially during the last period of rather sustained economic growth. On the other hand, the restructuring processes experienced by transition countries seem to have created a negative correlation between output performance and employment growth.

Moreover, bottlenecks in the labour market might have caused increases of wages that are more than proportional to the growth of productivity (as in the case of the Balassa-Samuelson effects in Eastern Europe). A better correspondence between demand and supply in the labour market, together with a higher degree of flexibility of wages (particularly in the CEECs) should then facilitate the adjustment of wages and prices to monetary policy manoeuvres and reduce their inflationary short-run effects on the real economy[15].

Finally, even the negative supply shocks occurred in the CEECs might have induced the estimation of a right-shifted Phillips curve for EMU-20. With the Gordon method, for instance, we estimated a higher coefficient for shocks coming from the energy sector, crucial for production; peripheral European countries, in effect, generally experience larger supply shocks.

To sum up, the empirical evidence, the traditional econometric estimation of the short-run Phillips curve (through the Gordon method) and the long-run relationship of cointegration between unemployment and inflation (and among all the other variables indicated above) point to a worsening of the unemployment/inflation trade-off in an enlarged EMU, a finding

[15]We recall that imperfections in the market of labour and the stickiness of prices are higher in the case of EMU-20, as it results from the estimations obtained with the Gordon method. These might in fact make monetary policy more inflationary in the short-run and less effective on unemployment; in addition, and as a consequence, they might worsen the trade-off in the long-run.

supported by plausible theoretical explanations. That suggests the ECB should change its monetary policy after enlargement, and even during the transition process, allowing for generally higher inflation rates if employment has to be preserved. Of course, this would imply a modification of its statute, which should be reformulated in order to take the changed conditions of an enlarged monetary union into account.

4 Money demand functions - EMU-12 vs. EMU-20

However, since the ECB strategy is based on two-pillars, before proposing such a policy change it is necessary to look at the additional consequences of an enlarged EMU on the first official element driving the ECB monetary policy, the element skipped in the previous section, namely the growth of money demand.

A stable and predictable demand for money is an essential pre-requisite to use targets for monetary aggregates as suitable intermediate objectives of monetary policy, and hence it is important to verify how the money demand would change, if passing from an EMU of 12 to one of 20 Member States. In order to assess this, we have performed a cointegration analysis regarding both money demand functions. Actually, the same investigation has been conducted with reference to two different monetary aggregates, M2 and M3. As known, the ECB considers only M3, but a further analysis for M2 had to be undertaken due to the following reason: not all the CEECs use M3 as the reference aggregate of their monetary policy. So, it was not originally possible to reconstruct an aggregated time series for M3 in EMU-20 because of the lack of statistical data. Hence, we estimated a coherent M3 aggregate for EMU-20 starting from M2 and performed the analysis on both M2 and (the estimation of) M3, then checking the sensitivity of the results to the two different measures.

Clearly, there exist several methodological problems in drawing conclusions on the EU monetary policy from money demand estimates. The most prominent problem at the theoretical level is the one connected with the *"Lucas critique"*: to be able to put any economic meaning into the estimates of aggregate money demand functions for countries constituting EMU-12 (and then for EMU-20), it is necessary to assume that the future behaviour of the variables involved in the study can be derived from past data. In other words, as well as for the previous econometric estimations, we have to assume that the creation of EMU in 1999 and the use of the money demand estimates by the ECB have not led to a significant structural break in people's behaviour. At this purpose, three arguments can be set forth to support the relevance and the correctness of conclusions based on past behaviours.

The first one builds upon the distinction between temporary and permanent effects of the economic shocks. Even though the creation of EMU has probably caused a shock in the money market, this might have had only a temporary effect: in such a case, the would-be ECB should not have had great problems to deal with the new situation, taking the break into account, starting from pre-unification data and using them as a guideline for its monetary policy.

A second argument, valid in the case of EMU-12, but to be verified in the case of EMU-20, is based on the potentially stabilizing effects brought about by creating a monetary union of countries already forming a zone of free capital mobility. Since optimal economic agents can switch in and out of their respective national currencies very easily, their individually optimal economic action may cause their respective national money demands to become highly unstable. Now, if the countries that experience the biggest share of mutual currency substitution entered a monetary union, these destabilizing effects would be removed by definition.

Third, and more compelling, there is evidence of a behavioural inertia in adapting to the new monetary framework: at the beginning of the EMU market participants had to adjust to a situation that they could not evaluate very precisely. They needed time to gain experience and learn about the new monetary environment. While this took place, it is likely that they continued to behave in the same way as they did before the birth of EMU, updating their behaviour as new information appeared. After four years from the creation of the union, even though the monetary policy has not always been completely clear, the adjustment process of economic agents should have been completed, and hence the structural break in people's behaviour re-absorbed[16].

Turning to the estimation of the money demand, the following is the long-run equation that commonly appears in the literature[17]:

$$m = \alpha + \beta y + \gamma r + \delta \pi$$

where m and y are, respectively, the logarithms of money balances and the scale variable (which might be the level of output, the real or nominal GDP including or not wealth mea-

[16] By contrast, the accession of Central European and Eastern countries might cause a break, at least temporarily, but that would happen just in the future. For this reason, we can use their data right now, never forgetting the backward-looking approach of our analysis.

[17] See for example the work of Fase and Winder (1998).

sures), both in real terms for our purposes; r is a vector of nominal returns on different assets and π is the inflation rate, which tries to reflect the role of expectations in the determination of the demand for money and the underlying hypothesis that inflation represents a cost of holding money. The coefficients to be estimated represent the elasticity (or the semi-elasticity, as in the case of the rate of return) of the real money with respect to the explanatory variables. In general, the economic theory predicts $\beta > 0$, but in some cases predictions are more precise: in the *quantity theory* $\beta = 1$; in the *Baumol-Tobin framework* $\beta = 0.5$. The expected sign of the parameter γ is positive for the returns in r that are relative to money components (*own rates*), negative if returns correspond to financial assets alternative to money (*outside rates*). In the case of our work, in which the aggregated interest rate has been constructed starting from treasury-bills rates and deposit rates, including interest rates for assets with maturity up to one year, the rate considered is clearly an outside rate, so its sign is expected to be negative.

We employ again the multivariate cointegration approach developed by Johansen, so starting with the estimation of the following VAR for both M2 and M3 in EMU-12 and EMU-20:

$$\begin{bmatrix} m_t \\ y_t \\ i_t \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} + \sum_{k=1}^{p} \Pi_k \begin{bmatrix} m_{t-k} \\ y_{t-k} \\ i_{t-k} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix}$$

where m is alternatively the logarithm of real M3 and M2, calculated as the difference between the logarithm of M3 (or M2) and the logarithm of the consumer price index; y is the logarithm of real GDP and i the short-term nominal interest rate[18]. As before, the optimal lag length according to the Schwarz criterion resulted to be $p = 2$, i.e. a VAR(2) model for both EMU-12 and EMU-20 was chosen. In both the cases the VAR turned out to be stable (all the inverse roots of the AR characteristic polynomials were inside the unit

[18] The insertion of the inflation rate in the VAR model implies the consideration of the role of rational expectations regarding prices. In effect, some of the most recent approaches to the money theory and to the money-demand function estimation try to take this aspect into account. Being aware of the difficulties of developing time series models capable of capturing rational expectations and given some inconsistent results obtained from the model including inflation, we preferred not reporting them. However, it is important to underline the fact that the unexpected results came mainly from the estimation of a money-demand function for EMU-20. On the other hand, the Keynesian approach to the money theory did not include the inflation rate among the explanatory variables for money demand and, despite the critique of the Nobel Prize winner von Hayek, Keynesian theories still represent a valid reference point for economic explanations needing a certain degree of measurability of the variables. Briefly, we developed and presented only the results of a model without inflation, nor real interest rates, mainly for comparative purposes, believing that the omission of such variables will not affect our conclusions. Lastly, we also had to take into account a problem of degrees of freedom emerging with the insertion of the inflation rate in our estimates (too many parameters to be estimated and too short time series).

circle) and yielded non-autocorrelated residuals. The Dickey-Fuller tests on the variables revealed that they are all I(1), and hence a cointegration analysis can be performed (see Table 7).

[Table 7 about here]

The estimated value for the coefficient associated to y_t in the long-run equation is $\beta > 0$, as the theory had predicted. The omission of financial wealth from money demand can lead to the overestimation of the money elasticity to income, especially if wealth accumulation grows faster than income (Filosa, 1995). However, due to the lack of reliable wealth data, both for EMU-12 and for the CEECs, we decided to measure income with real GDP. So, probably because of this reason, the money demand elasticity to income resulted greater than one. Other studies, instead, demonstrate that, when wealth is included, the corresponding estimates are less than (or equal to) one (Artis, Bladen-Hovell and Zhang, 1993).

From Table 7 it is clear that the response of real money (M3 as well as M2) to an increase of real GDP is greater in EMU-12 than in EMU-20, even though, as for real M3, the difference between the monetary union *ante* and *post* enlargement is very limited. Moreover, note that the estimated coefficient for the interest rate is greater (in absolute value) in EMU-20. This observation suggests the following remark: *ceteris paribus,* in EMU-20 the long-run money demand curve is more negatively sloped than that in EMU-12 with respect to the interest rate. This means that, while controlling the supply of money in the Euro area, the European Central Bank will probably face some more difficulties after the enlargement: the same variation of interest rates is likely to have a larger impact on the growth rate of money supply in the post enlargement situation. However, enlargement will not affect the theoretical bases on which the monetary policy of the European Central Bank is founded, since recursive estimates of the long-run money demand curve revealed an improvement in its overall stability (see Table 8).

[Table 8 and Graph 7 about here]

This is probably due to the fact that, with enlargement, some factors of instability in the money demand will be removed or just reduced, among all currency substitution, as previously recalled. Thus, the theoretical framework on which the adoption of a monetary target for the ECB policy stance is based is not likely to be affected by the new economic context.

5 Policy implications and conclusions

The analysis performed in the previous Sections suggests that, if the ECB maintains its current monetary policy stance, the shift of the Phillips curve, likely induced by the enlargement of the currency union, will be such to increase the average level of unemployment in Europe (that is, rigidities in the labour market, Balassa-Samuelson effects not completely absorbed, capacity constraints, hysteresis and low productivity rates might make any current rate of inflation correspond to higher unemployment rates). Graph 8 provides a qualitative explanation of this concept.

[Graph 8 about here]

The lower curve represents the long-run Phillips curve of EMU-12. At the inflation rate of $\pi_k = 2\%$ (i.e. the ECB "target") it is associated the unemployment rate U_{EMU-12}. As the accession countries enter the currency union, the Phillips curve is likely to shift towards the right and become steeper, as emerged from the analysis performed until now. If the ECB monetary policy stance remains unchanged, i.e. $\pi_k = 2\%$, then the associated level of unemployment will become $U_{EMU-20} > U_{EMU-12}$, and the equilibrium point pass from E to E', entailing some social costs. On the other hand, if the ECB wants to help governments reduce the unemployment rate, it should then allow, at least temporarily, higher inflation rates: at the limit, hoping to keep unemployment constant at the pre-enlargement levels (U_{EMU-12}), the new EMU-20 inflation target would have to become $\pi_\pi >> \pi_k$. But this might be politically unacceptable for the ECB, and even contrary to article 105 of the Treaty.

The question is then which the correct policy strategy to be implemented in such a context is. The ECB might initially consider the possibility of revising upward the current inflation target, which is already under severe criticism for being too strict, in order not to depress the perspectives of growth of each member state in an enlarged EMU (hence setting the combination π^*, U^* in Graph 8). However, the consideration that the enlargement itself, due to the capacity constraints in acceding countries and the Balassa-Samuelson effect, risks to generate structurally higher inflation levels in the EMU might prevent a straight loosening of the monetary policy. Briefly, in our opinion, under the main hypothesis that in four year the actual situation is depicted by the one described in the paper[19], the ECB might decide to raise interest rates and lower the target related to the growth of M3 during the transition period, letting the inflation rate go somewhat up in the short-run, but preventing

[19] Actually, the worsening is likely to be less dramatic with respect to the one estimated because of the convergence process going on in all the accession countries.

the unemployment rate from increasing too dangerously. In the medium-term, instead, the ECB would have to solve a problem of choice between two alternatives: it might want to fully respect the target of 2% as for the inflation rate, accepting a permanently higher level of unemployment in the Euro area; on the contrary, it might prefer (a rather unrealistic option) abandoning the 2% target and letting the inflation rate be somewhat higher. In this way, the unemployment rate would increase less and the equilibrium would then be at E".

As a result and given the perspectives described above, chances are that, in this situation, the ECB might be very conservative in changing its policy stance. On the one hand, a decrease of interest rates, due to the attempt to fight the worsening unemployment, would risk to boost inflation before significant results are obtained, because of the structural changes brought by enlargement (a steeper Phillips curve). On the other hand, increasing too much the interest rates in order to contrast possible inflationary pressures deriving from the enlargement might be risky and detrimental for the catching-up process of the CEECs. We believe that a certain downward rigidity in interest rates, more or less stable at the pre-enlargement level, is the only viable solution for the ECB, even in consideration of the fact that the new money demand function resulting in EMU-20 would probably imply a higher sensitivity of the level of money supply to changes of monetary policy, making the latter more difficult to be implemented.

What would this imply for the Growth and Stability Pact? Given the current sluggish economic growth in Europe, and the perspectives of a certain rigidity in the future monetary policy, chances are that, with an unchanged policy scenario, the Pact would become even more binding and, in some cases, too burdensome, for some countries in particular. In such a situation, an expansionary fiscal policy would be requested by Member States, but that would be possible (or should be possible, if rules are abided) solely if enough room of manoeuvre in terms of public finances is available: obviously that is not the case nowadays in Europe, where, in the larger Member States, even the room for the working of the automatic stabilizers is lacking. Hence, it might be felt that the constraints established in the Stability and Growth Pact prevent the European countries from expanding as they should, or at least would want to.

But the commitment to respect the already recalled parameters, necessary to assure the stability and the sustainability of the currency union, is crucial, especially since enlargement represents a delicate passage for the Union; as such, all uncertainties either in fiscal or monetary policy should be absolutely avoided. Otherwise, the consequences on unemployment, inflation and other variables of vital importance for the survival of the union would be harmful and Euroland might be liable to damages difficult to repair.

In conclusion, given the likely (and hoped) optimal response of the ECB during the enlargement process, only structural reforms implemented by governments would be capable of improving the economic performance of the European countries in the long-run, avoiding the foreseen shift of the Phillips curve towards the right or, at least, substantially limiting the worsening of the inflation-unemployment trade off.

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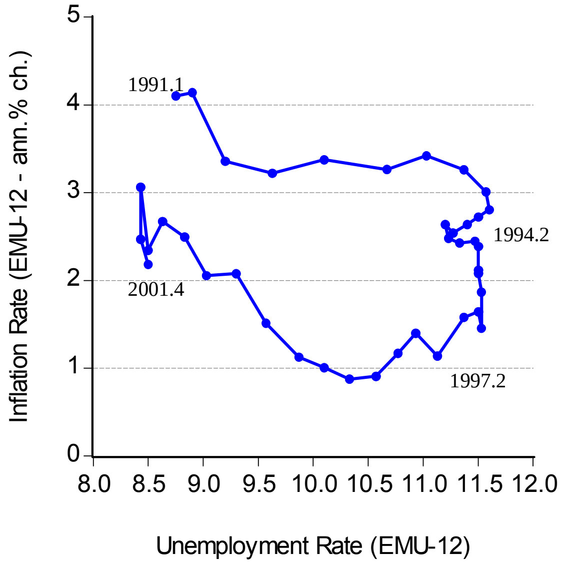
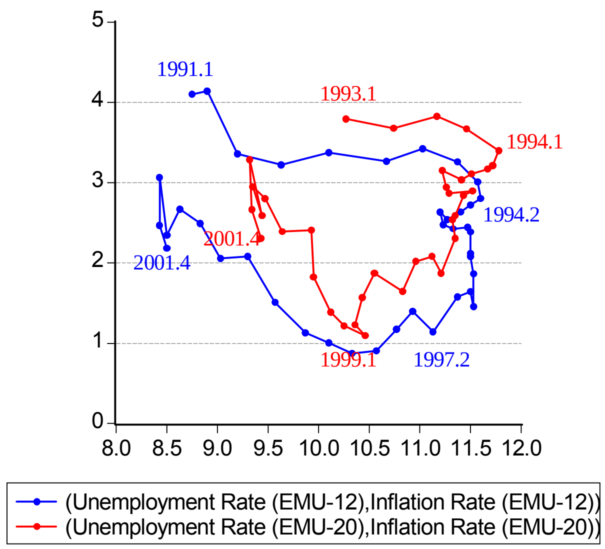
Graph 1. The re-emergence of the Phillips curve in EMU

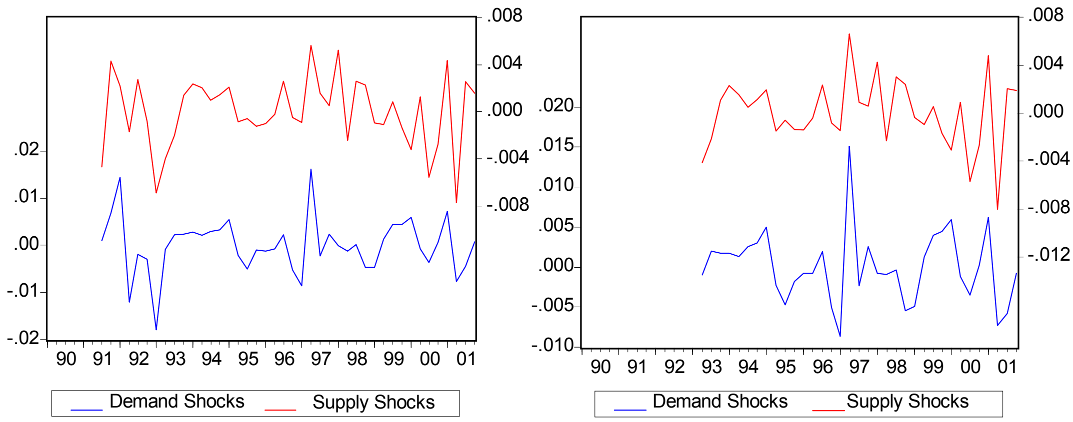


Graph 2. The Phillips curve in an enlarged EMU



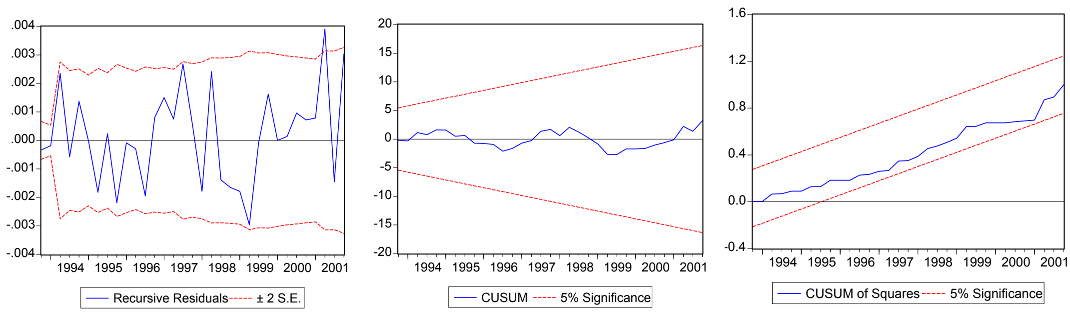
Graph 3. Graphical representation of the shocks estimated

EMU-12 EMU-20

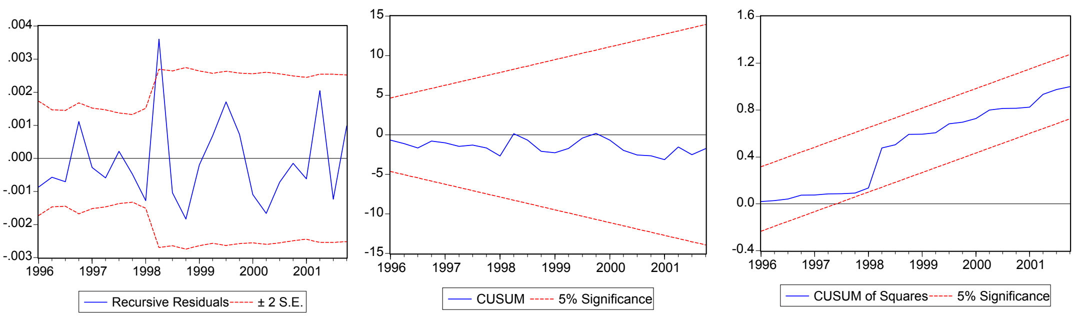


Graph 4. Recursive estimations of the regressions for Phillips curves Gordon method

EMU-12

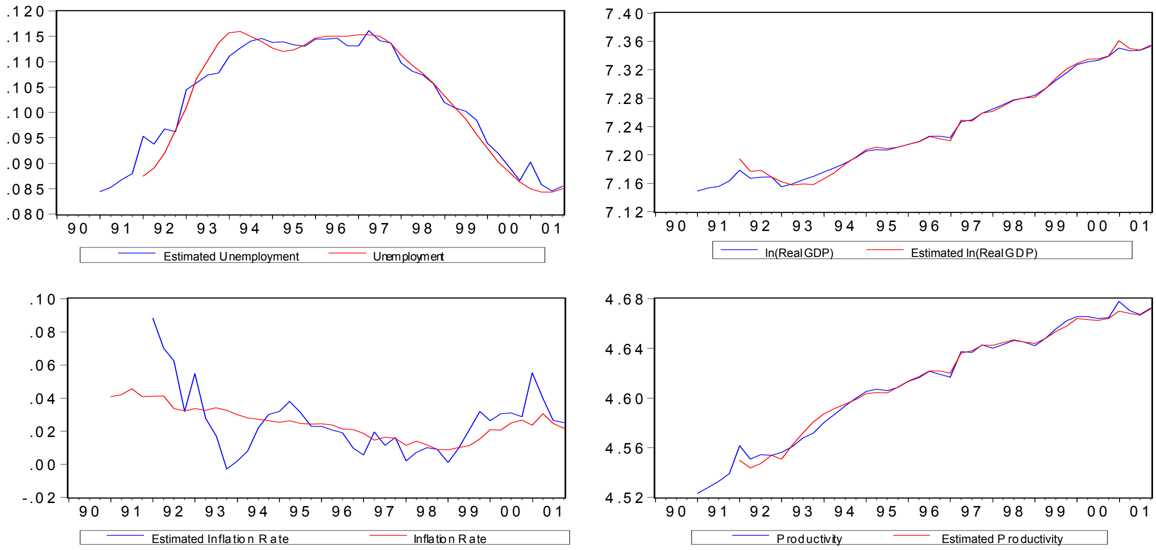


EMU-20

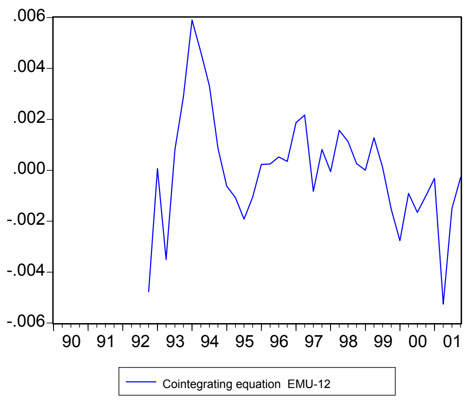


Graph 5. The fit of cointegration analysis

EMU-12 Cointegrating vector

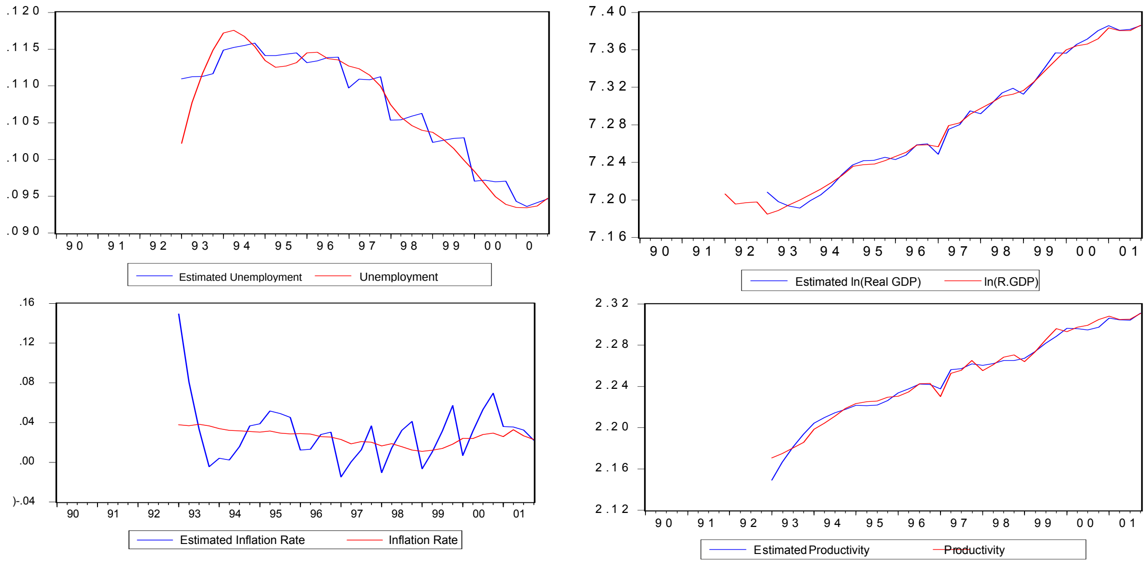


The cointegrating vector - EMU-12

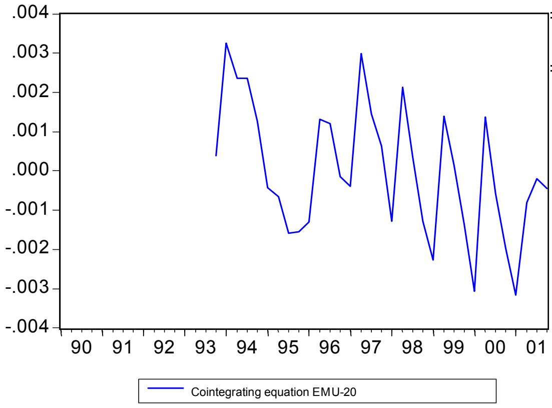


Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.506	0.506	10.250	0.001
		2	0.356	0.135	15.477	0.000
		3	0.008	-0.295	15.480	0.001
		4	-0.159	-0.162	16.585	0.002
		5	-0.247	-0.035	19.346	0.002
		6	-0.228	-0.006	21.765	0.001
		7	-0.179	-0.040	23.302	0.002
		8	-0.059	0.036	23.477	0.003
		9	0.061	0.082	23.667	0.005
		10	0.090	-0.044	24.100	0.007
		11	0.040	-0.127	24.187	0.012
		12	0.022	0.022	24.214	0.019

EMU-20 Cointegrating vector

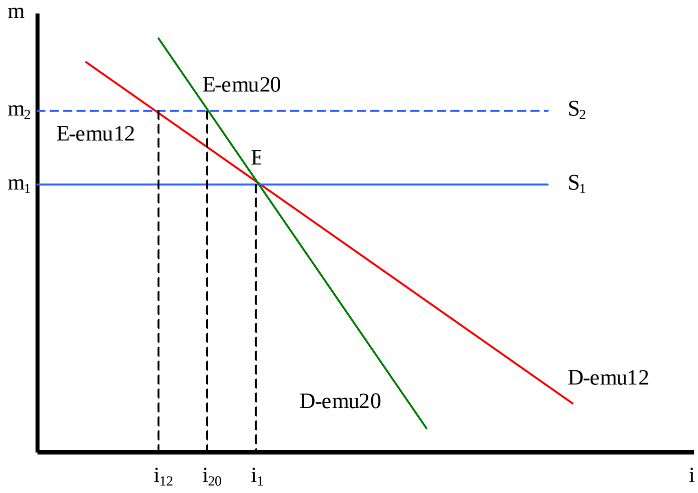


The cointegrating vector - EMU-20



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.366	0.366	4.8244	0.028
		2	0.030	-0.119	4.8586	0.088
		3	0.014	0.054	4.8667	0.182
		4	0.353	0.389	9.8164	0.044
		5	-0.128	-0.560	10.491	0.062
		6	-0.348	-0.060	15.685	0.016
		7	-0.189	0.174	17.278	0.016
		8	0.239	0.074	19.909	0.011
		9	-0.014	-0.037	19.918	0.018
		10	-0.135	0.073	20.827	0.022
		11	-0.060	-0.141	21.015	0.033
		12	0.245	0.014	24.318	0.018

Graph 6. M3 demand and supply schedules in EMU-12 and EMU-20



Graph 7. Qualitative policy implications

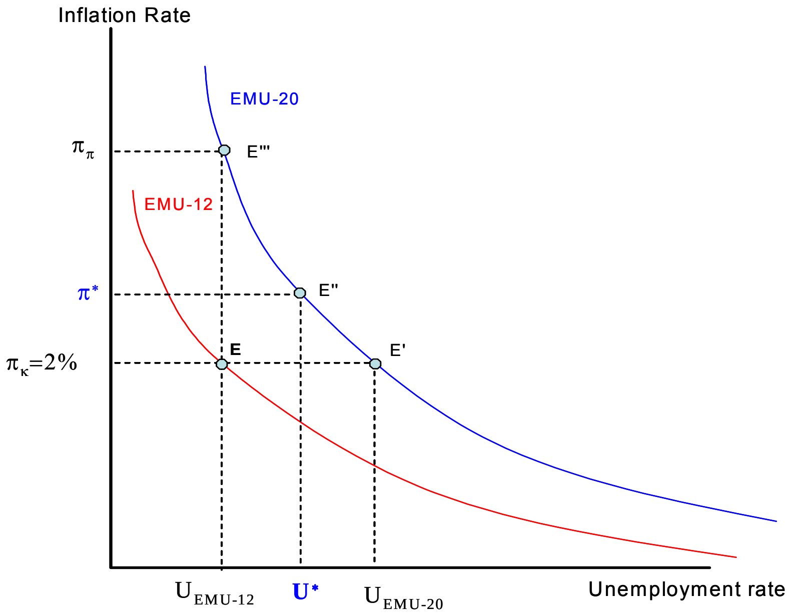


Table 1. The fulfilment of EMU criteria by candidate countries

Provisions related to the "Maastricht" criteria

EMU convergence

	Price stability avg. of period, % yoy			Interest rates 10Y bonds 1)	Exchange rate stability deviation from parity 2)		Fiscal balance, 3) % of GDP			General govt debt, 3) % of GDP		
	2000	2001e	2002f	Last	Last	Max (2Y)	2000	2001e	2002f	2000	2001e	2002f
Reference value	***2.8***	***3.6***	***3.2***	***7.1***		***+/-15%***	***-3.0***	***-3.0***	***-3.0***	***60.0***	***60.0***	***60.0***
Bulgaria	10.1	7.9	8.0	6.4	-0.1	-0.4	-1.1	-0.9	-0.8	83.8	73.9	59.3
Czech Republic	3.9	4.7	2.7	4.8	14.8	-4.6	-4.5	-3.6	-4.1	17.0	19.4	23.1
Estonia	4.0	5.8	3.0	4.4	0.0	-1.5	-0.7	0.4	-1.0	6.6	5.8	5.9
Hungary	9.8	9.2	5.6	7.8	2.5	-4.7	-3.7	-3.5	-4.0	56.1	53.6	51.8
Latvia	2.7	2.4	3.8	9.3	-4.0	5.0	-2.8	-1.8	-2.5	13.2	13.8	13.9
Lithuania	1.0	1.3	3.3	6.4	6.5	6.5	-2.8	-1.7	-1.5	28.3	29.1	28.4
Poland	10.1	5.5	2.8	7.7	-5.6	-8.1	-2.7	-5.6	-6.3	42.2	42.9	47.4
Romania	45.7	34.5	24.8	29.7	-39.9	-42.3	-4.1	-3.7	-3.3	29.2	31.2	32.1
Slovakia	12.0	7.3	3.9	7.4	-3.8	-3.9	-4.1	-4.0	-0.4	32.9	42.7	40.0
Slovenia	8.9	8.5	7.4	11.1	-7.0	-7.0	-1.4	-1.4	-2.8	25.1	26.9	28.5

1) If available; shorter maturities taken for: Bulgaria, Estonia, Latvia, Lithuania, Romania, Slovakia, Slovenia; Reference: Bunds+15bp.
2) Parity here: last 3-year average exchange rate against EUR.
3) Definitions may differ from those of the EU

Provisions related to the SECB

Country	Independence of the Central Bank from the Government	Budget Deficit Financing	Objective of the monetary policy
Cyprus	Not fully independent	---	monetary stability
Malta	Fully independent	Allowed	overall financial stability; soundness of the banking system
Poland	Formally independent	Not allowed	stable price level; supports policy of government
Hungary	Formally independent	Not allowed; presence of derogations	supports economic policy of government; safeguards domestic and external purchasing power of national currency
Czech Republic	Fully independent	Allowed	stability of national currency interpreted in terms of price stability
Slovenia	Relatively high degree of independence	Allowed	stability of domestic currency and implicitly price stability
Estonia	Largely independent	Not allowed	stability of domestic currency
Romania	Relatively independent	Allowed with restrictions	stability of domestic currency to contribute to price stability
Slovakia	Independent	Allowed	stability of domestic currency
Latvia	Independent	Not allowed	price stability
Lithuania	Largely independent	Not explicitly prohibited	stability of domestic currency
Bulgaria	Formally independent	Not allowed	stability of domestic currency

Table 2. Weighted dispersion of country employment growth rates

$$\sigma_t = \sum_{i=1}^{N} [s_{i,t}(g_{i,t} - \bar{g}_t)^2]^{0.5}$$

	σ EMU-12	σ EMU-20	σ EMU-20 in % of EMU-12
1996	0.023571	0.034499	1.463593
1997	0.036056	0.092457	2.564285
1998	0.033961	0.058605	1.725676
1999	0.025945	0.068958	2.657900
2000	0.023464	0.063451	2.704200

Table 3. Measuring demand and supply shocks in OCA-12 and OCA-20

$$\text{Model: } \begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} + \begin{bmatrix} k_1 \\ k_2 \end{bmatrix}$$

$$\sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix}_{EMU-12} = \begin{bmatrix} 0 & 2.227499 \\ 4.914552 & -12.347988 \end{bmatrix}$$

$$\sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix}_{EMU-20} = \begin{bmatrix} 0 & 1.947046 \\ 5.608021 & -11.828089 \end{bmatrix}$$

Demand shock correlations

	EMU-12	EMU-20
EMU-12	1.000000	0.994874
EMU-20	0.994874	1.000000

Supply shock correlations

	EMU-12	EMU-20
EMU-12	1.000000	0.991128
EMU-20	0.991128	1.000000

Standard Deviations (Individual Samples)

	Emu-12	Emu-20
Demand Shocks	0.006001	0.004516
Supply Shocks	0.003025	0.002880

Standard Deviations (Common Sample)

	Emu-12	Emu-20
Demand Shocks	0.004663	0.004516
Supply Shocks	0.002824	0.002880

Coefficients of Variation (Individual Samples)

	Emu-12	Emu-20
Demand Shocks	1.39192E+16	1.61991E+16
Supply Shocks	6.10376E+15	1.08103E+15

Coefficients of Variation (Common Sample)

	Emu-12	Emu-20
Demand Shocks	12.84305	1.61872E+16
Supply Shocks	20.17833	1.08107E+15

Table 4. The EMU-12 and EMU-20 Phillips curves

EMU-12

	Estimated Value	T-Statistic	Probability	Sig.
α	0.000417	*0.498857*	0.6212	-
β_1	0.974809	*25.489960*	0.0000	*1%*
β_2				
β_3				
γ_1	**0.088853**	*1.976388*	0.0565	*10%*
γ_2				
γ_3				
θ_0	0.146265	*4.127448*	0.0002	*1%*
θ_1				
θ_2	-0.203805	*-3.055377*	0.0044	*1%*
θ_3	0.125158	*2.042409*	0.0492	*5%*
φ_0	0.108737	*5.896663*	0.0000	*1%*
φ_1	-0.095007	*-5.585808*	0.0000	*1%*
φ_2				
φ_3				

R-squared	0.971533
Adjusted R-squared	0.965495
S.E. of regression	0.001633
Sum squared resid	8.80E-05
Log likelihood	209.3803
F-statistic	160.8909
Prob(F-statistic)	0.000000
Durbin-Watson stat	1.887965

EMU-20

	Estimated Value	T-Statistic	Probability	Sig.
α	0.000226	*0.246191*	0.8076	-
β_1	0.728830	*7.172283*	0.0000	*1%*
β_2	0.251651	*2.630879*	0.0146	*5%*
β_3				
γ_1	**0.184130**	*3.479802*	0.0019	*1%*
γ_2				
γ_3				
θ_0	0.125598	*3.590589*	0.0015	*1%*
θ_1				
θ_2	-0.166241	*-2.950548*	0.0070	*1%*
θ_3	0.123786	*2.356064*	0.0270	*5%*
φ_0	0.111121	*6.033715*	0.0000	*1%*
φ_1	-0.085898	*-4.976404*	0.0000	*1%*
φ_2				
φ_3				

R-squared	0.975461
Adjusted R-squared	0.967281
S.E. of regression	0.001259
Sum squared resid	3.80E-05
Log likelihood	178.7886
F-statistic	119.2526
Prob(F-statistic)	0.000000
Durbin-Watson stat	2.048535

with $\dot{Cpi}_t = \alpha + \sum_{i=1}^{l} \beta_i \cdot \dot{Cpi}_{t-i} + \sum_{j=1}^{m} \gamma_j \cdot OpGap_{t-j} + \sum_{k=0}^{n} \theta_k \cdot RC\dot{pif}_{t-k} + \sum_{w=0}^{o} \varphi_w \cdot RC\dot{pie}_{t-w} + \varepsilon_t$

Table 5. Additional Statistics – Gordon Method

- EMU-12

	P-Value
Chow Breakpoint Test	
1994.4 - 1998.4	0.002627
Chow Forecast Test	
2000.4	0.008163
Ramsey's RESET Test	
1 fitted term	0.780809
2 fitted terms	0.631150
3 fitted terms	0.812105
4 fitted terms	0.903512

Dynamic Forecasting RMSE	Static Forecasting RMSE	Mean RMSE
0.001873	0.001617	0.001745

Forecast Sample
2000.1 – 2001.4

- EMU-20

	P-Value
Chow Breakpoint Test	
1996.4 - 1999.4	0.000000
Chow Forecast Test	
2000.4	0.237945
Ramsey's RESET Test	
1 fitted term	0.589703
2 fitted terms	0.151071
3 fitted terms	0.090170
4 fitted terms	0.034327

Dynamic Forecasting RMSE	Static Forecasting RMSE	Mean RMSE
0.000682	0.000974	0.000828

Forecast Sample
2001.1 – 2001.4

Table 6. Cointegration analysis for the Phillips curve

Johansen cointegration test: EMU-12

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.797270	92.89798	47.21	54.46
At most 1 *	0.459589	33.85047	29.68	35.65
At most 2	0.214836	11.07973	15.41	20.04
At most 3	0.055963	2.130837	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 2 cointegrating equation(s) at the 5% level
Trace test indicates 1 cointegrating equation(s) at the 1% level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.797270	59.04751	27.07	32.24
At most 1 *	0.459589	22.77073	20.97	25.52
At most 2	0.214836	8.948896	14.07	18.63
At most 3	0.055963	2.130837	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates 2 cointegrating equation(s) at the 5% level
Max-eigenvalue test indicates 1 cointegrating equation(s) at the 1% level

Normalised cointegrating equation: EMU-12

U_t	y_t	π_t	q_t	c
1.000000	0.497893 (0.01320)	**0.165799** (0.03345)	-0.667323 (0.02552)	**-0.632255**

Augmented Dickey-Fuller test for the cointegrating equation

ADF Test Statistic	-3.679248	**1% Critical Value***	-3.6228
		5% Critical Value	-2.9446
		10% Critical Value	-2.6105

Johansen cointegration test: EMU-20

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.763323	83.04235	47.21	54.46
At most 1 *	0.525372	35.48747	29.68	35.65
At most 2	0.263025	10.89509	15.41	20.04
At most 3	0.024644	0.823435	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 2 cointegrating equation(s) at the 5% level
Trace test indicates 1 cointegrating equation(s) at the 1% level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.763323	47.55488	27.07	32.24
At most 1 *	0.525372	24.59238	20.97	25.52
At most 2	0.263025	10.07165	14.07	18.63
At most 3	0.024644	0.823435	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates 2 cointegrating equation(s) at the 5% level
Max-eigenvalue test indicates 1 cointegrating equation(s) at the 1% level

Normalised cointegrating equation: EMU-20

U_t	y_t	π_t	q_t	c
1.000000	0.371312	**0.078838**	-0.408356	**-1.895325**
	(0.02195)	(0.02508)	(0.03775)	

Augmented Dickey-Fuller test for the cointegrating equation

ADF Test Statistic	-3.789918	**1% Critical Value***	-2.6369
		5% Critical Value	-1.9517
		10% Critical Value	-1.6213

Table 7. Results of cointegration analysis for the money demand

EMU-12

M2:

m_t	y_t	i_t	c
1.000000	**-1.454406** (0.07632)	**0.001390** (0.00221)	6.952500

N.B. after adjusting the cointegration vector for weak exogeneity of y_t and i_t

M3:

m_t	y_t	i_t	c
1.000000	**-1.406155** (0.06954)	**0.002473** (0.00179)	6.448887

N.B. after adjusting the cointegration vector for weak exogeneity of i_t

EMU-20

M2:

m_t	y_t	i_t	c
1.000000	**-1.408802** (0.18900)	**0.017177** (0.00891)	6.607160

N.B. after adjusting the cointegration vector for weak exogeneity of y_t and i_t

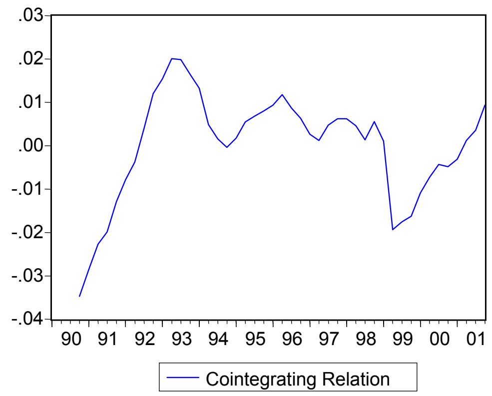
M3*:

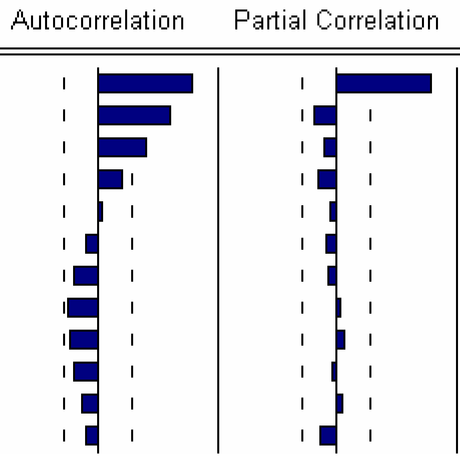
m_t	y_t	i_t	c
1.000000	**-1.395184** (0.18853)	**0.017149** (0.00889)	6.363241

N.B. after adjusting the cointegration vector for weak exogeneity of y_t and i_t

*M3 is estimated in EMU-20 applying to the available measures of M2 the cointegrating equation $\log(M3) = 0.994079\log(M2) + 0.193547$ derived from data on EMU-12

Long-run relationship M2-M3 in EMU-12





	AC	PAC	Q-Stat	Prob
1	0.824	0.824	32.601	0.000
2	0.618	-0.186	51.409	0.000
3	0.416	-0.114	60.104	0.000
4	0.209	-0.157	62.360	0.000
5	0.041	-0.042	62.448	0.000
6	-0.103	-0.098	63.020	0.000
7	-0.215	-0.070	65.588	0.000
8	-0.262	0.039	69.502	0.000
9	-0.243	0.079	72.968	0.000
10	-0.208	-0.038	75.574	0.000
11	-0.140	0.049	76.796	0.000
12	-0.107	-0.134	77.522	0.000

Augmented Dickey-Fuller test for the cointegrating equation

ADF Test Statistic	-2.787905	**1% Critical Value***	-2.6168
		5% Critical Value	-1.9486
		10% Critical Value	-1.6198

Table 8. Recursive estimates of the money demand

Calculated with reference to the mean

	EMU-12 y_t	EMU-12 i_t	EMU-12 c	EMU-20 y_t	EMU-20 i_t	EMU-20 c
Variance	0.163768	0.000032	8.722575	0.129520	0.000019	6.864021
Standard Deviation	0.404683	0.005693	2.953401	0.359888	0.004375	2.619928
Mean (Pole)	-1.801638	-0.003308	9.336119	-1.419517	0.023365	6.505930
Coefficient of Variation	0.224619	1.721090	0.316341	0.253529	0.187252	0.402698

Calculated with reference to the last estimated coefficient value

	EMU-12 y_t	EMU-12 i_t	EMU-12 c	EMU-20 y_t	EMU-20 i_t	EMU-20 c
Variance	0.307578	0.000063	16.387716	0.097732	0.000053	5.168376
Standard Deviation	0.554597	0.007958	4.048174	0,312621	0.007279	2.273406
Pole	-1.406155	0.002473	6.448887	-1.395184	0.017149	6.363241
Coefficient of Variation	0.307829	2.405959	0.433604	0.220230	0.311554	0.349436