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In 2009 all ECB publications feature a motif taken from the €200 banknote.

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Abstract

In this paper we address the question on whether EMU has amplified or dampened intra euro area divergencies, by looking at a time-varying VAR model of Italy's relative performance compared with the rest of the euro area, spanning from 1976 to 2009. Our main result is that EMU does not appear to have materially changed the transmission mechanism of idiosyncratic demand and cost push shocks, but has removed an importance source of relative performance variability given by idiosyncratic monetary shocks. The net effect of EMU, therefore, has been to reduce the relative performance variability. The conclusions that we reach could be usefully tested on other countries.

Keywords: EMU, relative economic performance, shocks, adjustment, Italy.

JEL Classification: E31, E32, E42.

Non-technical summary

As the euro has celebrated its tenth birthday last year in the midst of a major financial crisis, questions related to macroeconomic differentials in the euro area and talks of a break-up of the euro area due to unsustainable divergencies within it continue to catch the limelight. The basic theory of the macroeconomic adjustment within a monetary union is well known: any shock that raises inflation in a certain country but not in the union as a whole (say a local demand or a cost push shock) has two counteracting effects if the exchange rate is irrevocably fixed.

- On the one hand, there is a perverse channel operating in the short term related to the fall in the real interest rate brought about by the inflation rise in combination with nominal interest rates fixed at the area level, which is expansionary and may further fuel inflation (an effect known with the name "Walters critique").

- On the other hand, there is a stabilising channel operating in the medium to long term, the competitiveness channel whereby higher inflation translates into a real exchange rate appreciation, loss of competitiveness and fall in exports, ultimately having a contractionary effect on the domestic economy and imposing real exchange rate depreciation through a fall in the price level.

- The relative speed and strength of the two channels very much depend on the degree of flexibility and integration of the individual countries, hence the crucial role of structural reforms in fostering a smooth adjustment process.

With a free floating exchange rate, instead, a positive (excess) demand shock can be countered through an appreciation of the nominal and real exchange rate (normally accompanied by a rise in the local nominal interest rate) which might (more) rapidly restore the equilibrium. Whether a flexible exchange rate is effective as an equilibrating force or is rather itself a source of shocks is, however, a controversial question since exchange rates are not only relative prices, but also (and possibly even more) asset prices. The jury is therefore still out on whether abandoning a flexible exchange rate is a good idea or not.

In this paper, we set out to establish a possible empirical methodology to address, in the most rigorous and meaningful way possible, the question of the extent to which participation to a monetary union affects the macroeconomic adjustment within it. We specifying an SVAR model in relative terms, and in particular on the relative performance of Italy compared with the rest of the euro area. We also specify the VAR model as time-varying, in order to cater for the structural changes brought about by EMU to the relative performance of Italy as compared with the rest of the euro area. The model has therefore an "EMU" and a "non-EMU" state which depends on a latent variable, the "transition to EMU dynamics", that is estimated.

- Second, we provide a tentative counterfactual by providing an answer, at least within our model, to the following question: what would have happened to the divergence between Italy and the rest of the euro area in the last decade had the euro not been introduced?

The main results of this paper is that we find scant evidence of any change in the adjustment process to idiosyncratic demand and cost push shocks after the introduction of the euro; indeed, differences in impulse responses in the two regimes are not statistically or economically important. On the other hand, in the EMU regime the system is not hit by idiosyncratic monetary shocks, which are found to have a sizeable impact on the relative real economic performance in the pre-EMU period. Overall, therefore, we conclude that the introduction of the euro has reduced the variability of the divergence in real economic performance between Italy and the rest of the euro area, at least speaking from a business cycle frequency standpoint, by (i) eliminating an importance source of variability, and (ii) keeping the adjustment mechanisms to remaining idiosyncratic shocks largely unchanged. Our analysis also suggests that the same could hold for other euro area countries, though this will need to be formally tested in future work.

1 Introduction

As the euro has celebrated its tenth birthday in the midst of a major financial crisis, questions related to macroeconomic differentials in the euro area and talks of a break-up of the euro area due to unsustainable divergencies within it continue to catch the limelight. How long, it is wondered, can the weaker countries of the euro area continue to cope with rising divergencies without the tools of a flexible exchange rate and an autonomous monetary policy?

The basic theory of the macroeconomic adjustment within a monetary union is well known (Angeloni and Ehrmann 2007). Any shock that raises inflation in a certain country but not in the union as a whole (say a local demand or a cost push shock) has two counteracting effects if the exchange rate is irrevocably fixed. On the one hand, there is a perverse channel operating in the short term related to the fall in the real interest rate brought about by the inflation rise in combination with nominal interest rates fixed at the area level, which is expansionary and may further fuel inflation (an effect known with the name "Walters critique"). On the other hand, there is a stabilising channel operating in the medium to long term, the competitiveness channel whereby higher inflation translates into a real exchange rate appreciation, loss of competitiveness and fall in exports, ultimately cooling off the economy and imposing a real exchange rate depreciation through a fall in the price level. As emphasised among others by the EMU@10 report of the European Commission (2008), the relative speed and strength of the two channels very much depend on the degree of flexibility and integration of the individual countries, hence the crucial role of structural reforms in fostering a smooth adjustment process.[1]

With a free floating exchange rate, instead, a positive (excess) demand shock can be countered through an appreciation of the nominal and real exchange rate (normally accompanied by a rise in the local nominal interest rate) which might (more) rapidly restore the equilibrium. Whether a flexible exchange rate is effective as an equilibrating force or is rather itself a source of shocks is, however, a controversial question which has been raised with particular force in the context of the debate on whether the UK should at some point adopt the euro. There is indeed a literature on the so called 'exchange rate disconnect' which arises, on the one hand, from limited exchange rate pass-through and, on the other, because exchange rate developments primarily reflect capital market developments rather than cross-border trade (Flood and Rose 1999; Buiter 2000; Cobham 2002; Devereux and Engel 2002). Empirically, Artis and Ehrmann (2006) and Farrant and Peersman (2006) have shed some doubts on the shock absorbing role of the exchange rate, but also downplayed the potentially disruptive role of exchange rate flexibility for key macroeconomic variables, in line with the idea of an exchange rate disconnect. The jury is therefore still out on whether abandoning a flexible exchange rate is a good idea or not.[2]

[1] For an early analysis see Obstfeld and Peri (1998).

[2] Also note that market-based adjustment mechanisms could become stronger due to increased

Despite a lot of talk about macroeconomic adjustment within a monetary union, there is actually a dearth of empirical work on this matter (see Mongelli and Vega 2006 for a survey of the literature).

In this paper, we set out to establish a possible empirical methodology to address, in the most rigorous and meaningful way possible, the question of the extent to which participation to a monetary union affects the macroeconomic adjustment within it. We broadly follow the lead of Clarida and Gali (1994) by specifying a VAR model in relative terms, and in particular on the relative performance of Italy compared with the rest of the euro area. The choice of Italy is, obviously, not random: it is a country whose participation in the monetary union has remained in doubt up to very late in the second stage of EMU, and which has lost considerable competitiveness since the introduction of the euro, to the extent that it is sometimes labelled the "sick man of Europe" and expected to be forced to abandon the euro at some point. Also within Italy, several observers have criticised the common currency for being a straitjacket for the Italian economy and harmful for its competitiveness, in a context where Italian real GDP capita has fallen continuously in relation to other advanced economies over the past two decades and is now well below the euro area average. We would like to emphasise, however, that we use the Italian data primarily in order to learn something about an issue, macroeconomic adjustment within a monetary union, that is potentially interesting for many other countries, including those which still have to join the euro area.

Unlike Clarida and Gali, we specify the VAR model as time-varying, in order to cater for the structural changes brought about by EMU to the relative performance of Italy as compared with the rest of the euro area. The model has therefore an "EMU" and a "non-EMU" state which depends on a latent variable, the "transition to EMU dynamics", that is estimated. Because the model is built to be time-varying and is a stripped-down one, concerns related to the Lucas critique should be minimised.[3] We also explicitly test whether the parameters that are not necessarily time-varying (such as the autoregressive parameters of relative output and prices) have been the same before and after EMU. We then use the model to conduct two types of exercise. First, we analyse the impulse responses to shocks in the EMU and non-EMU states. This analysis is aimed at shedding some light on the adjustment process inside and outside the monetary union. Second, we provide a tentative counterfactual by providing an answer, at least within our model, to the following question: what would have happened to the divergence between Italy and the rest of the euro area in the last decade had the euro not been introduced?

economic and financial integration brought about by a monetary union, further downplaying the relative importance of the exchange rate as a stabilising force. A prominent channel appears to be risk sharing made possible by financial integration, as highlighted by, e.g., Kalemli-Ozcan et al. (2004).

[3] Moreover, Rudebusch (2005) has shown that autoregressive models are surprisingly robust to the Lucas critique.

Our paper is related to a number of recent VAR studies of the Great Moderation which have employed time-varying or regime-switching specifications; see, notably, Stock and Watson (2002), Primiceri (2005), and Sims and Zha (2006). None of the papers in this literature, however, deals with the impact of EMU on macroeconomic adjustment, which is the issue of interest in this paper and which by its nature requires a somewhat different modelling approach. Söderström (2008) uses an estimated DSGE model to assess whether Sweden would have benefited from joining the EMU. Pesaran, Shin and Smith (2006) use a Global VAR (GVAR) to conduct a counterfactual exercise of what could have happened since 1999 had the UK joined the euro area. Both the econometric approach and the objective of this paper are however quite different from the focus on this paper, although the spirit of the exercise is somewhat similar. Canova, Ortega and Ciccarelli (2009), Enders, Jung and Mueller (2009) and Giannone, Lenza and Reichlin (2008) have looked at the impact of EMU on the characteristics and synchronisation of business cycles in Europe; their approach is however of a reduced form type, while the focus of the present paper is on the transmission of relative structural shocks within the monetary union and before its creation.

The main result of this paper is that we find scant evidence of any change in the adjustment process to idiosyncratic demand and cost push shocks after the introduction of the euro; indeed, differences in impulse responses in the two regimes are not statistically or economically important. On the other hand, in the EMU regime the system is not hit by idiosyncratic monetary shocks, which are found to have a sizeable impact on the relative real economic performance in the pre-EMU period. Overall, therefore, we conclude that the introduction of the euro has reduced the variability of the divergence in real economic performance between Italy and the rest of the euro area, at least speaking from a business cycle frequency standpoint, by (i) eliminating an importance source of variability, and (ii) keeping the adjustment mechanisms to remaining idiosyncratic shocks largely unchanged. Our analysis also suggests that the same could hold for other euro area countries, though this needs to be formally tested in future work.

The paper is organised as follows. We present the econometric model in Section 2, the data in Section 3 and the estimation results, with some discussion, in Section 4. Section 5 concludes.

2 The model

2.1 A VAR model of Italy's relative performance

We follow the approach of Clarida and Gali (1994) and we specify the VAR model in relative terms. We state from the outset that this implies both benefits and costs in analytical terms and that a different modelling choice could potentially lead to qualitatively different results. On the plus side, the model remains parsimonious which

allows sharper inferences. Being Italy a relatively large economy within the euro area, block exogeneity restrictions based on the small open economy assumption would have been inadequate, with the implication that one would have to estimated a full model of Italy and the (rest of the) euro area jointly. Moreover, despite being parsimonious the model captures the phenomena we are interested in for this paper, namely the divergence of Italy from the rest of the euro area and more generally the intra-euro area divergencies. On the negative side, such a model cannot identify whether the shocks originate in Italy or in the rest of the euro area, and is dependent on the assumption that the transmission mechanism is the same for both types of shocks (see Artis and Ehrmann 2006). Therefore, it should be clear that the results we obtain in this paper are strictly conditional on the characterisation of the structural shocks in relative terms that we employ. For example, we are not able to distinguish between the domestic transmission of domestic shocks and the cross border transmission of foreign shocks. Enders, Jung and Mueller (2009) have documented that EMU has dampened the transmission of domestic shocks but increased the spillover of foreign shocks from within the monetary union.[4]

More concretely, we consider a model specified as follows:

$$Ax_t = \mu + B(L)x_{t-1} + e_t \tag{1}$$

where x is a vector of endogenous variables, z a vector of exogenous variables and e_t is a vector of structural disturbances with covariance matrix Σ. The x vector is specified as follows.

$$x = [\frac{p_{IT}}{p_{EMU}}, \frac{y_{IT}}{y_{EMU}}, e, \frac{R_{IT}}{R_{EMU}}] \tag{2}$$

where y is real GDP, p is the GDP deflator, e is the lira / ECU exchange rate[5], and R is a short-term interest rate. We estimate a structural VAR model based on these four endogenous variables using a recursive identification scheme. The model is sufficiently small to leave sufficient degrees of freedom so as to make a time-varying specification and stability analysis meaningful.

In a preliminary stage of the analysis we tried to include two additional variables, namely (i) the public debt to GDP ratio and (ii) the relative term structure, based on the relative difference between 10-year government bond yields and the short-term rates. We found that movements in the first variable at a business cycle frequency are dominated by the movements in relative GDP, while movements in the relative term structure are highly collinear with the relative short term rate. For this reason, we decided to stick to the simpler model in order to gain degrees of freedom and facilitate the identification of the key structural shocks we are interested in. We also tried to include some exogenous international variables, such as real GDP and

[4] They also show that EMU has led to a marked decrease in the volatility of the real exchange rate.

[5] In the continuation of this paper we will speak of lira / ECU and lira / euro exchange rate interchangeably, for easiness of exposition.

the real GDP deflator in the OECD total and the oil price, measured in US dollars. The idea behind this choice was that oil prices and global economic developments could have an asymmetric effect on Italy and the rest of the euro area. However, we find that the inclusion of these variables changes little in the impulse responses but somewhat reduces the sharpness of the estimates, and we therefore leave them out in the baseline specification.

Within the model in (2), it is relatively straightforward to impose constraints for EMU participation:[6]

$$\frac{R_{IT}}{R_{EMU}} = 1 \tag{3}$$

$$e = 1936.27 \tag{4}$$

When estimating the model for the complete sample period in a time-varying parameters specification, we are going to explicitly impose these restrictions in the model.

2.2 Identification of the structural shocks

There are four structural shocks we are interested in for the purpose of our analysis. First, a shock to the short-term interest rate that can be interpreted as a relative monetary policy shock; after such a shock the monetary policy stance is relatively more or less accommodative in Italy than in the rest of the euro area. It can therefore be characterised as a relative contractionary money supply shock and should move the relative short rate up and lead to an exchange rate appreciation. Second, a (negative) relative money demand shock should move the short rate up and lead to an exchange rate depreciation. This would happen, in particular, in case of an unsuccessful defence against a speculative attack on an exchange rate peg of the type experienced in 1992-93. Note that in this case the change in the exchange rate can be characterised as "non-fundamental", i.e. (at least directly) not motivated by underlying real shocks. Shocks to the relative GDP and price equations should be interpreted as, respectively, asymmetric demand and cost push shocks. Note that with the establishment of the monetary union the last two shocks remain in place, while the former two shocks drop out of the system.

Our preferred interpretation of the relative money demand shock is in terms of the relative credibility of the monetary regime in Italy vs. the rest of the euro area. For the two decades before the introduction of the euro, Italy has been most of the time in some sort of "soft peg" regime within the European Monetary System. The de facto characterisation by Garofalo (2005) indicates that from April 1976 onwards Italy's exchange rate regime has been a crawling peg (1976-1987), then a soft peg (1987-1992) and managed floating or soft peg (1993-1998); only in 1992-93 has it been a fully floating regime.[7] In this type of regimes, a shock which, say, raises short

[6] Note that the actual VAR model is specified in logs, with the exception of the short term rate ratio. We report the conditions in levels just for simplicity of illustration.

[7] See in particular Table 3 on page 28 in Garofalo (2005).

term interest rates in Italy but not in the rest of the euro area and, at the same time, leads to a depreciation of the lira vs. the euro (a negative relative money demand shock in our model) can be loosely interpreted as a loss of confidence in the credibility of the Italian monetary regime vs. the rest of the euro area, and in particular the anchor country, Germany.

We identify the SVAR model using a non-recursive identification scheme where[8]

$$\begin{Bmatrix} 1 & 0 & n & 0 \\ n & 1 & 0 & 0 \\ n & n & 1 & n \\ n & 0 & n & 1 \end{Bmatrix} \begin{bmatrix} \frac{p_{IT}}{p_{EMU}} \\ \frac{y_{IT}}{y_{EMU}} \\ e \\ \frac{R_{IT}}{R_{EMU}} \end{bmatrix}_t = B(L) \begin{bmatrix} \frac{p_{IT}}{p_{EMU}} \\ \frac{y_{IT}}{y_{EMU}} \\ e \\ \frac{R_{IT}}{R_{EMU}} \end{bmatrix}_{t-1} + e_t \tag{5}$$

where n indicates the parameters that are freely estimated. Under this identification scheme the exchange rate and the relative nominal short-term interest rate are allowed to interact contemporaneously, while the non-financial variables (the relative price level and relative real GDP) ordered first in a standard recursive way. The identification is achieved by imposing that the relative nominal interest rate does not react contemporaneously to relative real GDP, which may be justified based on the idea that this variable is not observable in real time for the monetary authorities. Finally, we also allow the relative price level to interact contemporaneously with the exchange rate; as a result, the model is exactly identified. In the end, however, the quality of the identification scheme can only be judged in terms of the structural interpretability of the resulting impulse response functions.

2.3 The smooth transition SVAR model

2.3.1 Set-up

The specification of the SVAR needs to be a time-varying one since the conditions in (3) and (4) are certainly valid during the monetary union, but not earlier. After 1999, the last two variables of the system (which represent Italy's monetary independence from the rest of the euro area) essentially drop out, and the system can be rewritten in a simplified format:

$$A' x'_t = \mu' + B'(L) x'_{t-1} + e'_t \tag{6}$$

where $x'_t = [\frac{y_{IT}}{y_{EMU}}, \frac{p_{IT}}{p_{EMU}}]$. This is equivalent to imposing a restriction on the μ vector and the A and $B(L)$ matrices in (1), whereby all coefficients associated to the last two variables in the system are restricted to zero.

We do not impose the restriction in the abrupt manner from the start of the monetary union, and rather allow for a smooth transition from the unrestricted set

[8] We do not pursue a sign restrictions approach (Uhlig 2005) because it would be very difficult to combine it with the time-varying nature of the VAR model, though this could be an interesting issue for future research. See, however, Fry and Pagan (2007) on some problematic issues concerning the sign restrictions approach.

of parameters in (1) to the restricted specification post monetary union in (6). So the model that we use is a smooth transition VAR model.

Let θ be the vector of all parameters in the VAR in (1), i.e. including μ, A and $B(L)$ as well as the covariance matrix of the errors Σ; we can partition this vector in two sub-vectors, θ_1 and θ_2. The vector θ_1 contains the parameters referred to the first two variables in the system in (1), including the constant terms, while the vector θ_2 includes the parameters referred to the last two variables. More formally:

$$\mu = \begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix} \tag{7}$$

$$A = \begin{pmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{pmatrix} \tag{8}$$

$$B(L) = \begin{pmatrix} B(L)_{11} & B(L)_{12} \\ B(L)_{21} & B(L)_{22} \end{pmatrix} \tag{9}$$

$$\sum = \begin{pmatrix} \sum_{11} & \sum_{12} \\ \sum_{21} & \sum_{22} \end{pmatrix} \tag{10}$$

where variables with the underscript 1 denote the first three variables in the system, those with underscript 2 the last two. The subset of parameters θ_2 includes all parameters where variables of the second group are involved; for example, the constant terms μ_2 belong to this category. The subset θ_1 includes all remaining parameters.

For the first set of parameters θ_2 (e.g., $B(L)_{12}$), we know a priori that EMU will have an effect; for the latter group, we instead want to test whether EMU has an impact. Therefore, we impose the values of the θ_2 vector exogenously after the transition to the monetary union, while we leave the values for θ_1 (such as $B(L)_{11}$) undetermined and subject to statistical testing.

The transition between the model in (1), before the monetary union, to (6), after the monetary union, follows

$$\theta_1 = G(\lambda)\theta_1^{NEMU} + (1 - G(\lambda))\theta_1^{EMU} \tag{11}$$

$$\theta_2 = G(\lambda)\theta_2^{NEMU} + (1 - G(\lambda))\theta_2^{EMU} \tag{12}$$

where $NEMU$ stays for the "pre-EMU" regime, and EMU for the "post-EMU" regime, θ_2^{EMU} is a vector almost entirely made by zeroes and

$$G(\lambda) = \frac{1}{1 + e^{-\lambda(t-t_0)}} \tag{13}$$

represents the "transition to EMU dynamics" which can be interpreted as a latent variable, where however the effective start of the monetary union t_0 is known a priori (end of 1998). The parameter λ governs the speed of the transition to the new regime and is freely estimated.

Regarding the specification of the covariance matrix Σ, we impose on it two sets of constraints

- that the block Σ_{11} is constant prior, during and after the convergence process to EMU;
- the blocks Σ_{12} and Σ_{22} turn to zero from inception of EMU onwards, since the second block of variables become deterministic.

The first set of constraints amounts to assuming that the instantaneous effects of structural shocks do not vary before and after the EMU.

2.3.2 Testing for the Lucas critique

In order to be able to draw structural inferences from the system and conduct counterfactuals, we need to test that the system is immune from the Lucas critique once we impose the restrictions in (3)-(4). Therefore, we need to test whether the parameters in the restricted system (6), or equivalently the parameters in the μ vector and in the A and $B(L)$ matrices in (1) that are not restricted by virtue of (3)-(4) are unchanged before and after EMU. Therefore, we run a Wald test on the restriction that an added set of parameters,

$$G(\lambda)\theta_1^* \tag{14}$$

is significantly different from zero. In fact, under the null that $\theta_1^{NEMU} = \theta_1^{EMU}$ once the parameter θ_1 is included in the model any interaction term with the EMU factor should be insignificant. Should this be the case, we would be able to conclude that the reduced system is robust to the Lucas critique and can be used for structural inferences and counterfactuals.

3 Data

The data are derived from the OECD World Economic Outlook for Italy, and from the ECB's Area Wide Model and Eurostat for the euro area. The sample period goes from the second quarter of 1976 to the second quarter of 2009.[9] The short-term interest rate a 3-month interbank rate. The data for the euro area excluding Italy are computed from the euro area aggregate, subtracting the corresponding Italian variables with a weight given by Italy's real GDP share in PPP, as reported in the IMF World Economic Outlook. The euro area variables refer to the euro-11 (i.e. excluding Slovenia, Malta and Cyprus which joined the euro area in 2007 and 2008, and Italy itself).

Figure 1 reports the data for the four endogenous variables showing Italy's relative performance compared with the rest of the euro area. It is striking to note from Figure 1 that all the variables appear to experience a clear discontinuity at the time just

[9] The starting period in 1976Q2 reflects the de facto exchange rate classification in Garofalo (2005). In particular, he notes that there is no material difference between 1976-1979 and the period after the official start of the EMS (see page 30 in Garofalo's paper).

before the start of the monetary union except relative real GDP, which has a peculiar development. It increases quite steadily from the late 1970s to the late 1980s, and then falls again amid some cyclical ups and downs. So, while the turning point for the nominal variables appears to be around 1998, that of relative GDP seems to be around 1988, namely ten years earlier.

(Insert Figure 1 here)

4 Results

We conduct the empirical analysis and present the results in four separate steps. First (Section 4.1), we estimate and evaluate the VAR model, in its full fixed parameters version in (1), on the 1976-1996 sample period. Second (Section 4.2), we estimate the time-varying parameters model and identify the EMU factor $G(\lambda)$ by making only the θ_2 parameters depend on it. Third (Section 4.3), we test whether the remaining parameters of the model, θ_1, are also affected by time variation as captured by the EMU factor. Fourth (Section 4.4), we use the resulting time-varying VAR model to conduct (i) impulse response analysis in the two regimes (EMU and non-EMU), and (ii) a counterfactual analysis for the 1999-2008 period.

4.1 The fixed parameters VAR in the 1976-1996 period

After estimating the VAR model in (1) over quarterly data from 1976 to 1996, we analyse the impulse responses to the structural shocks, in order to check whether they conform to the structural interpretation that we have outlined in Section 3. A lag order to 1 appears to be optimal based on the BIC information criterion, which favours a parsimonious specification. Figures 2 to 4 respectively report the impulse responses respectively to asymmetric demand, cost push, money demand and money supply shocks.

The effect of the asymmetric (negative) money demand shock (Figure 2) is to move the relative short term rate and the exchange rate in the same direction (i.e. leading to a depreciation of the exchange rate). Due to the depreciation, the effect of the shock is expansionary on relative output and inflation. Second, the asymmetric (again, negative) money supply shock (Figure 3) leads to a sharp rise in the short term interest rate and to an appreciation of the exchange rate, not only on impact but also later on. Predictably, the effect of this shock is contractionary and leads to a rather sharp and persistent fall in relative real GDP and in the relative price level compared with the baseline. Note that in the EMU regime, these first two shocks drop out of the system, and the transmission mechanism of the latter two shocks (relative demand and cost push), on which we will focus later on, has to operate without changes in the lira - euro exchange rate and in the relative short term interest rate.

The effect of the asymmetric demand shock (Figure 4) is in line with the conventional wisdom: the shock increases relative GDP and the price level over time, with some delay. It is important to note that the effects on the exchange rate and the relative short term rate are small and statistically insignificant. It is notable, therefore, that according to this evidence the exchange rate did not play a particularly relevant role in the adjustment of asymmetric demand shocks in the pre-EMU regime. The effect of the asymmetric cost push shock (Figure 5) is to increase the price level on impact; the impact of relative GDP is statistically insignificant on impact, but becomes significant and positive over time. This is probably mostly due to the fact that the shock leads to an exchange rate depreciation and to a fall in the relative short term rate over time (although the response on impact is positive).[10] These reactions are not in line with the idea that monetary independence leads to a swifter adjustment to this type of shock, as the reaction of the monetary variables tends if anything to prolong, rather than correct the idiosyncratic shock. The idea that relative interest rate and exchange rate movements are not explained by fundamentals but rather mainly reflect idiosyncratic shocks of a purely monetary nature is confirmed when looking at the variance decomposition of the SVAR model, reported in Table 1. For example, for the lira - euro exchange rate over 96 per cent of the variability is explained by relative monetary shocks, not by ("more fundamental") relative demand and cost push shocks. Conversely, monetary shocks have a somewhat more important impact on the relative price level and GDP. This evidence suggests that Italy's monetary independence before EMU has not been used to smooth idiosyncratic shocks and its divergences with the rest of Europe. Of course, this result is hardly surprising since minimising economic divergences within the monetary union was not an explicit task of monetary authorities in the pre EMU regime.

(Insert Figures 2-4 and Table 1 here)

4.2 Transition to EMU dynamics

As a second step in the analysis, we estimate the VAR model in (1) enriched with time variation in the subset of parameters that are certainly and mechanically affected by EMU:

$$Ax_t = \mu + B(L)x_{t-1} + e_t \tag{15}$$

$$\theta_2 = G(\lambda)\theta_2^{NEMU} + (1 - G(\lambda))\theta_2^{EMU} \tag{16}$$

$$G(\lambda) = 1 - \frac{1}{1 + e^{-\lambda(t-t_0)}} \tag{17}$$

[10] We may conjecture that the fall in the relative nominal short term interest rate is associated, and partly explained by, lower relative inflationary pressure during the winding down of the initial shock.

where $\theta_2 = [\ \mu_2, A_{21}, A_{22}, B_{12}(L), B_{21}(L), B_{22}(L), \sum_{22}]$. The $G(\lambda)$ is what we label the "EMU factor" since it captures the structural change associated with EMU. Theoretically, both the parameters λ (capturing the speed of the transition) and t_0 (capturing the timing) could be estimated; in practice, however, we are reasonably sure about the timing of the transition to EMU, and we impose $t_0 = 1997 : Q4$. This implies that practically all of the transition is over by 1999:Q1, the de iure start of the monetary union.

We estimate the model in the structural form, using the SUR estimation method.[11] We select the optimal λ based on a grid search as the value minimising the Schwarz information criterion.[12] The resulting estimated EMU factor is reported in Figure 6. It can be seen that the transition to EMU is estimated to be relatively quick. Figure 7 reports the residuals of the time-varying SVAR model, and shows that the model is able to capture the abrupt change in behaviour corresponding to Stage Three of EMU (in fact, the residuals for the last two variables collapse to very close to zero after 1999, as they should).

(Insert Figures 6 and 7 here)

4.3 Is the Smooth Transition SVAR immune to the Lucas critique?

As a next step, we check whether the model (14)-(16) can be characterised as structural to the extent that the remaining parameters θ_1 (i.e. all parameters in the model except those in θ_2) are independent of the change in regime. The Chi square statistic for the null hypothesis that $G(\lambda)\theta_1^* = 0$ is 8.04, for a p-value of 32.8%. Since this test cannot reject the null of stability in the reduced SVAR model, we take as the baseline Smooth Transition SVAR model (ST-SVAR) one which: (i) imposes an effect of the EMU transition dynamics on the θ_2 vector; (ii) imposes no other effect of the EMU transition dynamics on the remaining parameters in the θ_1 vector.

It is useful to mention here that the finding that the θ_1 parameters are not affected by the EMU factor is in contradiction with the idea that monetary unions in general, and EMU in particular, can change the structure of the participating economies so as to change the transmission mechanism of idiosyncratic shocks (the 'endogenous OCA' theory; see Frankel and Rose 1997). However, it should be noted that there are many other dimensions along which the endogenous OCA theory could be valid, and cannot be tested within our simple model.

[11] Other estimation methods (OLS equation by equation, FIML) led to very similar results.
[12] We also tried with other information criteria and the results were very similar.

4.4 A tradeoff between shocks and adjustment?

From now on, we interpret the ST-SVAR model as a structural model of the divergence between Italy and the rest of the euro area with two regimes, one (EMU) prevailing when $G(\lambda) = 0$ and the other (non EMU) when $G(\lambda) = 1$. At this point, we can analyse the impact of the four asymmetric structural shocks (relative demand, cost push, money demand, money supply) on the four endogenous variables in the model. We first present the impulse responses, then a counterfactual analysis.

The introduction of the euro raises the possibility of a tradeoff between shocks and adjustment. On the one hand, it may be argued, the disappearance of the exchange rate and an autonomous monetary policy could make the adjustment to idiosyncratic shocks harder since policy makers (both in Italy and in the rest of the euro area) do not have a policy lever at their disposal any more. On the other hand, the relative performance of Italy compared with the rest of the euro area is not hit by idiosyncratic monetary (demand and supply) shocks once the monetary union is in place; shocks that, as have seen in Figures 2 and 3, exerted an important impact on relative output and prices in the pre-EMU regime. In the remainder of our analysis, we are going to test for this idea using the ST-VAR model specified so far.

4.4.1 Impulse responses

Figure 8 is the centrepiece of our analysis and shows the impulse responses of relative output and the price level to a relative demand and cost push one standard deviation shocks under the EMU and non-EMU regimes. The relevant impulse responses for the idiosyncratic monetary shocks can be seen in Figures 2 and 3 which have been already reported and commented on in Section 4.1. The thick, red lines refer to the EMU regime, and the thinner, black lines to the non-EMU regime. Note that standard errors are slightly smaller for the EMU regime, which makes sense since in the time-varying SVAR model this is estimated based on data from 1976 to 2009.

The general impression that can be derived from Figure 8 is that there is very little difference in the adjustment to relative demand and cost push shocks between the two regimes.[13] In the case of the latter shock, we see a slightly higher degree of persistence in the relative price response in the non-EMU regime, but the difference with the EMU regime is not statistically significant. We can conjecture that the expansionary role of the exchange rate depreciation after a relative cost push shock in the pre-EMU regime is replaced, in the EMU regime, by the real interest rate channel described in the Introduction; that is, the relative price increase temporarily raises inflation and reduces the relative real interest rate, boosting relative output. However, it should be emphasised that especially in the EMU regime the expansionary impact of the cost push shock on output is temporary, suggesting that over time the

[13] This is in turn quite consistent with the results of Canova, Ciccarelli and Ortega (2009) and Giannone, Lenza and Reichlin (2008) that the euro has not fundamentally changed the business cycles in the euro area.

real interest rate channel is increasingly dominated by the competitiveness channel over the medium term.

Since the transmission of idiosyncratic demand and cost push shocks are essentially the same under the two regimes, we can relatively safely conclude that the EMU regime is the one which minimises variability in relative economic performance. In fact, in the non-EMU regime relative performance is also influenced by relative monetary shocks that disappear altogether in the EMU regime. Hence, we conclude that the impression and concerns that EMU would lead to increasing divergence between Italy and the rest of the euro area are not corroborated by our analysis.

(Insert Figure 8 here)

4.4.2 Counterfactuals

As a final step in our analysis, we address the question of what the outcome would have been had Italy remained out of EMU in the past decade. Of course, this type of counterfactual analysis is fraught with enormous uncertainties, which we do not want to downplay; it is also not even clear what the counterfactual scenario exactly is (i.e. either one where the euro has been realised but Italy is out, or where the euro itself does not exist). The exercise that we conduct here is purely mechanical: we simulate the ST-VAR model in the pre-EMU regime over the period from 1999 to 2009, given (i) the demand and cost push shocks estimated in the baseline specification of the model; (ii) simulated idiosyncratic monetary shocks, using the probability distributions estimated during the 1976-1996 period. We compute confidence intervals around the counterfactuals using a bootstrapping procedure.

The result of this mechanical counterfactual analysis is reported in Figure 9. As could have been largely predicted by eyeballing the data in Figure 1, in the counterfactual scenario Italy would have had a higher short term interest rate compared with the rest of the euro area and the lira - euro exchange rate would have depreciated considerably, by almost 40% in nominal terms; both effects are statistically significant. It should emphasised that both projections are affected not only by the dynamic behaviour embedded into the VAR model, but also by the presence of a linear trend in the pre-EMU period which then drops out in the EMU regime; in that respect, our counterfactual analysis is admittedly relatively mechanistic. Italy's relative price level would have been significantly higher in the counerfactual scenario, by a total of about 10% compared with the actual development (i.e. an annual inflation a bit less than 1% higher per annum), while relative real GDP would have been higher by about 6%. Taken together and with due regard to all the necessary caveats about this type of analysis, our results suggest that Italy's divergence from the rest of the euro area may have been more significantly more pronounced for the nominal variables and somewhat less pronounced for relative GDP.[14]

[14]Note that our results are silent on whether this latter result would have been achieved by lower

It might also be argued that, had Italy remained outside of the euro area, one would have not observed a return to the situation in the 1970s and that a more credible exchange rate regime would have been introduced. To cater for this possibility, we repeat the same exercise estimating the TV-SVAR model starting from a later date, in 1987:Q1, namely at the start of the so-called 'hard EMS' period; in this case, the assumption is that the relevant pre-EMU scenario for an hypothetical no-EMU scenario after 1999 is the 1987-1996 sample period. The results for this alternative scenario, reported in Figure 10, suggest however similar conclusions as for the baseline exercise.

(Insert Figures 9-10 here)

5 Conclusions

In this paper we have proposed a possible approach to study the changes brought about by EMU to the intra-euro area adjustment to asymmetric shocks. In particular, we have used a time-varying SVAR (ST-SVAR) model to shed light on Italy's relative performance compared with the rest of the euro area. Our main conclusion is that EMU has brought very little changes to the transmission mechanism of asymmetric demand and cost push shocks, but has removed a significance source of variability related to idiosyncratic money demand and supply shocks that exerted a significant impact on relative economic performance before the monetary union. The net effect, therefore, has been to stabilise the intra euro area divergencies, at least speaking from a business cycle frequency. At the same time our results also indicate that EMU does not appear to have changed the structural factors that facilitate a smoother macroeconomic adjustment within EMU, for which structural reforms remain of paramount importance.

The results obtained in this paper could be useful information especially in the context of the debate on whether other countries (such as the UK) should adhere to the euro in the future. The results of this paper, especially if extended to other countries, could also suggest that the risk that the monetary union complicates the adjustment to idiosyncratic shocks (an argument often made just before the introduction of the euro[15]), and would therefore invariably lead to closer political integration, has perhaps been exaggerated.[16]

Applying the same methodology to other countries appears to be the most interesting issue for further research. Applying our ST-SVAR methodology in a panel setting, in particular, seems an intriguing avenue for future work.

growth in the rest of the euro area or higher growth in Italy. We stress once again the extremely mechanistic nature of this exercise.

[15] See e.g. Obstfeld and Peri (1998).

[16] Hodson (2009) elaborates on this argument in much more detail.

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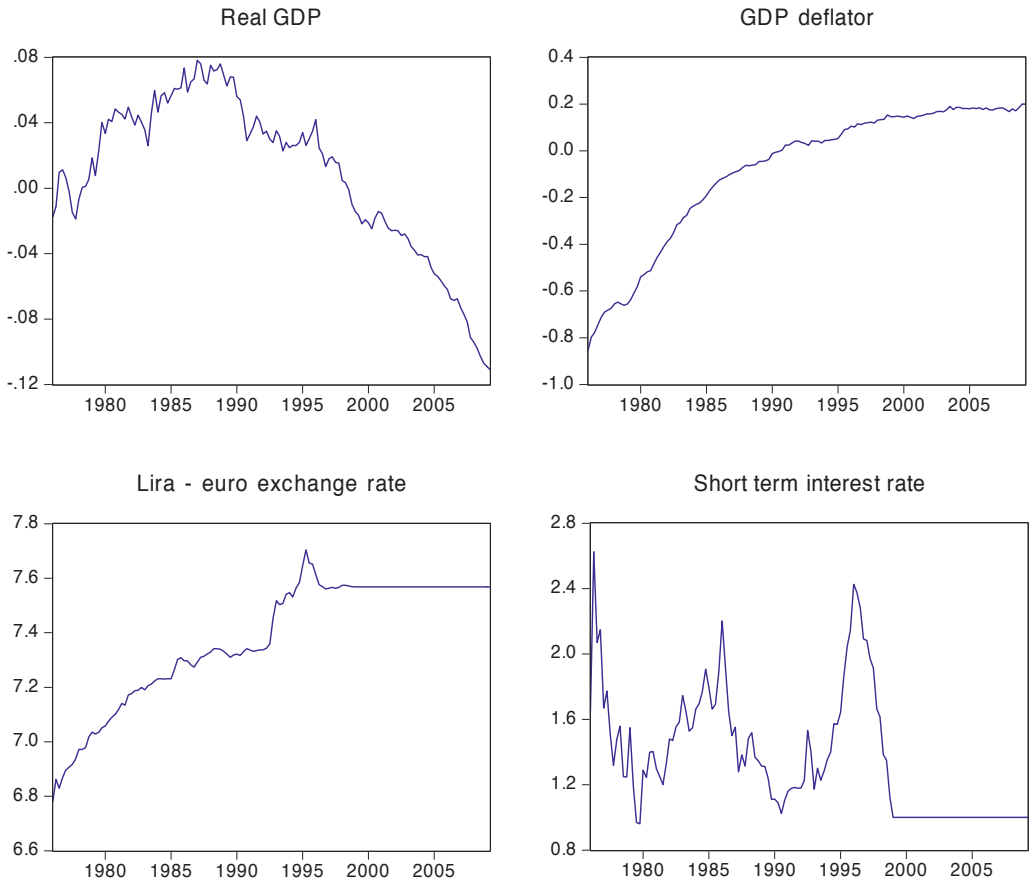
TABLE 1. Variance decomposition of the fixed parameters VAR, 1976-1996

	Relative cost push	Relative demand	Relative "money supply"	Relative "money demand"
Relative price level	67.0	17.8	7.8	7.4
Relative GDP	17.2	62.1	6.9	13.9
Lira-euro exchange rate	3.0	0.8	61.5	34.7
Relative short term rate	3.6	3.3	26.1	67.0

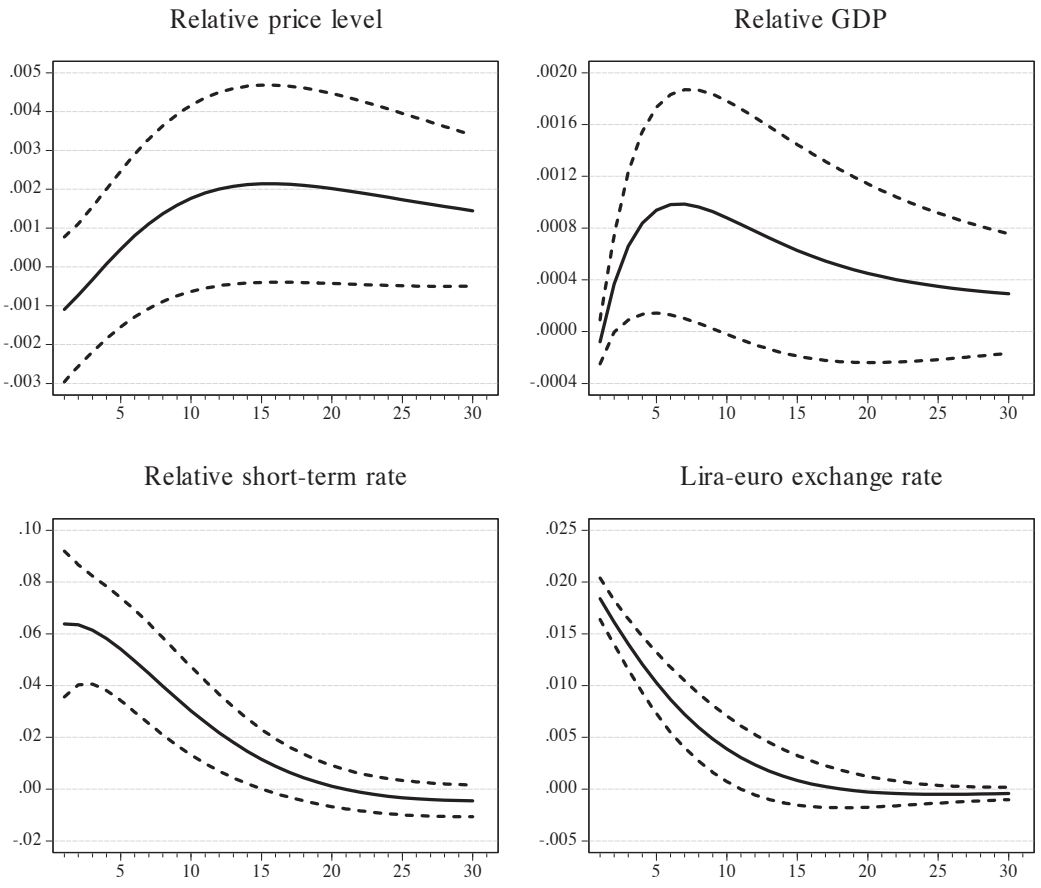
Note: Sample period is 1976:2 to 1996:4. The table reports the share of the variance explained by the shocks in the columns at an horizon of 24 quarters. The model is the fixed parameters VAR estimated in Section 4.1; see text for further explanations.

FIGURE 1. Italy's relative macroeconomic performance compared with the rest of the euro area, 1976-2009



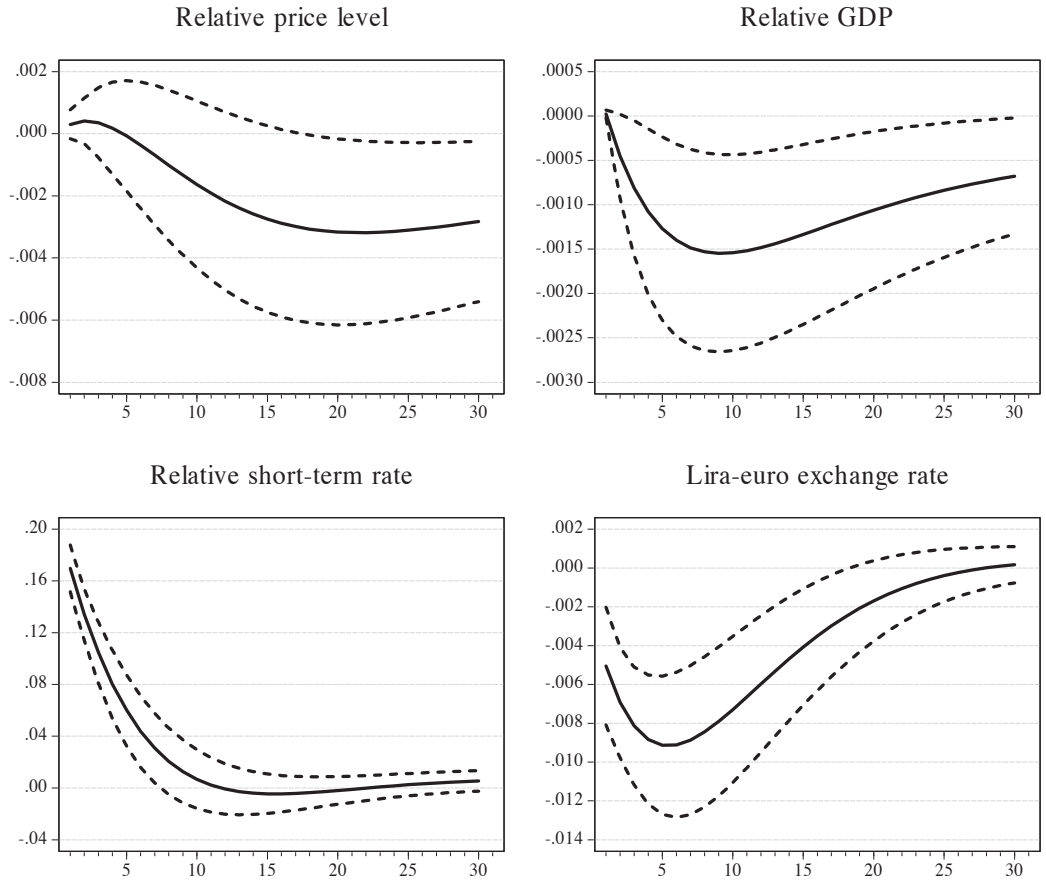
Sources: OECD Economic Outlook, ECB Area Wide Model database, Eurostat. The data refer to the log ratio between the variables in Italy and in the rest of the euro area (to the simple ratio for the short-term interest rate and to the log value for the lira-euro exchange rate).

FIGURE 2. Impulse responses to relative negative money demand shocks, non-EMU regime



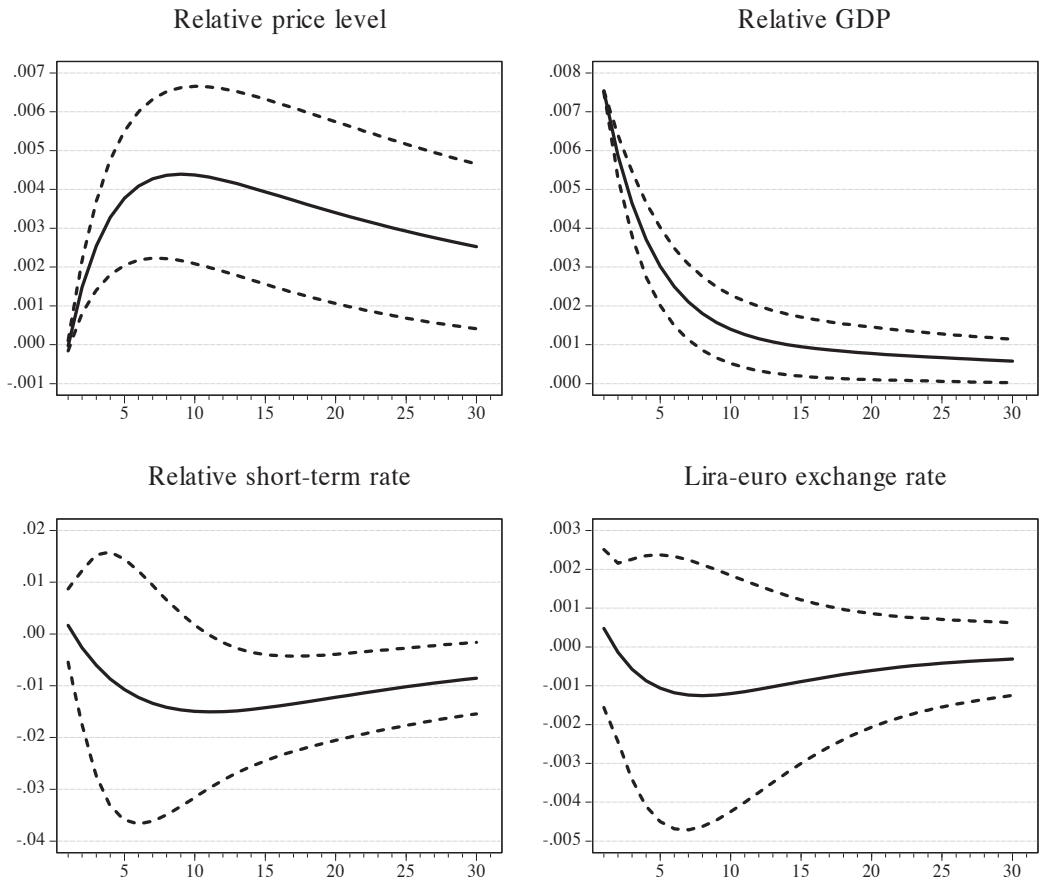
Note: The figures report the impulse response with 68% confidence bands. Based on SVAR estimated on the 1976:Q2 to 1996:Q4 sample period.

FIGURE 3. Impulse responses to relative negative money supply shocks, non-EMU regime



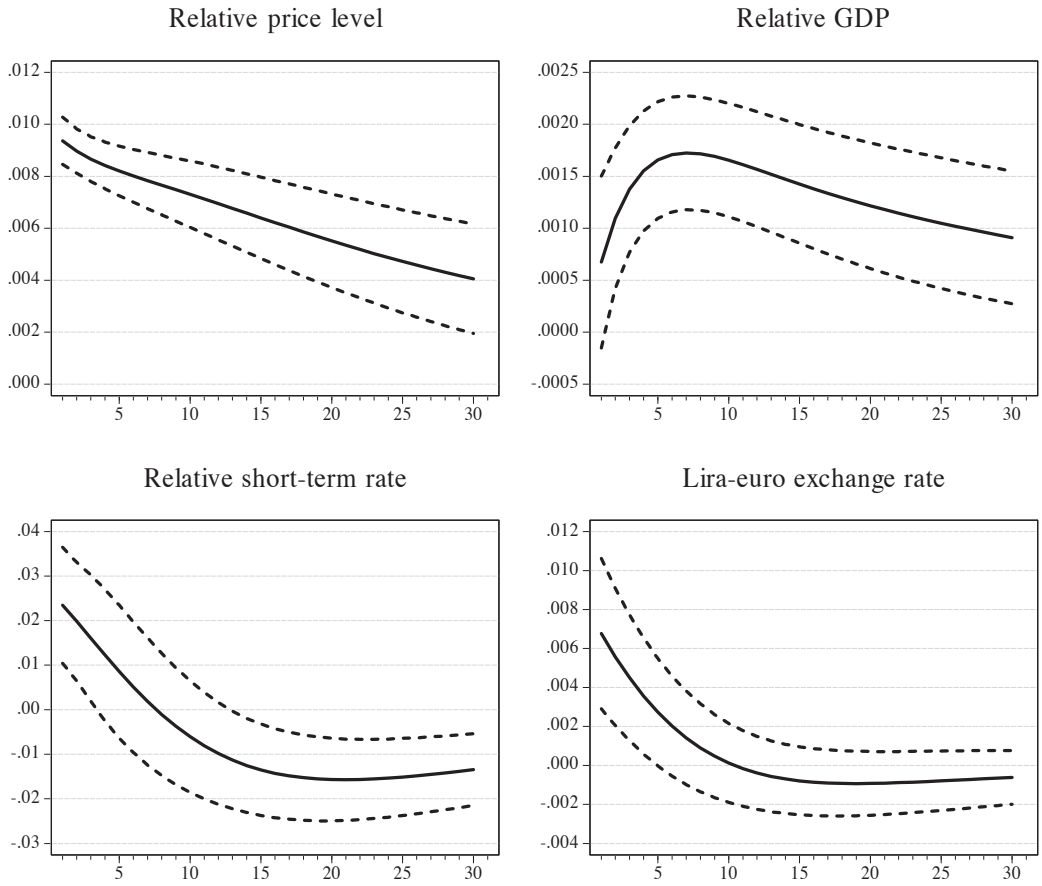
Note: The figures report the impulse response with 68% confidence bands. Based on SVAR estimated on the 1976:Q2 to 1996:Q4 sample period.

FIGURE 4. Impulse responses to relative aggregate demand shocks, non-EMU regime



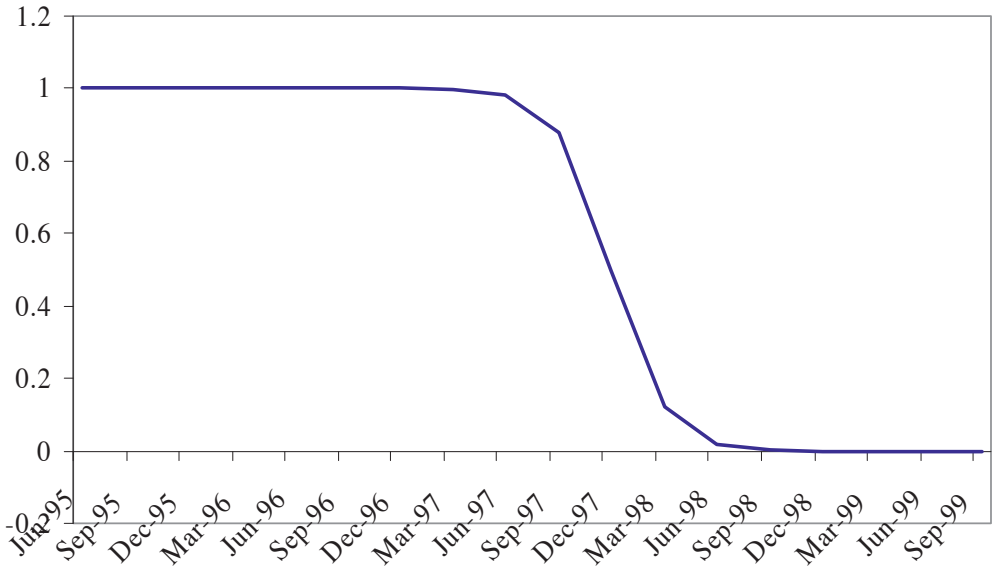
Note: The figures report the impulse response with 68% confidence bands. Based on SVAR estimated on the 1976:Q2 to 1996:Q4 sample period.

FIGURE 5. Impulse responses to relative cost push shocks, non-EMU regime



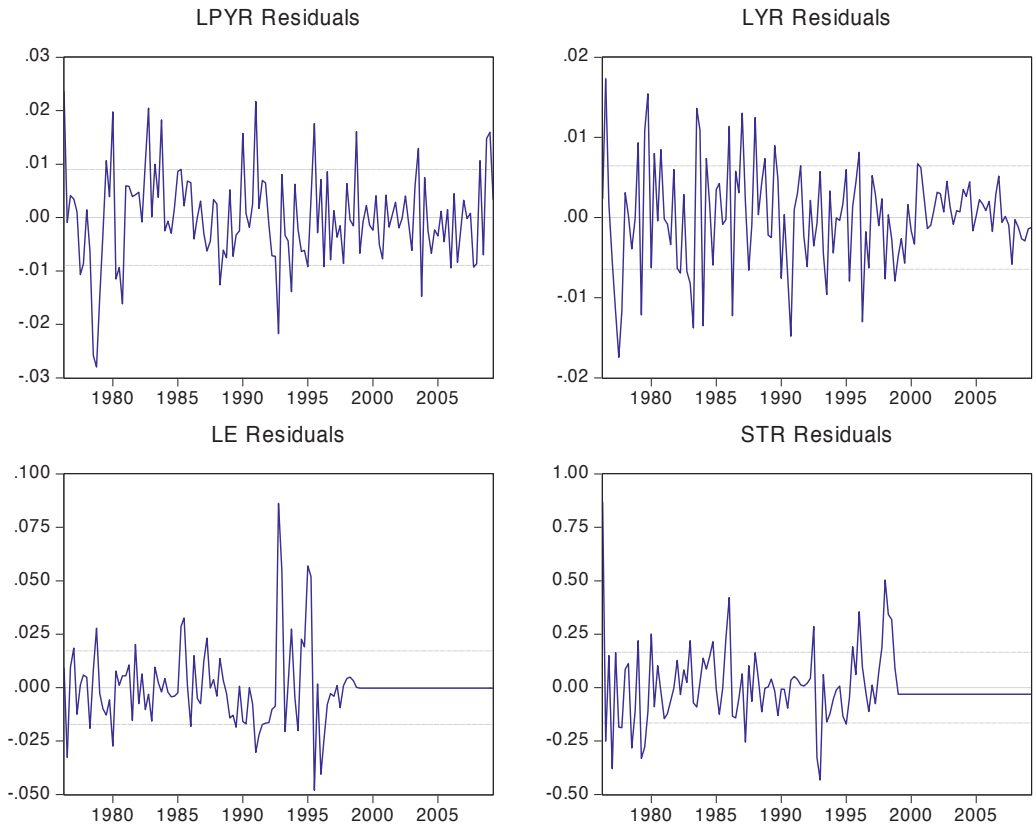
Note: The figures report the impulse response with 68% confidence bands. Based on SVAR estimated on the 1976:Q2 to 1996:Q4 sample period.

FIGURE 6. The estimated EMU factor



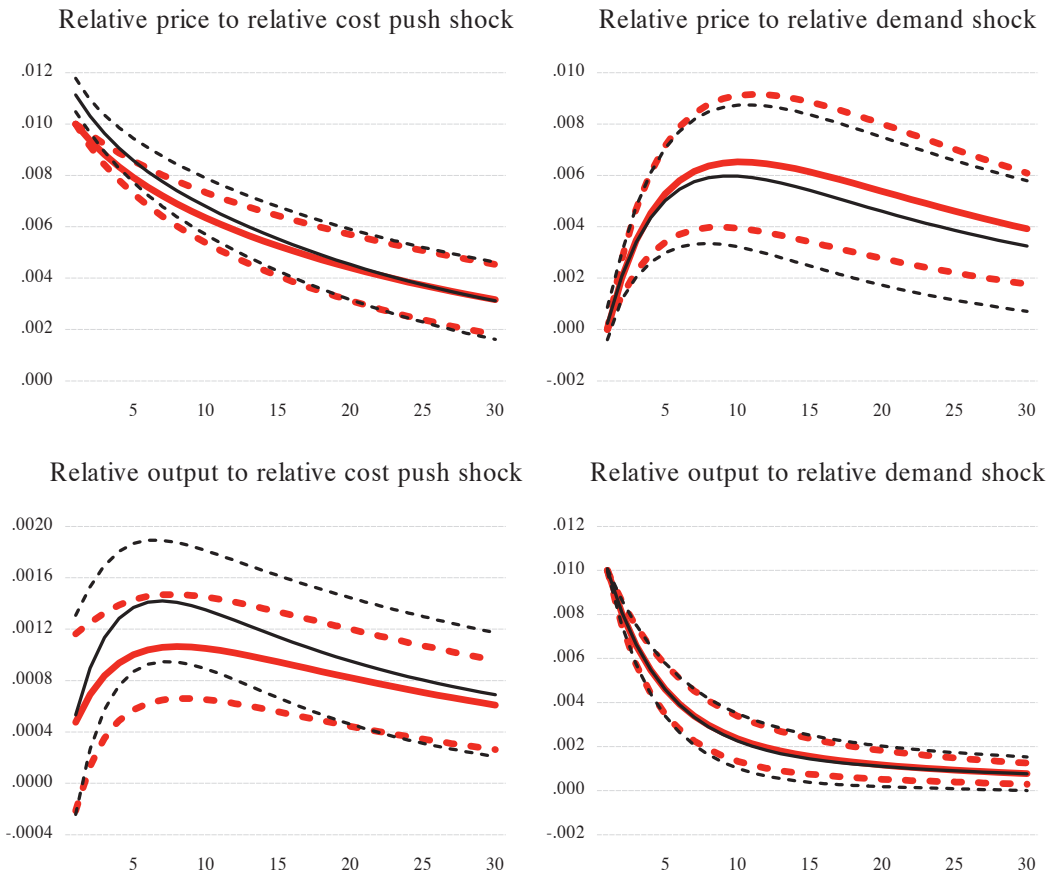
Note: See text (Section 3) for further explanations.

FIGURE 7. Residuals from the time-varying SVAR (TV-SVAR) model



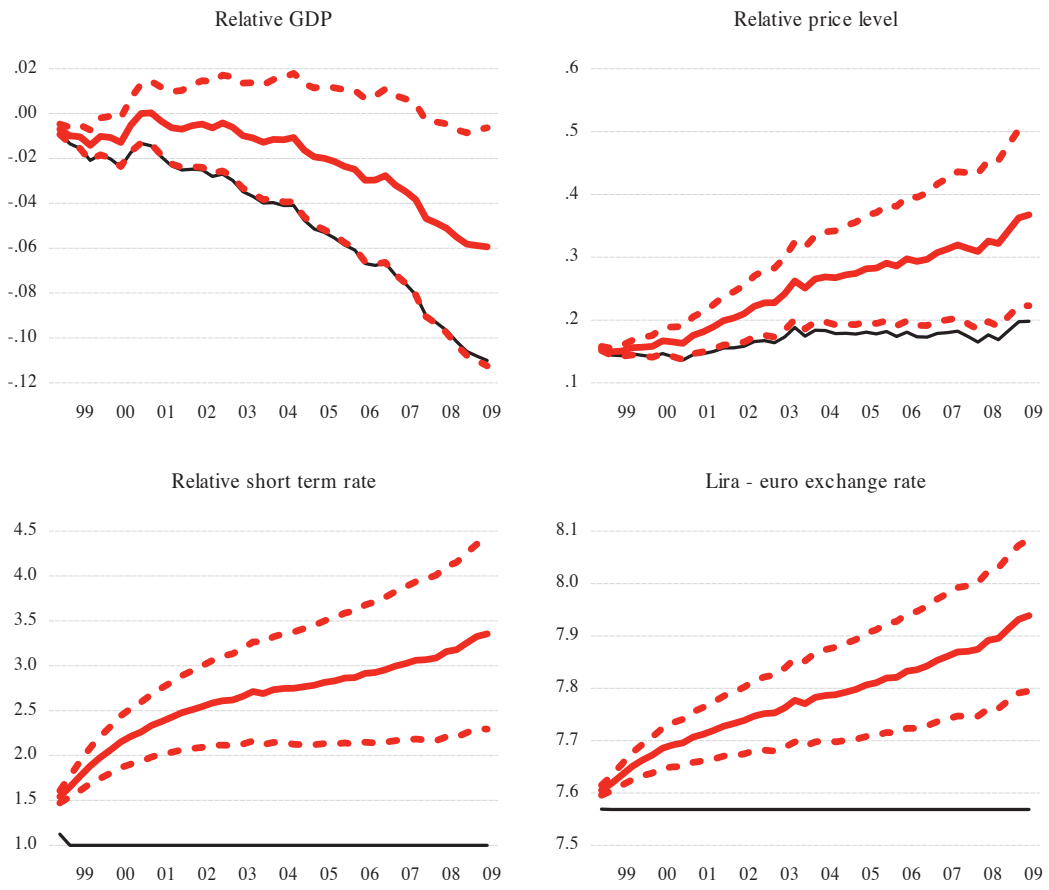
Note: These charts show the residuals from the estimation of the four-variable time-varying VAR model; the sample period is 1976:Q2 to 2009:Q2.

FIGURE 8. Impulse responses to relative cost push and demand shocks: EMU vs. non-EMU regime



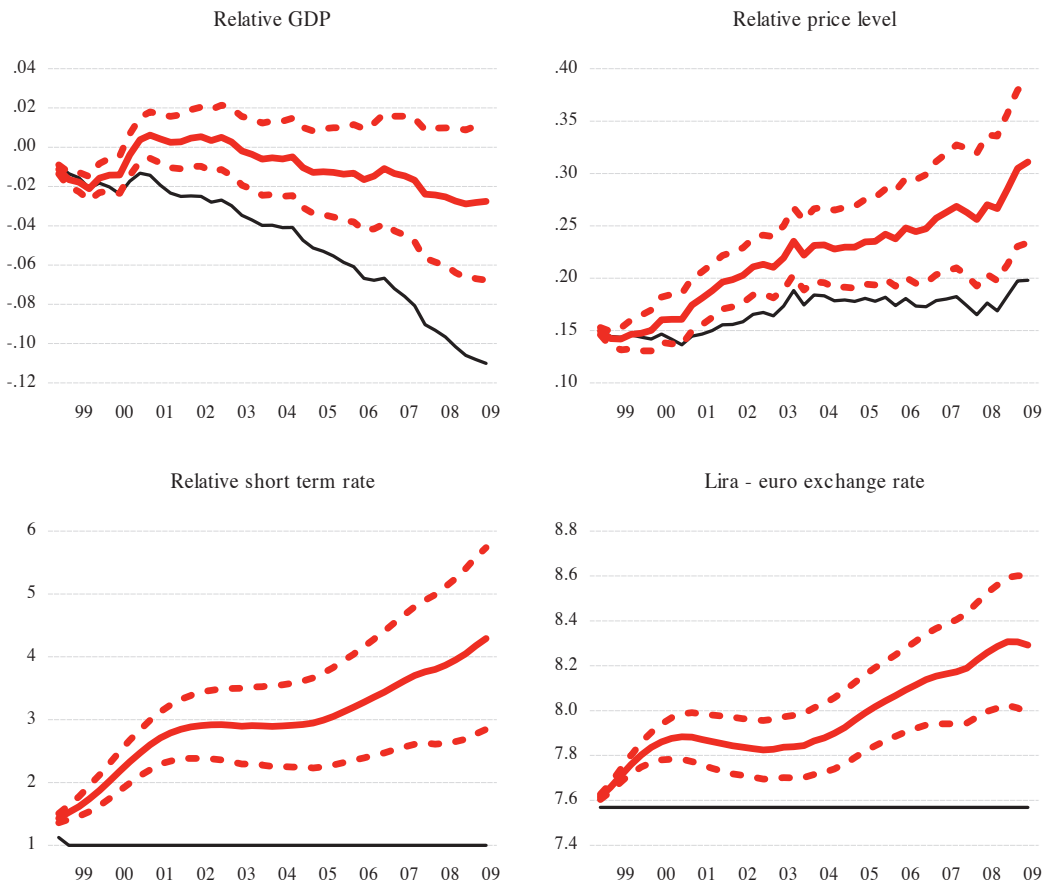
Note: The figures report the impulse response from the TV-VAR model with 68% confidence bands to a simulated one-off shock of 1% to respectively the relative price level (relative cost push shock) and relative GDP (relative demand shock). Standard errors are obtained using a bootstrap procedure with 1,000 repetitions. The thick, red line represents the EMU regime, the thin, black line the non-EMU regime. The sample period used for the estimation is 1976:Q2 to 2009:Q2.

FIGURE 9. Actuals and counterfactuals (non-EMU regime)



Note: The counterfactuals are computed by running the TV-SVAR model and imposing that the EMU factor is equal to 1 also in the EMU period. The confidence bands are at 68% probability; standard errors are computed by bootstrapping 1,000 times. The thin, black line indicates actual data, and the thick, red lines the counterfactuals. The sample period is 1976:Q2 to 2009:Q2.

FIGURE 10. Actuals and counterfactuals (non-EMU regime since 1987)



Note: The counterfactuals are computed by running the TV-SVAR model and imposing that the EMU factor is equal to 1 also in the EMU period. The confidence bands are at 68% probability; standard errors are computed by bootstrapping 1,000 times. The thick, black line indicates actual data, and the thin, red lines the counterfactuals. The sample period is 1987:Q1 to 2009:Q2.

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