Growing too fast? Shock asymmetries and the Euro area enlargement

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Abstract:

This study gives an empirical assessment of the EMU enlargement. Following Bayoumi and Eichengreen (1993), asymmetries are measured by correlations among the structural shocks from a VAR. We address two questions: what is the impact of new adhesions on the stability of the enlarged union? Is the measurement of asymmetries robust to identification of shocks? Using monthly data over 1995-2007, Slovenia and Greece stay at the periphery of the EMU like Estonia and Lithuania, despite their adhesion. While currency unions' endogeneity is supported by the greater symmetry between responses to shocks, using long-run restrictions puts the overall assessment into question.

JEL classification: E3, E42, C32.

Keywords: Euro area enlargement, optimal currency area, shock asymmetry, VAR identification.

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I. Introduction

Following the positive statement on July 11, 2006 after the publication of the EU Convergence Report, Slovenia joined the Economic Monetary Union (EMU) in January 2007**.** Cyprus and Malta participate also since January 2008, while Slovakia is expected now to join in 2009. The Euro area has thus been enlarged step by step, six years after the entry of Greece. While little attention has been paid to the adhesion of the Drachma, the perspective of a widening to the currencies of the Central and Eastern European Countries has revived the debate around the pre-conditions to a participation in a monetary union.

Ten of them indeed became the New Member States (NMS) of the European Union (EU) since May 1, 2004: Cyprus, Estonia, Malta, Hungary, Latvia, Lithuania, Poland, the Czech Republic, Slovakia and Slovenia. They were followed by Bulgaria and Romania in January 2007. So many and fast accessions could however jeopardize the stability of the enlarged union as well as the definition and the exercise of stabilization policies. It would be the case if the eligible countries add to the heterogeneity of the whole system opening the way to new asymmetries or reinforcing the existing ones.

The aim of the paper is to answer to the following questions: what is the impact of new adhesions on the stability of the enlarged union? Is the measurement of asymmetries robust to alternative methods to identify shocks?

These issues are especially important keeping in mind that newcomers have no opting-out, as stated in their accession act to the EU. These countries cannot resort to any escape clause, contrary to Denmark and the United Kingdom. Nevertheless, a prerequisite for EMU accession is compliance with the "Maastricht" criteria, set in 1992 and included in the Amsterdam Treaty.

Although absent from the Treaty, asymmetries represent an essential source of cost in the theory of optimal currency areas to which the Euro area is often related. Resorting to adjustment mechanisms other than a flexible exchange rate is still an open issue. According to Weimann (2003), labour mobility and fiscal transfers are presumably not good substitutes for exchange rates variations as adjustment mechanisms within the EMU. Consequently, the prospect for new enlargements calls for identifying and quantifying asymmetries between applicant countries and the (European) monetary union they wish to join.

From this perspective, the core-periphery approach[1] popularized by Bayoumi and Eichengreen (1993) has been widely used to assess empirically the eligibility of a given country to join a currency union. Their method relies on the identification of the so-called "structural" supply and demand shocks using Vector Auto-Regressive (VAR) models before estimating correlations between common and idiosyncratic disturbances or between the dynamic responses of representative aggregates (economic activity and prices) to them.

Even if it has become a widespread technique, the robustness of correlation estimates through Blanchard and Quah's (1989) decomposition of shocks is worth discussing. Following Faust and Leeper's (1997) critique, a renewed attention has been paid indeed to the relationship between the lack of correlation and the "structural" nature of the underlying macroeconomic shocks at the country level.

To this end, section 2 will discuss the identification of structural shocks through long-run restrictions in the light of the new findings on business cycle synchronization and the price-output correlation as stressed by Cover, Enders and Hueng (2006). Section 3 describes our econometric work carried out on the asymmetries. We consider four countries with respect to the Euro area: on the one hand Greece and, on the other hand, the first three NMS-EU - Slovenia, Estonia and Lithuania - which have participated to the Exchange Rate Mechanism[2] (ERM II) on June 28, 2004. Using monthly data on the industrial production growth and

[1] Among the eleven founder members, Austria, Belgium, Finland, France, Germany, Italy, the Luxemburg, the Netherlands, and Spain are the core-countries according to Bayoumi and Eichengreen (1993), while Ireland and Portugal remain at the periphery of the Euro aera.

[2] In addition to the Danish Krown, the Latvian Lats, the Cypriot Pound, and the Maltese Lira take part in the ERM II since April 29, 2005, the Slovak Krown since November 28, 2005.

inflation between January 1995 and September 2007, correlations are estimated between the 'structural' shocks and also among the impulse response functions of the aggregates. Our results show no clear tendency towards a significant decrease in the asymmetries against the Euro area both on the aggregate demand and aggregate supply sides. This picture is in sharp contrast with the fulfilment of the convergence criteria by the countries under study. In accordance with the previous empirical findings, Slovenia and Greece seem to lie at the periphery of the Euroland as do the other two EU Members, despite their entry into the EMU. However, correlations between impulse response functions show far greater, though variable, symmetry in the adjustment to the shocks from the Euro area. In the debate surrounding the endogeneity of currency unions, the final section concludes about the policy and institutional issues raised by our findings. Above all, the recurrence of specific shocks within EMU may lead to a lack of business cycle synchronization. These heterogeneities may thus complicate the implementation of ECB's monetary policy.

II. Asymmetries and the underlying structural shocks in a monetary union

A way of assessing business cycle synchronization between several applicant countries for a monetary union consists in measuring correlations of shocks according to their origin and/or of impulse responses of domestic aggregates to either specific or common shocks.

It has thus become familiar to evaluate these kinds of asymmetries on the basis of autoregressive vector models (VAR). The identification of the VAR indeed makes it possible to extract the "structural" innovations and to isolate their properties. The identification strategy raises several questions however.

1. The basic core-periphery approach

A particular procedure of shock decomposition has been popularised by Bayoumi and Eichengreen (1993) to measure the extent of asymmetries between candidate countries to the monetary union in Europe. The strategy of identification rests thus on constraints on the long-term effects of the various “structural” shocks. Blanchard and Quah (1989) initially built this method to evaluate the contribution of technological shocks to the business cycle. It enables to distinguish between demand and supply shocks given their supposed long-run effects on economic activity and prices. According to the aggregate supply/demand textbook model (AS-AD), a demand shock is supposed to have no long-run effect on output, unlike a supply shock. On the other hand, both disturbances have a permanent impact on prices.

Let us consider, as a first step, the VAR(p) representation for one country (or a set of them):

$$\begin{pmatrix} g(t) \\ \pi(t) \end{pmatrix} = \begin{pmatrix} a_1^0 \\ a_2^0 \end{pmatrix} + \begin{pmatrix} a_{11}^1 & a_{12}^1 \\ a_{21}^1 & a_{22}^1 \end{pmatrix} \begin{pmatrix} g(t-1) \\ \pi(t-1) \end{pmatrix} + \cdots + \begin{pmatrix} a_{11}^p & a_{12}^p \\ a_{21}^p & a_{22}^p \end{pmatrix} \begin{pmatrix} g(t-p) \\ \pi(t-p) \end{pmatrix} + \begin{pmatrix} \varepsilon_1(t) \\ \varepsilon_2(t) \end{pmatrix} \qquad (1)$$

with $g(t)$ the rate of economic growth as the first-order log-difference of the activity index (GDP or industrial production), and $\pi(t)$ the inflation rate as the first-order log-difference of the price index (retail prices, (H)CPI or producer prices) at the date *t*. The terms a_i^0, a_{ij}^k are the parameters of interest of the model, while the random disturbances $\varepsilon_i(t)$ are white noise processes with covariance matrix: $\Sigma = \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{21} & \sigma_2^2 \end{pmatrix}$.

Provided that the VAR (p) is stable, the corresponding VMA (∞) form is given by:

$$\begin{pmatrix} g(t) \\ \pi(t) \end{pmatrix} = \begin{pmatrix} b_1^0 \\ b_2^0 \end{pmatrix} + \sum_{k=0}^{+\infty} \begin{pmatrix} b_{11}^k & b_{12}^k \\ b_{21}^k & b_{22}^k \end{pmatrix} \begin{pmatrix} \varepsilon_1(t-k) \\ \varepsilon_2(t-k) \end{pmatrix} \qquad (2)$$

As a second step, the identification procedure is used to derive the (“structural”) innovations from the residuals after the estimation of the VAR for each “country”: the candidate one and the Euro area itself. Four structural shocks are thus isolated according to whether they relate to the supply or to the demand side and whether they are common to the single currency area or specific to the candidate country.

For the applicant country as for the reference area, the VAR residuals are initially expressed as a linear combination of the structural innovations:

$$\begin{pmatrix} \varepsilon_1(t-k) \\ \varepsilon_2(t-k) \end{pmatrix} = \begin{pmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{pmatrix} \begin{pmatrix} u^S(t-k) \\ u^D(t-k) \end{pmatrix}, \quad \forall k \in IN \tag{3}$$

with u^S the ("structural") supply shock and u^D the ("structural") demand shock.

The moving average representation becomes:

$$\begin{pmatrix} g(t) \\ \pi(t) \end{pmatrix} = \begin{pmatrix} b_1^0 \\ b_2^0 \end{pmatrix} + \sum_{k=0}^{+\infty} \begin{pmatrix} c_{11}b_{11}^k + c_{21}b_{12}^k & c_{12}b_{11}^k + c_{22}b_{12}^k \\ c_{11}b_{21}^k + c_{21}b_{22}^k & c_{12}b_{21}^k + c_{22}b_{22}^k \end{pmatrix} \begin{pmatrix} u^S(t-k) \\ u^D(t-k) \end{pmatrix} \tag{4}$$

Blanchard and Quah's (1989) identification constraints lead to the following system:

$$\begin{cases} V(u^D(t)) = 1 \\ V(u^S(t)) = 1 \\ Cov(u^D(t), u^S(t)) = 0 \\ \sum_{k=0}^{+\infty} c_{12}b_{11}^k + c_{22}b_{12}^k = 0 \end{cases} \tag{5}$$

The first two equations lead to the normalization of the variance of the structural shocks. The third one implies that the demand and supply are not correlated in a given country. To ensure the uniqueness of the decomposition, Blanchard and Quah choose as a fourth condition to impose the lack of a permanent (over an infinite horizon) effect of demand shocks on output.

A third and final step is to evaluate asymmetries by calculating correlations between either supply shocks or demand shocks. Computing the various impulse response functions to the identified innovations enables to calculate the correlations between dynamic multipliers. These statistics are supposed to reflect the more or less perfect symmetry of adjustment to shock between countries within and out of the monetary union.

However assessing asymmetries through such correlations encounters a "*sufficiency*" problem. As pointed out by Artis (2003), the economic theory remains curiously silent about the required degree of correlation between shocks to give a pass to an adhesion to a monetary union. Not only this ambiguity of interpretation of the estimates prevails, but the endogeneity of the optimal currency areas is also to be considered[3].

2. Identification assumptions and the correlation between structural shocks

Leaving (temporarily) aside these "economic" issues, the econometric approach frequently used since Bayoumi and Eichengreen (1993) is itself more and more debated (*cf* Saint Amant and Tessier (1998), Chari, Kehoe and McGrattan (2005)).

The identification procedure employed to appreciate whether building or enlarging a monetary union is advisable rests on one strong assumption: structural innovations specific to the applicant country and those which monetary union undergoes must be uncorrelated. Results can then be biased. A similar point has already been discussed by Blanchard and Quah (1989) themselves, followed by other authors such as Wagonner and Zha (2003).

Besides it is in the vein of Faust and Leeper's (1997) criticism against the identification of the VAR with long-run restrictions. They put into question the relevance of the long-run identifying restrictions imposed on the unrestricted VAR model. They show that inference based on the impulse response functions will be biased whatever the sample size.

Another major issue lies in aggregation of shocks and time aggregation that could lead to unreliable results from structural VARs because of the correlation between shocks. In order to elucidate the enigma on the exaggeratedly strong weight of technological shocks in the real business cycle, Cover, Enders, and Hueng (2006) (hereafter CEH) present a new method of

[3] In this view, structural changes following adhesion may imply more symmetrical shocks and/or adjustments than during the phase of transition.

decomposition of the residuals of the VAR. Their procedure is consistent with standard macro-economic models, new-classical as well as neo-Keynesian ones.

Following CEH (2006), a simple version of the AD-AS model is described by the following set of equations:

$$\begin{cases} y^S(t) = y^a_{|I(t-1)}(t) + \alpha\left(p(t) - p^a_{|I(t-1)}(t)\right) + u^S(t) \\ y^D(t) = y^a_{|I(t-1)}(t) - \left(p(t) - p^a_{|I(t-1)}(t)\right) + u^D(t) \\ y^S(t) = y^D(t) = y(t) \end{cases} \quad (6)$$

where y and p, respectively, are the logarithms of output and price levels of a country and $x^a_{|I(t-1)}(t)$ the expected value of x given past information available.

Under extrapolative expectations such that $x^a_{|I(t-1)}(t) = a_x(L) = \sum_{i=1}^{n} a_{x,i} L^i x(t)$, with L the lag operator, the preceding system can be written as:

$$\begin{pmatrix} y^S(t) \\ y^D(t) \end{pmatrix} = \begin{pmatrix} a_y(L) & \alpha\left(1 - a_p(L)\right) \\ a_y(L) & -\left(1 - a_p(L)\right) \end{pmatrix} \begin{pmatrix} y(t) \\ p(t) \end{pmatrix} + \begin{pmatrix} u^S(t) \\ u^D(t) \end{pmatrix} \quad (7)$$

One can already notice the strong analogy between this system and equation (1). The reduced form from the structural model (7) is:

$$\begin{cases} y(t) = \alpha a_y(L) y(t) + \dfrac{1}{1+\alpha} u^S(t) + \dfrac{\alpha}{1+\alpha} u^D(t) \\ p(t) = \alpha a_p(L) p(t) - \dfrac{1}{1+\alpha} u^S(t) + \dfrac{1}{1+\alpha} u^D(t) \end{cases} \quad (8)$$

According to CEH (2006), if the system is stable, its VMA (∞) representation can be deduced from (7) and (8):

$$\begin{pmatrix} y(t) \\ p(t) \end{pmatrix} = \left(I - \begin{pmatrix} a_{11}(L) & a_{12}(L) \\ a_{21}(L) & a_{22}(L) \end{pmatrix} \right)^{-1} \begin{pmatrix} \dfrac{1}{1+\alpha} & \dfrac{\alpha}{1+\alpha} \\ -\dfrac{1}{1+\alpha} & \dfrac{1}{1+\alpha} \end{pmatrix} \begin{pmatrix} u^S(t) \\ u^D(t) \end{pmatrix} \quad (9)$$

Within this framework, the first two constraints of the identification system (5) are maintained. CEH substitute the two last conditions by the new following restrictions:

- the slope of the aggregate demand (AD) curve is set unity which assumes complete indexation in the long run ;
- the assumption that the structural AD shock has no long-run effect on output yields an estimate for α, the slope of the aggregate supply (AS) curve. Indeed, the response of economic activity to the demand shock is given by:

$$\frac{1}{1+\alpha}\left(\alpha\left(1-a_{22}(1)\right)+a_{12}(1)\right)=0 \Leftrightarrow \alpha=-\frac{a_{12}(1)}{1-a_{22}(1)} \tag{10}$$

It is thus no longer necessary to impose that the contemporaneous structural shocks hitting a given country are orthogonal. This leads to relax one of the “auxiliary” identifying restrictions. In this sense, it circumvents one “identification failure” of the structural VAR approach. As underlined by Cooley and Dwyer (1998), such auxiliary assumptions have a dramatic impact on the structural dynamics, although they have no appealing economic interpretation since they do not derive from a well-defined theoretical model.

One rationale often advocated for the instantaneous correlation between the supply and the demand shocks lies in the central bank’s reaction. According to this view, inflationary pressures may arise from a negative productivity shock that the central banker may wish to counteract. This can be done by an increase in the interest rate which would then modify the (nominal here) demand side. At the macro level, this will imply a simultaneous shift of the AS and AD curves.

As such, the first step of the CEH identification method does not allow however to directly obtain the response functions to the structural impulses since the latter are not correlated. This is why CEH undertake a further Cholesky decomposition of the correlated shocks u^S and u^D

according to the assumed "causality" among them. We will go back to this two-step procedure when discussing our results in the next section.

III. Asymmetries in the enlarging Euro area

The data include price and output time series. As a proxy for output we consider the industrial production index in volume, and the consumer price index is also used. Both are taken from the International Monetary Funds on a monthly basis over the period 1995:01-2007:09. They are extracted from Datastream as seasonally adjusted data. EMU members are included in the sample – through the Euro area – as well as the four candidates (old, current or may-be future): Estonia, Greece, Lithuania, and Slovenia.

The Phillips-Perron, the Kwiatowski-Phillips-Schmidt-Shin (KPSS), and the Augmented Dickey-Fuller unit root tests are run in order to assess the stationarity of the time series. As revealed by the results reported in Annex 1, it is hard to reach definite conclusions about the (non)stationarity of our series. However, for ease of comparisons with the previous studies, we consider the first-order (log-)difference of the price and industrial production indices, as they proxy inflation and economic growth (see Huchet-Bourdon and Pentecôte (2008) for a survey of the related empirical studies).

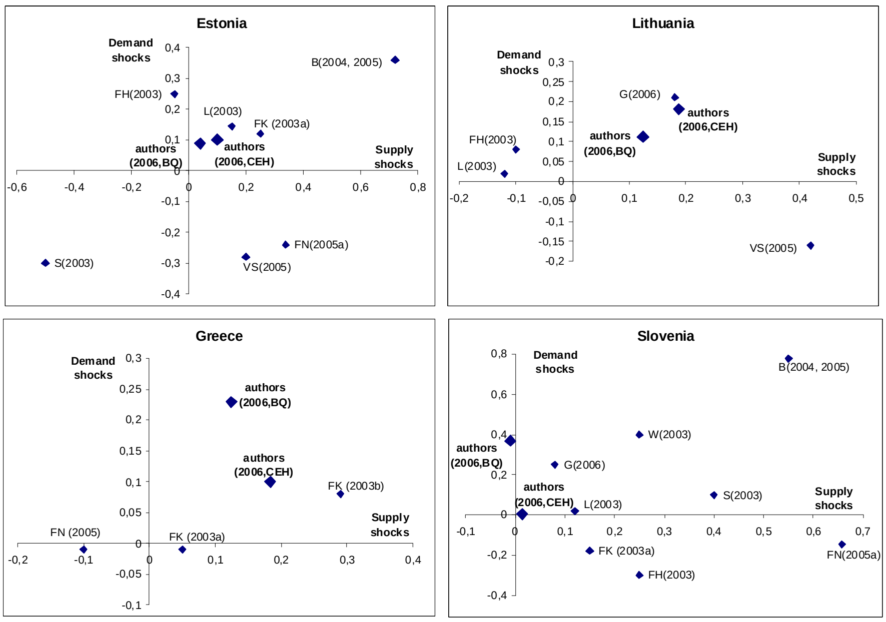
One lag is introduced into the VAR specifications according to the Schwarz criterion. The estimates from the VAR allow to measure the (instantaneous and dynamic) correlations between supply and demand shocks and for each candidate country to the Euro area. Given its successive enlargements, various indexes are considered for the Euro area in order to avoid spurious correlation: with 11 countries for Greece, with 11 and then 12 countries since 2001 for Slovenia, and from 11 to 13 countries (since 2007) for Estonia and Lithuania. We also compute the response functions of the aggregates (growth or inflation) to the impulses (supply or demand) for each country compared to the monetary union[4]. Correlations between these responses are then measured.

Finally, these correlations are calculated owing to two identification methods of the structural shocks: the standard Blanchard and Quah's (1989) named BQ thereafter, and that recently proposed by Cover, Enders and Hueng (2006) called CEH. The results are compared to assess the robustness of the conclusions about the degree of asymmetries between the Euro area and its candidates.

1. Supply and demand asymmetries: the core and the periphery

Figure 1 shows the correlations between the aggregate supply and demand shocks obtained over the whole sample period (1995-2007) for each country with respect to the Euro area. For ease of comparisons, the results of previous studies are also reported.

Figure 1: Correlations of supply and demand shocks – full sample



Notes: B (2004,2005): Babetskii; FH (2004): Fidrmuc and Hagara; L (2003): Lättemäe; FK (2003a, 2003b): Fidrmuc and Korhonen; FN (2005a): Frenkel and Nickel; VS (2005): Valentinaite and Snieska; S (2003): Süppel; G (2006): Gilson.

[4] The impulse-response functions are represented in Annex 2.

Consider first the estimated correlations of supply shocks after BQ identification (labelled "authors BQ" on the graphics). They are positive though rather weak since they lie in the lower range of the values taken from previous works. Slovenia shows the greatest asymmetries as correlations with supply disturbance to the Euro area is almost nil. By contrast, correlations of demand shocks generally reach higher values and appear more consistent with those (also positive) of the quoted studies.

Babetskii (2004, 2005) only obtains especially pronounced correlations for Estonia and Slovenia, though calculated with respect to the EU-15 rather than the single currency area itself.

Our results are however in line with Süppel's (2003) findings that business cycles of the studied accession countries are on average less synchronised with the Euro area than those of the three "Opt-Outs" (Denmark, Sweden, and the United Kingdom). In the latter countries, demand shocks have yet become more symmetric since the launch of the Euro. According to Frenkel and Nickel (2005b), the corresponding correlations are ranging from 0.4 to 0.8 in most cases. It is thus difficult to conclude about the extent to which the accession path of the New EU-member countries has been eased by the set-up of EMU.

Looking at its first eleven members, correlation with the Euro area is generally found to be higher in terms of supply than in terms of demand shocks as reported by De Haan and al. (2008) (see references therein). In "core" countries (Austria, the Benelux, Finland, France, Germany, Italy, the Netherlands, and Spain), correlations reach significantly "high" levels (at least 0.4 on the supply side, and 0.2 on the demand side) compared with those lying at "periphery" of the European currency union (namely Ireland and Portugal).

There is however no clear-cut picture due to the strong variability of the estimates from one study to another. It is thus doubtful whether accession countries are also less synchronised than the Euro "periphery". Moreover sizeable idiosyncratic shocks could be a major source of risk in countries like Lithuania.

Keeping also in mind the "sufficiency issue", it is even more difficult to relate the obtained values to the eligibility of a given candidate country, like Greece or Slovenia, to the EMU. There is indeed no threshold value to which the estimated correlations of shocks can be compared. However supply and demand disturbances do not have the same effect on output. One may thus ask if their corresponding trigger levels necessarily match.

The implementation of the identification procedure of the shocks of CEH (2006) delivers two further results. On the one hand, the rise in the correlations of supply shocks (with the Euro area) is observed for Estonia and Lithuania outweighs the increase in correlations of demand shocks. On the other hand, demand shocks are clearly less correlated than those derived from the BQ-identification system for Greece and Slovenia.

All in all, there is no tendency to a reduction in shock asymmetries, even if we consider the most recent period. To this regard, the recent adhesions of Greece and Slovenia seem to add rather than to lower heterogeneity in the Euro area. It thus may increase the risk of destabilizing the monetary union as it would be more prone to idiosyncratic shocks.

Our results also question how the Euro area can cope with such asymmetries. Various mechanisms of diversifying such risks have already been suggested. One may think in particular to appropriate common monetary and/or fiscal stabilization policies. Before addressing this issue we have first to know how countries may adjust to these shocks.

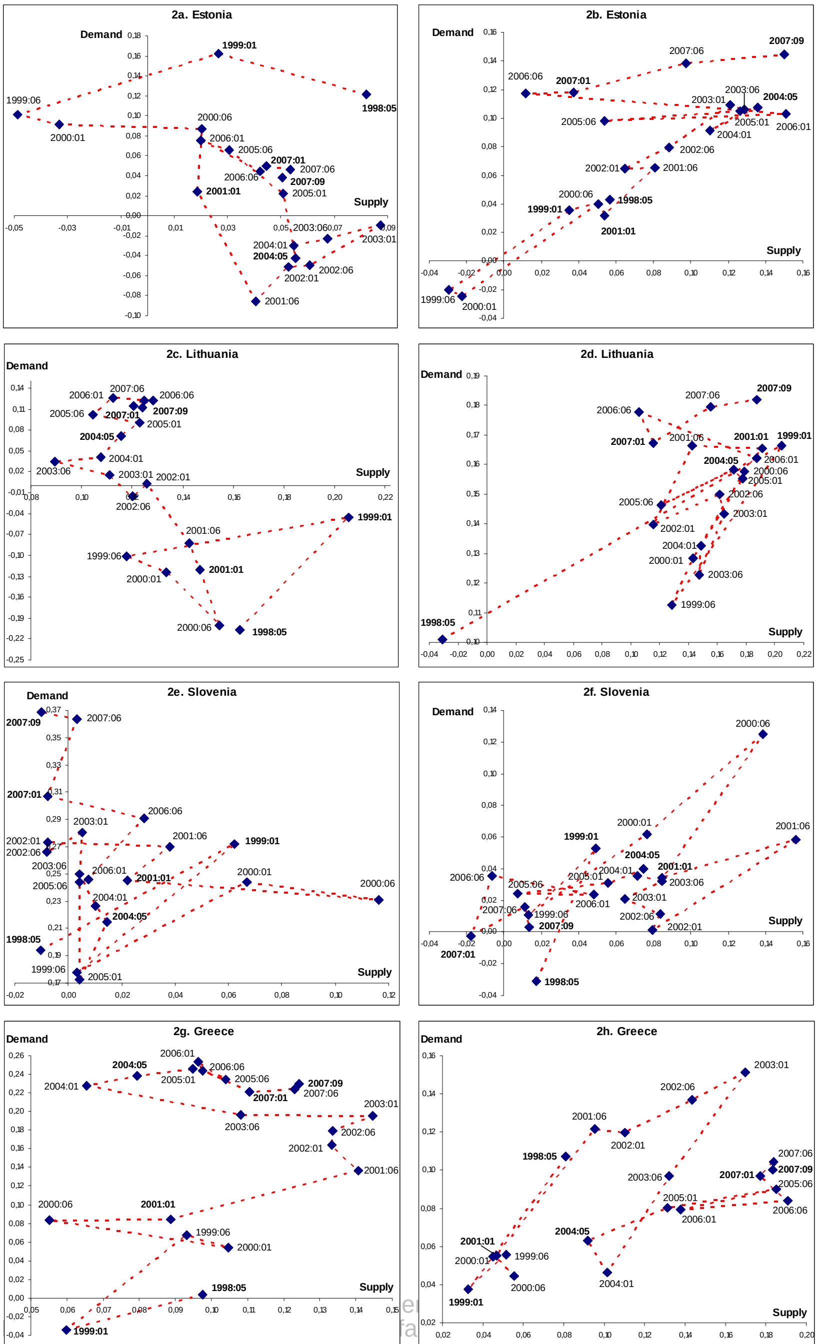
As already stressed by Fidrmuc and Korhonen (2006), there is considerable variability in the correlations of shocks from the reviewed empirical studies. This instability has already been observed in the founding Member States before as well as after the advent of the Euro. It is thus hard to assess the extent of asymmetries only on the basis of these point estimates. To complete this picture, it is useful to detail how the shocks correlations have evolved since the advent of the Euro after the declaration of its founders in May 1998.

2. Lower or greater asymmetries since the Euro?

In order to show how asymmetries may have changed since the inception of the single currency, we have run iterative estimates by adding successively a new monthly observation to the initial window 1995:01-1998:05.

Figures 2a-2h: Correlations of the supply and demand shocks since 1998:05

(BQ/CEH on the left/right panel)



According to figures 2a-2h above, correlations between BQ-demand shocks are higher in 2007 than at the time of the official statement in 1998, except for Estonia. On the contrary, the comparison of correlations between BQ-supply shocks gives results for Greece diametrically opposed to those for Estonia and Lithuania: unlike these two hypothetical candidates to the Euro, asymmetries have been reduced in the former country. While the CEH-method confirms the results obtained for demand asymmetries (except for Estonia), those in the supply side differ sharply according to the identification method used.

The iterative BQ-estimates show the variety of the time-paths. In Greece, effective adhesion to the Euro points out a breakdown in 2001 which is characterized by a surge in the correlations (figure 2g). In Lithuania, the correlation between demand shocks becomes positive and is growing only after 2003 (figure 2c). In spite of its erratic path, the correlation of the demand shocks in Estonia has been divided by two compared to the beginning of the sample period (figure 2a). Finally, there is no noticeable increase in the correlations of shocks in Slovenia: asymmetries of the supply shocks remain very important, even during the first months following its changeover to the Euro (fig. 2e).

The identification of shocks according to CEH confirms the observed break in Greece (fig. 2h). A similar trend appears in Estonia (fig. 2b), the year 2001 also outstanding a turning point. The correlations of the two types of shocks are likely to increase in Lithuania (fig. 2f). Finally, the variability observed in the Slovenian case outweighs the weakness of correlations, in particular in terms of demand (fig. 2f).

In short, whatever the method, it seems difficult to show a noticeable and permanent reduction in shock asymmetries from all the countries against the Euro area. Furthermore the correlations of the shocks remain moderate since they do not exceed 0.4.

2001 is however a key date on several occasions as it coincides with a step-change in the correlations path. It also corresponds to the first widening of the Euro area to Greece.

This seemingly reduction in asymmetries observed after 2001 is however difficult to interpret. It may be related to the effective adhesion of Greece to the EMU. This would be a signal of the greater credibility of the Euro area and its readiness to be widened to other NMS. It could also reflect the single efforts carried out by Greece as a candidate to join the eleven founders.

These graphs thus highlight a mitigate picture about asymmetries. They confirm that the diversity of the paths followed by these correlations seems to be more sensitive to the identification strategy than to the period under study. This new empirical finding is to be added to Fidrmuc and Korhonen's (2006) meta-analysis.

What do these asymmetries tell us about the eligibility to the Euro? It is surprising that even countries such as Slovenia and Greece seem as far away from an entry to the monetary union as the other two EU Members. This is especially troublesome since it is often argued that attention should mostly be paid to supply shocks because they have permanent, thus costly, effects on output.

There may be asymmetries among the shocks hitting the countries. But discrepancies may also arise in the adjustment mechanisms to these disturbances. It is therefore useful to analyze correlations between the responses to the supply and demand shocks.

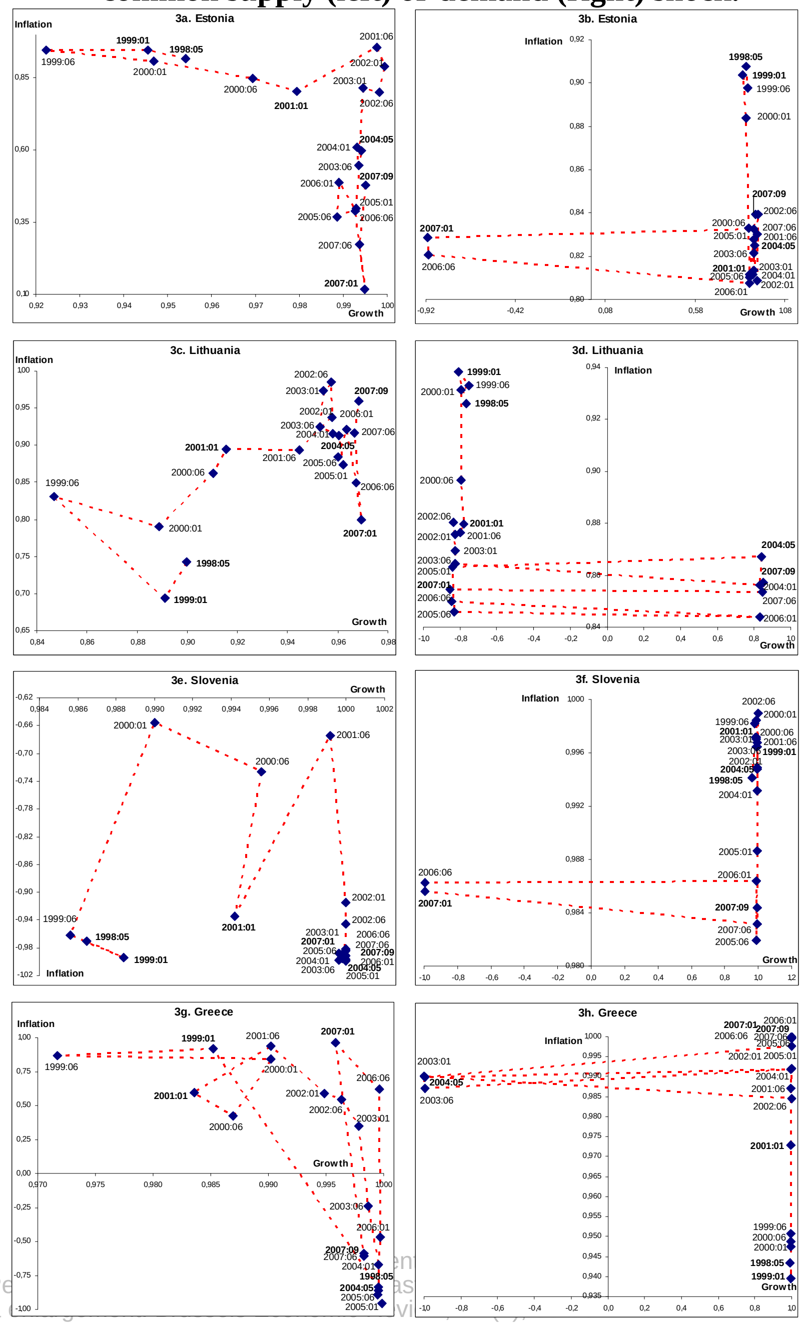
3. Asymmetries in the adjustment mechanism

We compute the impulse response functions (Irfs) to demand and supply innovations for the Euro area and the four abovementioned countries.

Over the whole sample period, countries exhibit contrasting adjustment paths to the structural shocks (see Annex 2). On one hand, the responses of inflation to demand shocks as well as those of activity growth to supply shocks look very similar between the original Euro area and Greece, although their magnitudes differ sharply. On the other hand, Lithuania and Estonia show together the same slow adjustment of inflation to nominal demand innovations. Such gradual responses contrast also with the erractic ones of growth to shock from the supply side.

These Irfs also allow to measure the correlation between the responses of each country with respect to the Euro currency area. The scatter plots 3a-3h (below) report on the left the correlations between either rates of industrial output growth or inflation rates adjustments to a supply shock. The right panel illustrates the corresponding correlations to a demand shock. Dynamic multipliers are computed here according to the BQ method. As advocated by CEH (2006) themselves, their identifying procedure leads to the same impulse response functions if "causality" is assumed to run from supply to demand shocks when performing the Cholesky decomposition in the second step (see the above section).

Figures 3a-3h: Correlations of the impulse responses of growth and inflation rates to a common supply (left) or demand (right) shock.



These graphs highlight a more or less important variability of the correlations whatever the origin of shocks. This seemingly strong instability should not however avoid the fact that correlations are very close to unity.

Symmetry thus seems to prevail among EU Members' reactions of growth and inflation rates to both types of shock. It is also worth noting that the Euro currency area is characterized by substantially greater symmetry in the adjustments to rather than in the occurrence of shocks.

Moreover, these measurements reveal closer synchronization of the business cycles, except in Greece and Lithuania where the instability of the reactions to a demand shock is observed since 2003.

The complete desynchronization of output adjustments to demand shocks in Estonia and Slovenia during the months preceding the switch of the latter to the Euro may be surprising.

In most cases, reactions of inflation are less symmetrical than responses of output growth, except in Lithuania in the case of a supply shock, and in Greece and Slovenia as a response to a demand shock. This increase in asymmetries of the reactions of inflation is not so surprising knowing that New Member States experienced high inflation rates with respect to the Euro area standard.

Following a supply shock, the results reveal that the adjustments of the Greek inflation rate are either negatively or positively correlated to those of the Euro area since mid-2003. Under the assumption that the supply shocks between Greece and the Euro area are strongly correlated over this period, this country tends to react asymmetrically to a common shock while at the same time it belongs to the monetary union.

If such a situation were to be lasted, it could jeopardize the ECB single monetary policy. Indeed, one may wonder whether these opposite reactions are actually a serious matter of concern and to what extent they are likely to undermine the credibility of the Euro area itself.

The Greek record raises new questions about the relationship between shock asymmetries and the enlargement of monetary unions. This country seems to be less exposed to specific demand and supply shocks after having adopted the single European currency. But it has recently shown greater discrepancy in the adjustment of its inflation rate to a common shock. This ambiguous picture calls for a deeper analysis in the debate surrounding the endogeneity of currency unions.

In the current state, however, Greece does not seem to be viewed as neither an impeding nor a dividing factor. It is nevertheless clear that these heterogeneities complicate the implementation of the monetary policy of the ECB. The costs induced by these asymmetries could then be lowered if the ECB was to modify its monetary policy stance or through a reinforced coordination of the national budget policies.

4. To what extent are the correlation-based asymmetries reliable?

As it stands, no firm conclusions can be drawn from such an indirect measurement of asymmetries based on shock correlations. The correlations of responses built from CEH method are quite erratic and are thus not easily interpretable. So they are voluntarily omitted here. This instability of the correlations can be explained by the original two-step procedure of identification invoked by CEH (2006).

The non-linear estimation carried out[5] indeed enables to undertake the shocks decomposition according to the following relationship:

$$AE(t) = BU(t) \quad , A = \begin{pmatrix} 1 & -\alpha \\ 1 & 1 \end{pmatrix} \quad et \quad B = \begin{pmatrix} b_{11} & 0 \\ b_{21} & b_{22} \end{pmatrix} \tag{11}$$

with *E(T)* residuals from the estimated VAR and *U(t)* orthogonal structural shocks.

[5] Using the CVMODEL instruction of WinRats© which requires besides the successive use of two search algorithms (Genetic, then BFGS) to ensure convergence.

First of all, the identification of the correlated structural shocks (stage 1) relies on a particular theoretical framework. As it considered here, the iterative estimates reveal the instability of the long-run dynamic response multipliers. Further inspection reveals that the $a_{22}(1)$ multiplier is highly variable over the sample period. Moreover it dangerously approaches unity in some cases which has an undesirable effect on the structural parameter α given the identification condition (10).

Then, the structure of variance-covariance matrix of the national structural shocks also derives from the precise form of the AS-AD theoretical model. One can indeed show that the representation, adopted by CEH and used in this study, severely constrains the covariance between these innovations as it must be strictly proportional to the variance of the supply shock (b_{11}^2) only (provided that b_{21} is significantly different from zero). Consequently, the correlation between the structural shocks of the same country is itself supposed to be proportional to the ratio of the standard errors of the innovations. This means for country *i*:

$$corr\left(u_i^S(t), u_i^D(t)\right) = b_{21}\frac{b_{11}}{b_{22}} \qquad (12)$$

But it has to be noticed that the CEH methodology can lead, under broader assumptions, to the joint identification of the structural shocks and the expectation scheme about inflation and growth. From this perspective, a more general version of the system (6) initially considered by CEH (2006) can be stated as:

$$\begin{pmatrix} y^S(t) \\ y^D(t) \end{pmatrix} = \begin{pmatrix} \lambda & \alpha \\ \eta & -\beta \end{pmatrix} \begin{pmatrix} y^a_{|I(t-1)}(t) \\ p(t) - p^a_{|I(t-1)}(t) \end{pmatrix} + \begin{pmatrix} u^S(t) \\ u^D(t) \end{pmatrix} \qquad (13)$$

The underlying structural parameters – λ, α, η and β - can be identified under a basic first-order extrapolative expectation scheme for both the industrial production growth and the CPI inflation rate.

Allowing for instantaneous correlation between the identified shocks raises many questions. First, it is often argued that that lack of independence among shocks implies that some underlying causal relationship between them is left unexplained. Thus, at least one of the structural shocks cannot be viewed as 'fundamental' (Mountford (2005)).

In this view, the structural shocks identification and/or the corresponding response functions are sensitive to specification errors (Ravenna (2007)), to the recursiveness of the long-term responses as well as to the order of the variables of the VAR which results from it (Keating (2002)).

A related issue is the robustness, and thus the reliability, of the results so obtained. A failure of such restrictions set lies in that the corresponding structural VAR model is not over- but just-identified. As a consequence, many other identifying conditions are consistent with the underlying "true" structural model.

A way to overcome this difficulty is to estimate VAR models with many other variables as advised by Braun and Mittnik (1993). Faust and Leeper (1997) conclude that the robustness of the results should be assessed relative to changes in the specification of the estimated VARs.

This is in line with Bergmann's (2005) critical appraisal to long-run restrictions in a VAR model. Using simulated data, the author shows that statistical inference is highly sensitive to the variance ratio of underlying structural shocks. In particular, unequal volatilities may lead to a substantial bias in the impulse responses. The exclusion of a third structural shock from the VAR also leads to biased impulse responses and variance decompositions.

In the context of optimal currency areas, this third shock may well reflect monetary policy impulses through either the domestic interest rate (Weimann (2003)) or the exchange rate in an open economy (Enders and Hurn (2007)).

IV. Conclusion

The aim of this paper is to assess the eligibility of the New EU Member States to an enlargement of the Euro area based on shock asymmetries.

This paper shows first of all, that the estimated correlations between supply or demand shocks do not reveal a clear trend towards lower asymmetries between these countries and the Euro area. However the NMS fulfil the convergence criteria, despite high though decreasing inflation rates. In accordance with the previous empirical findings, Slovenia and Greece seem to lie at the periphery of the Euroland as do the other two EU Members, despite their entry into the EMU.

Nevertheless, correlations between impulse response functions show far greater, though variable, symmetry in the adjustment to the Euro area shocks. This result puts again into question the endogeneity of monetary unions (De Grauwe and Mongelli (2005)).

Besides, the discussion in the last section shows that the evaluation of the correlations is particularly sensitive to the identification method of the structural shocks from VAR models: that "traditional" one of Blanchard and Quah (1989) and that recently proposed by Cover, Enders and Hueng (2006).

This calls for a deeper analysis to check for the robustness, and thus the reliability, of our results. It would be already interesting to connect these results to the various phases in the countries' cycle like to the monetary policy of the ECB and the NMS. Another promising way is to tackle the issue of the specification error. This may lead to introduce a third monetary variable - interest rate or real exchange rate - in order to disentangle the effects of real demand shocks aside from those of the monetary policy impulses.

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Annex 1: Unit root tests

Note: *Critical values at 5% level:*
ADF & PP: -2.88(with constant) and -3.44 (with constant and trend) H0: Non stationarity
KPSS: 0.46 (with constant) and 0.14 (with constant and trend) H0: Stationarity

Results of **Philips-Perron** tests, series in **level** (log)

Series	Lags	Model with constant	Model with constant and trend	Series	Lags	Model with constant	Model with constant and trend
IPI-€11	3	-0.05	-1.83	CPI-€11	0	-0.05	-2.08
IPI-€11-12	4	-0.15	-1.95	CPI-€11-12	0	0.35	-2.03
IPI-€11-13	4	-0.14	-1.94	CPI-€11-13	0	0.35	-2.03
IPI-G	1	-1.75	-2.83	CPI -G	6	-2.73	-4.12
IPI-E	8	-0.66	-8.48	CPI -E	4	-6.25	-7.17
IPI-L	1	-2.52	-4.07	CPI -L	7	-6.82	-6.46
IPI-S	8	-4.08	-9.52	CPI -S	0	-4.03	-0.08

Results of **Augmented Dickey-Fuller** tests, series in **level** (log)

Series	Lags	Model with constant	Model with constant and trend	Series	Lags	Model with constant	Model with constant and trend
IPI-€11	3	-0.06	-1.69	CPI-€11	0	-0.05	-2.06
IPI-€11-12	4	-0.14	-1.82	CPI-€11-12	0	0.35	-2.01
IPI-€11-13	4	-0.13	-1.82	CPI-€11-13	0	0.35	-2.01
IPI-G	1	-1.71	-2.23	CPI -G	6	-2.60	-4.04
IPI-E	8	0.09	-2.56	CPI -E	4	-2.10	-4.09
IPI-L	2	-1.53	-3.08	CPI -L	7	-4.38	-6.30
IPI-S	8	1.30	-0.64	CPI -S	0	-4.01	-0.08

Results of **KPSS** tests, series in **level** (log)

Series	Lags	Model with constant	Model with constant and trend	Series	Lags	Model with constant	Model with constant and trend
IPI-€11	3	-0.06	-1.69	CPI-€11	0	-0.05	-2.06
IPI-€11-12	4	2.88	0.37	CPI-€11-12	0	15.24	2.82
IPI-€11-13	4	2.88	0.37	CPI-€11-13	0	15.24	2.81
IPI-€	3	3.58	0.43	CPI-€	0	15.29	2.09
IPI-G	1	6.24	1.45	CPI -G	6	2.24	0.36
IPI-E	8	1.76	0.26	CPI -E	4	2.82	0.52
IPI-L	2	3.57	0.74	CPI -L	7	1.36	0.29
IPI-S	8	1.47	0.23	CPI -S	0	15.06	3.40

Results of **Philips-Perron** tests, series in **first differences**

Series	Lags	Model with constant	Model with constant and trend	Series	Lags	Model with constant	Model with constant and trend
IPI-€11	2	-17.43	-17.45	CPI-€11	0	-9.49	-9.51
IPI-€11-12	3	-19.04	-19.05	CPI-€11-12	0	-11.40	-11.44
IPI-€11-13	3	-19.01	-19.02	CPI-€11-13	0	-11.40	-11.44
IPI-€	2	-17.43	-17.45	CPI -€	8	-9.49	-9.51
IPI-G	0	-18.23	-18.28	CPI -G	0	-11.75	
IPI-E	7	-23.43		CPI -E			
IPI-L	1	-14.88		CPI -L			
IPI-S				CPI -S	0		-10.57

Results of **Augmented Dickey Fuller** tests, series in **first differences**

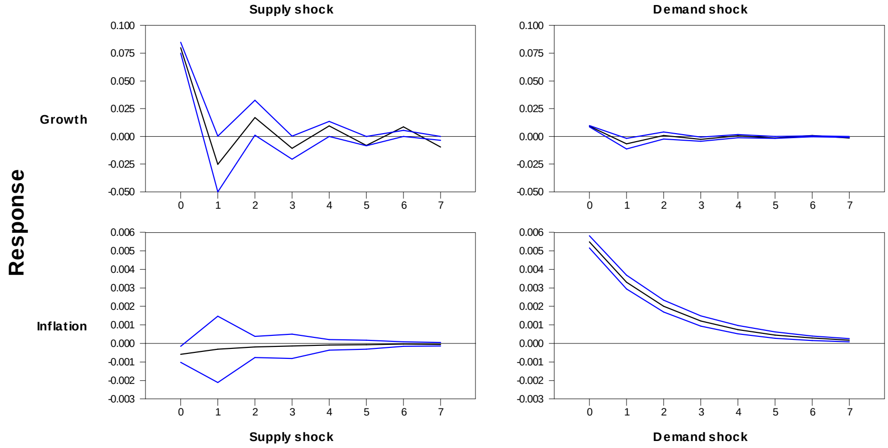
Series	Lags	Model with constant	Model with constant and trend	Series	Lags	Model with constant	Model with constant and trend
IPI-€11	2	-6.11	-6.10	CPI -€11	0	-12.08	-12.09
IPI-€11-12	3	-4.82	-4.81	CPI-€11-12	0	-11.33	-11.33
IPI-€11-13	3	-4.82	-4.82	CPI-€11-13	0	-11.32	-11.33
IPI-G	0	-18.11	-18.09	CPI –G	0	-11.68	
IPI-E	7	-5.62	-5.63	CPI –E	3	-3.61	
IPI-L	1	-11.11	-11.09	CPI –L			
IPI-S	8	-3.58	-3.78	CPI –S	0		-10.47

Results of **KPSS tests**, series in **first differences**

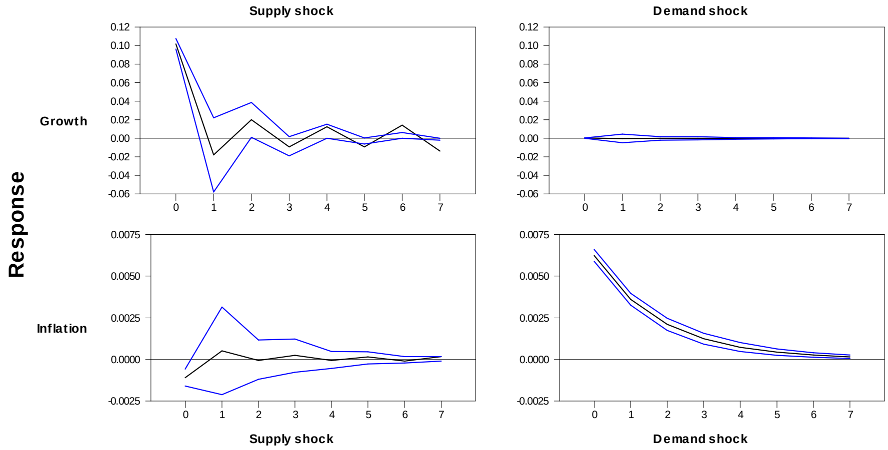
Series	Lags	Model with constant	Model with constant and trend	Series	Lags	Model with constant	Model with constant and trend
IPI-€11	2		0.11	CPI -€11	0		0.05
IPI-€11-12	3	0.09	0.10	CPI-€11-12	0	0.08	0.03
IPI-€11-13	3	0.10	0.10	CPI-€11-13	0	0.08	0.03
IPI-G	0	0.04	0.01	CPI -G	0	0.13	0.02
IPI-E	7	0.05	0.02	CPI -E	3	1.40	0.47
IPI-L	1	0.02	0.02	CPI -L	8	0.68	0.32
IPI-S	8	0.08	0.02	CPI -S	0	1.69	0.08

Annex 2: Impulse-response functions, whole sample 1995:01 – 2007:09

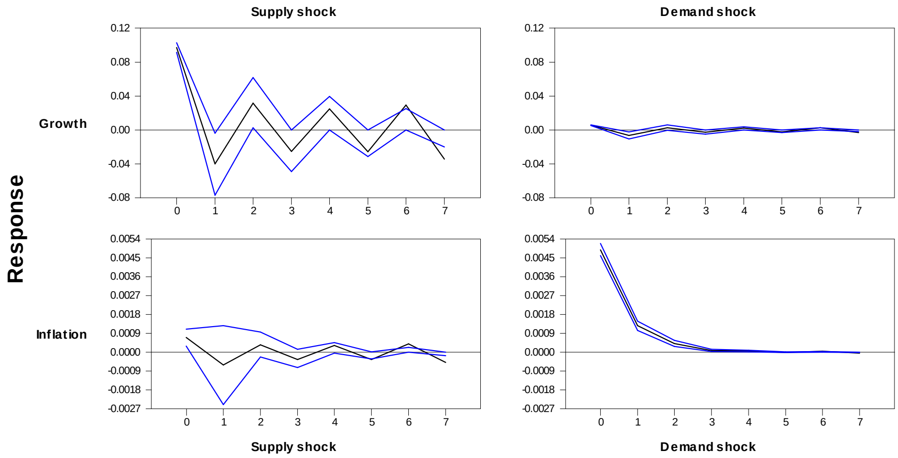
I.r.fs of Estonian aggregates



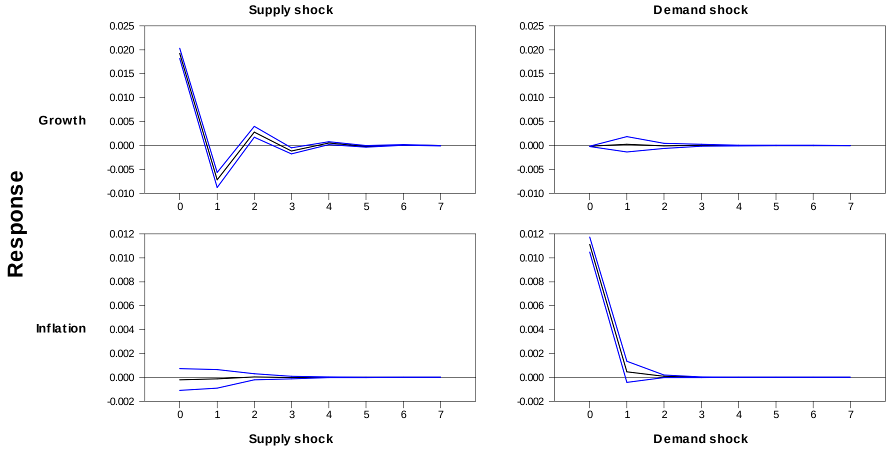
I.r.fs of Lithuanian aggregates



I.r.fs of Slovenian aggregates



I.r.fs of Greek aggregates



I.r.fs of Euro-11 aggregates