# Annex 4 - Monetary Transmission in Acceding Countries

## 1. Introduction and objectives

The analysis of the monetary transmission mechanism tries to describe the channels through which monetary policy decisions are transmitted to the economy and affect policy objectives. Knowledge of the monetary transmission mechanism underpins effective conduct of monetary policy. It allows not only selection of an adequate set of policy instruments but also their implementation in a timely way.

Two aspects are important in evaluating how monetary policy affects the real economy. First, the transmission from the instruments directly under the central bank's control (i.e., short-term interest rates or reserve requirements) to those variables that most immediately affect conditions in the non-financial sector (loan rates, deposit rates, asset prices and the exchange rate). Second, the link between financial conditions and the spending decisions of households and firms that will affect aggregate demand.

In this paper, we will focus on this second aspect of monetary transmission. In the literature, four different mechanisms have been identified. The first channel is related with the direct interest rates effects (Taylor, 1995): changes in interest rates alter the marginal cost of borrowing, leading to changes in investment and saving and thus in aggregate demand. The second channel is related with effects through the exchange rate (Menon, 1995). When the exchange rate is floating, a tightening of monetary policy increases interest rates, raises the demand for domestic assets, and hence leads to an appreciation of the nominal and –at least initially- the real exchange rate (Kamin *et al*. 1998). This appreciation can affect spending in two ways: the relative price effects (foreign goods are more attractive than domestic ones and, so, aggregate demand is reduced) and the balance-sheet effects (if residents are net debtors to the rest of the world, their balance sheet improves and this can expand domestic demand). The third channel is through the impact of monetary policy on domestic asset prices (Meltzer, 1995). Changes in bonds, equities and real estate can provide different financing conditions for firms (who would revise their investment decisions) and can trigger a revision of expectations and cause households to adjust consumption. The last channel (the credit channel –Bernanke and Gertler, 1995-) is related with the fact that, in some cases, interest rates may not move to clear the market. As a result, aggregate demand is often influenced by the quantity of credit rather than its price. In this context, recent literature has also focused the attention on the bank lending channel (Ehrmann *et al.*, 2003) and the firm investment channel (Chatelain *et al.*, 2003).

There is a broad empirical evidence on the effects and the transmission of monetary policy for the United States, the Euro Area and for most European Union countries (see, Ganev *et al.*, 2002, Ehrmann *et al*, 2003 or Goodhart, 2003) using three different and well-defined methodologies:

- First, one possible approach is to use what has been called as "narrative method". Following Ganev *et al.* (2002), this method consists of identifying policy shocks and, then, develop a counterfactual (what would have happened to the outcome variables in the absence of the shock) and compare the actual with the counterfactual and draw conclusions.
- Second, some authors use structural VAR models or small (or large) scale macroeconomic models to analyse and quantify the existence of different effects of monetary policy on output and prices. The comparison of the responses to a monetary shock with the ones obtained for other countries could shed light on the existence of different transmission channels.

- Last, other authors use micro data in order to analyse how the effects of the monetary policy come about. Asymmetries in the transmission of monetary policy are usually related to the characteristics of the mechanisms through which monetary policy influences the real economy and how agents behave (financial and non-financial firms, households, …).

This paper is related with the second set of literature. In particular, it tries to shed light on monetary transmission in Acceding Countries, comparing their transmission mechanisms with the ones in the Euro Area using structural VAR models. In this context, it is important to highlight that the results by Ehrmann (1998) for EMU countries show that considerable differences in the transmission mechanism exist between these economies, mainly in intensity, but also in timing. These asymmetries could help to explain, in part, the different macroeconomic evolutions of EMU countries in recent years (Kieler and Saarenhimo, 1998). In fact, as Hughes Hallet and Piscitelli (1999) point out, asymmetries in monetary transmission could destabilise the business cycle, and put countries out of phase with one another in a way that could not be corrected by deficit constrained fiscal policies. The effect would be to delay convergence.

The analysis of the monetary transmission in Acceding Countries is especially relevant because, after joining the EU, they will try to adopt the Euro and enter the single monetary policy area. In fact, as more central banks in Acceding Countries move towards inflation control, good knowledge of the transmission mechanism in the economy becomes crucial for implementing good policies (Ganev *et al.*, 2002). Moreover, as Lavrac (2003) highlights, the monetary history of Acceding Countries has been characterized by a wide spectrum of exchange rate regimes constantly evolving over time, according to the need to balance exchange rate stability with the control of the inflation rate. In fact, there is a clear link between the exchange rate regime and the way monetary policy affects real economy. In the current situation, three countries adopted an inflation targeting regime: Czech Republic, Hungary and Poland. Two countries experienced a currency board regime: Estonia and Lithuania. Two countries adopted a managed floating regime: Slovak Republic and Slovenia. Last, Latvia adopted a fixed peg with the SDR.

In this context, the use of monetary policy (and the way it has been used) has not been independent from the exchange rate system adopted. Those Acceding Countries that rely on fixed exchange rates, particularly on hard pegs like currency boards, have tied hands in monetary policy. On the other hand, those Acceding Countries that opted for floating exchange rate regimes, particularly free floaters with inflation targeting, retain independence in their monetary policies, with those relying on intermediate regimes, such as managed floating, somewhere in between.

For this reason, as Rusek (2001) highlights, in Acceding Countries exchange rate dynamics reflects not only the domestic monetary conditions, but also, to a significant degree, the capital flows, reflecting changing expectations of a future economic performance. In fact, according to Rusek (2001), p. 85, "the conditions of transition economies cast doubts on the stability of the relationship between monetary aggregates on one side and the price level, nominal output and nominal exchange rates on the other. Whether monetary policy has an impact and plays the role under these circumstances is, therefore, an empirical question which can only be answered by data".

In fact, due to the continuous changes experienced by these economies, the analysis of the role of monetary policy and its transmission is not an easy task. As Gollinelli and Rovelli (2002) highlight, in official policy reports of some central banks during the past decade, one

often encountered statements implying that "monetary aggregates behaved unpredictably", "the relation between money and growth was unpredictable" or "changes in interest rates did not significantly affect in a negative way domestic demand"[1].

An additional aspect to take into account is that the size and sophistication of money and financial markets, and the composition and quality of bank portfolios have improved considerably in the course of transition in Acceding Countries, while the productive sector has been subject to considerable restructuring (Gollinelli and Rovelli, 2002). As a result the channels of transmission should have evolved somewhat, although, again, this is mainly an empirical question. It is worth mentioning that they obtained evidence in favour of the stability of the analysed relationships.

The rest of the paper is structured in four sections: the next section briefly summarises the theoretical literature on transmission channels; the third section summarises the literature considering monetary transmission in Acceding Countries; the fourth section presents our empirical evidence on the role of monetary policy in Acceding Countries, and last, the fifth section summarises the main findings of the paper.

## 2. The mechanics of monetary transmission

From a very simple point of view, interactions between financial variables and non-financial activity can be reduced and simplified to interactions between interest rates and non-financial activity. In this sense, the underlying presumption of this literature is that the monetary authority exercises power over the economic behaviour of private-sector agents by influencing the financial (opportunity) cost relevant to the spending decisions of these agents The main implication of this view is that variations in the interest rate operating through changes in the cost of capital are extremely important in the monetary transmission mechanism (Taylor, 1995). This is called the interest rate channel. In Taylor's model, contractionary monetary policy raises the short-term nominal interest rate and then, through a combination of sticky prices and rational expectations, the real long-term interest rate rises as well, at least for some time. These higher real interest rates lead to a decline in business fixed investment, residential housing investment, consumer durable expenditure and inventory investments, which produces the desired decline in aggregate output. This mechanism is based, then, on the well-known IS-LM keynesian model. Following this view, the main features of the transmission of the monetary policy are related to the extent to which the central bank interest rate is being used in the economy and to the other factors such as the "life" of financial contracts (if the interest rate is fixed for a long period of time, the effect of monetary policy will be lower).

Another factor through which changes in monetary policy instruments influence non-financial activity operates through the exchange rate (Menon, 1995). The interpretation of the exchange rate channel is related with the impact of monetary policy decisions on non-financial activity through movements in the balance of payments. Under flexible exchange rates, a change in the domestic instrument variable, ceteris paribus, elicits movements in the exchange rate. This channel also involves interest rates effects, because when domestic real interest rates rise, domestic national currency deposits become more attractive relative to deposits denominated in foreign currencies leading to a rise in the value of national currency deposits relative to other currency, which causes an appreciation of the national currency. The

[1] In this context, it is not surprising that at the start of the transition period many Acceding countries have not chosen to exercise an active, independent monetary policy and instead have adopted a fixed exchange rate policy.

higher value of the domestic currency makes domestic goods more expensive than foreign goods, thereby causing a fall in net exports and hence in aggregate output (altering the relative prices of national and foreign goods).

As Meltzer (1995) emphasises, a key objection to the keynesian paradigm for analysing monetary policy effects on the economy (present in the two previously presented "channels"), is that it only focuses on one relative asset price, the interest rate (and the exchange rate but in relation to it). The description of the Japanese experience during the 80s and 90s in Meltzer (1995) shows how monetary policy can have a relevant impact on non-financial activity through its effect on land and property values. This channel, known as asset prices channel, relative prices channel or stock market channel, assumes that monetary policy has influence on the prices (and composition) of the agent's assets portfolio through changes in the opportunity cost. As a result, when agents try to bring into balance their portfolios (having effects on their consumption decisions), the investment decisions of firms that are quoted at the stock market are also affected. Following this theory, the main source of differences in the monetary transmission will be related to the extent to which the agents hold financial assets whose prices may vary in reaction to unexpected changes in monetary policy.

However, these channels of monetary transmission (or at least the most traditional: interest rate and exchange rate) have recently received considerable criticism due to the assumption that credit markets tend to return to equilibrium. In fact, the main criticism to the previous approaches is related to the assumption of perfect information and the lack of consideration of incentive problems. In this alternative view, financial prices do not clear the credit market (Bernanke and Gertler, 1995). This approach to the transmission process is known as the credit channel. In this case, the efficient functioning of the market credit is hindered by asymmetries in information between borrowers and lenders, resulting in principal-agent problems. These problems lead to endogenous and varying credit conditions, which help to shape the transmission of monetary policy decisions to economy. This uncertainty generates a potential important role for financial intermediaries who specialise in gathering and distilling agent-specific information. The implication is that financial intermediaries, usually banks, play a unique role in the monetary transmission process, acting as an interface between the policy decisions of the central bank and non-financial activity.

Bernanke and Gertler (1995) emphasise how asymmetric information and costly enforcement of contracts creates agency problems in financial markets. Two basic channels of monetary transmission arise as a result of agency problems in credit markets: the bank lending channel and the balance-sheet channel.

The bank lending channel is based on the view that banks play a special role in the financial system because they are especially well suited to deal with certain types of borrowers, in particular small firms where the problems of asymmetric information can be very pronounced. In this context, the relationships between small firms and banks play a strategic role in the transmission of monetary policy. The way this channel works is the following: assuming that the total available quantity of credit is limited, a restriction of bank credit will restrict the investment possibilities of small firms (not for large firms, since they can access to credit through stock markets), translating the restrictive effects, through multiplier-effects, to the rest of the non-financial sector.

The balance-sheet channel operates through the net worth of business firms and this is related with the ability of firms to borrow. In this literature, the borrower's financial position is influenced by the monetary policy and the business cycle. Under a restrictive monetary policy, the firm's asset prices are lower, reducing the net worth of the firm, while the cost of external financing is higher, making investment much more difficult. As Schmidt (1999)

remarks, for firms with problems to access external credit markets, there is an "external finance premium cost" which is a positive function of the interest rate: the cost moves in the same direction because of the own situation of the firm.

FIGURE 1

## 3. Review of the empirical literature on monetary transmission in Acceding Countries

### 3.1. Introduction

The objective of this section is to summarise the available evidence on monetary transmission in Acceding Countries.

In this context, one aspect that should be taken into account is the relationship between the exchange rate system and the level of capital controls of the considered country and the degree of monetary independence. The evolution of the different exchange rate systems in these countries is shown in table 1.

TABLE 1

Taking this into account, and instead of looking at the available evidence for individual countries, we will present it in three different groups.

The first group is the Czech Republic, Hungary and Poland. The three countries have adopted a direct inflation targeting approach to guide their monetary policy (although in Hungary more than one nominal anchor is considered). Poland has a free floating exchange rate system while the Czech Republic has a managed floating exchange rate system and Hungary has a fixed peg, but with ±15% bands. In the three countries, we should expect a high degree of autonomy in the conduct of monetary policy.

The second group are the Slovak Republic and Slovenia. Both countries use the exchange rate as nominal anchor for monetary policy and their exchange rate system is a managed floating one. It is worth mentioning that, apart from the exchange rate, in Slovenia there is also a monetary aggregate target, while in the Slovak Republik various indicators are also monitored in order to conduct the monetary policy. In both cases, the ability to use discretionary monetary policy would be similar, although a bit more limited, than in the previous case.

The third group corresponds to Estonia, Lithuania and Latvia. In the first two countries, we find currency board arrangements, while Latvia adopted Latvia that adopted a fixed peg with the SDR. One of the main reasons for introducing the currency board was to obtain price stability by eliminating the (money-supply related) domestic sources of inflation. Under a currency board arrangement there is no active monetary policy. This means that exogenous changes in interest rates or money supply do not arise from monetary policy. In fact, once the currency board is in place, fluctuations in the nominal exchange rate become external shocks to which the system adjusts automatically. Something similar happens in Latvia, where the role of monetary policy is very limited.

Taking into account the previous exposition, Figure 2 summarises the interactions between the exchange rate system, capitals controls and monetary independence.

FIGURE 2

### 3.2. Czech Republic, Hungary and Poland

*i) Czech Republic*

After its creation at the end of 1992, the Czech Republic introduced a currency peg in 1991, which was formally abandoned at the end of 1997 after a series of speculative attacks. Currently, the exchange rate is in free float, although the Euro is informally used as a reference currency. In 1997, the Czech central bank began to announce inflation targets and, apparently, it has not had any impact on the behaviour of exchange rates, that have been almost constant in nominal terms and under constant appreciation in real terms. Nowadays, the situation can be described as a managed float (after a short period of free floating) with inflation targeting.

Regarding the monetary transmission mechanism, the first work (to our knowledge) that considers this issue in this context is Rusek (2001). Using monthly data from 1993.1 to 1999.12, he finds that active use of monetary policy in the Czech Republic, Hungary and Poland was rather difficult. In fact, according to his results, the lack of equilibrium relationships between the monetary policy variables and the other macroeconomic variables of interest in these economies limits the use of monetary policy for inflation and output stabilization.

In a more recent work, Gollinelli and Rovelli (2002) specify and estimate a small structural macro model using quarterly data from 1991 (1993 for the Czech Republic) to 2000 to explain the process of disinflation in the Czech Republic, Hungary and Poland, to interpret the main features of monetary policy in each country and to identify the channels of monetary policy transmission. The specified model is in the lines of Svensson (2000), with forward-looking inflation and exchange rate expectations and, according to the authors, it can adequately characterize the relationship between the output gap, inflation, the real interest rate and the exchange rate during the course of transition. Using this model, they assess the relative importance of the interest rate channel and the exchange rate channel in determining the evolution of inflation. They find that the effect of the real exchange rate on the evolution of inflation is much more direct in the case of the Czech Republic, than in the other analysed countries (Hungary and Poland). They also find that in the Czech Republic, real interest rates affect demand only with a very long lag, whereas the competitiveness effect takes place with a shorter lag and is much stronger than in the other countries. According to them, the empirical evidence of a well-specified mechanism of policy transmission in these countries provides strong support for the feasibility of an inflation targeting strategy for monetary policy. In fact, Kotlan and Navratil (2003), using quarterly data from the first quarter of 1995 to the second quarter of 2002, also find that the inflation targeting regime has contributed to higher macroeconomic stability of the Czech economy.

Ganev *et al.* (2002) analyse the monetary transmission mechanism in ten Central and Eastern Europe countries (including the Czech Republic) using generalized impulse responses. They find evidence of both an interest rate channel and an exchange rate channel in most of the countries under consideration.

Korhonen (2002) calculates monetary conditions indices for the Czech Republic, Poland and Slovakia using data from 1994 to 2001. Monetary conditions indexes measure how changes in interest rates and in the exchange rate (even if the monetary authority does not control or manage the exchange rate) affect output and/or inflation (see Mayes and Virén, 1998). Using this approach, he finds that for the Czech Republic, results do not differ from those obtained earlier for the current Euro Area members. For Poland, the results indicate a surprisingly large influence of the exchange rate on output developments, which may be due to the exchange rate policy pursued during the 1990s. Something similar happens with the exchange rate for Slovakia that seems to be clearly less important than domestic interest rates.

Lavrac (2003) analyses the role of inflation targeting in the Czech Republic, Hungary and Poland. One aspect related to this strategy is the type of price level to be targeted in forming the inflation rate. This issue is crucial for these countries, where are many prices are still regulated. According to this author, probably, the best measure of inflation to be targeted is the headline inflation rate, measured as the rate of change of the Consumer Price Index, instead of considering a measure of the inflation computed net of the regulated prices[2]. Another aspect Lavrac (2003) highlights is the relevance of the degree of openness of the economy on the effectiveness of the exchange rate channel. In this sense, and according to this author, the exchange rate pass-through could be quite relevant for the Czech Republic.

Coricelli, Jazbec and Masten (2003) have analyzed the exchange rate pass-through in four Acceding Countries: the Czech Republic, Hungary, Poland and Slovenia. The empirical analysis indicates that, especially for Slovenia and Hungary, there is a very large pass-through from exchange rates to domestic inflation. In fact, in Slovenia shocks to the exchange rate play a dominant role in determining inflationary pressures. However, a smaller impact is found for the Czech Republic and Poland, where autonomous shocks are more relevant in determining inflation. In fact, these results permit to establish a ranking of countries according to the size of the pass-through effects and the importance of exchange rates shocks with respect to overall inflationary performance: Slovenia, Hungary, Poland and the Czech Republic. As expected, a perfect pass-through effect is associated with accommodative exchange rate policy, which can moreover become the most important source of inflationary pressures. This result suggests that an early adoption of the Euro could provide an efficient framework for reducing inflation in these countries.

Summarising, the available evidence for the Czech Republic shows that monetary transmission could be quite similar to the one found in other Euro Area countries operating through, both, the interest rate and the exc hange rate channel.

*ii) Hungary*

Hungary adopted a crawling band since 1995, with the rate of depreciation being gradually reduced as disinflation proceed. The rate of crawl, initially at 1.9% per month, was gradually reduced to 0.3% per month in April 2000, and finally to 0.2 in April 2001. In May 2001, the fluctuation band was widened up to ±15%. A few months later (in July 2001), the central bank began to announce quantitative targets for inflation[3]. Although it is not strictly true (the

[2] Mishkin (2002) points out that one other factor affecting inflation controllability that is especially relevant in the emerging market context is the (at times large) incidence of government-controlled prices on the index used to compute headline inflation. As a result, inflation targeting may demand a high degree of coordination between monetary and fiscal authorities on the timing and magnitude of future changes in controlled prices or, alternatively, the exclusion of controlled prices from the targeted price index, as in the Czech Republic.

[3] It is worth mentioning that the first "inflation report" of the Hungary central bank was published in 1998 (Golinelli and Rovelli, 2002).

fluctuation bands still operate), nowadays the situation can be described as quite similar to the case of Poland or the Czech Republic.

Regarding this issue, Siklos and Abel (2001) studied whether the adoption of inflation targets for Hungary was a desirable option. They considered the qualitative and quantitative pre-conditions required for a successful adoption of inflation control objectives. Their results showed that although the National Bank of Hungary appeared to possess a reaction function with some of the main features found in those estimated for industrial economies, there were certain aspects of the relationship between the government and the central bank that required clarification. One of these aspects was related to the role of the transmission mechanism. The new regime might lead to a change of emphasis among the various channels through which monetary policy affects the real economy. Together with developments in the banking sector, there is sufficient evidence to warrant considerable caution concerning the smooth functioning of the transmission mechanism.

In this sense, and with the only exception of Rusek (2001), Gollineli and Rovelli (2002), Korhonen (2002) and Coricelli, Jazbec and Masten (2003) find evidence of an interest rate channel with shorter lags and a more relevant influence of the exchange rate channel than in the Czech Republic.

*iii) Poland*

Poland, similarly to the Czech Republic, adopted a currency peg in 1990. The commitment to fix the exchange rate did not last long, and in October 1991, Poland moved to a crawling peg system. The pre-announced monthly rate of crawl was gradually reduced, and then, also transformed (May 1995) into a crawling band regime, with a band of ±7%. The band was further widened in the next years (up to ±15% in March 1999) and finally abandoned, giving way to a free float in April 2000. While pursuing its exchange rate policy, the Poland central bank defined its official strategy in terms of other variables: monetary targets until 1997 and direct inflation since October 1998. Nowadays, the situation can be described as free-float with inflation targeting. In this sense, Christoffersen *et al.* (2001) find a significant relationship between inflation and monetary instruments in Poland during the period 1992-1998.

Garbuza (2003) makes an extensive analysis of monetary transmission in Poland using a structural VAR model estimated with data from January 1995 to September 2002. The obtained results show that monetary policy shocks via the interest rate and the exchange rate channel have clear effects on output and inflation.

With the only exception of Rusek (2001), Gollineli and Rovelli (2002), Korhonen (2002) and Coricelli, Jazbec and Masten (2003) find similar results to the ones by Garbuza (2003), which are in line with the ones observed for the Czech Republic: the interest rate and the exchange rate channels are relevant.

### 3.3. Slovak Republic and Slovenia

*i) Slovak Republic*

Until recently the framework of monetary policy in Slovakia was based on controlling monetary aggregates rather than setting interest rates.

Using data from 1993 to 2000, Kuijs (2002) analyses the monetary transmission in Slovakia using a structural VAR model. The results from the model suggest that the most relevant transmission channel is the exchange rate channel, while the impact of broad money changes and interest rates changes seems to be modest. The results by Ganev *et al.* (2002) provide similar conclusions.

*ii) Slovenia*

The monetary policy framework in Slovenia has been modified three times since its independence in 1991. First, price stabilisation was pursued with a framework that relied on monetary anchor (1991-1995). After that period, from 1996 to 2001 the stability of prices and the exchange rate was pursued by means of dual targeting of both base money and of the exchange rate, although formally monetary aggregates were used as intermediate and operating targets. The last change in 2001 was related to the persistence of inflation and to the accession requirements. A framework that uses the exchange rate as a nominal anchor for reducing inflation has been operating from that moment.

However, the exchange rate system, a managed floating regime since independence, has been "de facto" modified in accordance with the main policy objectives that guided monetary policy in the different periods (Caprirolo and Lavrac, 2003). In the 1991-1995 period, the exchange rate regime can be characterized as a freely falling regime with a high currency risk. In 1996, the exchange rate regime shifted to a de facto passive crawling exchange regime. The last change was in 2001 when a "de facto" active crawling exchange rate regime was established.

According to Caprirolo and Lavrac (2003), the main characteristic of monetary policy throughout the three different periods is the preference of the monetary authorities to use non-market arrangements for pricing monetary policy instruments, including capital controls, in order to minimize the costs of implementing monetary policies. This has resulted in a policy framework that is vulnerable to exchange rate shocks, as the interest rate channel of monetary policy remains blocked. In particular, the lack of use of interest rates to defend the currency in 1995 and 1999 resulted in reversals of the disinflation trends that preceded both shocks. This result is also found by Delakorda (1999) using a small structural macroeconomic model, by Ganev *et al.* (2002) after estimating generalized impulse responses and by Coricelli, Jazbec and Masten (2003) analysing the exchange rate pass-through.

### 3.4. Estonia, Lithuania and Latvia

Estonia and Lithuania introduced a currency board arrangement to obtain price stability by eliminating the (money-supply related) domestic sources of inflation. In this context, as Lättemäe (2003) highlights, there is no active monetary policy. This means that exogenous changes in interest rates or money supply do not arise from monetary policy. Both indicators develop endogenously, subject to economic development, external financing and arbitrage conditions. In fact, the currency board transmission mechanism has been defined as an "automatic stabiliser". However, there are two aspects that should be considered: the risk premium (that can modify the behaviour of the domestic interest rate in relation to external interest rates) and the fact that capital flows respond to changes in the level of the interest rate more rapidly than trade flows. As a result, Lättemäe (2003) views the currency board arrangement as "a long-run relationship between monetary conditions and not as a rapid current account adjustment mechanism". In fact, a peg of the domestic currency to some anchor currency does not completely eliminate fluctuations in the effective exchange rate,

since the domestic currency and its anchor continue to float against the currencies of other trade partners of the pegging country. So, changes in the exchange rate could represent just another source of inflationary or deflationary pressure and this is the reason because analysing monetary transmission in these two countries can be of some interest.

*i) Estonia*

Nowadays, the Estonian central bank has only two significant monetary policy instruments: the forex window (unlimited foreign exchange between the anchor currency and the Estonian Kroon, which determines the base money supply) and the reserve requirement.

Considering this, and using the monthly small structural macro model by Pikkanni (2001), Lättemäe (2003) concludes that the Estonian economy's reaction to shocks is surprisingly fast. External shocks in financial conditions (ECB interest rates) are rapidly transmitted to the rest of the economy (the expected result under the currency board arrangement). Using the same model, Pikkani (2001) also finds similar results when the effects of a domestic interest rate shock (related to changes domestic credit rationing) and the effects of a nominal effective exchange rate shock are considered. Lättemäe and Pikkani (2001) interpret these results as evidence of the presence of the interest rate and credit channels but not the exchange rate channel (a large proportion of trade is settled in the anchor currency). They also point out that the effects of existing transmission channels on the real economy are small and short-lived (Bems, 2001). A similar conclusion was reached by Ganev *et al* (2002).

Dabusinkas (2003) analyses the exchange rate pass-through in Estonia, who runs a currency board arrangement. The results showed that about 30% of Estonian imports were subject to statistically significant short- and long-run pass-through. The pass-through effects became insignificant in the case of consumer prices, but remained statistically significant for producer prices in manufacturing.

*ii) Lithuania*

Regarding the monetary policy framework, as it has been previously mentioned, Lithuania represents an example of one end of the range of possible monetary policies (a currency board arrangement), that significantly limits the ability of the monetary authorities to conduct a discretionary monetary policy. The possibilities for the monetary authorities to influence the domestic money stock are limited by coverage commitments and usually are limited to actions such as changing the reserve/liquidity requirements and playing the role of the lender-of-last resort (to the extent allowed by the presence of excess foreign reserves). The specifics of this monetary policy environment would probably increase the relative importance of particular channels.

Vetlov (2003) analyses the monetary transmission mechanism in Lithuania. According to this author, the level of financial intermediation in Lithuania remains low. In fact, using data from Garbaravicius and Kuodis (2002), he highlights that the total size of the financial sector in 2002 was only half of total GDP. The slow development of the financial sector is conditioned by a number of factors ranging from the macroeconomic situation and fiscal policy failures to insufficient investment culture among the residents. Moreover, the performance of the market is determined mainly by actions taken by commercial banks (or the government). Regarding the economic structure of Lithuania, it is worth mentioning that there

is a significant share of capital intensive activities while the Lithuanian economy is highly open and, thus, vulnerable to the external environment.

Using a narrative approach, Vetlov (2001) finds evidence of a direct interest rate channel and of an exchange rate channel, but not a credit channel. The reasons to find evidence of an exchange rate channel (under the currency board arrangement) are related with the fact that the anchor currency was the dollar and with the relative high importance of trade with Russia. However, the results by Ganev *et al.* (2002) are not as clear regarding the influence of this channel.

Taking these aspects into account, Vetlov (2003) specifies and estimates a small-scale structural macroeconomic model that incorporates three monetary transmission channels that are expected to operate in the Lithuanian economy: the interest rate, the bank lending and the exchange rate channels. The model is specified in terms of error correction mechanisms and it is formed by 40 equations (26 stochastic and 14 identities). It is a quarterly model and it has been estimated using data from 1995 1st quarter to 2001 4th quarter. Using impulse-response analysis of the estimated model, Vetlov concludes that the interest rate and exchange rate channels have been effective in the considered period. The GDP response is greater and the CPI response is smaller under the interest rate shock scenario as compared to the exchange rate shock case. Similar to findings in the Euro Area, he also finds that investment is more sensitive than consumption to the interest rate shock.

*iii) Latvia*

The principal stated goal of the Latvia central bank is price stability, although the bank has never set an explicit inflation target. During the stabilisation period, the central bank operated in a very underdeveloped financial system in which the target was to control the money supply. The exchange regime was a managed float. At the beginning of 1994, the exchange rate was pegged to the SDR currency basket and, since then, the peg has remained unchanged.

Once stabilisation was achieved, the central bank concentrated in developing more sophisticated monetary policy instruments. Thus, direct measures like credit ceilings were replaced by market instruments. In fact, nowadays the set of market-based monetary policy instruments are similar to the ones used by the European Central Bank (Babich, 2001).

Using the narrative method, Babich (2001) provides evidence that is supportive of the view that the monetary transmission in Latvia works through interest rate and credit channels (but not the exchange rate), although the final effects of monetary shocks on real activity appear to be weak or non-existent.

The results by Ganev *et al.* (2002), obtained in a cointegrating VAR framework, show that there is evidence on both the interest rate channel and the exchange rate channel, although their results are probably due to "possible instability of the Latvian system estimated here" (p. 32).

### 3.6. Summary

As Ganev *et al* (2002) highlight, the literature on the monetary transmission mechanisms in Acceding Countries does not hold much evidence on a clear monetary transmission. Most of the studies dealing with the first step of transmission find some link between market interest rates (the ones influenced or set by central banks) and commercial banks' deposit and lending rates. However, this link is usually very weak.

Given this weak first step of transmission, the studies generally do not find evidence of a significant second step of transmission between monetary variables and inflation or GDP, although the role of the interest rate and exchange rate channels has been highlighted for most considered countries.

In particular, the available evidence for the Czech Republic and Poland shows that monetary transmission could be quite similar to the one found in other Euro Area countries operating through, both, the interest rate and the exchange rate channel. The evidence for Hungary also highlights the role of both channels, although the exchange rate seems to be more important in relative terms.

In the Slovak Republic and Slovenia, there is clear evidence of an exchange rate channel, while it seems that the interest rate channel of monetary policy remains blocked. In this context, and given the critical importance of joining the Euro Area as soon as possible, the monetary authorities should pursue further de-indexation of the financial contracts and stand ready to use interest rates to defend the currency and fight inflation. For example, Festi (2001) defends the use of open market policy instruments by the Slovenian central bank. In fact, he highlights that it can enable a permanent flow of money between commercial banks and the central bank that would permit to send signals to the money market. In fact, shifting to a balanced conduct of monetary policy that also relies on the interest rate channel in a de-indexed economy environment would contribute to prepare the financial sector to the ECB policy-operating environment, where monetary policy is implemented and transmitted primarily through interest rates (Suardi, 2001), and only to a minor extent through the exchange rate (Angeloni *et al.*, 2003b).

The results for Estonia show evidence of the presence of the interest rate and credit channels, but not the exchange rate, while for Lithuania the results are different: interest rate and exchange rate channels have been effective in the transmission of monetary policy. According to Vetlov (2001), the reasons to find evidence of an exchange rate channel for Lithuania but not for Estonia are related with the fact that in Lithuania the anchor currency was the dollar and with the relative high importance of trade between Lithuania and Russia.

Last, the evidence for Latvia is not as clear. Babich (2001) provides evidence that supports for the view that the monetary transmission in Latvia works through the interest rate and credit channels but not the exchange rate. However, Ganev *et al.* (2002) provide evidence in favour of the interest rate and exchange rate channels (although these results are probably due to the instability of the Latvian equations in their model).

## 4. Empirical evidence

### *4.1. Methodology and data*

In order to analyse the role of monetary policy in Acceding Countries and the relevance of the different monetary transmission channels, we will use different VAR models trying to capture the dynamics of the relationships between output, prices, interest rates, money and the exchange rate. As in Morsink and Bayoumi (2001), we have chosen this methodology, instead of the previously mentioned alternatives, because it allows us to place minimal restrictions on how monetary shocks affect the economy. In fact, it explicitly recognizes the simultaneity between monetary policy and macroeconomic developments (reaction function) as well as the dependence of economic variables on monetary policy. Moreover, as Garnev (2003) highlights "it is the most widely used tool in the literature for the analysis of monetary

transmission mechanisms" (p. 26), so, the obtained results can be easily compared with the ones obtained by other authors for different countries.

Regarding the data, it is important to take into account structural changes in Acceding Countries and the fact that the quality of the data at the beginning of the transition period for some countries is not comparable to that in Euro Area countries. For these reasons, the period considered for the analysis here starts in 1993 (or 1995) and the countries considered are the following: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic and Slovenia[4]. The calculations in this section use quarterly data or monthly data obtained from the OECD Main Economic Indicators, the IMF International Financial Statistics and the European Central Bank data set and different national sources. Annex 1 provides detailed information on the data set considered. All data have been previously deseasonalised and outliers corrected using Tramo/Seats.

### *4.2. Monetary transmission in the Euro Area and the United States*

#### *i) The basic specification*

In order to analyse the peculiarities of the monetary transmission in Acceding Countries, we first specify and estimate a benchmark VAR model to analyse the effects of a monetary policy shock in the Euro Area.

The specified VAR model for the Euro Area, which is in line with Peersman and Smets (2001), is the following:

$$\begin{bmatrix} y_t^{EA} \\ p_t^{EA} \\ m_t^{EA} \\ s_t^{EA} \\ x_t^{EA} \end{bmatrix} = A(L) \cdot \begin{bmatrix} y_{t-1}^{EA} \\ p_{t-1}^{EA} \\ m_{t-1}^{EA} \\ s_{t-1}^{EA} \\ x_{t-1}^{EA} \end{bmatrix} + B \cdot \begin{bmatrix} cp_t^{W} \\ y_t^{US} \\ s_t^{US} \end{bmatrix} + U_t^{EA} \qquad (1)$$

where, $y_t^{EA}$ denotes Euro Area real GDP, $p_t^{EA}$ consumer prices, $m_t^{EA}$ broad money, $s_t^{EA}$ the short term interest rate and $x_t^{EA}$ the real effective exchange rate. $cp_t^{W}$ is a world commodity price index, $y_t^{US}$ the US real GDP and $s_t^{US}$ the short term interest rate in the US[5],[6].

The inclusion of $cp_t^{W}$, $y_t^{US}$ and $s_t^{US}$ helps to solve the so-called "price puzzle"[7]. The effect of these exogenous variables on the Euro Area endogenous variables is assumed to be contemporaneous. By treating these variables as exogenous, it is implicitly assumed that there is no feedback from the Euro Area variables to the world and US variables.

The monetary policy shock is identified through a standard Cholesky decomposition with the variables ordered as in (1). The underlying assumption is that policy shocks have no contemporaneous impact on output, prices and money, but may have contemporaneous effect

[4] Malta and Cyprus are not included in the analysis due to data restrictions.

[5] As in Peersman and Smets (2001), monetary aggregates are included in the specification due to the prominence assigned to them by a number of central banks included in the study.

[6] When convenient, different dummy variables have been included in order to control for "known" structural breaks.

[7] The empirical finding in the literature that prices rise following an interest rate tightening (see, for example, Sims, 1992).

immediately. However, the interest rate does not respond contemporaneously to changes in the effective exchange rate[8]. We think this assumption is appropriate, since the Euro Area (as a whole) is a large and relatively closed economy (Peersman and Smets, 2001)[9].

The model has been estimated in levels[10] using quarterly data, which implicitly allows for cointegrating relationships among the variables under consideration (see Ramaswamy and Slok, 1998). In this sense, it is important to take into account that this specification is necessarily simple in order to be comparable with the one for the Acceding Countries. As stated before, available data for Acceding Countries for most macroeconomic series are available from the beginning of the nineties and, as a result, the considered time period is quite short, which impedes an explicit analysis of the long-run behaviour of the considered variables. The lag order of the VAR model is determined using the Schwarz criteria and, usually, it turns out to be of order one to three when using different samples.

As in other empirical works, we specify and estimate a similar model for the United States in order to analyse the differences between monetary transmission in the Euro Area, in the Acceding Countries and in other countries. In particular, the VAR model specification for the US, which is consistent with the specification by Christiano *et al.* (2000), is the following:

$$\begin{bmatrix} cp_t^W \\ y_t^{US} \\ p_t^{US} \\ m_t^{US} \\ s_t^{US} \\ x_t^{US} \end{bmatrix} = A(L) \cdot \begin{bmatrix} cp_{t-1}^W \\ y_{t-1}^{US} \\ p_{t-1}^{US} \\ m_{t-1}^{US} \\ s_{t-1}^{US} \\ x_{t-1}^{US} \end{bmatrix} + U_t^{US} \qquad (2)$$

where, $cp_t^W$ is a world commodity price index, $y_t^{US}$ denotes US real GDP, $p_t^{US}$ consumer prices, $m_t^{US}$ broad money, $s_t^{US}$ the short term interest rate and $x_t^{US}$ the real effective exchange rate.

The identification strategy is similar to the one explained before for the Euro Area[11] and the model has been estimated with variables in levels using quarterly data[12].

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[8] The economics behind this identification scheme have been widely treated in the literature on VARs and monetary policy. See, for example, Sims (1992).

[9] Apart from this recursive identification strategy, there are other alternative identification schemes to identify monetary policy shocks (see, for example, Ramaswamy and Slok, 1998). For example, we could allow for a contemporaneous interaction between the short-term interest rate and the exchange rate using a structural VAR model (as in Sims and Zha, 1998 or Peersman and Smets, 2001) or we could combine short and long restrictions as in Galí (1992) or Gerlach and Smets (1995). We have tested some of this alternative identification schemes and the results were quite similar to the ones shown here, although in some cases there were convergence problems when estimating the structural decomposition, probably due to the short number of available observations. These results are available from the authors on request.

[10] We have also estimated a VAR model including GDP year-on-year growth rate, the inflation rate, the monetary aggregate year-on-year growth rate, the interest rate and the real effective exchange rate year-on-year growth rate. The obtained results were quite similar to the ones obtained with the variables in levels and are available from the authors on request.

[11] Again, the US economy can be treated as a closed economy regarding the interactions between the exchange rate and interest rates. See, for example, Eichenbaum and Evans (1995).

[12] See footnote 9.

*ii) Extensions of the basic specification*

In this section, we specify three different VAR models that would provide empirical evidence on the influence of a monetary policy shock on other macroeconomic variables that have not been included in the basic model. In particular, we would consider the effects of a monetary policy shock on various components of GDP: private consumption, gross fixed capital formation and net trade of goods and services.

The impact of a monetary shock on GDP components is interesting from the point of view of policy analysis. The analysis of the reactions of consumption, investment and net exports across different countries provides relevant information to identify the most relevant transmission channels but, also, which agents are more affected by expansionary or contractionary monetary policies.

With this aim, three different alternatives have been considered:

- First, GDP is replaced in models (1) and (2) by the variable of interest (for example, consumption or investment) applying the same ordering as before in the Cholesky decomposition.
- Second, the variable of interest is subtracted from total GDP and it is placed second in models (1) and (2)[13]. As before, the Cholesky decomposition is applied using this ordering.
- Third, models (1) and (2) are augmented with the macro-economic variable of interest (for example, consumption or investment), being this the last one variable in the model[14]. With this ordering, when applying the Cholesky decomposition, we assume that the macroeconomic variable of interest does not affect the block of endogenous variables in each of the models.

As the three strategies yielded very similar results, we will present the results using the second strategy as it permits the interactions between the considered GDP component and the other ones. As before, the models are estimated in levels[15] and the lag length is determined using the Schwarz criteria.

*iii) Results*

The results of the impulse response functions of the VAR models for the Euro Area, using data from 1985:1 to 2003:2, are shown in figure 3 and figure 4[16]. In particular, the first part of these figures summarises the effects of a one-standard deviation monetary policy shock[17] on real GDP, consumer prices, the real effective exchange rate and the short-term interest rate.

[13] See Morsink and Eichengreen (2001).
[14] A similar approach can be found in Peersman and Smets (2001) and Mojon and Peersman (2001).
[15] See footnote 7.
[16] The stability of the results has been checked using different samples. The obtained impulse response functions were quite similar and are available from the authors on request.
[17] The standard deviation of monetary policy shocks has been usually used in order to simulate the effects of monetary policy as it represents the "average" monetary policy shock in the considered county for the given period. Of course, other alternative exists but this approach has become the "standard" in the VAR literature. One criticism pointed out by Bagliano and Favero (1998) is related with the fact that the standard deviation of monetary policy shocks depends on the specification used. However, as they recognise that the impulse-response functions estimated, using different definitions, are not substantially different from each other.

The second part shows the impact of the monetary policy shock for each of the components of the GDP (consumption, investment and net exports) that have been calculated using different augmented VAR models [18].

FIGURES 3 AND 4

The impulse response patterns in the two figures are broadly in line with standard results in the literature (Adao *et al.* 2003). In particular, an unexpected increase in the short-term interest rate, followed by a real appreciation of the exchange rate, temporarily reduces output, prices and money.

Comparing the results for the Euro Area and the US, the main difference is that a typical monetary policy shock is greater in the US than in the Euro Area, which is also reflected in a higher impact on prices (but not on output). Moreover, the impact on prices is much faster and the impact on the exchange rate is more persistent in the US.

Regarding the response of the GDP components, consumption and investment have similar responses to a monetary policy shock both in the US and in the Euro Area (as in Peersman and Smets, 2001). The response patterns of consumption and investment are quite similar to the response of real GDP. However, the magnitude of the effect on investment is considerably higher than the response of real GDP. In contrast, the response of consumption is weaker and slower. However, it is worth mentioning that the response of consumption in relation to the response of investment is higher in the US than in the Euro Area (as pointed out by Angeloni *et al.* 2003).

### *4.3. Monetary transmission in Acceding Countries*

#### *i) The VAR models*

In the extensive mid-nineties literature on measuring monetary policy shocks using VAR models, the exchange rate was typically omitted from the analysis. As Smets (1997) points out, "While the neglect of the exchange rate may be justified for a large relatively closed economy like the United States, the exchange rate plays a prominent role in more open economies. Indeed many countries find it useful to target the exchange rate. In such a regime, domestic monetary policy shocks will be mainly reflected in exchange rate innovations. More generally, monetary authorities in open economies may offset some of the contemporaneous exchange rate shocks they face because the shocks significantly affect the economy, again suggesting a role for a exchange rate in the measurement of the policy stance." (p. 1). The point here is that the inclusion of the exchange rate in a VAR model complicates the identification problem. As in the cases of the United States or the Euro Area, it seems reasonable to assume that the interest rate does not respond contemporaneously to changes in the effective exchange rate, because we are dealing with large and relatively closed economies[19]. However, this kind of assumption does not seem reasonable for the case of the Acceding Countries.

[18] The responses of the other variables in the models are not shown as they are quite similar to the ones shown in the first part of the figures, but are available from the authors on request.

[19] Morsink and Eichengreen (2001) apply a similar reasoning for the case of Japan.

In particular, we will specify two different VAR models: one for the Czech Republic, Hungary, Poland, the Slovak Republic and Slovenia where there is a certain degree of monetary independence and another one for Estonia, Latvia and Lithuania where the adopted exchange rate system severely limits the role of monetary policy.

The model for the first set of countries is the following:

$$\begin{bmatrix} y_t^A \\ p_t^A \\ x_t^A \\ m_t^A \\ s_t^A \end{bmatrix} = A(L) \cdot \begin{bmatrix} y_{t-1}^A \\ p_{t-1}^A \\ x_{t-1}^A \\ m_{t-1}^A \\ s_{t-1}^A \end{bmatrix} + B \cdot \begin{bmatrix} y_t^{EA} \\ p_t^{EA} \\ s_t^{EA} \end{bmatrix} + U_t^A \qquad (3)$$

where, $y_t^A$ denotes real GDP, $p_t^A$ consumer prices, $x_t^A$ the real effective exchange rate, $m_t^A$ the quantity of money and $s_t^A$ the short term interest rate for the considered accession country. As before, $y_t^{EA}$ the real GDP in the Euro Area, $p_t^{EA}$ the level of prices in the Euro Area, and $s_t^{EA}$ the short term interest rate in the Euro Area[20].

The model for the second set of countries is the following:

$$\begin{bmatrix} s_t^{EA} \\ y_t^A \\ p_t^A \\ m_t^A \\ s_t^A \end{bmatrix} = A(L) \cdot \begin{bmatrix} s_{t-1}^{EA} \\ y_{t-1}^A \\ p_{t-1}^A \\ m_{t-1}^A \\ s_{t-1}^A \end{bmatrix} + B \cdot \begin{bmatrix} x_t^A \\ y_t^{EA} \\ p_t^{EA} \end{bmatrix} + U_t^A \qquad (4)$$

where $s_t^{EA}$ denotes the short term interest rate in the Euro Area, $y_t^A$ real GDP, $p_t^A$ consumer prices, $m_t^A$ the quantity of money and $s_t^A$ the short term interest rate for the considered accession country. As before, $x_t^A$ the real effective exchange rate for the considered accession country, $y_t^{EA}$ the real GDP in the Euro Area and $p_t^{EA}$ the level of prices in the Euro Area.

For the Czech Republic, Hungary, Poland, the Slovak Republic and Slovenia, the monetary policy shock is identified through a standard Cholesky-decomposition with the variables ordered as in (3)[21]. This means that there is a contemporaneous impact of all the endogenous variables on the monetary policy variables. On the other hand, there is no immediate impact of a monetary policy shock on the other variables (see Mojon and Peersman, 2001).

For the Estonia, Latvia and Lithuania, the monetary policy shock is identified through a standard Cholesky-decomposition with the variables ordered as in (4). This approach is

[20] Instead of including $y_t^{EA}$, $p_t^{EA}$ and $s_t^{EA}$, we have also tested to include the corresponding variables for the United States $y_t^{US}$, $p_t^{US}$ and $s_t^{US}$. The results were quite similar to the ones shown here and are available from the authors on request.

[21] Garbuza (2003) applies a similar approach for the case of Poland.

similar to the one applied for Estonia in the structural model by Pikkani (2001) and Lättemäe and Pikkani (2001)[22].

In both cases, as before, and in order to consider the effects of a monetary policy shock on various components of GDP (private consumption, gross fixed capital formation and net trade of goods and services), models (3) and (4) are augmented with the macro-economic variable of interest following a similar strategy to the one applied for the Euro Area and the United States. The different VAR models for Acceding Countries are estimated in levels[23] using quarterly data from 1993:1 (or 1995:1) up to 2002:2 [24]. the lag length is determined using the Schwarz criteria (usually among one and three).

*ii) Results*

The results of the impulse response functions of the VAR models for the Acceding Countries are shown in figures 5 to 12. As in figures 3 and 4, the first part of the figures summarises the effects of a one-standard deviation monetary policy shock on real GDP, consumer prices, the real effective exchange rate and the short-term interest rate, while the second part shows the impact of the monetary policy shock for each of the components of the GDP (consumption, investment and net exports).

Following Morsink and Bayoumi (2001), and with the aim of getting an idea of the share of fluctuations in output and prices that are caused by different shocks, the table at the bottom of each figure shows the results of calculating variance decomposition at forecasts horizons of one to four years. The second column of each subtable gives the forecast error of the variable for each forecast horizon[25]. A higher relative influence of each kind of shock could be interpreted as evidence of a higher relevance of the associated transmission channel: the interest rate channel or the exchange rate channel.

In most cases, the observed impulse response functions are broadly in line with the results found for the Euro Area and the United States, in the sense that an unexpected increase in the short-term interest rate, followed by a real appreciation of the exchange rate, temporarily reduces output and prices[26].

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[22] The different specification for these countries is related with the discussion in the previous section about the different exchange rate systems. Of course, other differences between countries such as the financial (Carlino and DeFina, 1998a, 1998b and 1999) or the legal structure (Ceccheti, 1999) could play an important role in explaining differences in the transmission of monetary policy are not explicitly considered in this paper. However, it is worth mentioning that although the degree of financial development is surely relevant in the two steps of monetary transmission (from policy variables to market interest rates, loans, etc. and from financial conditions to real activity), some authors have stressed that it would be more relevant for the first step than for the second (see Cecchetti, 1999). Moreover, other authors such as Carlino and DeFina (1998a and 1999) have found evidence that the effects of the banking system are clearly interrelated with other variables such as the average size of firms or the predominance of more interest-rate sensitive sectors such as manufacturing or building. Further research would focus in these two aspects.

[23] We have also estimated a VAR model including all variables except interest rates as year-on-year growth rates. The obtained results were quite similar to the ones obtained with the variables in levels and are available from the authors on request.

[24] All the models have also been estimated using monthly data (see annex 2) where total GDP is replaced by industrial production. Otherwise indicated, the obtained results are similar to the ones shown here and are available from the authors on request.

[25] As indicated by Morsink and Bayoumi (2001), the source of the forecast error is the variation in the current and future values of the innovations to each variable in the VAR model.

[26] However, it is worth mentioning that confidence bands around the estimates of the responses to the monetary policy shock are very high, probably due to the short time period considered due to data availability. For this

In the Czech Republic (figure 5), the response of GDP and prices is very low and, in the case of prices, is only negative eight quarters after the initial shock. The reactions of consumption and investment are very similar to the one observed for overall GDP. Regarding the results of the variance decomposition of output and prices, we have obtained that the relative contribution of interest rates in explaining the variance of output and prices is very high (more than 50% after two years of the initial shock) while the relative contribution of the exchange rate is also relevant for the case of prices (around the 20%). These results can be interpreted as evidence of the relevance of both transmission channels in this country.

FIGURE 5

In Hungary (figure 6), the reaction of, both, real GDP and prices is faster than in the Euro Area (only three or four quarters after the shock). However, the effects are not as persistent as in the Czech Republic. In contrast with the results of previous authors, the variance decomposition of output and prices shows that the most relevant transmission channel is the interest rate, with a relative contribution around the 30% after two years of the initial shock for, both, output and prices.

FIGURE 6

For Poland, two sets of results are shown: the ones obtained using quarterly data (figure 7) and the ones obtained using monthly data (figure 7b). The reason to present both sets of results is that in the first model there was too much uncertainty, an uncertainty that was reduced when increasing the number of available observations using monthly data. Looking at these results, it seems clear that the observed patterns for the impulse response functions are quite close to the ones observed for the Euro Area, with the only exception that the response of real GDP is much faster than in the Euro Area. The results of the variance decomposition highlight the relevance of the interest rate channel (directly and through money) in the transmission of monetary policy while the exchange rate channel does not seem to be very important. This fact could be related with the strategy of the Poland central bank before adopting an inflation targeting regime.

FIGURES 7 AND 7B

The results for the Slovak Republic (figure 8) are different from the ones previously mentioned: the reaction of real GDP is of sign opposite to the one expected after a contractionary monetary policy shock. The cause of that movement is related with the impact of the shock on the exchange rate and the effects on consumption and investment, which surprisingly increase after the shock. The results are better behaved when the model is estimated using monthly data (figure 8b), but the "exchange rate puzzle" is still present. A possible explanation of these results can be related with the high level of foreign direct investment during this period in the considered country, a kind of investment which is not

reason, and as it will highlighted in the last section, the results should be taken with some cautious as, in some cases, differences across countries are likely to be not significant.

only related with domestic monetary conditions but also with global economic developments. Regarding the transmission channels, as in Kuijs (2002) or Ganev *et al*. (2002), the results from the model suggest that the most relevant transmission channel is the exchange rate channel, while the impact of broad money changes and interest rates changes seems to be modest.

FIGURE 8 AND 8B

The results for Slovenia (figure 9) are quite similar to the ones for the Slovak Republic: the responses of GDP and the exchange rate to a monetary shock are opposite to the expected ones. As previously mentioned, and according to Caprirolo and Lavrac (2003), the main characteristic of monetary policy in Slovenia has been the preference of the monetary authorities to use non-market arrangements for pricing monetary policy instruments, including capital controls, in order to minimize costs of implementing monetary policies. This has resulted in a policy framework that is vulnerable to exchange rate shocks, as the interest rate channel of monetary policy remains blocked. The results of the variance decomposition confirm this fact: the relative contribution of interest rates to output and prices is below 1% while the role of the exchange rate is clearly relevant (more than 25% in both cases after two years).

FIGURE 9

In Estonia (figure 10), the reaction of GDP and prices to a monetary shock is very fast, although the magnitude of these effects is small and they are short-lived. This result is in line with the ones by Pikkani (2001) and Lättemäe and Pikkani (2001). There is no clear evidence of the presence of a well-defined interest rate or exchange rate channel.

FIGURE 10

The results for Latvia (figure 11) show a clear response of prices to a monetary shock but monetary policy does not seem to have clear effects on output. In fact, the reaction of the domestic interest rate in the opposite direction of the Euro Area monetary policy shock would explain the positive reaction of consumption and investment and, as a result, of real GDP. The results of the variance decomposition provide evidence that support for the view that monetary transmission in Latvia works through interest rate and credit channels (but not the exchange rate).

FIGURE 11

As in Vetlov (2001), the results for Lithuania (figure 12) show clear effects of monetary policy on output, but not so clear on prices. In fact, the response of prices is the opposite of expected, but probably not significantly different from zero. Regarding GDP components, and similar to findings in the Euro Area, investment is much more sensitive than consumption to

the interest rate shock. Regarding the transmission channels, the "direct" interest rate channel seems to have been effective during the considered period.

FIGURE 12

Summarising, the obtained evidence permits to conclude that monetary policy has been effective to fight inflation or to stabilize output in nearly all the considered Acceding Countries due to the relevance of the interest rate channel and, in some cases, combined with the exchange rate channel. The only exceptions are the Slovak Republic and Slovenia (see figures 13 and 14).

FIGURES 13 AND 14

*iii) Extension of the basic results: the interactions between monetary and fiscal policy*

As highlighted in the EFN 2003 spring report, the interaction between fiscal and monetary policies is clearly relevant for the Acceding Countries[27]. In fact, during the past, decisions to loosen fiscal policy have been accompanied by tightenings in monetary policy to fight inflation. In some countries, most notably in Poland but also in Hungary, this mix of monetary and fiscal policies led to a large inflow of foreign speculative portfolio that reduced the availability of domestic credit and investment. Moreover, as Ganev *et al* (2002) highlight, "during transition, the institutions which are important for the effectiveness of monetary policy are underdeveloped by definition, while processes hampering monetary transmission (budget deficits, bad loans) may be very strong or even dominant at times. This environment may even force the monetary authority itself into inconsistent actions, decreasing their effectiveness even further."

In order to analyse the role of the interactions between monetary and fiscal policy in monetary transmission[28], we have re-estimated model (3) for Hungary and Poland, introducing as an exogenous variable their fiscal deficit. In this sense, the procedure is similar to the one applied by Morskink and Bayoumi (2001) to analyse the role of broad money on private demand in the Japanese economy. Including fiscal deficit as an exogenous variable, generates a VAR identical to the original, except that it blocks off any responses within the VAR which pass through the deficit, hence comparisons of the responses of the two models provide a measure of the importance of interactions between fiscal and monetary policy[29]. The impulse response functions of prices to a monetary shock in these countries using this alternative VAR model are shown in figures 15 and 16, respectively.

FIGURES 15 AND 16

[27] This aspect has also been highlighted by Kutan and Brada (2000).

[28] One disadvantage of this empirical approach is that it does not provide any intuition on the economics behind this interaction. Further research will devote more attention to this issue.

[29] The effects of conditioning for fiscal deficit have also been considered for the rest of analyzed countries (when possible taken into account data restrictions) The results were quite similar to the ones shown in the previous sub-section.

From these figures, it seems clear that the interactions between fiscal and monetary policy have negatively affected the efficiency of the second to fight inflation. In this sense, it is worth reminding that the independence of the central bank is necessary for an effective conduct of monetary policy, and not only because it is a legal pre-requisite to accede the Monetary Union, but also for economic reasons.

## 5. Concluding remarks

The objective of this paper was to compare the mechanisms of monetary transmission in Acceding Countries with the ones existing in the Euro Area. The obtained evidence, using VAR models, permits to conclude that monetary policy has been effective to fight against inflation or to stabilize output in nearly all the considered Acceding Countries due to the relevance of the interest rate channel and, in some cases, combined with the exchange rate channel. The only exceptions are the Slovak Republic and Slovenia.

Another issue that has been addressed in the paper is the role of the interactions between fiscal and monetary policies in Hungary and Poland. The obtained results, using VAR models and conditioning for fiscal deficits, have shown that fiscal policy has negatively affected the efficiency of the monetary policy to control inflation. In this sense, it is worth reminding that independence of the central bank is necessary for an effective conduct of monetary policy, and not only because it is a legal pre-requisite to accede the Monetary Union, but also for economic reasons.

However, there are some issues that should be taken into account when interpreting the previous results. First, and due in part to the short time period considered due to data availability, confidence bands around the estimates of the responses to the monetary policy shock are very high (probably, in some cases, differences across countries are likely to be not significant). Moreover, one of the problems with cross-country comparisons is that the size of the estimated monetary policy shocks differs across countries. Even if we imposed the same initial disturbance, the problem would not be solved, as we would have to assume that the estimated parameters of the model are invariant to the specification of the policy rule and then the Lucas critique would apply (see, Mojon and Peersman, 2001).

In any case, it seems that monetary policy can play an important role as a stabilization tool for these countries, a tool that would be lost as soon as they join the Euro Area. For this reason, more attention should be focused on the analysis of transmission channels of the monetary union using micro data on banks and firms.

To our knowledge, the only study that has analysed this issue in this context is the one by Brada *et al.* (2003). They investigate empirically the role of bank lending in monetary transmission mechanism in the Czech Republic using bank level data for 1994-2001. Their results show that changes in monetary policy indicators have counter intuitive results. In fact, in terms of the bank lending hypothesis, monetary policy does not appear to have a significant effect on the supply of bank loans. According to them, these findings suggest that Czech policymakers cannot influence aggregate demand through shifts in loan supply and, as a result, it seems that the bank-lending channel has a limited role in designing monetary policy strategies. This result, which is in line with the previous studies using macro data (including this one), clearly provides additional information to have a better knowledge of how monetary policy works. This kind of research should be extended to the rest of Acceding Countries in a near future and the experience for current Euro Area members in the context of the

Eurosystem Monetary Transmission Network should provide an excellent guideline (see Angeloni *et al.*, 2003b, or Chatelain *et al.*, 2003 and Ehrmann *et al.*, 2003 for case studies)[30].

## 6. References


Adao, B., Alves, N. and Correia, I. (2003), 'The conduct of monetary policy: A critical review', *Banco de Portugal Economic Bulletin*, Mach, 1-12.

Angeloni, I., Kashyap, A., Mojon, B. and Terlizzese, D. (2002), 'Monetary transmission in the Euro Area: Where do we stand?' *ECB Working Paper*, 114.

Angeloni, I., Kashyap, A., Mojon, B. and Terlizzese, D. (2003a), 'The output composition puzzle: a difference in the monetary transmission mechanism in the Euro Area and U.S.' *ECB Working Paper*, 268.

Angeloni, I., Kashyap, A., Mojon, B. and Terlizzese, D. (2003b), 'Monetary transmission in the Euro Area: Does the interest rate channel explain all?', *NBER Working Paper 9984*.

Babich, V. (2001), 'Monetary Transmission in Latvia', *Baltic Economic Trends*, 2, 16-27.

Bagliano, F. C. and Favero, C. A. (1998), 'Measuring Monetary Policy with VAR Models: An Evaluation', *European Economic Review*, 42, 1069-1112.

Bems, R. (2001), 'The Monetary Transmission Mechanisms in the Baltic States: Introduction', *Baltic Economic Trends*, 2, 3-6.

Bernanke, B. and M. Gertler (1995), 'Inside the black box: The credit channel of monetary policy transmission', *Journal of Economic Perspectives*, 9, 27-48.

Brada, J., Denizer, C., Kutan, A. M. and Yigit, T. M. (2003), *Is there a bank lending channel in transition economies? Evidence from Czech banks' balance sheets*', mimeo.

Caprirolo, G. and Lavrac, V. (2003), 'Monetary and exchange rate policy in Slovenia', *Ezoneplus working paper* No. 17G: Regional Input on Monetary and Fiscal Policies. Supplement to Working paper No. 17 (available at www.ezoneplus.org).

Carlino, G. and DeFina, R. (1998a), 'The Differential Regional Effects of Monetary Policy', *Review of Economics and Statistics*, 80, 4, 572-587.

Carlino, G. and DeFina, R. (1998b), 'Monetary Policy and the U.S. States and Regions: Some Implications for European Monetary Union', *Federal Reserve Bank of Philadelphia Working Paper* 98-17.


[30] In 1999, the ECB launched, together with the National Central Banks of the countries of the euro area, a major research initiative to study the transmission of monetary policy. 23 papers were produced: six of them were related with macroeconomic studies of both the entire euro area economy and the constituent countries; seven of them studied firm-level investment behaviour; and, the other ten analysed bank-level balance-sheets and income statements. For more details, see Angeloni *et al.* (2003b).

Carlino, G. and DeFina, R. (1999), 'The Differential Regional Effects of Monetary Policy: Evidence from the U.S. States', *Journal of Regional Science*, 39, 2, 339-358.

Cecchetti, S. (1999), 'Legal Structure, Financial Structure, and the Monetary Policy Transmission Mechanism', *NBER Working Paper 7151* (available at papers.nber.org).

Chatelain, J. B., Generale, A., Hernando, I., von Kalckreuth, U. and Vermeulen, P. (2003), 'New findings on firm investment and monetary transmission in the Euro Area', *Oxford Review of Economic Policy*, 19, 1, 73-83.

Christiano, L., Eichenbaum, M. and Evans, C. (2000), 'Monetary policy shocks: What have we learned and to what end?', in Taylor, J. and Woodford, M. (eds), *Handbook of Macroeconomics*, North-Holland, Amsterdam.

Christoffersen, P. F., Sloek, T. and Wescott (2001), 'Is inflation targeting feasible in Poland?' *Economics of Transition*, 9.

Coricelli, F. Jazbec and Masten I. (2003), 'Exchange Rate Pass-Through in Candidate Countries', *CEPR Discussion Paper*, 3894.

Dabusinkas, A. (2003), 'Exchange rate pass-through to Estonian Prices', *Eesti Pank Working Paper* 10.

Dean, J. W. (2003), *Exchange rate regimes in Central and Eastern European Transition Economies*, mimeo.

Delakorda, A. (1999), 'The Money-Income Relation and the Monetary Transmission Mechanism. The case of Slovenia', *Eastern European Economics*, 37, 4, 22-49.

Ehrmann, M., Gambacorta, L, Martinez-Pagés, J., Sevestre, P. and Worms, A. (2003), 'The effects of monetary policy in the Euro Area', *Oxford Review of Economic Policy*, 19, 1, 58-72.

Festi, M. (2001), 'Monetary Policy Instruments in Slovenia', *Eastern European Economics*, 39, 5, 64-86.

Fidrmuc, J. and Korhone, L. (2003), 'The euro goes East. Implications of the 2000-2002 economic slowdown for synchronisation of business cycles between the euro and CEECs', *BOFIT Discussion Papers*, 6.

Frömmel, M and F. Schobert (2003), 'Nominal Anchors in EU Acceding Countries – Recent Experiences', *Universität Hannover Discussion Paper* 267.

Galí, J. (1992), 'How well does the IS-LM model fit postwar US data', Quarterly Journal of Economics, 107, 709-738.

Ganev, G. Molnar, K., Rybinski, K. and Wozniak, P. (2002), 'Transmission of Monetary Policy in Central and Eastern Europe', *CASE reports*, 52.

Garbuza, Y. (2003), *The transmission mechanism of Monetary Policy: Investigating the exchange rate channel for Central and Eastern European Countries (case of Poland)*, mimeo.

Garvaravicius, T. and Kuodis, R. (2002), 'The structure and the functioning of the financial sector in Lithuania', *Monetary studies*, Bank of Lithuania, 1, 18-47 (in Lithuanian).

Gerlach, S. and F. Smets (1995), 'The Monetary transmission mechanism: Evidence from the G-7 countries', *CEPR Discussion Paper*,1219.

Golinelli, R. and Rovelli, R. (2002), 'Monetary policy transmission, interest rate rules and inflation targeting in three transition countries', *Ezoneplus Working Paper*, 10.

Goodhart, M. (2003), *EMU and the monetary transmission mechanism*, EMU study, HM treasury.

Hughes-Hallet, A. and Piscitelli, L. (1999), 'EMU in reality: The Effect of a Common Monetary Policy on Economies with Different Transmission Mechanisms', *Empirica*, 26, 4, 337-358.

Kamin, S., Turner, P. and Van't Dack, J. (1998), 'The Transmission Mechanism of Monetary Policy in Emerging Market Economies: An Overview', *BIS Working paper*, pp. 5-64.

Kieler, M. and T. Saarenhimo (1998): 'Differences in monetary policy transmission? A case not closed', *Economic Papers*, 132.

Korhonen, L. (2002), 'Selected aspects of monetary integration', *Focus on Transition*, I, 101-107.

Kuijs, L. (2002), 'Monetary Policy Transmission Mechanisms and Inflation in the Slovak Republic', *IMF Working Paper*, WP/02/80.

Kutan, A. M. and Brada, J. C. (2000), 'The Evolution of Monetary Policy in Transition Economies', *Federal Reserve Bank of St. Louis*, March/April, 31-40.

Lättemäe, R. (2001), 'Monetary Transmission Mechanism in Estonia – Some Theoretical Considerations and Stylized Aspects', *Working Papers of Eesti Pank*, No 4.

Lättemäe, R. (2003), 'Monetary Transmission Mechanism in Estonia', *Kroon & Economy*, 1, 58-67.

Lättemäe, R. (2003), 'EMU accession issues in Baltic countries', *Ezoneplus Working Paper*, 17A.

Lättemäe, R. and Pikkani. R. (2001), 'The Monetary Transmission Mechanism in Estonia', *Baltic Economic Trends*, 2, 7-15.

Lavrac, V. (ed.), 'Final Report: Monetary and Fiscal Policy', *Ezoneplus Working Paper* 17 (available at www.ezoneplus.org)

Mayes, D. and Virén, M. (1998), 'The Exchange rate and Monetary Conditions in the Euro Area', *Bank of Finland Discussion Paper* 27/98.

Meltzer, A. (1995): 'Monetary, credit and (other) transmission processes: A monetarist perspective', *Journal of Economic Perspectives*, 9, 49-72.

Menon, J. (1995): 'Exchange rate passthrough', *Journal of Economic Surveys*, 9, 197-231.

Mishkin, F. S. (2000), 'Inflation targeting in emerging market countries', *American Economic Review*, 90, 105-109.

Mojon, B. and Peersman, G. (2001), 'A VAR description of the effects of monetary policy in the individual countries of the Euro Area', *ECB Working Paper*, 92.

Morsink, J. and Bayoumi, T. (2001), 'A Peek Inside the Black Box: The Monetary Transmission in Japan", *IMF Staff Papers*, 48, 22-57.

Orlowski, L. T. (2000), 'Monetary policy regimes and real exchange rates in Central Europe's transition economies', *Economics Systems*, 24, 145-166.

Pikkani, R, (2001), 'Monetary Transmission Mechanism in Estonia – Empirical Model', *Working Paper of Eesti Pank*, No. 5, Bank of Estonia

Peersman, G. and Smets, F. (2001), 'The monetary transmission mechanism in the Euro Area: More evidence from VAR analysis', *ECB Working Paper*, 91.

Ramaswamy, R. and Slok, T. (1998), 'The real effects of monetary policy in the European Union: What are the differences?', *IMF Staff Papers*, 45, 374-396.

Rusek, A. (2001), 'The role and impact of monetary policy in CEFTA countries', *International Advances in Economic Research*, 7, 1, 83-90.

Schmidt, R. (1999), 'Differences Between Financial Systems in European Countries: Consequences for EMU', *Working Paper Series: Finance and Accounting, Fachbereich Wirtschaftswissenschaften Johann Wolfgang Goethe-Universität*, 35.

Siklos, P. L. and Abel. I. (2001), *Is Hungary ready for Inflation Targeting?*, available at (http://papers.ssrn.com/sol3/papers.cfm?abstract_id=285712)

Sims, C. (1992), 'Interpreting the time series facts: The effects of monetary policy', *European Economic Review*, 36, 5, 975-1011.

Sims, C. and Zha, T. (1998), 'Does monetary policy generate recessions?', *Federal Reserve Bank of Atlanta Working Paper*, 98-12.

Smets. F. (1997), 'Measuring monetary policy shocks in France, Germany and Italy: The Role of the Exchange Rate', *BIS Working papers*, 42.

Suardi, M. (2001), 'EMU and asymmetries in monetary policy transmission', *Economic Papers*, 157.

Süppel, R. (2003), 'Comparing economic dynamics in the EU and CEE Acceding countries', *ECB Working Paper* No. 267.

Taylor, J. (1995), 'The monetary transmission mechanism: An empirical framework', *Journal of Economic Perspectives*, 9, 11-26.

Vetlov, I. (2001), 'Aspects of Monetary Policy and the Monetary transmission mechanism in Lithuania', *Baltic Economic Trends*, 2, 28-36.

Vetlov, I. (2003), *Monetary transmission mechanism in Lithuania*, Bank of Lithuania, mimeo.

**7. Tables and figures**

*Figure 1. Monetary policy transmission channels*

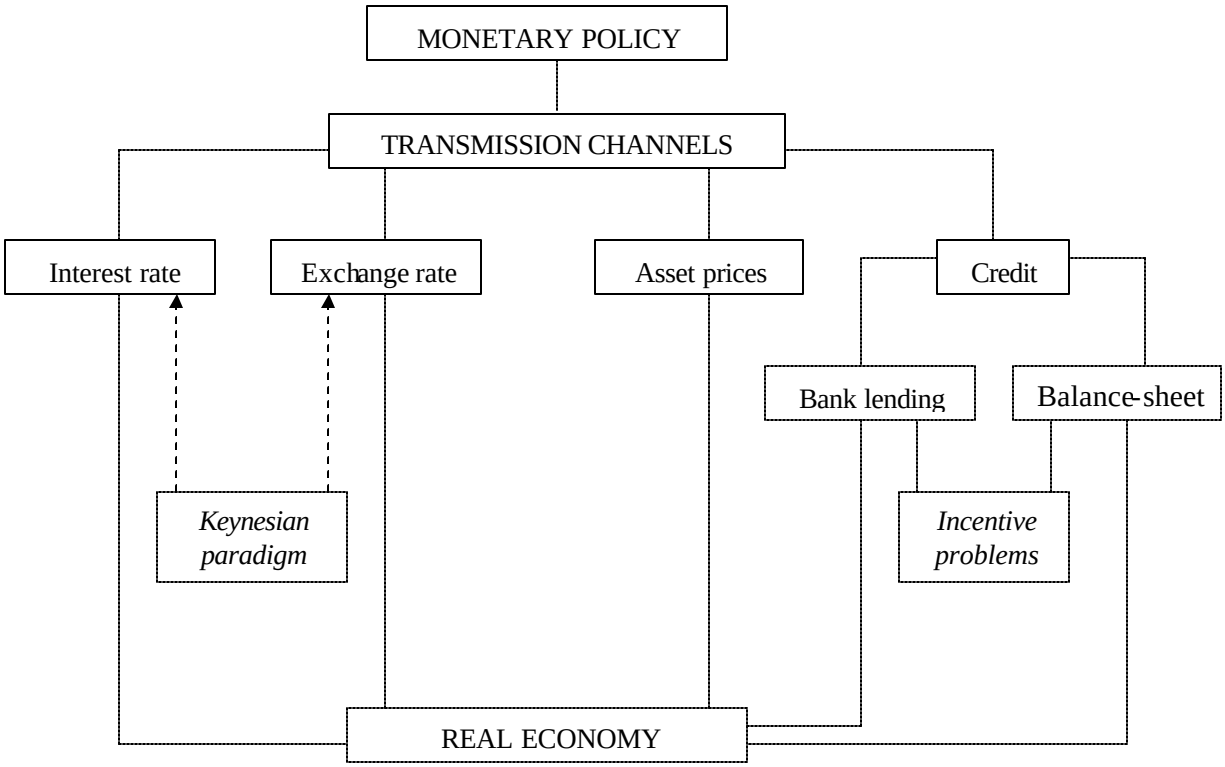


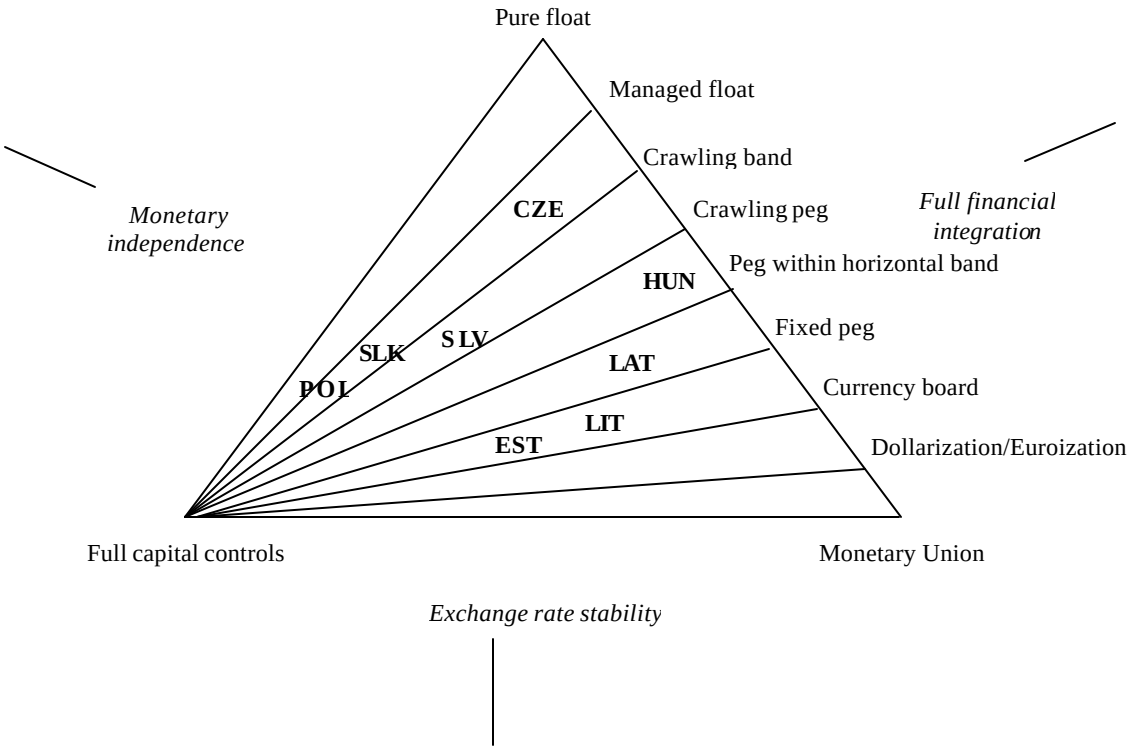
*Table 1. Official exchange rate regimes since 1994*

| Czech Republic | | Estonia | | Hungary | | Latvia | |
|---|---|---|---|---|---|---|---|
| 1994-1996 | Basket Peg<br>65% DEM, 35% USD<br>Band +- 0.5% | 1992 - | Currency board<br>Ecu/Euro | 1994-1996 | Crawling peg<br>70% ECU, 30% USD<br>Band +-2.25% | 1994- | Fixed Peg<br>SDR*<br>Band +-1% |
| 1996-1997 | Basket Peg<br>65% DEM, 35% USD<br>Band +- 7.5% | | | 1997-1999 | Crawling peg<br>70% DEM, 30% USD<br>Band +-2.25% | | |
| 1997-2001 | Managed floating | | | 2000-2001 | Crawling peg<br>100% Euro<br>Band +-15% | | |
| 2001-2002 | Free floating | | | 2001- | Fixed Peg<br>Euro<br>Band +-15% | | |
| 2002- | Managed floating | | | | | | |

| Lithuania | | Poland | | Slovak Republic | | Slovenia | |
|---|---|---|---|---|---|---|---|
| 1994-2002 | Currency board<br>USD | 1994-1995 | Crawling peg<br>45% USD, 35% DEM,<br>10% GBP, % FF, 5% SF<br>Band +-1% | 1994-1996 | Basket peg<br>60% DEM, 40% USD<br>Band +-1,5% | 1994- | Managed Floating |
| 2002- | Currency board<br>Euro | 1995-1998 | Crawling peg<br>45% USD, 35% DEM,<br>10% GBP, % FF, 5% SF<br>Band +-7% | 1997-1998 | Basket peg<br>60% DEM, 40% USD<br>Band +-7% | | |
| | | 1998-1999 | Crawling peg<br>45% USD, 35% DEM,<br>10% GBP, % FF, 5% SF<br>Band +-10% | 1998- | Managed floating | | |
| | | 1999-2000 | Crawling peg<br>45% USD, 55% EUR<br>Band +-7% | | | | |
| | | 2000- | Free floating | | | | |

Source: Frömmel and Schobert (2003) and IMF, Annual report on Exchange Rate Arrangements and Exchange Restrictions, various issues.
* SDR is a basket of currencies, including the USD, the Euro, the Yen and the Pound Sterling.

*Figure 2. The exchange rate system, capital controls and monetary policy independence*




Adapted from Dean (2003)

*Figure 3. Impulse-response functions for the Euro area (1985:1-2003:2)*

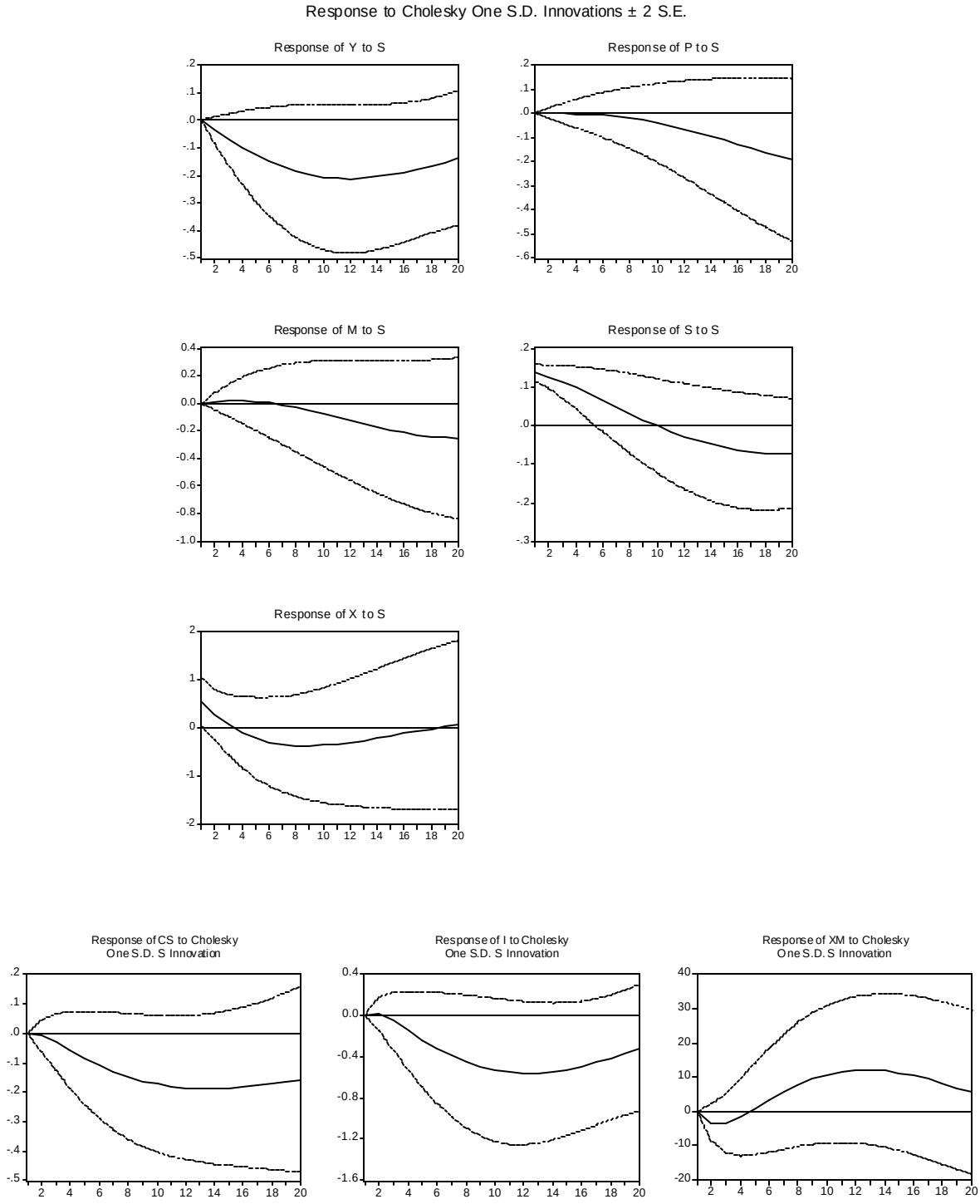


*Figure 4. Impulse-response functions for the United States (1985:1-2003:2)*

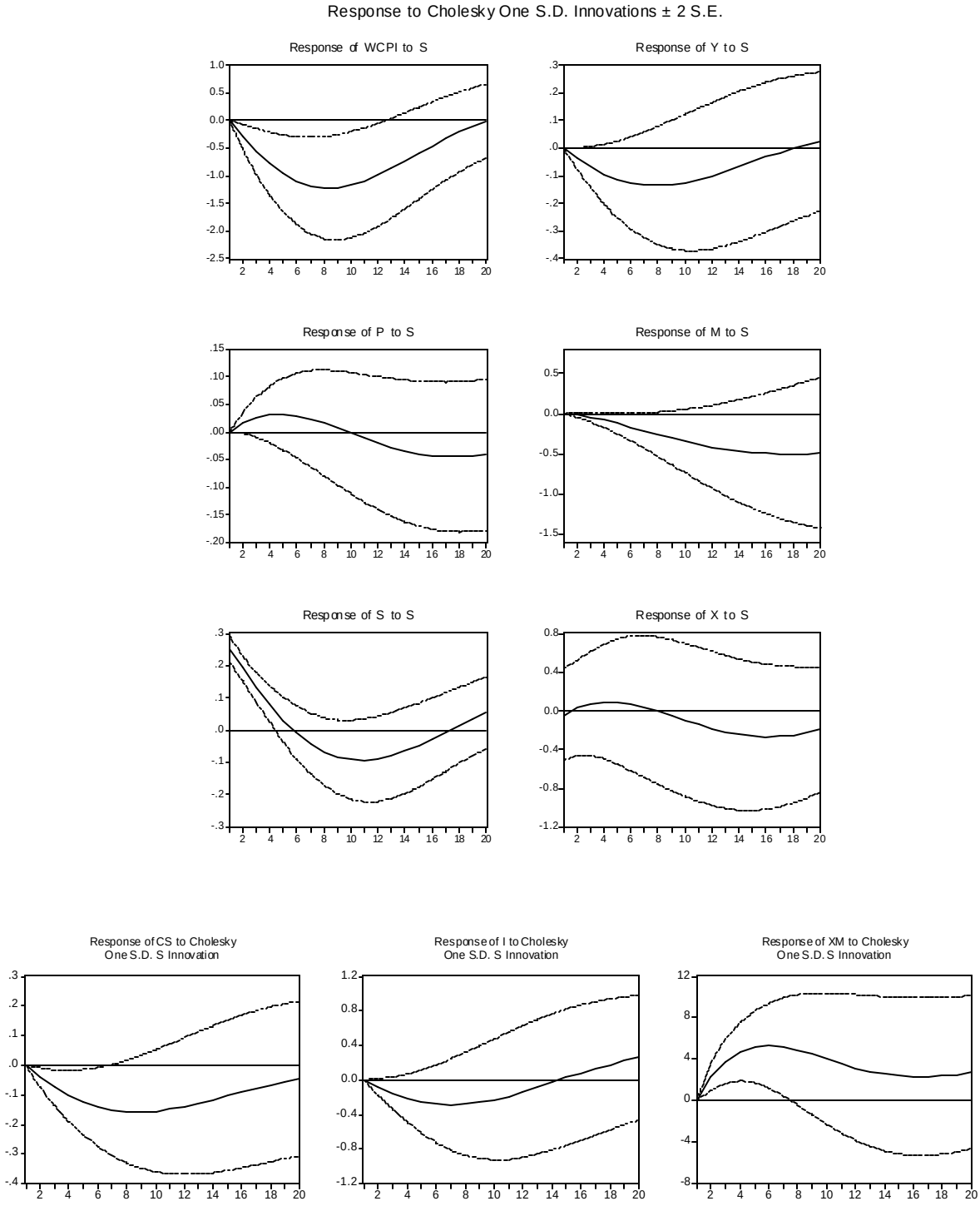
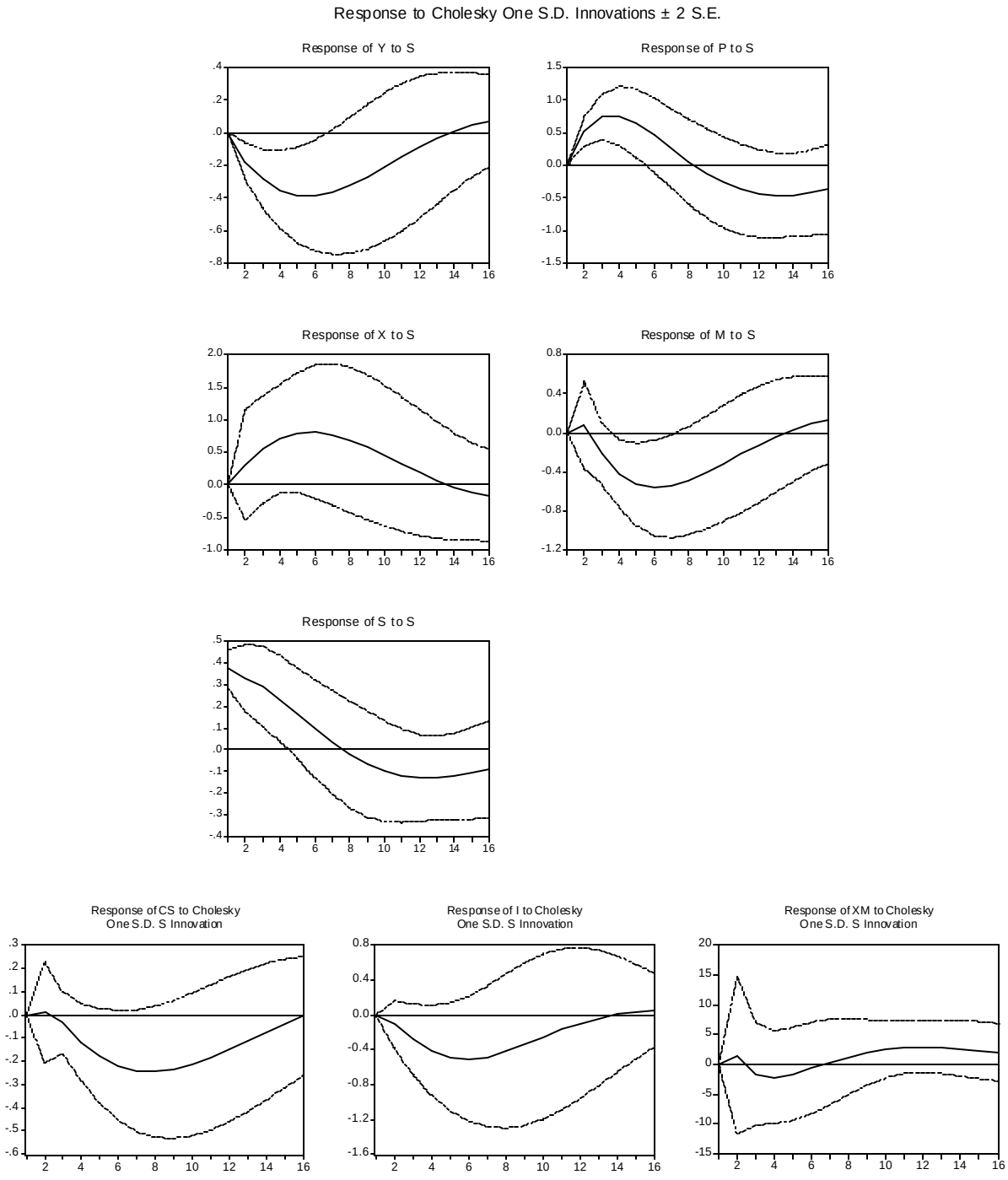
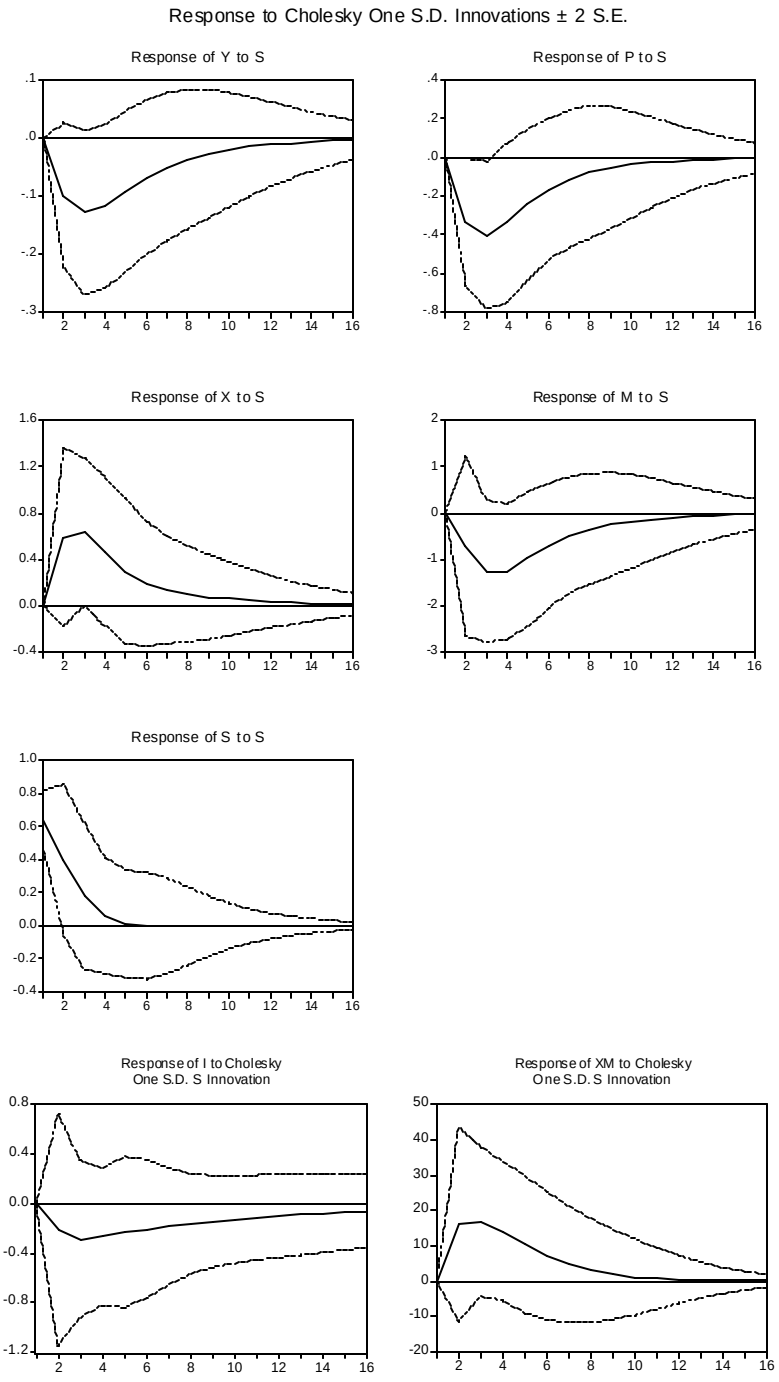


*Figure 5. Impulse-response functions for the Czech Republic (1994:1-2003:2)*




| CZECH REPUBLIC | | error | Y | P | X | M | S |
|---|---|---|---|---|---|---|---|
| *Y* | 4 | 0.85 | 59.69 | 0.08 | 5.95 | 1.13 | 33.15 |
| | 8 | 1.22 | 41.09 | 0.06 | 4.01 | 2.80 | 52.03 |
| | 12 | 1.29 | 37.23 | 0.06 | 3.85 | 3.34 | 55.51 |
| | 16 | 1.31 | 37.76 | 0.06 | 4.31 | 3.29 | 54.57 |
| *P* | 4 | 1.59 | 3.02 | 22.77 | 13.84 | 5.65 | 54.72 |
| | 8 | 1.99 | 7.71 | 15.17 | 18.95 | 6.03 | 52.15 |
| | 12 | 2.28 | 17.93 | 11.57 | 18.05 | 4.86 | 47.59 |
| | 16 | 2.50 | 18.70 | 9.63 | 15.40 | 4.80 | 51.46 |

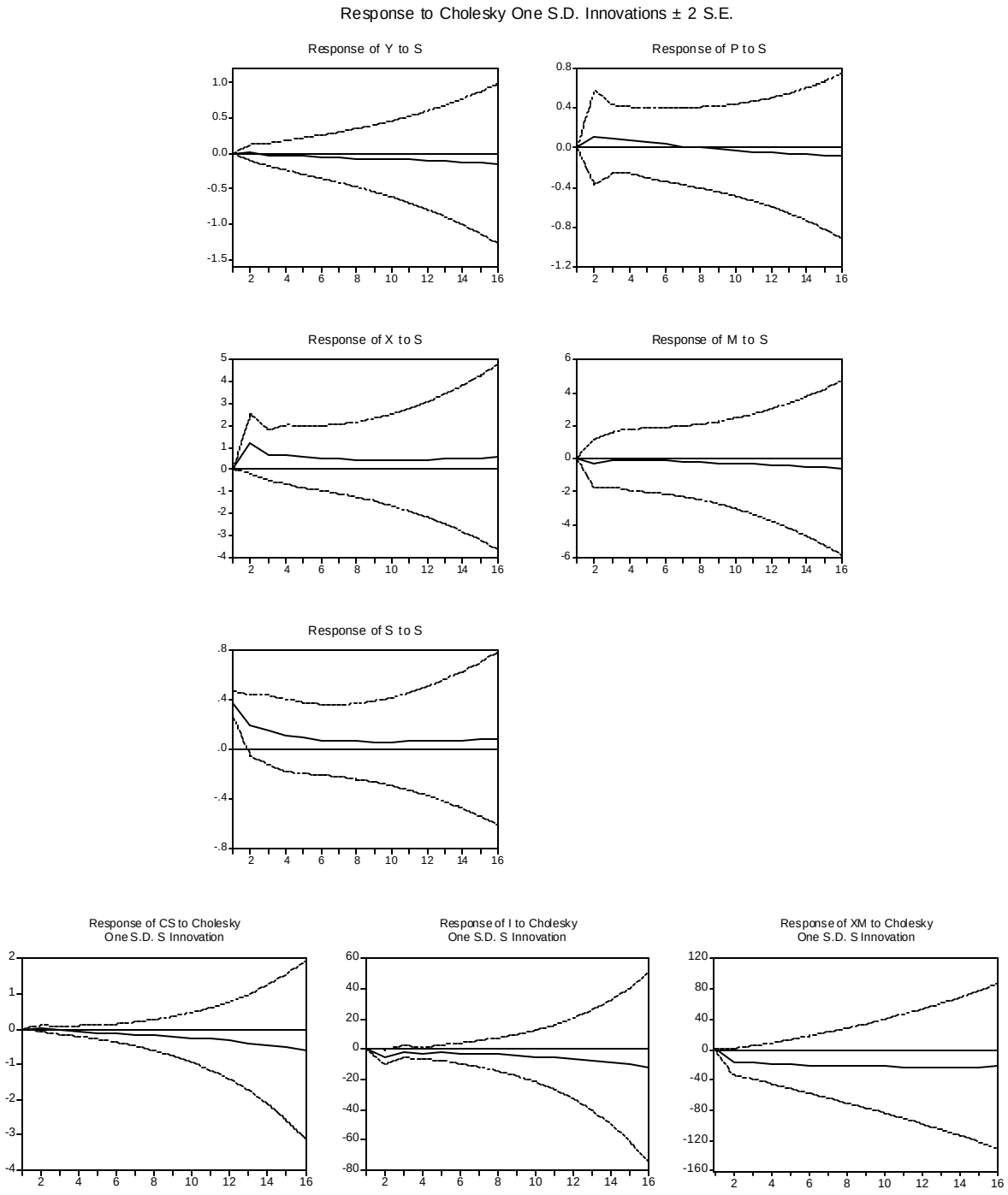
*Figure 6. Impulse-response functions for Hungary (1985:4-2003:2)*[31]




| HUNGARY | | error | Y | P | X | M | S |
|---|---|---|---|---|---|---|---|
| *Y* | 4 | 0.38 | 65.09 | 2.57 | 3.03 | 1.61 | 27.71 |
| | 8 | 0.42 | 55.93 | 3.99 | 3.52 | 4.54 | 32.02 |
| | 12 | 0.43 | 55.15 | 4.09 | 3.60 | 4.81 | 32.34 |
| | 16 | 0.43 | 55.08 | 4.10 | 3.61 | 4.84 | 32.37 |
| *P* | 4 | 1.07 | 0.10 | 50.25 | 9.34 | 6.24 | 34.07 |
| | 8 | 1.17 | 0.10 | 45.00 | 9.34 | 9.49 | 36.06 |
| | 12 | 1.18 | 0.12 | 44.72 | 9.36 | 9.63 | 36.17 |
| | 16 | 1.18 | 0.12 | 44.70 | 9.36 | 9.64 | 36.17 |

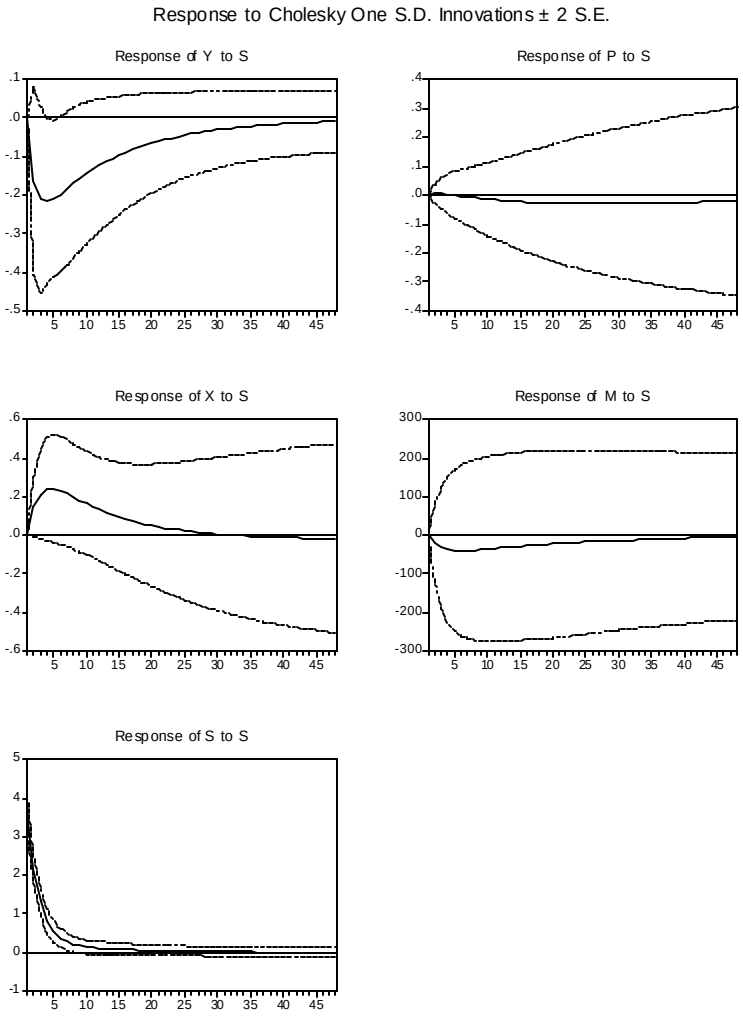
[31] The results for consumption are not shown because the time series for this variable starts in 2000:1.

*Figure 7. Impulse-response functions for Poland (1996:4-2003:2)*



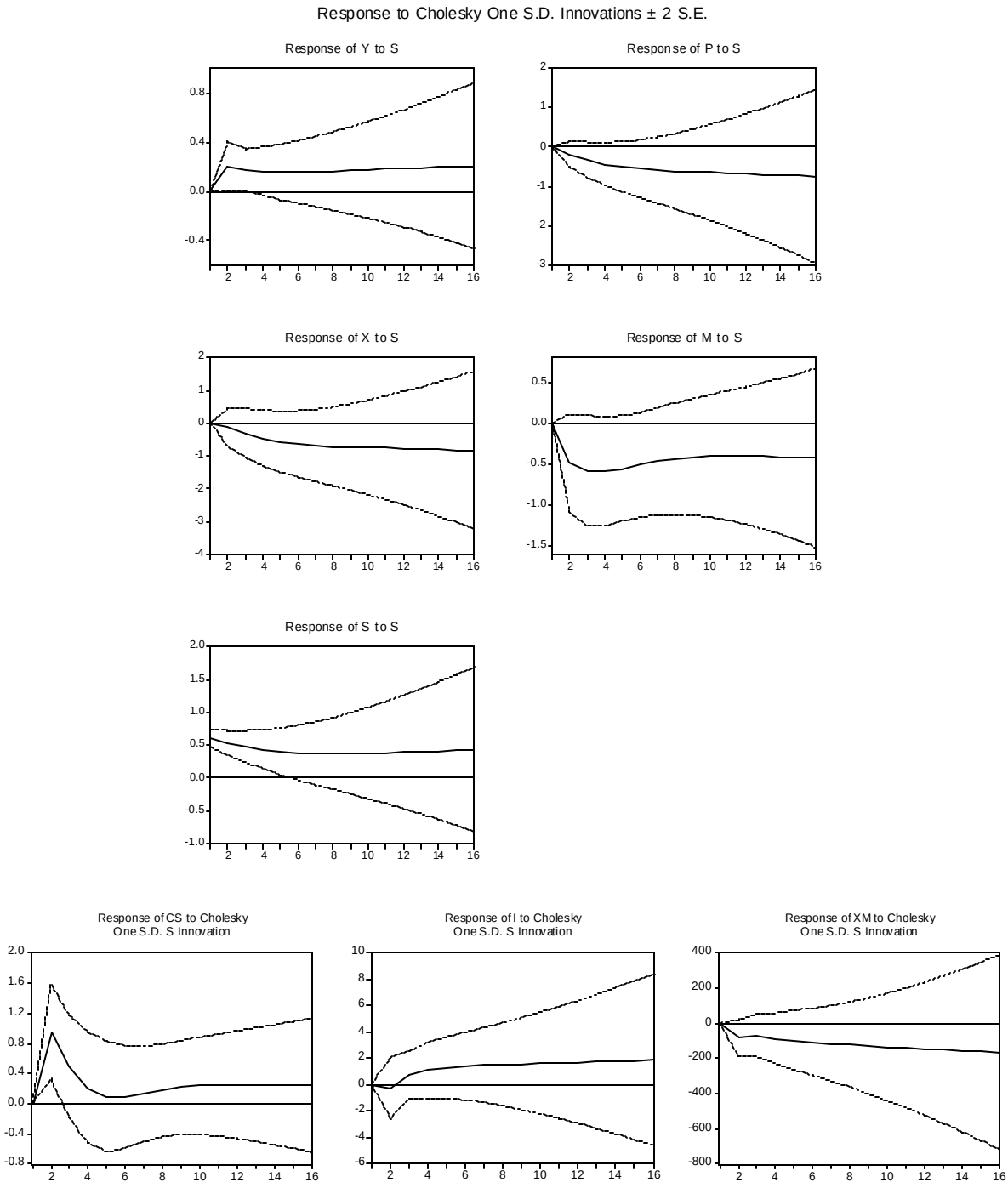

| POLAND | | error | Y | P | X | M | S |
|---|---|---|---|---|---|---|---|
| *Y* | 4 | 0.46 | 75.83 | 7.73 | 5.46 | 10.35 | 0.63 |
| | 8 | 0.79 | 62.28 | 12.51 | 8.35 | 14.68 | 2.18 |
| | 12 | 1.19 | 57.19 | 14.05 | 9.90 | 15.73 | 3.13 |
| | 16 | 1.73 | 55.02 | 14.64 | 10.70 | 16.01 | 3.64 |
| *P* | 4 | 1.10 | 18.27 | 57.19 | 0.62 | 22.00 | 1.92 |
| | 8 | 1.24 | 21.64 | 49.91 | 0.64 | 26.02 | 1.79 |
| | 12 | 1.38 | 27.44 | 43.71 | 1.72 | 25.43 | 1.69 |
| | 16 | 1.60 | 34.13 | 36.46 | 3.87 | 23.46 | 2.09 |

*Figure 7b. Impulse-response functions for Poland (1990:1-2003:6) – monthly data*



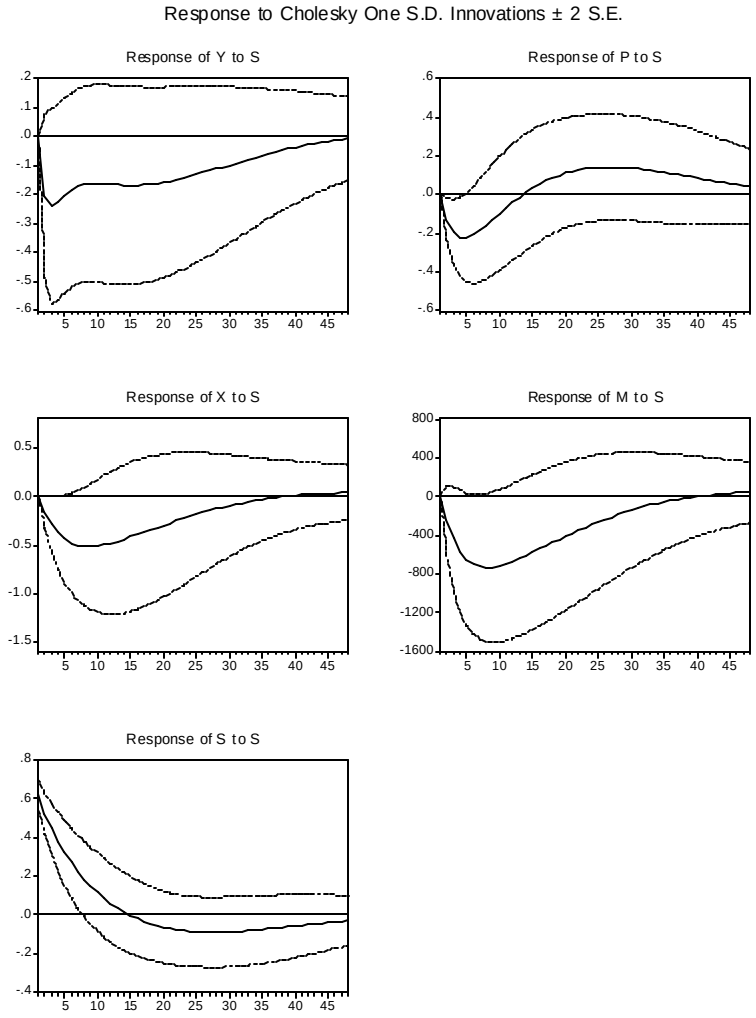

| POLAND | | error | Y | P | X | M | S |
|---|---|---|---|---|---|---|---|
| *Y* | 12 | 5.07 | 56.50 | 0.19 | 39.50 | 2.47 | 1.34 |
| | 24 | 5.40 | 49.83 | 0.57 | 40.93 | 7.21 | 1.45 |
| | 36 | 5.57 | 46.98 | 1.01 | 39.16 | 11.45 | 1.41 |
| | 48 | 5.69 | 44.98 | 1.44 | 37.52 | 14.70 | 1.35 |
| *P* | 12 | 2.36 | 0.60 | 62.78 | 9.81 | 26.79 | 0.02 |
| | 24 | 4.33 | 0.35 | 41.67 | 12.30 | 45.62 | 0.05 |
| | 36 | 6.22 | 0.24 | 33.07 | 11.61 | 55.03 | 0.05 |
| | 48 | 7.98 | 0.19 | 28.69 | 10.53 | 60.55 | 0.04 |

*Figure 8. Impulse-response functions for the Slovak Republic (1993:1-2003:2)*



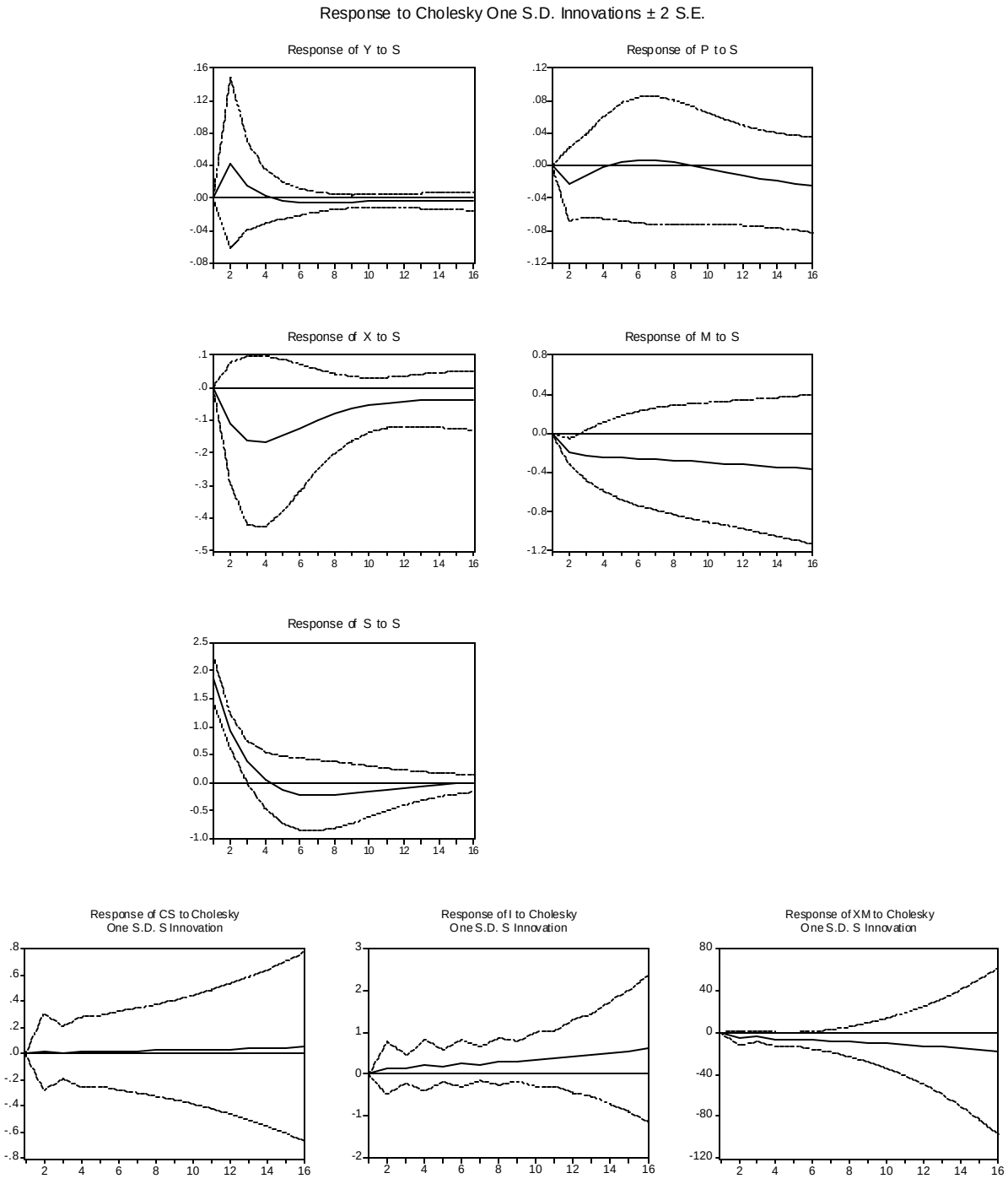

| SLOVAK REPUBLIC | | error | Y | P | X | M | S |
|---|---|---|---|---|---|---|---|
| *Y* | 4 | 1.08 | 59.83 | 15.27 | 11.96 | 4.74 | 8.20 |
| | 8 | 1.33 | 41.57 | 28.08 | 14.28 | 5.08 | 10.99 |
| | 12 | 1.56 | 31.70 | 36.19 | 14.30 | 4.79 | 13.02 |
| | 16 | 1.80 | 25.19 | 41.78 | 13.84 | 4.54 | 14.64 |
| *P* | 4 | 2.39 | 0.46 | 91.77 | 1.70 | 0.13 | 5.94 |
| | 8 | 3.42 | 1.72 | 78.67 | 4.51 | 0.88 | 14.22 |
| | 12 | 4.44 | 2.93 | 71.39 | 6.45 | 1.90 | 17.33 |
| | 16 | 5.46 | 3.61 | 67.61 | 7.75 | 2.50 | 18.52 |

*Figure 8b. Impulse-response functions for the Slovak Republic (1993:1-2003:6) – monthly data*



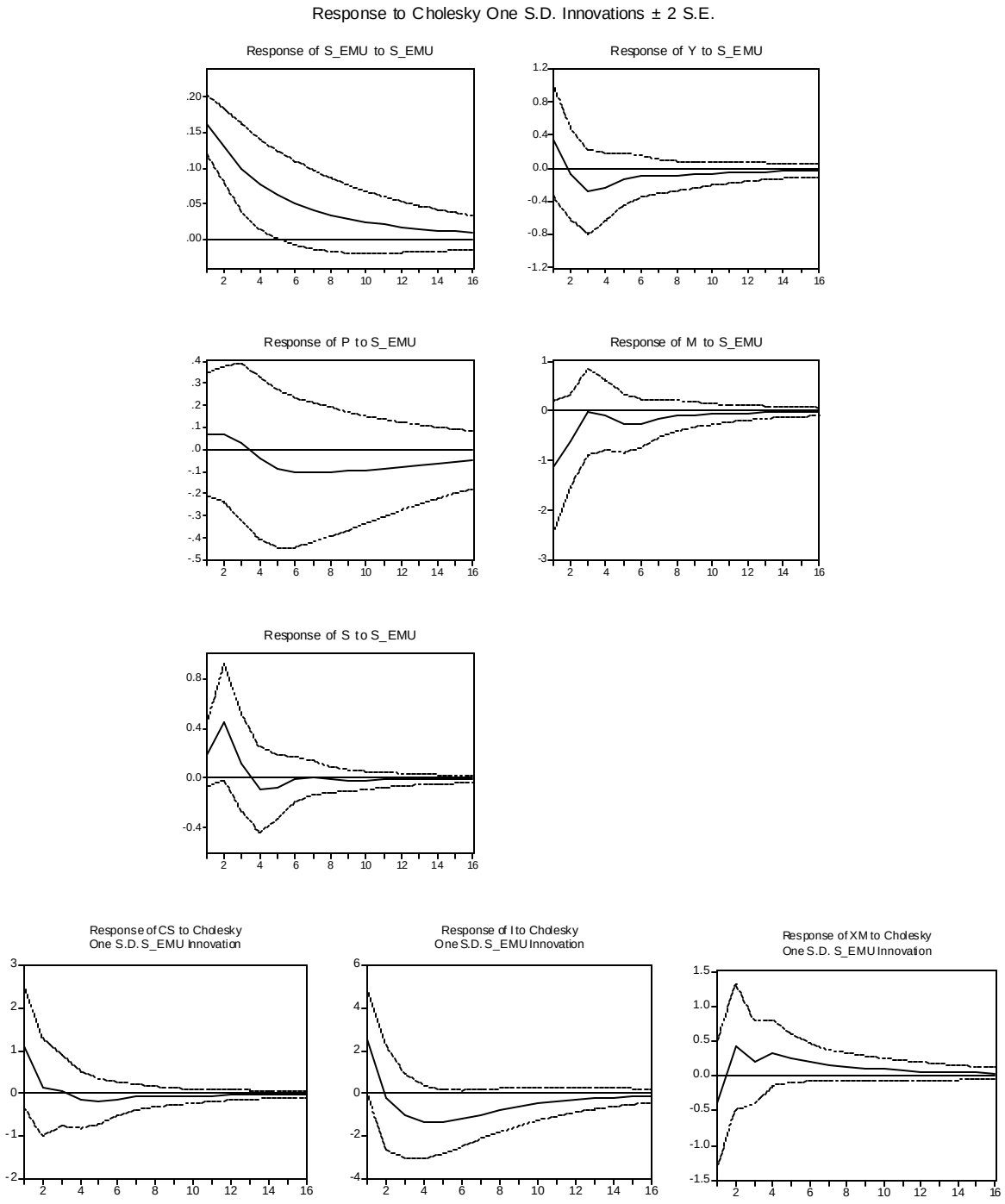

| SLOVAK REPUBLIC | | error | Y | P | X | M | S |
|---|---|---|---|---|---|---|---|
| *Y* | 12 | 3.28 | 79.75 | 2.30 | 13.47 | 0.83 | 3.65 |
| | 24 | 3.56 | 70.91 | 3.81 | 18.84 | 0.92 | 5.52 |
| | 36 | 3.65 | 68.16 | 5.16 | 19.18 | 1.38 | 6.12 |
| | 48 | 3.66 | 67.71 | 5.47 | 19.08 | 1.57 | 6.17 |
| *P* | 12 | 2.14 | 0.79 | 76.57 | 6.88 | 9.49 | 6.27 |
| | 24 | 2.52 | 5.78 | 57.03 | 21.77 | 9.23 | 6.20 |
| | 36 | 2.75 | 8.14 | 50.33 | 25.59 | 8.08 | 7.88 |
| | 48 | 2.81 | 8.40 | 49.55 | 25.46 | 8.25 | 8.34 |

*Figure 9. Impulse-response functions for Slovenia (1993:1-2003:2)*



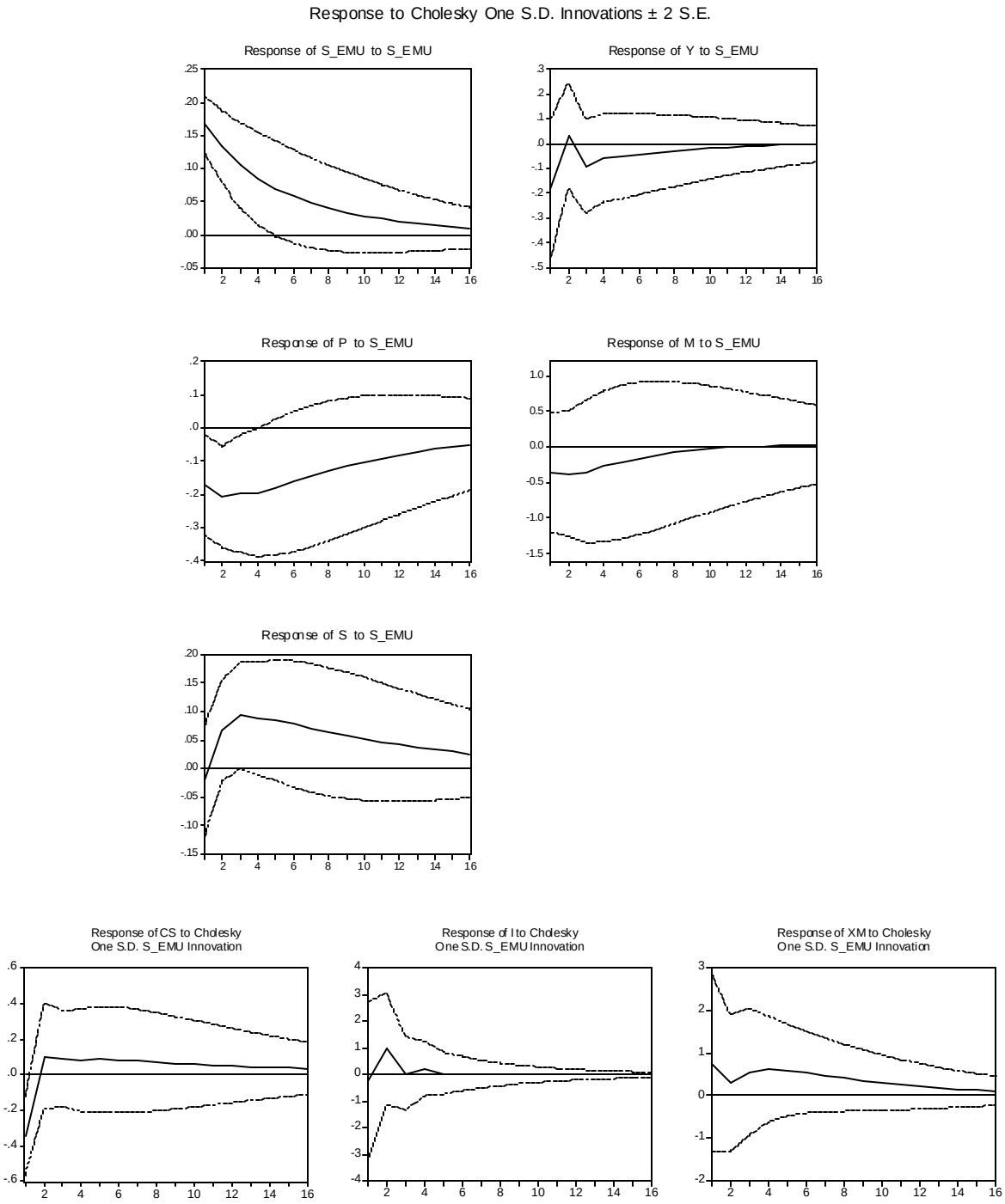

| SLOVENIA | | error | Y | P | X | M | S |
|---|---|---|---|---|---|---|---|
| *Y* | 4 | 0.92 | 98.16 | 0.61 | 0.91 | 0.08 | 0.25 |
| | 8 | 0.92 | 97.97 | 0.61 | 0.96 | 0.20 | 0.26 |
| | 12 | 0.92 | 97.77 | 0.62 | 0.97 | 0.38 | 0.26 |
| | 16 | 0.92 | 97.51 | 0.63 | 0.99 | 0.61 | 0.27 |
| *P* | 4 | 0.69 | 26.34 | 46.89 | 23.74 | 2.88 | 0.14 |
| | 8 | 0.90 | 32.62 | 30.76 | 30.09 | 6.44 | 0.10 |
| | 12 | 1.00 | 35.69 | 25.13 | 27.86 | 11.22 | 0.10 |
| | 16 | 1.08 | 36.99 | 21.71 | 24.48 | 16.60 | 0.23 |

*Figure 10. Impulse-response functions for Estonia (1996:1-2003:2)*



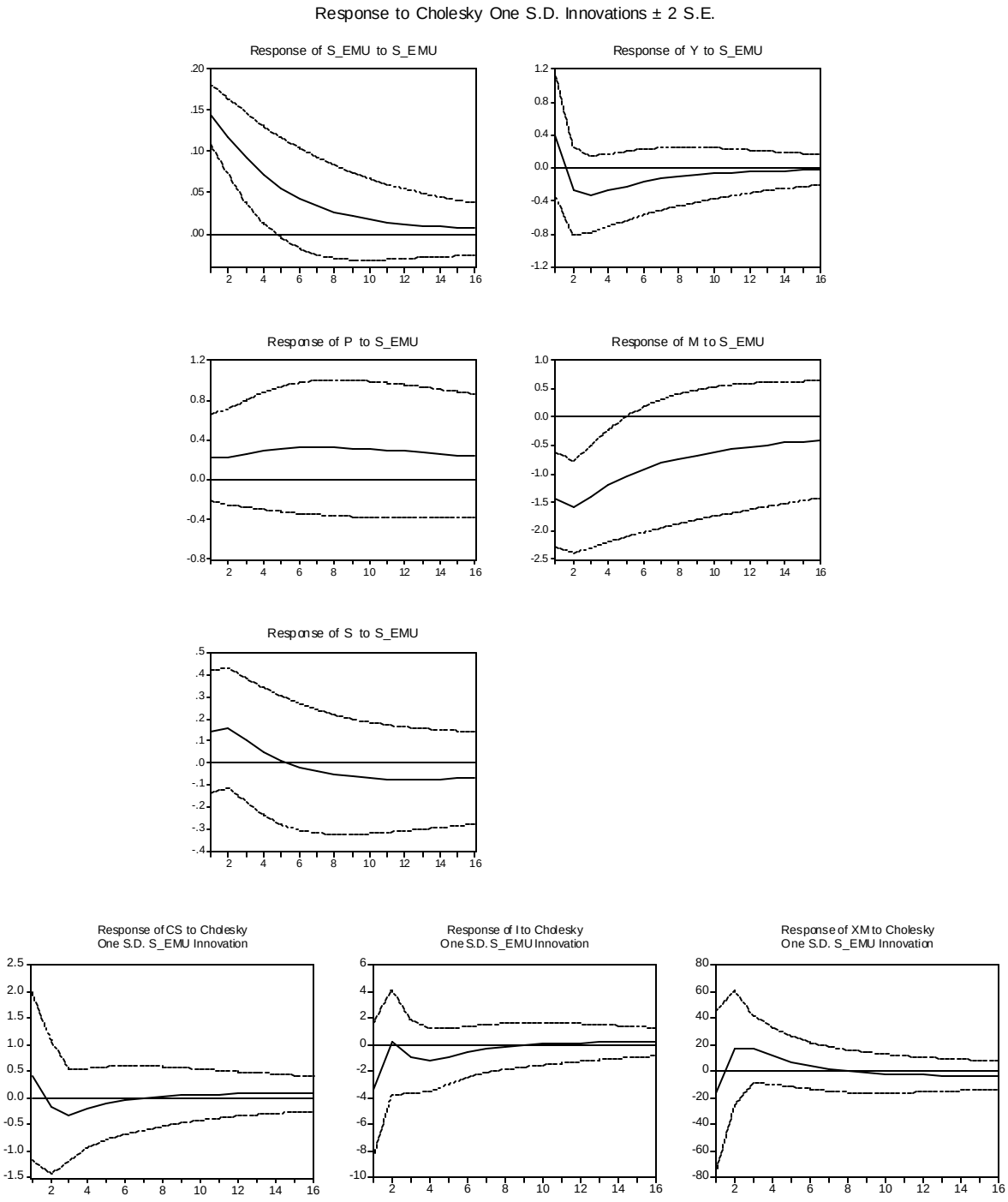

| ESTONIA | | error | S_EMU | Y | P | M | S |
|---|---|---|---|---|---|---|---|
| *Y* | 4 | 0.25 | 5.67 | 91.34 | 0.50 | 1.94 | 0.55 |
| | 8 | 0.27 | 6.52 | 90.10 | 0.88 | 1.95 | 0.55 |
| | 12 | 0.28 | 6.80 | 89.67 | 1.03 | 1.94 | 0.55 |
| | 16 | 0.28 | 6.88 | 89.54 | 1.09 | 1.94 | 0.55 |
| *P* | 4 | 2.14 | 0.71 | 34.37 | 64.70 | 0.17 | 0.05 |
| | 8 | 2.16 | 2.48 | 35.81 | 61.52 | 0.16 | 0.04 |
| | 12 | 2.17 | 3.77 | 35.62 | 60.42 | 0.15 | 0.04 |
| | 16 | 2.17 | 4.32 | 35.47 | 60.02 | 0.15 | 0.04 |

*Figure 11. Impulse-response functions for Latvia (1996:1 -2003:2)*




| LATVIA | | error | S_EMU | Y | P | M | S |
|---|---|---|---|---|---|---|---|
| *Y* | 4 | 0.26 | 5.59 | 78.57 | 0.46 | 11.96 | 3.43 |
| | 8 | 0.29 | 5.91 | 76.30 | 0.45 | 14.01 | 3.34 |
| | 12 | 0.30 | 5.89 | 75.70 | 0.44 | 14.64 | 3.33 |
| | 16 | 0.30 | 5.86 | 75.51 | 0.44 | 14.87 | 3.33 |
| *P* | 4 | 0.89 | 30.42 | 3.72 | 55.90 | 8.08 | 1.89 |
| | 8 | 0.93 | 33.76 | 7.84 | 43.56 | 12.60 | 2.24 |
| | 12 | 0.95 | 34.22 | 9.40 | 39.91 | 14.14 | 2.33 |
| | 16 | 0.95 | 34.24 | 10.03 | 38.60 | 14.76 | 2.36 |

*Figure 12. Impulse-response functions for Lithuania (1995:1-2003:2)*




| LITHUANIA | | error | S_EMU | Y | P | M | S |
|---|---|---|---|---|---|---|---|
| *Y* | 4 | 0,24 | 6,89 | 80,18 | 2,37 | 0,54 | 10,02 |
| | 8 | 0,27 | 7,84 | 72,80 | 4,77 | 1,19 | 13,39 |
| | 12 | 0,27 | 7,96 | 71,67 | 5,04 | 1,35 | 13,98 |
| | 16 | 0,28 | 7,99 | 71,49 | 5,04 | 1,38 | 14,10 |
| *P* | 4 | 2,44 | 4,98 | 6,79 | 87,18 | 0,34 | 0,70 |
| | 8 | 2,56 | 8,34 | 8,66 | 78,83 | 1,05 | 3,11 |
| | 12 | 2,58 | 10,54 | 9,51 | 72,89 | 1,69 | 5,37 |
| | 16 | 2,58 | 11,83 | 9,96 | 69,16 | 2,11 | 6,94 |

*Figure 13. Variance decomposition of prices two years after the shock*
*(Czech Republic, Hungary, Poland, Slovak Republic and Slovenia)*

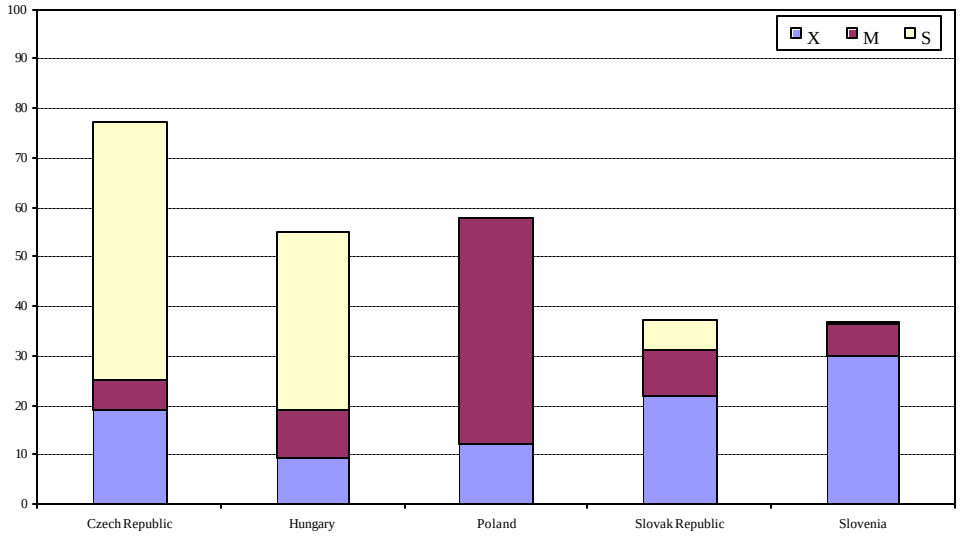



*Figure 14. Variance decomposition of prices two years after the shock*
*(Estonia, Latvia and Lithuania)*

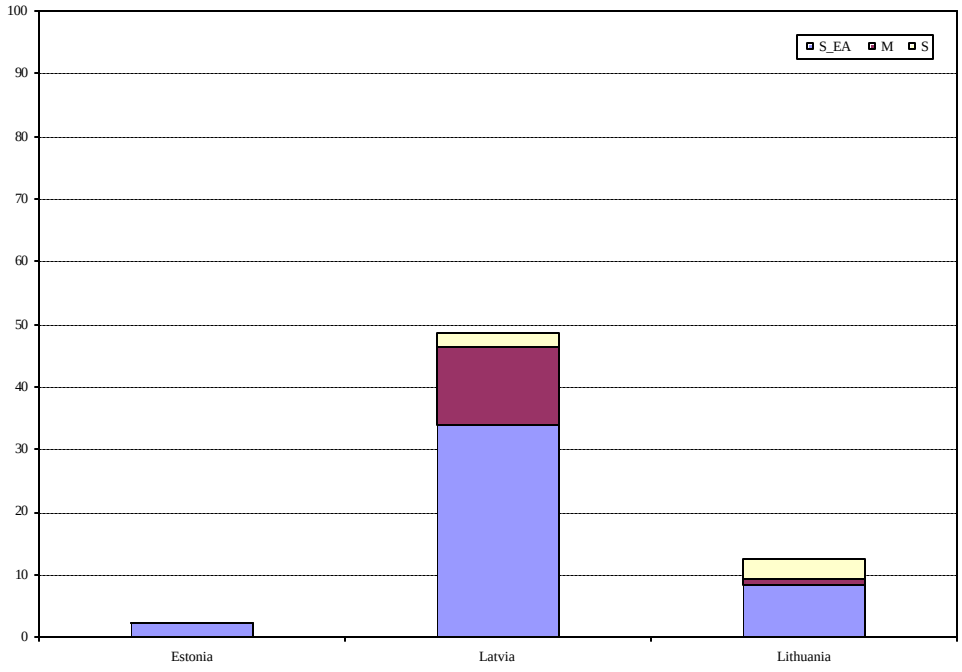


*Figure 15. Interactions between monetary and fiscal policies - Hungary*

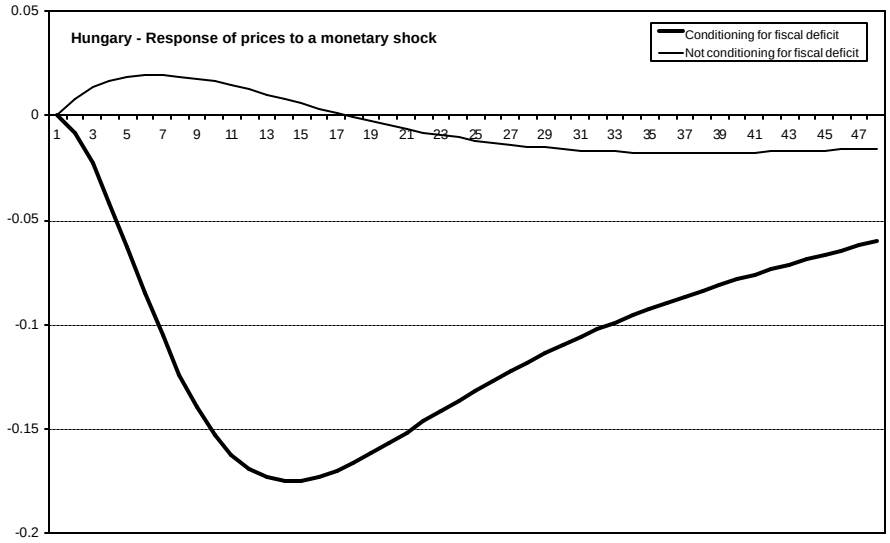
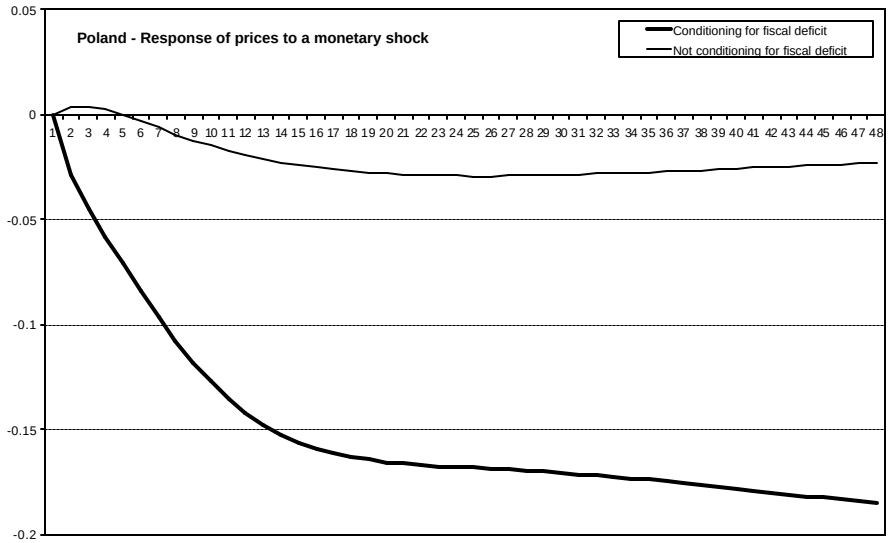



*Figure 16. Interactions between monetary and fiscal policies - Poland*



## Annex 1. Data availability for the Euro Area, the US and Acceding Countries

| ***QUARTERLY DATA*** | ***Real GDP*** | ***Consumer prices*** | ***Short term interest rate*** | ***Money*** | ***Real effective exchange rate*** | ***Surplus/deficit*** | ***Private Final Consumption expenditure*** | ***Gross fixed capital formation*** | ***Net exports of goods and services*** |
|---|---|---|---|---|---|---|---|---|---|
| *Main source* | *OECD Quarterly National Accounts* | *OECD Main Economic Indicators* | *IMF International Financial Statistics* | *IMF International Financial Statistics* | *OECD Main Economic Indicators* | *IMF International Financial Statistics* | *OECD Quarterly National Accounts* | | |
| *Euro area* | 1985:1-2003:2 | 1985:1-2003:2 | 1985:1-2003:2 | 1985:1-2003:2 | 1985:1-2003:2 | --- | 1985:1-2003:2 | 1985:1-2003:2 | 1985:1-2003:2 |
| *United States* | 1985:1-2003:2 | 1985:1-2003:2 | 1985:1-2003:2 | 1985:1-2003:2 | 1985:1-2003:2 | --- | 1985:1-2003:2 | 1985:1-2003:2 | 1985:1-2003:2 |
| *Czech Republic* | 1994:1-2003:2 | 1991:1-2003:2 | 1993:1-2003:2 | 1992:1-2003:2 | 1993:1-2003:2 | 1993:1-2003:2 | 1994:1-2003:2 | 1994:1-2003:2 | 1994:1-2003:2 |
| *Estonia* | 1993:1-2003:2 | 1991:1-2003:2 | 1993:2-2003:2 | 1993:1-2003:2 | 1996:1-2003:2 | --- | 1993:1-2003:2 | 1993:1-2003:2 | 1993:1-2003:2 |
| *Hungary* | 1995:1-2003:2 | 1985:1-2003:2 | 1985:1-2003:2 | 1990:4-2003:2 | 1985:1-2003:2 | 1997:1-2003:2 | 2000:1-2003:2 | 1995:1-2003:2 | 1995:1-2003:2 |
| *Latvia* | 1991:1-2003:2 | 1992:3-2003:2 | 1993:3-2003:2 | 1993:1-2003:2 | 1996:1-2003:2 | 1996:1-2003:2 | 1995:1-2003:2 | 1995:1-2003:2 | 1995:1-2003:2 |
| *Lithuania* | 1995:1-2003:2 | 1991:1-2003:2 | 1993:1-2003:2 | 1993:1-2003:2 | 1993:3-2003:2 | 1999:1-2003:2 | 1993:1-2003:2 | 1993:1-2003:2 | 1993:1-2003:2 |
| *Poland* | 1995:1-2003:2 | 1995:1-2003:2 | 1989:4-2003:2 | 1996:4-2003:2 | 1985:1-2003:2 | 1996:1-2003:2 | 1995:1-2003:2 | 1995:1-2003:2 | 1995:1-2003:2 |
| *Slovak Republic* | 1993:1-2003:2 | 1991:1-2003:2 | 1993:1-2003:2 | 1990:1-2003:2 | 1990:1-2003:2 | 2001:1-2003:2 | 1993:1-2003:2 | 1993:1-2003:2 | 1993:1-2003:2 |
| *Slovenia* | 1992:1-2003:2 | 1991:1-2003:2 | 1991:4-2003:2 | 1992:1-2003:2 | 1992:1-2003:2 | 1993:1-2003:2 | 1999:1-2003:2 | 1999:1-2003:2 | 1999:1-2003:2 |

| ***MONTHLY DATA*** | ***Industrial production index*** | ***Consumer prices*** | ***Short term interest rate*** | ***Money*** | ***Real effective exchange rate*** | ***Deficit/deficit*** |
|---|---|---|---|---|---|---|
| *Main source* | *OECD MEI/ IMF IFS* | *OECD Main Economic Indicators* | *IMF International Financial Statistics* | *IMF International Financial Statistics* | *OECD Main Economic Indicators* | *IMF International Financial Statistics* |
| *Euro area* | 1990:1 -2003:6 | 1990:1 -2003:6 | 1990:1 -2003:6 | 1990:1-2003:6 | 1990:1-2003:6 | --- |
| *United States* | 1990:1 -2003:6 | 1990:1 -2003:6 | 1990:1 -2003:6 | 1990:1-2003:6 | 1990:1-2003:6 | --- |
| *Czech Republic* | 1992:1 -2003:6 | 1993:1 -2003:6 | 1993:1 -2003:6 | 1993:1-2003:6 | 1996:1-2003:6 | 1993:1-2003:6 |
| *Estonia* | 1994:1 -2003:6 | 1992:1 -2003:6 | 1993:2 -2003:6 | 1992:6-2003:6 | 1990:1-2003:6 | --- |
| *Hungary* | 1990:1 -2003:6 | 1990:1 -2003:6 | 1990:1 -2003:6 | 1990:3-2003:6 | 1990:1-2003:6 | 1997:1-2003:2 |
| *Latvia* | 1996:1 -2003:6 | 1992:1 -2003:6 | 1993:7 -2003:6 | 1993:6-2003:6 | 1996:1-2003:6 | 1996:1-2003:2 |
| *Lithuania* | 1997:1 -2003:6 | 1992:5 -2003:6 | 1992:12 -2003:6 | 1993:1-2003:6 | 1993:7-2003:6 | 1999:1-2003:2 |
| *Poland* | 1990:1 -2003:6 | 1990:1 -2003:6 | 1990:1 -2003:6 | 1990:1-2003:6 | 1990:1-2003:6 | 1997:1-2003:2 |
| *Slovak Republic* | 1992:1 -2003:6 | 1993:1 -2003:6 | 1993:1 -2003:6 | 1993:1-2003:6 | 1990:1-2003:6 | --- |
| *Slovenia* | 1991:1 -2003:6 | 1992:1 -2003:6 | 1993:1 -2003:6 | 1991:12-2003:6 | 1992:1-2003:6 | 1993:1-2003:2 |