THE TRANSMISSION MECHANISM OF MONETARY POLICY: INVESTIGATING THE EXCHANGE RATE CHANNEL FOR CENTRAL AND EASTERN EUROPEAN COUNTRIES

(*case of Poland*)

by

Yuriy Garbuza

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Abstract

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Head of the State Examination Committee: Ms.Svitlana Budagovska,
Economist, World Bank of Ukraine

The analysis in this thesis is devoted to the study of exchange rate channel of monetary transmission mechanism in transition economies of Central and Eastern European region with a special emphasis on the investigation of the response of external sector variables to monetary policy shocks. Using Poland as a case study, I specify and estimate vector-autoregressive model in VEC form to study the responses of real effective exchange rate, money market interest rate, nominal trade balance, volumes of exports and imports, consumer and export and import prices to monetary policy shocks. The obtained dynamic responses of the named variables to monetary policy shocks are in many cases in contrast to what one usually observes for developed market economies. I argue that discrepancies in the responses of economic variables to monetary policy shocks in transition and developed economies may be explained by such factors as insufficient development of banking sector and weak financial intermediation, low level of external economic integration and currency substitution, which are common for transition economies but not present in developed ones.

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GLOSSARY

AIC – Akaike information criterion

CEE – Central and Eastern Europe

CEEC's – Central and Eastern European countries

CB – central bank

EA – Euro Area

FPE – final prediction error statistics

HQ – Hannan-Quinn information criterion

LR – likelihood ratio statistics

MTM – monetary transmission mechanism

NBP – National Bank of Poland

PPI – producer price index

SC – Schwarz information criterion

Chapter 1

INTRODUCTION

Issues concerning the impact of money on the real economy have always been a subject of great interest for economists and policymakers. Primarily, this is due to the fact that monetary policy can be a powerful tool at the disposal of central banks through which it is possible to influence such important macroeconomic variables as output and inflation. In this regard the study of *transmission mechanism* – i.e. channels through which changes in money supply affect economic variables – seems to be a subject of even greater interest. The strength and timing of the effects brought into the economy by the actions of policymakers are determined by the channels of monetary transmission mechanism. That is why the ability of monetary authorities to conduct their policy successfully depends to a large extent on how well they are aware of the channels through which monetary shocks are pervaded into real economy.

The investigation of transmission mechanism of monetary policy in transition economies, such as of Central and Eastern Europe, appears to be both a crucially important and challenging task. First, it is important since under circumstances of uncertainty in economic environment and underdevelopment of market institutions, which may be considered as deviations from "neoclassical" conditions, traditional policy tools are less effective. The successfulness of economic transformation, therefore, depends on how good policymakers are being able to predict the consequences of their actions. Besides, as more central banks in CEE move towards inflation targeting[1], a good knowledge of

[1] For example national banks of Poland, Czech Republic…

transmission channels is one of the key factors needed for monetary policy to be successful. Second, it is challenging because the transition is a dynamic phenomenon and is a subject to constant structural changes that complicate formal analysis. Moreover, the transition countries of Central and Eastern Europe are small open economies. Identifying exogenous monetary policy shocks in an open economy can lead to substantial difficulties in the analysis since, different from the case of autarky, when a country is isolated from the rest of the world, in an open economy monetary policy may experience an impact (or in some cases even be strongly influenced) from outside.

In modern economic literature there are a lot of studies that offer various approaches to the investigation of monetary transmission mechanism. Following Ganev et al. (2002) all these approaches can be classified within four broad categories. To the first category can be attributed approaches based on descriptive methods of analysis, which deal with observation and comparison of relevant economic variables so as to make inferences about MTM. The second category includes approaches that use VAR methodology and its different variations like VECM and Granger causality tests for the analysis of monetary transmission. Approaches that consider construction of small structural macroeconometric models and are aimed to investigate specific aspects of transmission mechanism constitute the third category. Finally, the fourth category consists of approaches that try to develop large macroeconometric models in order to capture the various links in the monetary transmission process.

So far the number of studies devoted to investigation of MTM in Central and Eastern Europe is limited. In case of transition economies of CEE this can be explained by at least two reasons. The first is the lack of sufficiently long time series data of proper quality. The second is the already mentioned problem of an unstable economic environment that undergoes constant structural changes. This thesis contributes to the literature by investigating the exchange rate channel of monetary transmission mechanism in Poland with a special emphasis on the analysis of the response of external sector variables to monetary policy shocks.

The approach to be implemented in this work will ground on VAR methodology since it became a standard in the literature on this topic. What is more, structural models that also can be used to study MTM consider analysis of various links between different sectors of an economy, but this is not necessary for the purposes of this research.

The rest of the paper proceeds as follows. *Chapter 2* provides a concise review of empirical studies devoted to the investigation of monetary transmission mechanism. The analysis of the literature on MTM suggests that despite the fact that the impacts of monetary policy shocks on economic variables are studied in depth for developed economies, it is still unclear whether inferences about MTM that are true for market economies are valid for transition ones. In *chapter 3* follows the discussion of issues related to MTM in the context of transition period. The analysis in this part concludes that during transition the institutional infrastructure[2] which is important for the effectiveness of economic transformation is not developed enough to guarantee the stability of economic environment and thus, economic processes that take place are often influenced by exogenous non-economic factors that seriously distort the pace of economic reforms and complicate the formal analysis. *Chapter 4* dials with methodological issues and provides a description of a model to be estimated in this thesis. Here follows the discussions of the main statistical tool used in the analysis of MTM – the vector autoregression – and the most common identification technique used in estimating the economic effects of a monetary policy shock, i.e. recursiveness

[2] Market institutions, legal regulations etc.

assumption. *Chapter 5* deals with data analysis, verification and transformation. *Chapter 6* presents the results of the empirical analysis. Finally, *chapter 7* concludes the paper with the summary of results and suggests directions for further investigation.

Chapter 2

REVIEW OF RELEVANT EMPIRICAL STUDIES

In this part of the paper follows a concise review of the empirical studies devoted to the analysis of monetary transmission mechanism. It is worth mentioning that in the last ten years the interest in empirical research of transmission mechanism of monetary policy has increased. Jacobson et al. (2001) name two reasons why this has happened. First, deregulation of financial markets made monetary policy more oriented towards open market operations than regulatory measures; second, in many countries the emphasis in monetary policy has shifted toward explicit use of policy rules and monetary targeting. Both these changes, as stated by the authors, have made monetary policy more transparent and more interesting for the formal analysis.

In the preceding part of this paper it was discussed that there are various approaches to the analysis of MTM. At the heart of all of them is the concept of monetary policy shocks. The analysis of monetary transmission is per se an investigation of the response of various economic variables to these shocks. As Christiano et al. (1998) point to there is no commonly excepted approach in the literature to the identification of monetary policy shocks. Hence, the identification problem remains the major cause of discrepancies that give rise to various theories and methodologies.

In view of this it appears reasonable to organize this section as follows. First, I give the definition and some possible interpretations of monetary policy shocks that are currently available in the literature. After that the discussion of strategies used in the empirical studies for identification of monetary policy shocks follows. Then I present a review of the literature on monetary transmission. This review is constrained to those papers with a primary focus on the exchange rate channel of monetary transmission but some references to the literature that investigates other channels and aspects of MTM are also provided. Finally, I conclude with a description of what is to be done in this paper and how it contributes to the literature reviewed in the section.

Insights to Subject Matter

There is a widespread opinion among economists that the decisions made by monetary authorities represent their systematic reaction to changes in the economic environment. For example, one may observe that low levels of output in an economy may induce policymakers to reduce the official interest rate in order to make investment opportunities cheaper and thus, to extend the volume of credit to the economy that, in consequence, should stimulate production. Usually one cannot be sure that policy actions will lead to desired changes in target variables (like output in the above example). This happens because not all policy actions can be attributed to a systematic reaction of monetary authorities to the state of the economy. Such policy actions that are not induced by changes in economic environment constitute the essence of a *monetary policy shock*. Christiano, Eichenbaum and Evans (1998) define a monetary policy shock as a disturbance term in an equation of the form

$$S_t = f(\Psi_t) + \sigma_S \varepsilon_t^S \tag{2.1}$$

where S_t is the instrument in the disposal of the monetary authorities (for example an interest rate, as in the example above), f is a linear function[3], Ψ_t is the information set that is available to monetary authorities when S_t is set. The

[3] A possible interpretation of f is that it represents the monetary authority's reaction function.

stochastic term, $\sigma_S \varepsilon_t^S$, is a monetary policy shock, where ε_t^S is orthogonal[4] to the elements of Ψ_t and normalized to have unit variance, σ_S is referred to as the standard deviation of the monetary policy shock. There are various economic interpretations of the policy shocks; some of them are given below.

Following Christiano et al. (1998) ε_t^S reflects exogenous shocks to the inclinations of the monetary authorities, which may arise as random changes in the relative weight given to inflation and unemployment. These changes may reflect shocks to the preferences of the policymakers, or to the weights by which their votes are aggregated, and may be caused by shifts in the political power of individual members of monetary authority or the groups that they represent. Chari, Christiano and Eichenbaum (1997), referring to Ball (1995), emphasize on strategic behavior of monetary authorities as a source of unsystematic behavior that gives rise to monetary policy shocks. In particular authors argue that it may be in the interest of policymakers to accommodate private agents' expectations because not doing so may bring undesirable outcomes for the economy[5]. Finally, ε_t^S may be of technical nature. As Christiano et al. (1998), referring to Bernanke and Mihov (1995), state, ε_t^S may represent a measurement error in the elements of Ψ_t.

In the analysis of monetary policy one may not simply concentrate on the actions of policymakers because in this case inferences may turn out to be invalid as non-monetary developments in the economy, that also influence policymakers' actions, are ignored. So, in order to approach the analysis of monetary policy one

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[4] This is the most frequently used assumption in the literature.

[5] The example provided by the authors is that in case of high inflation expectations not accommodating private agent's expectations may lead to a recession.

has to distinguish monetary policy shocks from the rest of shocks to the economy.

In the economic literature there are several strategies for isolating monetary policy shocks. Two of them, discussed most frequently, are described below. The first one suggests making enough identifying assumptions necessary to estimate the parameters of the reaction function f. Following the description of this approach in Christiano et al. (1998), necessary identifying assumptions include assumptions about functional form of f, assumptions about composition of an information set Ψ_t, and assumption about policy instrument S_t. Besides, assumptions about the nature of the relation between the policy shock and the elements of Ψ_t are required. One approach is to assume that the policy shock is orthogonal to the variables in Ψ_t (Sims (1980, 1992)). In the literature this assumption is usually referred to as *recursiveness assumption*. The economic meaning of this assumption is that there is no contemporaneous link between monetary policy shock and elements of the information set Ψ_t. Another approach is to assume some specific form of relationship between the policy shock and variables in the reaction function. This approach seems to be more sophisticated since a broader set of economic relations has to be identified. Following Christiano et al. (1998) models consistent with former approach can be found in Christiano, Eichenbaum and Evans (1997), Rotemberg and Woodford (1997), with the latter one – in Bernanke (1986), Sims (1986) and Leeper, Sims and Zha (1996).

The second strategy for identifying monetary policy shocks, usually based on the so called historical approach[6] used by Romer and Romer (1989), does not require explicit modeling of the reaction function f. Following the discussion of this

[6] Sometimes it is also referred to as narrative approach.

approach in Bernanke and Mihov (1995) monetary shocks are identified with decisions of monetary authorities to change the stance of the monetary policy. The dates, when such decisions are made, are assigned dummy variables that define the monetary policy shock in an econometric model. The major drawback of this approach is its qualitative nature: it does not consider the strength of the monetary shock (Barran et al. (1996)). Within this identification strategy there is also an approach to identify policy shocks with any movements in monetary aggregates (Cooley and Hansen (1997), Christiano and Eichenbaum (1995)).

Empirical Findings in the Literature so far

Despite the fact that there is no common opinion about particular set of assumptions for identifying the effects of an exogenous shock to monetary policy Christiano, Eichenbaum and Evans (1998) in their survey of the VAR literature on the effects of monetary policy find that:

'…there is a considerable agreement about the qualitative effects of a monetary policy shock in the sense that the inference is robust across a large subset of the identification schemes that have been considered in the literature… after a contractionary monetary policy shock, short term interest rates rise, aggregate output, employment, profits and various monetary aggregates fall, the aggregate price level responds very slowly, and various measures of wages fall by modest amounts.'

This is a generalized summary of findings of many empirical studies reviewed in the survey; and I refer an interested reader to the body of the Christiano et al.'s paper for details and further references. The rest of this section proceeds with the review of the literature that focuses on investigation of the exchange rate channel of monetary transmission mechanism.

Numerous studies have explored the impact of a monetary policy shock on exchange rates. Identifying exogenous monetary policy shocks in an open economy can lead to substantial difficulties in the analysis since, different from the case of autarky, when a country is isolated from the rest of the world, in an open economy monetary policy may experience an impact (or in some cases even be strongly influenced) from outside.

Eichenbaum and Evans (1995) investigate the impact of shocks to US monetary policy on real and nominal exchange rates. Based on recursiveness assumption authors employ the following three measures of the monetary policy shock: orthogonalized shocks to the federal funds rate, orthogonalized shocks to the ratio of nonborrowed to total reserves and changes in index of monetary policy suggested by Romer and Romer. In their study authors find a significant link between monetary policy and exchange rates. In particular, according to expositions in the paper, the following effects of a contractionary monetary policy shocks are observed. First, significant and persistent appreciations in US exchange rates, both nominal and real. Second, significant departures from uncovered interest rate parity. Following Christiano et al. (1998), under uncovered interest rate parity an increased difference between interest rates caused by a contractionary US monetary policy shock should be counteracted by expected future depreciation of the dollar. However, Eichenbaum and Evans' empirical results show that the opposite is true i.e., the expected future appreciation of the dollar actually magnifies interest rate differential.

Grilli and Roubini (1995) apply an approach similar to Eichenbaum and Evans' to analyze the effects of a monetary policy shock in non-US G7 countries. In their analysis the authors use reaction functions in which interest rates serve as instruments of monetary authorities. The authors get the results that are inconsistent with findings of Eichenbaum and Evans. In particular, authors find that while in US positive monetary shocks lead to appreciation of the dollar, in G7 countries the effect is opposite i.e., currency depreciates. Authors explain such outcome of the analysis first, by the fact that US monetary policy significantly influences the decisions of monetary authorities in G7 countries, second, by inflationary expectations. After controlling for these effects authors obtain conventional results (i.e., currency appreciation is observed) and also find that a contractionary shock to monetary policy leads to a temporary fall in output.

Cushman and Zha (1997) for Canada, and Clarida and Gertler (1997) for Germany use VAR models to analyze the effects of a contractionary monetary policy shock on economic variables. Different from the already mentioned studies these authors abandon recursiveness assumption from their analyses. In both studies authors assume that the information sets of monetary authorities include money supply, exchange rate, and index of world commodity prices. In the study for Canada US interest rate is also included into the reaction function of monetary authorities. Since it is assumed that monetary policy shock is not orthogonal to the elements of the information set, it cannot be recovered from an ordinary least squares regression. Therefore, the authors assume the existence of a group of variables that are predetermined relative to the policy shock and use these variables as instruments for estimating the parameters of monetary authorities' reaction functions. In both studies authors find that contractionary monetary policy shock leads to exchange rate appreciation, fall in output and monetary aggregates, and rises interest rates.

Barran, Coudert, and Mojon (1996) study the effects of monetary policy shocks in the nine countries of the European Union: Austria, Denmark, Finland, France, Germany, Italy, the Netherlands, Spain and the United Kingdom. Authors use VAR methodology and adopt recursiveness assumption to test the importance of different transmission channels of monetary policy, i.e. interest rate, exchange rate, and credit channels. Contrary to what one would expect for open economies, this study does not indicate that the exchange rate channel significantly strengthens the impact of monetary policy shock. Authors explain such outcome by the fact that most of the countries in the sample are members of the European Monetary System, and by the fact that monetary authorities use their policy to counter the variations in the exchange rates. At the same time the performed tests show that the credit channel appear to be effective in the European countries, as credit has a tendency to contract more than money, in response to a negative monetary shock. As emphasized by the authors this later result does not seem to hold for France and Germany, however.

In a more recent study Smets and Wouters (1999) use the VAR approach to analyze the effects of monetary policy shock on the German economy. They include in the analysis US real GDP and US federal funds rate to capture world economic and financial conditions, which they believe to have a significant effect on an open economy such as Germany one. The authors also adopt the recursiveness assumption and assumptions that US variables contemporaneously cause the German variables and that German output and inflation are contemporaneously predetermined with respect to German interest rate and exchange rate. The main findings are summarized in the paper as follows. First, the interest rate and the exchange rate channels have different effects on the various components of GDP. While a rise in interest rates mainly affects the interest-rate-sensitive components of GDP, the corresponding appreciation in the exchange rate influences, mainly, net exports through relative price effects. As a result the interest rate and exchange rate channels have opposite effects on trade balance: while the former leads to an improvement of the trade balance, the latter deteriorates it. Second, the exchange rate has an important direct effect on import prices, making the transmission of policy shock to prices more straightforward than in closed-economy models.

The researches conducted for Central and Eastern European countries concentrate, primarily, on investigation of interest rate and credit channels of monetary transmission[7]. Among studies that focus also on exchange rate channel are: Dovciak (1999), Babich (2001) and Vetlov (2001) for Slovakia, Latvia and Lithuania respectively. While the former two studies do not find conclusive evidence of the existence of exchange rate channel in Slovakia and Latvia the latter one indicates that exchange rate have some impact on inflation and GDP in Lithuania.

Ganev, Molnar, Rybiński and Woźniak (2002) investigate monetary transmission in CEE. The authors empirically assess the strength of interest rate and exchange rate channels for 10 transition economies of CEE[8]. To account for possible external shocks to monetary policy in these countries they include in their analysis as exogenous the following variables: European Union industrial output, European Union PPI, and Euro area interest rate. The authors abandon recursiveness assumption, and apply the concept of generalized impulse responses[9]. The outcomes of the study point to relative importance of interest and exchange rate channels in monetary transmission in the region. For most countries the exchange rate channel appear to be stronger and much more stable then the interest rate one. In this sense, the results are similar to those of Smets and Wouters for Germany. The authors find that for most CEE countries responses of inflation are consistent with the theory and other empirical studies, i.e. interest rate rise decreases inflation while the exchange rate depreciation has an opposite effect. The latter also concerns output response, i.e. production increases as exchange rate depreciates.

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[7] See Ganev et al. (2002).

[8] The research is conducted for Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

[9] For references to the literature concerning this concept see Ganev et al. (2002).

Ganev et al. (2002) provide a compact review about 40 studies on monetary transmission in CEE. In order to preserve a reasonable length of this thesis I will not discuss all these papers here but rather present a short summary of their main finding; an interested reader, however, is encouraged to check Ganev et al. (2002) for details. The following general conclusions can be made. First, almost all studies of monetary transmission mechanism in CEE concentrate on investigation of the credit channel of MTM. Second, in these studies authors attempt to explore the credit channels in its two steps of transmission, where the first step relates to transmission from the instrumental variable of monetary authority to some intermediate variable such as money market rates or monetary aggregates, and the second step relates to transmission from these intermediate variables to the target variables such as output and inflation. Finally, despite the fact that for many CEE countries there were found some weak relationship between economic variables in the first step of transmission, there were found no conclusive evidence of the existence of the second step of transmission. Ganev et al. conclude that most of the authors explain the weak first step and the non-existent second step of transmission with institutional considerations like underdevelopment of banking sector and hence weak financial intermediation.

Some interesting conclusions can be made if to compare findings of Barran, Coudert, and Mojon for developed Europe with those of Ganev, Molnar, Rybiński, Woźniak, and other authors for transition economies of CEE. While in Western European countries credit channel of monetary transmission is the one which is important, it appears to play much less significant role in the monetary transmission in CEE. Such outcome looks reasonable if to take into account that the financial systems of Western economies is much more developed if compared to transition countries. The situation is different when the exchange rate channel of MTM is considered. Due to limitations imposed by European Monetary Union on member countries the role of this channel in monetary transmission in

Western European region is limited. At the same time, as Ganev et al. (2002) show, for open economies of Central and Eastern Europe the role of exchange rate channel in MTM is significant.

Motivation for Subsequent Analysis

The impacts of monetary policy shocks on economic variables have been studied in depth for developed economies. And the question that is naturally to ask now is whether inferences about MTM that are true for market economies are valid for transition ones. The answer to this question is: *probably no,* as the economic environment in transition countries significantly differs from that in developed market economies. Weak competition, insufficient development of banking and financial sectors, low levels of openness of the economies to international trade and capital flows, high degree of uncertainty, underdevelopment of market institutions, and improper legislation – these are some features that are uncommon for developed countries but very frequently observed in transition economies. With such striking discrepancies in the economic conditions, one may reasonably expect that the results of formal analyses of economic processes in two distinct economic environments will also be different.

The VAR analysis of MTM carried out by Smets and Wouters (1999) for Germany shows that in an open economy with sticky prices a contractionary monetary policy leads to a substantial real appreciation of the exchange rate that has two clearly discernible effects. First, it lowers the prices of imported goods that, in consequence, have a twofold impact on consumer prices i.e., reduces the prices of imported consumer goods and also reduces the prices of imported intermediate goods thereby reducing the marginal cost of firms. Second, the loss of competitiveness due to currency appreciation results in substitution effects as both domestic and foreign demand shifts towards foreign goods. An important policy implication of this latter outcome is that in developed economies governments have to sacrifice competitiveness in external sectors of their economies when trying to pursue macro-stabilization policies.

To investigate whether the findings of Smets and Wouters (1999) and other literature on the MTM obtained for developed economies apply to transition economies, I address the following questions:

- Do differences in development of financial and banking sectors, and differences in levels of economic integration between Western and Central and Eastern European countries give rise to discrepancies in monetary transmission in these countries?
- What is the relative strength of exchange rate and interest rate channels of monetary transmission in transition economies? Indeed, weakness of credit channel of monetary transmission, caused by underdevelopment of banking sectors in transition economies, is most likely compensated by relative strength of interest and exchange rate channels of MTM. Taking into account that transition economies are less open to international trade and capital flows one may also expect that exchange rate channel will not dominate in strength the interest rate one as it happens in developed market economies.
- How do external sector variables, such as trade balance, volumes of export and import, and export and import prices, respond to monetary policy shocks and what consequences does it have for country's competitiveness in international markets? Here I hypothesize that low level of economic integration between transition economies of CEE region may result in delayed substitution effects that, in consequence, may provoke unexpected (not predicted by the theory) dynamics in the reaction of economic variables to monetary policy shock. In particular,

export and import prices as well as volumes of exports and imports may initially rise after a contractionary monetary policy shock. If this is true than it is possible that at least in the short run in transition economies governments will not face a need to sacrifice competitiveness in external sectors of their economies in order to achieve macroeconomic stabilization in the country.

- Does monetary policy shocks transmitted via exchange rate and interest rate channels of MTM have similar impacts on economic activity (measured by GDP) in a country? If the suggestions in the above hypothesis hold, it is probably that monetary policy shocks transmitted via exchange rate and interest rate channels of MTM will differently influence economic activity in the country. While shocks transmitted via interest rate channel will tend to reduce industrial production (because cost of investment increases) and will negatively influence GDP, shocks transmitted via exchange rate channel will positively influence trade balance and thus will tend to improve GDP.

My analysis is carried out by using the Polish economy data. The choice of Poland is motivated by the fact that this country can be considered as a representative example of the CEE economy in transition[10] and thus it will be possible to make some generalized inferences from the obtained results. The choice of Poland has also an additional advantage that the complete set of data needed for analysis is available.

[10] As the analysis in the subsequent section shows the transition process in Poland cannot be characterised as significantly different from those in the rest of the countries in the CEE region.

Chapter 3

PECULIARITIES OF MONETARY POLICY ENVIRONMENT IN TRANSITION PERIOD

In this part of the work it will be shown that economic environment in which monetary policy was conducted in Central and Eastern European countries in the beginning and middle of nineties was far from "neoclassical" conditions. In particular it will be demonstrated that first years of transition in CEE region were characterized by underdevelopment of market institutions and legal regulations – which are keystones to success in economic transformation – and thus the monetary processes that took place in CEEC's were often influenced by exogenous non-economic factors that seriously rendered the effectiveness of traditional policy tools. The purpose of this chapter is to provide some valuable insight into the peculiarities of economic environment in transition period and to reveal the limitations for the formal analysis of MTM in CEE.

Goals, Targets and Tools of Monetary Policy in CEE Countries

In the beginning of transition period in the early nineties almost all central banks of CEE region – including CB's of Poland, Czech Republic, Hungary, Slovakia, Slovenia, Bulgaria, Romania and Baltic States – declared stability of their national currencies as the main goal of monetary policy. As Ganev et al. (2002) in their study of transition process in CEE countries point out despite the identical goals of monetary policy the outcomes with respect to inflation were different across countries. In particular authors provide the following comparative statistics. While during the period from 1993 to 2000 Czech Republic and Slovakia managed to maintain an average annual rate of inflation at a level below 10% the corresponding indicators for Romania and Bulgaria exceeded 70%. The divergent performance with respect to GDP growth was also observed during the same period across countries. By the end of 2000 in Hungary, Poland, Slovakia and Slovenia GDP grew by more than 25% as compared to its level in 1993. For Czech Republic, Estonia, Latvia and Romania the growth of the main indicator of economic activity was smaller and not exceeded 25%. For Bulgaria and Lithuania there was, actually, observed a decline in economic activity (GDP index below 100).

Regarding monetary instruments there was a tendency in the region to shift towards the use of market-based ones that are common in Western European countries. During the first years of transition monetary authorities in some CEE countries mainly relied on administrative tools, such as credit ceiling and refinancing rationing[11]; by the second half of the nineties, however, almost all countries[12] adopted traditional market instruments – open market operations, discount rates and reserve requirements (Ganev et al. (2002)).

During last decade central banks in CEE exploited different strategies with respect to operating and intermediate targets of monetary policy. In some countries these strategies were persistent in others they changed several times. For example, following Ganev et al. (2000), money market rate in Hungary, and monetary base in Slovakia and Latvia were the only operating targets used in these countries during the whole period of transition. At the same time CB's of Poland and Czech Republic changed the preferences of their monetary policies several times. In Poland money market rate served as an operating target in period from 1993 to 1995. In 1996 – 1997 it was replaced by bank reserves

[11] Bulgaria until 1993, Poland until 1992, Czechoslovakia before 1992.

[12] The exceptions were the countries with currency board regimes.

variable. Finally, after 1998 money market rate was again adopted as an operating target of monetary policy in Poland. In Czech Republic operating target changed four times: from monetary base in 1992 – 1993 to bank reserves in 1994 – 1995 then to money market rate in 1996 – 1997 and, finally, to the one week PRIBOR. The most frequently used intermediate target of monetary policy in CEEC's in the beginning and middle of nineties was exchange rate target. Following the discussion of intermediate targeting in transition economies by the National Bank of Hungary[13] the popularity of exchange rate as a nominal anchor of monetary policy can be explained by several reasons. First, exchange rate directly influences the price of traded products and thus facilitates inflation targeting. Second, provided that exchange rate target is credible i.e., the evolution of exchange rate is foreseeable and therefore there is no unanticipated uncertainty that could affect returns of investment, the announcing of devaluation rate may efficiently condition inflation expectations and the prices of non-tradable goods and services. One more issue is that economic agents can continuously observe exchange rate and its influence on inflation that makes exchange rate targeting capable of anchoring private agents' inflation expectations. Exchange rate serves as an intermediate target of monetary policy in Hungary from 1987. The same intermediate target is used in Estonia, Latvia and Lithuania In Poland and Czech Republic this target was abandoned only recently after the countries adopted explicit inflation targeting (Ganev et al. (2002)).

The above analysis suggests that due to often changes in target variables of monetary policy, when approaching formal analysis, one may expect weak causality between economic variables in CEE countries. Another valid

[13] "Monetary Policy in Hungary", May 2000.

observation so far[14] is that in transition economies of CEE region monetary authorities have actively managed exchange rates to achieve their ultimate goals.

Evolution of Exchange Rate Regimes in CEEC's

Since the beginning of economic transformation in early nineties exchange rate regimes evolved differently across countries. Referring to the discussion of exchange rate patterns in Iacone and Orsi (2002) the following facts can be provided. Poland, Czech Republic, and Hungary after commitment to fixed exchange rate regimes in the beginning of transformation period, subsequently moved to free float by the end of 1990th. In particular after crawling peg regime that was introduced in Poland in 1991 this country adopted narrow oscillation band in the middle of 1990th that was gradually widened and in 2000 substituted with free float. Czech Republic introduced free float in 1997 without any gradual transformations in exchange rate regime. Hungary adopted crawling peg with 15% per side fluctuating band in 1995. On the contrary, Bulgaria, Latvia and Lithuania launched reforms with regimes close to free float but later on introduced hard and formalized pegs. In Estonia and Slovenia exchange rate regimes remained unchanged during 1990th (Currency Board Arrangement and managed float regime respectively) (Ganev et al. (2002)). The above illustrates that in Baltic States and largest CEEC's[15] almost opposite patterns in evolution of exchange rate regimes were observed. Iacone and Orsi (2002) provide the following explanations to this phenomenon. The authors argue that first '…rigidity in labor market prevented a quick realignment of wages, making the internal burden of the adjustment of tight exchange rate management very heavy'[16], and second '… the incentive to keep the exchange rate firmly fixed

[14] Also emphasized in Ganev et al (2002).

[15] Poland, Czech Republic, and Hungary.

[16] CEEC's

depends on the size of the country, making the advantage bigger for those having a high degree of openness to the international trade'[17].

Exchange rate regimes are important for the monetary transmission in transition countries. First of all, as noted by Smets and Wouters (1999), the aspect of openness of the economies suggests that the interest rate channels in the MTM may be supplemented by significant exchange rate channels. In this case it is important to know the impact of exchange rate fluctuations on output and inflation in order to conduct successful monetary policy. In addition, Ganev, Molnar, Rybiński and Woźniak (2002) argue that in transition countries exchange rate policies may have a significant impact on the level of currency substitution. But the latter may strongly influence effectiveness of monetary policy instruments. Exchange rate regime is also one of the important factors that determine the attractiveness of the investment climate in the country.

Monetary Sector Developments during Transition

One of the most distinctive features of economic transformation during transition period is that, different from economic reforms, transformation suggests cardinal changes in almost all areas of economic, political, and social life of the country. Such changes are usually accompanied by temporary loss of governmental control over the processes that take place in the country. This leads to such situation in economic environment when non-economic exogenous factors may influence the decisions of policymakers rendering traditional policy tools less effective.

One of the peculiarities of monetary sector development in CEEC's in the beginning of 1990[th] was the necessity to build two-tier banking systems similar to

[17] Baltic States

those in developed market economies. Under socialist regime banking systems in almost all countries were comprised of a single state bank, which performed the functions of the central bank and also provided credits for state owned enterprises, and several subsidiary banks, which served specific areas of economic activity like international trade and households' deposits. The distribution of credits in such baking system was based on directives of central planners and not on the basis of the creditworthiness of enterprises as it is common in market economies (Kutan and Brada (1999)). As a consequence, in the beginning of 1990th the newly established central banks in CEE countries inherited a great deal of bad loans from their socialist counterparts. Thus, such an option as independence of central banks in conducting monetary policy could not be successfully exploited during the first years of transition as decisions made by monetary authorities were frequently influenced by outside debtors (mainly former state owned enterprises). As a result of such situation one could observe inconsistencies in monetary policy of CB's of CEE countries. Some examples taken from Ganev et al. (2002) are provided below.

Commitment of the Hungarian National Bank to fixed exchange rate regime in the first half of 1990th was in conflict with other goals and actions of both the fiscal and the monetary authorities that resulted in currency devaluation in more than 23 times during the named period. In 1992 the policy of the Bank of Latvia to decrease inflation through relatively high interest rates, was inconsistent with its decision to grant direct loans to the government that was the precondition for inflationary impulse. When in two years the Bank of Latvia tried to stimulate economic growth with low interest rates its expansionary policy was sterilized by the actions of the government which started to return the accumulated debt.

The inconsistencies in behavior of CB's in CEE region provoked by the impact of non-monetary exogenous factors in the beginning of transition period mean that, when approaching formal analysis of monetary transmission issues, one may expect a lack of stable and clear links between economic variables. This somehow explains inconclusive results obtained so far in empirical studies on MTM in CEE region.

Insufficient development of commercial banks that form the basis of transmission mechanism of monetary policy may be considered as the second important factor that restrained the development of monetary processes in the region. A considerable growth of the number of commercial banks in CEE in early 1990th had per se a little effect on improvement of conditions in monetary environment. As indicated in different studies on reforms of banking sector and evolution of monetary policy in CEE[18], newly established commercial banks usually experienced the lack financial assets, had inefficient managerial structure, and were internationally noncompetitive. Moreover, there were cases when even domestic competition among commercial banks was weak. In some countries (like Hungary, for example) commercial banks were granted mandates that give them an exclusive right to operate in a particular sector of an economy. Under such circumstances commercial banks could operate as monopolists that seriously undermined competition among them (Kutan and Brada (1999)). Problems of moral hazard and adverse selection in banking sectors of CEEC's should also be mentioned. Almost in all countries banking sector crises erupted in different periods of 1990th (Estonia (1992), Latvia (1995), Lithuania (1995-1996), Bulgaria (1996-1997), Czech Republic (1997)) (Ganev et al. (2002)).

[18] See for example Kutan and Brada (1999), Ganev et al. (2002), Maslennikov (1999), Yerofeyeva and Puhtayevich (1998).

Short Summary

The discussion of peculiarities of monetary policy environment in CEEC's in 1990th presented in this chapter shows that during transition market institutions, specifically banking sector, and legal regulations which are important for the effectiveness of economic transformation were not developed enough to guarantee the stability of economic environment and thus, economic processes that took place were often influenced by exogenous non-economic factors that seriously distorted the pace of economic reforms and rendered the effectiveness of traditional policy tools. Another valuable observation[19] is that the transition period of 1990th in CEEC's was characterized by constant structural changes and that towards the end of the period the monetary environment was much closer to Western standard conditions than in the beginning, thus making later periods (second part of 1990s) more favorable for the formal analysis.

[19] Originally made by Ganev et al. (2002)

C h a p t e r   4

NOTES ON METHODOLOGY AND MODEL DESCRIPTION

A most widely used tool in the literature for the analysis of monetary transmission mechanism is the vector autoregression. As Christiano et al. (1998) note, VAR is a convenient device for summarizing the first and the second moment properties of the data. This section starts with the description of what VAR is and then discusses the identification problem involved in measuring the dynamic response of economic variables to a monetary policy shock. The expositions and explanations regarding methodological part of this chapter are adopted from Christiano et al. (1998) as they became a standard in the literature.

Vector Autoregression and Identification Problem

Consider a *p*-dimensional autoregressive process X_t, defined by the following equations:

$$X_t = B_1 X_{t-1} + \ldots + B_q X_{t-q} + \Phi D_t + u_t, \quad E(u_t u_t^{'}) = \Omega \qquad (4.1)$$

where q is a nonnegative integer and u_t is a stochastic term, uncorrelated with all variables dated $t-1$ and earlier. The deterministic term D_t can contain a constant, trend and dummy variables, and also other variables that are assumed to be predetermined with respect to elements in X_t. For simplicity of further expositions I will omit ΦD_t in (4.1) and without loss of generality will assume that one of the elements of X_t is identically equal to unity. Following Christiano et al. (1998) consistent estimates of the B_i's can be obtained by running OLS equation by equation on (4.1). The estimate of Ω matrix then can be obtained from residual series generated in the first step.

Christiano et al. (1998) argue that even if B_i's, the u_t's and Ω are known, it is still impossible to calculate the dynamic response function of X_t to the monetary policy shock. The reason is that u_t is the one step ahead forecast error in X_t. Every element of u_t reflects the effects of all the economic shocks and one cannot be sure that any element of u_t corresponds to some particular economic shock, for example, monetary policy shock.

Further it is assumed that VAR disturbances relate to economic shocks, ε_t, as follows: $C_0 u_t = \varepsilon_t$. C_0 is an invertible square matrix and $E(\varepsilon_t \varepsilon_t^{'}) = \Re$, where $\Re$ is a positive definite matrix. As stated in Christiano et al. (1998) this corresponds to the assumption that the economic shocks can be recovered from a finite list of current and past X_t's. Premultiplication of (4.1) by C_0 gives:

$$C_0 X_t = C_1 X_{t-1} + \ldots + C_q X_{t-q} + \varepsilon_t \tag{4.2}$$

where C_i is a $p \times p$ matrix of constants, $i = \overline{1,q}$ and

$$B_i = C_0^{-1} C_i, \quad i = \overline{1,q}, \quad \Omega = C_0^{-1} \Re (C_0^{-1})^{'} \tag{4.3}$$

In this case the response of X_{t+h} to a unit shock in ε_t, φ_h, can be computed as shown below. If $\tilde{\varphi}_h$ is the solution of the difference equation:

$$\tilde{\varphi}_h = B_1 \tilde{\varphi}_{h-1} + \ldots + B_q \tilde{\varphi}_{h-q}, \quad h = 1, 2, \ldots \tag{4.4}$$

with initial conditions

$$\tilde{\varphi}_0 = I, \ \tilde{\varphi}_{-1} = \tilde{\varphi}_{-2} = \ldots = \tilde{\varphi}_{-q} = 0 \tag{4.5}$$

then,

$$\varphi_h = \tilde{\varphi}_h C_0^{-1}, \quad h = 0, 1, \ldots \tag{4.6}$$

Above, the (j,l) element of φ_h represents the response of the j^{th} element of X_{t+h} to a unit shock in the l^{th} element of ε_t. The φ_h's thus, characterize the impulse response functions of the elements of X_t to the elements of ε_t.

Relation (4.6) requires knowledge of C_0 as well as the B_i's to enable computation of the impulse response function. While B_i's can be obtained from least squares estimation of (4.1), getting C_0 is a more complicated task. The only available information about C_0 is that it solves the equations in (4.3). But equations in (4.3) cannot be unambiguously solved without imposing additional restrictions on C_0. According to Christiano et al. (1998) the VAR literature on MTM usually imposes the restriction that the fundamental economic shocks are uncorrelated, i.e. $\Re$ is diagonal matrix, and places no restrictions on C_i, $i=\overline{1,q}$. Given this and with absence of any additional restrictions on C_0 one can set

$$\Re = I \tag{4.7}$$

With unrestricted C_i's, the equations given by $C_0 B_i = C_i$, $i=\overline{1,q}$ provide no information about C_0. Relationship, $\Omega = C_0^{-1}(C_0^{-1})'$ contains all information about C_0. The set of solutions to this equation contains, actually, many elements. This is because C_0 has p^2 parameters while the symmetric matrix, Ω, has at most $p(p+1)/2$ distinct elements. Thus, the set of solutions to $\Omega = C_0^{-1}(C_0^{-1})'$ is the set of solutions to $p(p+1)/2$ equations in p^2 unknowns, and for any $p>1$, there are many solutions to $\Omega = C_0^{-1}(C_0^{-1})'$, i.e. there is an identification problem. To overcome this problem one need $p(p-1)/2$ additional restrictions on the p^2 elements of C_0. A conventional way to add these $k(k-1)/2$ restrictions is to assume that C_0 is lower triangular and implement the Cholesky decomposition of the matrix Ω. Following Barran et al. (1996) this assumption has become standard since it was introduced by Sims (1980, 1992). It literally means that the residuals ε_t are from a recursive system. Since the recursiveness assumption is the most frequently exploited tool in the literature for overcoming the identification problem it deserves a closer look here[20].

In order to estimate the response of en economic variable to a monetary policy shock one may follow the two-step procedure given below. First, get estimates of the policy shocks which are the residuals from the ordinary least squares regression of S_t on the elements of Ψ_t[21]. Second, estimate the dynamic response of a variable to a monetary policy shock by regressing this variable on the current and lagged values of fitted residuals from step one. As argued in Christiano et al. (1998) the above two-step procedure can be substituted with an asymptotically equivalent VAR-based procedure. The VAR procedure can be considered a superior one since it helps to preserve the degrees of freedom. To see this, just note that two-step approach implies that one lose a number of initial data points equal to the number of dynamic responses that he/she wishes to estimate, plus the number of lags, q, in Ψ_t. With the VAR procedure one only loses the latter. To show how the recursiveness assumption restricts C_0 and helps to overcome the identification problem Christiano et al. (1998) provide the following exposition. Partition X_t into three blocks: the p_1 variables, X_{1t}, whose contemporaneous values appear in Ψ_t, the p_2 variables, X_{2t}, which only appear with a lag in Ψ_t, and S_t itself. Then, $p = p_1 + p_2 + 1$, where p is the dimension of X_t. That is:

[20] Discussion continue to follow expositions of Christiano et al. (1998)

[21] See equation (2.1)

$$X_t = \begin{pmatrix} X_{1t} \\ S_t \\ X_{2t} \end{pmatrix}$$

It is considered that $p_1, p_2 > 0$, and that when $p_1 = 0$, so that X_{1t} is absent from the definition of X_t, $p_2 > 0$; and vice versa, if $p_2 = 0$, $p_1 > 0$. The recursiveness assumption imposes the following zero restrictions on C_0:

$$C_0 = \begin{pmatrix} \underset{(p_1 \times p_1)}{c_{11}} & \underset{(p_1 \times 1)}{0} & \underset{(p_1 \times p_2)}{0} \\ \underset{(1 \times p_1)}{c_{21}} & \underset{(1 \times 1)}{c_{22}} & \underset{(1 \times p_2)}{0} \\ \underset{(p_2 \times p_1)}{c_{31}} & \underset{(p_2 \times 1)}{c_{32}} & \underset{(p_2 \times p_2)}{c_{33}} \end{pmatrix} \tag{4.8}$$

Above, expressions in parentheses indicate the dimension of the corresponding matrix and $c_{22} = 1/\sigma_s$, with $\sigma_s > 0$. The zeros in the middle row of matrix (4.8) indicate that the policy maker does not see X_{2t} when S_t is set. The two zero blocks in the first row of (4.8) reflect the assumption that the monetary policy shock is orthogonal to the variables in X_{1t}. In principle the recursiveness assumption is not sufficient to identify all the elements of C_0. This is because the first p_1 equations are indistinguishable from each other, as are the last p_2 equations. However, the recursiveness assumption is sufficient to identify the object of interest, i.e.: the dynamic response of X_t to a monetary policy shock. The following three propositions determine that:

1) There is a nonempty family of C_0 matrices, one of which is lower triangular with positive elements on the diagonal, which are consistent with the recursiveness assumption (i.e., satisfy (4.8)) and satisfy $\Omega = C_0^{-1}(C_0^{-1})'$.

2) Each member of this family generates the same dynamic response function of the elements of X_t to a monetary policy shock.

3) If one adopt the normalization of always selecting the lower triangular C_0 matrix identified in proposition one, then the dynamic response of the variables in X_t are invariant to the ordering of variables in X_{1t} and X_{2t}.

The proof of these propositions can be found in Christiano et al. (1998, p.16).

According to propositions 1) and 2), under the recursiveness assumption the data are consistent with an entire family of C_0 matrices. Despite the fact that that the recursiveness assumption is not sufficient to evaluate the dynamic response function of the variables in X_t to every element of ε_t, each C_0 in the entire family does generate the same response to ε_t that corresponds to the monetary policy shock. In this sense the recursiveness assumption identifies the dynamic response of X_t to a monetary shock, but not the response to the other shocks. In practice, computational convenience dictates the choice of some particular C_0. A standard normalization adopted in the literature is that the C_0 is lower triangular with nonnegative diagonal elements. This still leaves open the question about the ordering of the variables in X_{1t} and X_{2t}. However, according to proposition 3), the dynamic response of the variables in X_t to a monetary policy shock is invariant to this ordering.

Model Description

Below follows the description of the VAR model which is to be estimated for the purposes of my research. The variables included in the VAR analysis can be partitioned into four groups. The first group consists of the Euro Area industrial output, ip_t^{EA}, and the Euro Area money market interest rate, r_t^{EA}. These variables are included to capture the European economic and financial conditions which are assumed to have significant effects on open economies of CEE. In the subsequent analysis I assume that these variables are exogenous to the Polish variables in the VAR model. In other words, it is assumed that European output and interest rate influence the variables of Polish economy, but there is no feedback from the latter to the former.

The second group of variables consists of the two goal variables of the NBP: the Polish industrial production, ip_t, and the Polish consumer price index, cpi_t. The third group includes the financial variables which capture the stance of monetary policy in an open economy the NBP lombard (or discount) rate[22], r_t^d, the money market interest rate r_t^m and the real effective exchange rate, er_t. Finally, the last group consists of external sector variables that are included in the VAR to analyze their response to a policy shock. This group includes nominal trade balance, nx_t, import prices, mp_t, and export prices, xp_t, volumes of export and import, xv_t and mv_t respectively.

Because of a small sample constraint, VAR model will initially comprise of three blocks, which were mentioned first. In the benchmark model the third block will include only discount rate variable, r_t^d. Under such specification second and third blocks combined together explicitly model the reaction function of NBP.

Using the standard notation, the benchmark VAR-model can be written as:

[22] This is an official instrument of monetary authorities in Poland.

$$\begin{pmatrix} ip_t \\ cpi_t \\ r_t^d \end{pmatrix} = B_1 \begin{pmatrix} ip_{t-1} \\ cpi_{t-1} \\ r_{t-1}^d \end{pmatrix} + \ldots + B_q \begin{pmatrix} ip_{t-q} \\ cpi_{t-q} \\ r_{t-q}^d \end{pmatrix} + \Phi \begin{pmatrix} ip_t^{EA} \\ r_t^{EA} \end{pmatrix} + u_t \qquad (4.9)$$ [23]

All other variables not included into the benchmark model will be added into analysis one by one and the following models will be estimated.

$$\begin{pmatrix} ip_t \\ cpi_t \\ r_t^m \\ r_t^d \end{pmatrix} = B_1 \begin{pmatrix} ip_{t-1} \\ cpi_{t-1} \\ r_{t-1}^m \\ r_{t-1}^d \end{pmatrix} + \ldots + B_q \begin{pmatrix} ip_{t-q} \\ cpi_{t-q} \\ r_{t-q}^m \\ r_{t-q}^d \end{pmatrix} + \Phi \begin{pmatrix} ip_t^{EA} \\ r_t^{EA} \end{pmatrix} + u_t \qquad (4.10)$$

$$\begin{pmatrix} ip_t \\ cpi_t \\ er_t \\ r_t^d \end{pmatrix} = B_1 \begin{pmatrix} ip_{t-1} \\ cpi_{t-1} \\ er_{t-1} \\ r_{t-1}^d \end{pmatrix} + \ldots + B_q \begin{pmatrix} ip_{t-q} \\ cpi_{t-q} \\ er_{t-q} \\ r_{t-q}^d \end{pmatrix} + \Phi \begin{pmatrix} ip_t^{EA} \\ r_t^{EA} \end{pmatrix} + u_t \qquad (4.11)$$

$$\begin{pmatrix} ip_t \\ cpi_t \\ r_t^d \\ xp_t \end{pmatrix} = B_1 \begin{pmatrix} ip_{t-1} \\ cpi_{t-1} \\ r_{t-1}^d \\ xp_{t-1} \end{pmatrix} + \ldots + B_q \begin{pmatrix} ip_{t-q} \\ cpi_{t-q} \\ r_{t-q}^d \\ xp_{t-q} \end{pmatrix} + \Phi \begin{pmatrix} ip_t^{EA} \\ r_t^{EA} \end{pmatrix} + u_t \qquad (4.12)$$

$$\begin{pmatrix} ip_t \\ cpi_t \\ r_t^d \\ mp_t \end{pmatrix} = B_1 \begin{pmatrix} ip_{t-1} \\ cpi_{t-1} \\ r_{t-1}^d \\ mp_{t-1} \end{pmatrix} + \ldots + B_q \begin{pmatrix} ip_{t-q} \\ cpi_{t-q} \\ r_{t-q}^d \\ mp_{t-q} \end{pmatrix} + \Phi \begin{pmatrix} ip_t^{EA} \\ r_t^{EA} \end{pmatrix} + u_t \qquad (4.13)$$

$$\begin{pmatrix} ip_t \\ cpi_t \\ r_t^d \\ nx_t \end{pmatrix} = B_1 \begin{pmatrix} ip_{t-1} \\ cpi_{t-1} \\ r_{t-1}^d \\ nx_{t-1} \end{pmatrix} + \ldots + B_q \begin{pmatrix} ip_{t-q} \\ cpi_{t-q} \\ r_{t-q}^d \\ nx_{t-q} \end{pmatrix} + \Phi \begin{pmatrix} ip_t^{EA} \\ r_t^{EA} \end{pmatrix} + u_t \qquad (4.14)$$

[23] Here and further constant term is omitted for simplicity of expositions.

$$\begin{pmatrix} ip_t \\ cpi_t \\ r_t^d \\ xv_t \end{pmatrix} = B_1 \begin{pmatrix} ip_{t-1} \\ cpi_{t-1} \\ r_{t-1}^d \\ xv_{t-1} \end{pmatrix} + \ldots + B_q \begin{pmatrix} ip_{t-q} \\ cpi_{t-q} \\ r_{t-q}^d \\ xv_{t-q} \end{pmatrix} + \Phi \begin{pmatrix} ip_t^{EA} \\ r_t^{EA} \end{pmatrix} + u_t \tag{4.15}$$

$$\begin{pmatrix} ip_t \\ cpi_t \\ r_t^d \\ mv_t \end{pmatrix} = B_1 \begin{pmatrix} ip_{t-1} \\ cpi_{t-1} \\ r_{t-1}^d \\ mv_{t-1} \end{pmatrix} + \ldots + B_q \begin{pmatrix} ip_{t-q} \\ cpi_{t-q} \\ r_{t-q}^d \\ mv_{t-q} \end{pmatrix} + \Phi \begin{pmatrix} ip_t^{EA} \\ r_t^{EA} \end{pmatrix} + u_t \tag{4.16}$$

In order to identify the monetary policy shocks from the reduced-form residuals in models (4.9) – (4.16), I use a block-recursive identification scheme as in Christiano et al. (1998). In this scheme industrial output, ip_t, inflation, cpi_t, exchange rate, er_t and money market interest rate, r_t^m, are assumed to be contemporaneously predetermined with respect to monetary policy instrument, r_t^d. In other words, NBP current discount rate may respond to current output, inflation, exchange rate and market rate shocks, but not vice versa, i.e. policy shock has only lagged effect on listed variables. This is a plausible assumption for high-frequency data[24].

As might became obvious from the above discussion in the subsequent analysis monetary policy shock will be identified as an error term from r_t^d equations in the VAR models (4.9) – (4.16). By explicitly including into a VAR analysis the exchange rate and money market interest rate I try to capture the first step of monetary transmission i.e., the transmission from the monetary environment to intermediate variables (er_t and r_t^m in this particular case). This step of monetary transmission is usually not investigated by researches in their empirical studies but simply assumed to exist. However explicitly modeling the first step of monetary

[24] In the empirical analysis monthly data is used.

transmission provides several advantages. First, the identification of a monetary shock is simplified in this case. Second, it becomes possible to assess the strength of different transmission channels. Since in the above VAR specifications, both money market rate and exchange rate are explicitly included in the model, it will be possible to compare the strength of interest rate and exchange rate channels of monetary transmission by comparing the responses of corresponding intermediate variables to monetary policy shock. The external sector variables are ordered just after the discount rate, since it is assumed that they have no contemporaneous effect on monetary policy.

Chapter 5

DATA DESCRIPTION[25]

Most data series on Poland used in empirical analysis come from the International Monetary Fund's International Financial Statistics Database. If the data were not available in the IFS the Economists Intelligence Unit Database and the National Bank's of Poland publications were used. Euro Area data series come from European Central Bank Database. All time series are in monthly frequency and cover the period January 1995 – September 2002 so, there are 93 monthly observations.

In *Table 5.1* below follows a complete list of variables used in subsequent analysis with indication of all transformations of data.

Table 5.1: Data Description and Transformation

Descriptor	Country	Notation used in the text	Units	Notation used in econometric model and transformation of data
Industrial Production[1)]	Euro Area[2)]	IP^{EA}	Index number, (1995=100)	$ip_t^{EA} = \log(IP^{EA})$
Money Market Interest Rate	Euro Area	R^{EA}	% per annum	$r_t^{EA} = 1 + R^{EA}/100$
Industrial Production	Poland	IP	Index number, (1995=100)	$ip_t = \log(IP)$
Consumer Price Index	Poland	CPI	Index number, (1995=100)	$cpi_t = \log(CPI)$
Money Market Interest Rate	Poland	R^m	% per annum	$r_t^m = 1 + R^m/100$

(Continued on the next page)

[25] All calculations in this and subsequent section are made with EViews 4.1 software.

Table 5.1: Data Description and Transformation (continued)

Descriptor	Country	Notation used in the text	Units	Notation used in econometric model and transformation of data
Real Effective Exchange Rate	Poland	ER	Index number, (1995=100)	$er_t = \log(ER)$
NBP Discount Rate	Poland	R^d	% per annum	$r_t^d = 1 + R^d / 100$
Nominal Trade Balance	Poland	NX	mln. USD	$nx_t = \log(NX)$
Export Prices	Poland	XP	Index number, (1995=100)	$xp_t = \log(XP)$
Import Prices	Poland	MP	Index number, (1995=100)	$mp_t = \log(MP)$
Volume of Export	Poland	XV	Index number, (1995=100)	$xv_t = \log(XV)$
Volume of Import	Poland	MV	Index number, (1995=100)	$mv_t = \log(MV)$

1) Original time series are seasonally adjusted.
2) Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Denmark, Norway, Sweden, Switzerland, United Kingdom.
Note: all series, except interest and exchange rates, and Euro Area industrial production, were seasonally adjusted by the author using Tramo/Seats procedure in EViews 4.1 software.

Further, the integration analysis of the data follows. For this purpose Phillips-Perron (PP) unit root test, which is considered to be superior to conventional ADF test in case of a possibility of structural changes in the data, is employed. Taking into account monthly frequency of the data, PP test statistics are calculated using maximum lag order of twelve and, since the limited sample size suggests the use of parsimonious models, the Bayesian Information Criterion (BIC) is chosen as the one that involves bigger punishment for adding regressors to the model. The results of the analysis are summarized in *Table 5.2* below.

Table 5.2: Phillips-Perron Test Results

Tested variable	Phillips-Perron Unit Root Test with intercept *Critical value (95%/99% confidence level): -2.89/-3.50*			Phillips-Perron Unit Root Test with intercept and linear trend *Critical value (95%/99% confidence level): -3.46/-4.06*		
	Level/lag	1st Δ/ lag[1]	Order of integration	Level/lag	1st Δ/ lag	Order of integration
IP^{EA}	-0.95/0	-11.64/0	1	-1.40/0	-11.69/0	1
R^{EA}	-1.80/0	-13.21/5	1	-1.83/0	-10.60/0	1
IP	-1.48/1	-7.12/0	1	-1.59/1	-7.25/0	1
CPI	-1.93/3	-3.59/2	1	-3.29/3	-5.69/0	1
ER	-1.99/1	-6.34/0	1	-3.48/1[2]	-6.36/0	1
R^m	-0.06/0	-11.43/2	1	-2.01/3	-10.93/2	1
R^d	0.15/0	-4.52/2	1	-1.96/3	-4./49/2	1
NX	-3.50/4[2]	-135.39/7	1	-2.64/1	-131.27/7	1
XP	-1.82/3	-24.21/2	1	-1.20/3	-23.49/2	1
MP	-1.91/0	-11.31/0	1	-1.93/0	-11.50/0	1
XV	-0.89/0	-8.96/0	1	-2.16/0	-8.94/0	1
MV	-2.46/3	-25.91/2	1	-2.17/3	-15.02/1	1

1) Δ denotes difference
2) Stationary under 5% level of significance

The above figures indicate that tested variables are integrated of order one, $I(1)$, both around constant and linear trend. Phillips-Perron test results point out that application of VAR in levels is not an appropriate methodology for the analysis of the data at hand. As econometric theory claims, regressing the levels of a series which is $I(1)$ on the levels of one or more other series which are also $I(1)$ is generally not a good thing to do. At worst, a researcher may obtain an entirely spurious relationship. At best, he or she may consistently estimate the elements of some cointegrating vector, but since standard asymptotic theory is not applicable to such estimates, it will be impossible to make correct inferences about estimated parameters. Therefore, above suggests that Vector Error Correction (VEC) specification of the VAR model should be applied in subsequent empirical analysis.

Chapter 6

EMPIRICAL ANALYSIS

As was indicated in the preceding part of this paper the time series available for the empirical analysis are non-stationary, and thus estimation of VAR models (4.9) – (4.16) in levels is not appropriate. That is why the subsequent analysis proceeds as follows. First, VAR models are tested for lag order. Then, for each model specification series are tested for cointegration and, depending on the results of the cointegration test, VAR models (4.9) – (4.16) are estimated in either first differences or VEC specification. Finally, the impulse responses of the economic variables to a monetary policy shocks are studied.

Table 6.1 below provides the results of the test for lag order of VAR model.

Table 6.1: VAR Lag-Length Test Results[1]

		Model							
		(4.9)	**(4.10)**	**(4.11)**	**(4.12)**	**(4.13)**	**(4.14)**	**(4.15)**	**(4.16)**
Info Criteria	**LR**	2 lags	2 lags	2 lags	2 lags	3 lags	3 lags	2 lags	3 lags
	FPE	2 lags	2 lags	2 lags	2 lags	3 lags	3 lags	2 lags	3 lags
	AIC	2 lags	2 lags	2 lags	2 lags	3 lags	3 lags	2 lags	3 lags
	SC	1 lag	1 lag	1 lag	1 lag	1 lag	1 lag	1 lag	1 lag
	HQ	2 lags	2 lags	1 lag	1 lag	2 lags	2 lags	2 lags	1lag
Lag order chosen for subsequent analysis[2]		2	2	2	2	3	3	2	3

[1] Reported results are for 5% level of significance.
[2] ***Note:*** in VEC specification number of lags included will be reduced by 1 (because of differencing of the variables).

Taking into account the above results Johansen cointegration test (JCT) is performed to find the number of cointegrating equations. The results of the test are provided below.

Table 6.2: Johansen Cointegration Test Results[1)]

Model	(4.9)	(4.10)	(4.11)	(4.12)	(4.13)	(4.14)	(4.15)	(4.16)
Lag length in VEC specification	1	1	1	1	2	2	1	2
# of cointegrating equations revealed by JCT	1	1	1	1	1	1	1	1

[1)] Trace Statistic results at 5% level of significance are reported.

The results of the above tests suggest that VAR models (4.9) – (4.16) should be estimated in VEC specification with one cointegrating vector in each model. Estimation outputs of the VEC models are presented in *Appendix*[26]. All estimated models satisfy the stability condition i.e., slope coefficients at correction terms are negative and less than unity in absolute value. Below follows the analysis of impulse responses of economic variables under consideration to a monetary policy shock.

Figure 1 depicts the effects of a policy shock on industrial production and the CPI index. As can be seen monetary policy tightening (contractionary monetary policy shock) leads to almost immediate fall in output. Such reaction is in accord with the theory. As official interest rate rises due to positive policy shock money market rates also rise making investment more expensive and thus, lowering production. The response of CPI to a monetary policy shock is somewhat

[26] Two dummy variables for periods 08/1997 – 04/1998 and 11/1999 – 02/2001 were included into all estimated VAR models, to account for structural changes in the dynamics of the interest rates in Poland (while downcast interest rates dynamics prevailed during the whole sample period, in the named two sub-periods the official interest rate and money market rate were actually rising)

puzzling from theoretical point of view; however, the observed response dynamics does not contradict the empirical findings in the VAR literature. There is a temporary increase in price level after a shock; only after three months does prices start to decline, becoming negative after seven months. One of the most recent explanations of the phenomenon of price puzzle that can be found in the literature claims that the described dynamics of the response of price level to monetary policy shock is observed because supply and demand forces alter policy shocks impact on prices differently. Considering the demand side one should expect that policy tightening will lead to fall in aggregate demand and price level. However, on supply side one may observe and increase in interest payments on loans that may expand money supply and push inflation up (Schabert (2001)). So the net outcome depends on what effect, demand or supply, dominates.

Figure 1: Responses of Industrial Production and CPI to Monetary Policy Shock

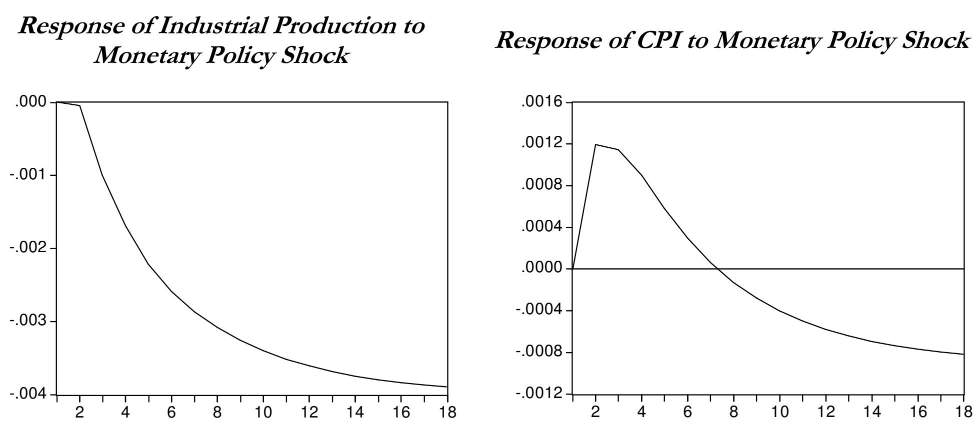
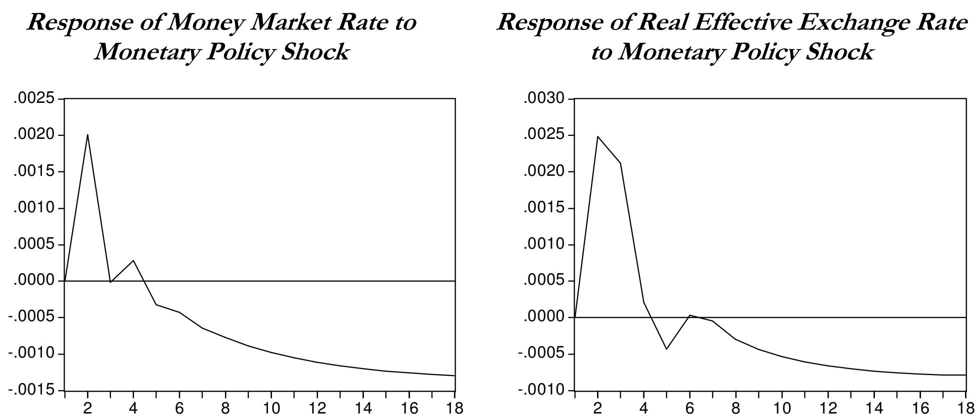


Figure 2 shows the effects of a policy shock on money market interest rate and real effective exchange rate. Several observations are worth nothing. First, both variables increase in response to policy tightening. This is an expected outcome that is in accord with economic theory. Money market rate goes up since the cost of money for commercial banks increases after a contractionary shock to monetary policy. Higher interest rates in the country stimulate capital inflows that

increase foreign demand for domestic currency and thus, exchange rate appreciates. Second, the exchange rate reaction to monetary policy shock is slightly stronger if compared to interest rate's one. This may point to a relative strength of exchange rate channel in the first step of monetary transmission.

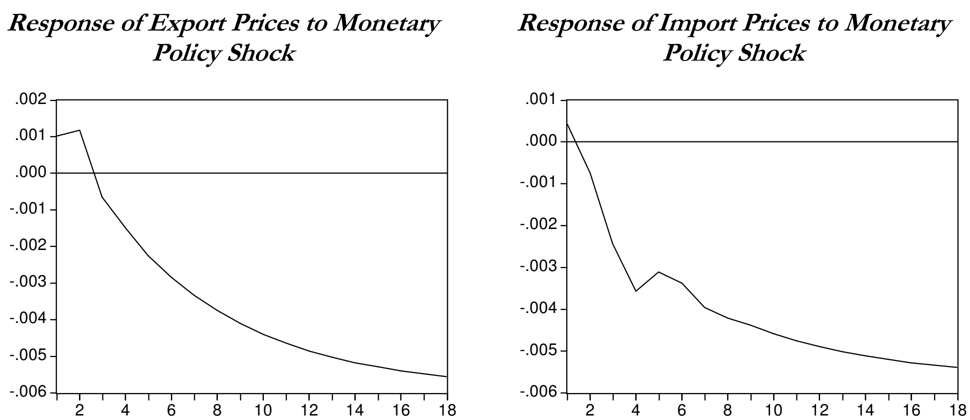
Figure 2: Responses of Money Market Rate and Real Effective Exchange Rate to Monetary Policy Shock



However, the following important observation should be emphasized. If to compare obtained results with those of similar studies for developed economies (see, for example, Smets and Wouters (1999) for Germany), one may conclude that the exchange rate channel in case of Polish economy does not strongly dominate interest rate one. The reason is that, as was found for German economy, the response of exchange rate to policy tightening is about three times higher than the interest rate response, and this is in contrast with findings of this study. Another valid observation is a small magnitude of the responses of intermediate variables (money market and exchange rates) to monetary policy shock. This is most likely because of weak causality between economic variables that results from unstable economic environment and frequent structural changes that characterize transition period.

Figure 3 shows the effects of monetary policy shock on export and import prices. As can be seen from the graph after a contractionary monetary policy shock both export and import prices initially go up and after about two months start to decline. The initial response of export prices is stronger if compared to the response of import prices. In other words export prices increase more on impact than import prices. The reverse is observed when downward dynamics of prices is considered. Export prices decline slower then import prices. Such price dynamics allows concluding that monetary policy tightening leads to an improvement in terms of trade, which are defined as ratio of export to import prices.

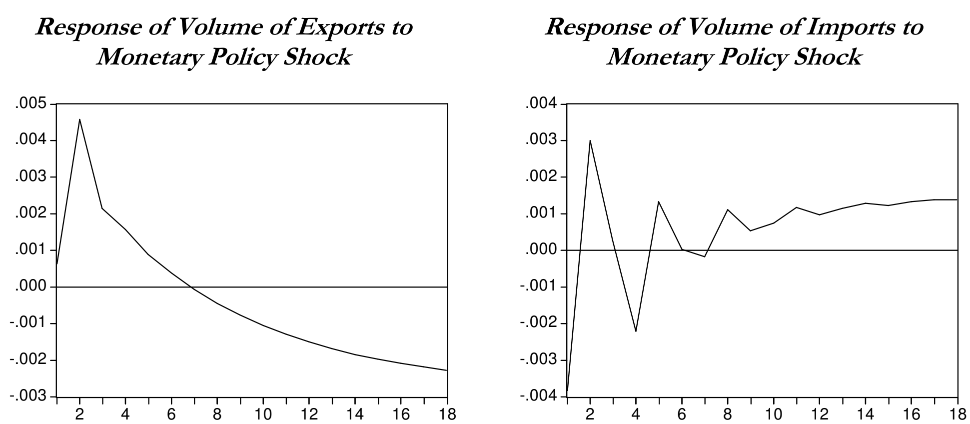
Figure 3: Responses of Export and Import Prices to Monetary Policy Shock



Improvement in terms of trade confirms with the studied above dynamics of interest and exchange rates. Since national currency appreciates because of a contractionary monetary policy shock, the cost of Polish exports to foreigners increases while the cost of foreign imports for Polish people decreases. The outcomes for developed economies also show that policy tightening improves terms of trade. However, one important observation should be emphasized. In case of developed countries no hump-shaped dynamics of responses of export and import prices is observed. As was, for example, found for Germany (Smets and Wouters (1999)) both price indexes decline immediately after a policy tightening, with a decline in import price index being stronger as compared to the decline in export price index. The difference in the initial responses may be explained by several reasons. First, let us consider export prices. As exchange rate appreciates one should expect export prices to increase. However, in a highly competitive economic environment, such as in Euro Area, price increase may result in substitution effect that reduces demand and thus, pushes prices down. In case of developed market economies of Western Europe substitution effect may arise very quickly since high economic integration allows quick switching between different suppliers of imports. In case of transition economies there may be observed a delay in substitution effect because of low external economic integration that prevents quick adjustment to changes in economic environment. Now let us turn to import prices. Although, the response of import prices is more similar to what is observed in developed countries, the initial increase (not vary significant) give rise to the question why such dynamics is actually observed. Currency substitution my cause such reaction of import prices. Since individuals are usually not allowed to perform transactions in foreign currency they first need to exchange it for national currency in order to by imports. But since exchange rate appreciates the purchasing power of foreign currency held by individuals reduces making imports more expensive. Nevertheless, it should be noted that the observed phenomenon of an increase of price of imports is rather weak. A more natural explanation of the initial upward shifts in price indexes by presence of long term contracts may be challenged. First, under uncertainty in economic environment it is unlikely that long term contracts prevail in transition economies. Second, if long term contracts could explain upward shifts in prices then for developed countries, where long-term contracts indeed prevail, a similar upward dynamics would be observed.

The responses of volumes of exports and imports to monetary policy shocks are shown in *Figure 4*. As can be seen exports increase while imports deteriorate on impact. After about two months exports start do decline with a response becoming negative after seven months. The dynamics of imports response is somewhat volatile: changing from positive to negative several times during the first eight months. Only after about nine month does the response of imports to monetary policy shock converge to a stable positive level. The observed responses of export and import indexes reveal some interesting facts about the dynamics of real trade balance after a monetary policy shock, which, should be mentioned, is in contrast to what is typical in developed economies. A common observation in empirical studies is that after a contractionary monetary policy both real exports and imports deteriorate, with a reaction of the former being stronger, that on net leads to worsening of real trade balance. For data at hand the following holds. During the first six months the positive reaction of real exports dominates the response of real imports and thus real trade balance improves. However, in the longer time span (after seven months) situation reverses i.e., imports improve while exports deteriorate and, hence, real trade balance worsens.

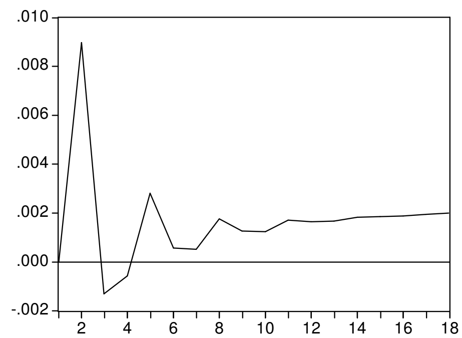
Figure 4: Responses of Exports and Imports to Monetary Policy Shock



Iinferences made above about the impact of policy tightening on real trade balance are somewhat puzzling since currency appreciation provoked by monetary policy shock should lead to deterioration of real net exports and not to its improvement. The observed phenomenon is difficult to explain. However, it has an important policy implication. As economic theory predicts in open economy government that tries to curb inflation in order to achieve macroeconomic stabilization have to sacrifice competitiveness in external sector of its economy to achieve this goal. But as current analysis shows it might be that in transition economies the issues of international competitiveness should be the subject of policy concern only in the long run because currency appreciation does not negatively influences real net exports in the short run. At this stage it is difficult to explain the observed phenomenon without a thorough study of Polish external trade, which would include the investigation of exports composition, determination of main trade partners etc. However, the following suggestion can be made. If the main trade partners of Poland are transition economies of CEE and intermediate goods is a subject of export then it is possible that insufficient international integration and trade barriers make trade environment less competitive and thus, consumers (in CEE countries) find themselves fettered to supplies (in Poland) and substitution effect that should have reduced exports from Poland (after a contractionary monetary policy shock) does not work. Moreover, if these consumers (in CEEC's) aware of such situation their initial response to Polish currency appreciation may be to increase consumption rather then to reduce it in order to accumulate enough reserves before the prices reach their peak.

Nominal trade balance dynamics after a contractionary monetary policy shock is depicted in the *Figure 5* below.

Figure 5: Response on Nominal Trade Balance to Monetary Policy Shock



As can be seen an improvement in terms of trade (discussed earlier) positively influences nominal trade balance. Moreover the initial positive response is magnified by improvement in real trade balance. After some period (about eight months) of fluctuation the response of nominal trade balance to monetary policy shock converges to a stable positive level meaning that in the long run valuation effect (improvement in terms of trade) dominates quantity effect (worsening of real net exports).

Despite the fact that the above analysis revealed interesting facts that point to discrepancies in the reaction of economic variables to monetary policy shocks in developed and transition economies, the obtained results should be considered with caution because of several drawbacks of the analysis which are suggested below.

- The analysis is based on the assumption that information variables of monetary authority are contemporaneously predetermined with respect to policy variable. In other words it is assumed that monetary authorities in Poland observe current values of output and inflation and immediately respond to them by setting discount rate. This assumption may be questioned in case of high frequency data (monthly in this study).

- The information set used in this analysis is constrained to have only two variables (industrial production and CPI). Including too few variables in a model may cause a misspecification problem. However, in current analysis the decision to restrict the number of variables was motivated by small sample size and the fact that presence of lagged variables in VAR quickly consumes degrees of freedom.
- The use of VEC model because of non-stationarity in data does not allow computation of error bands for response functions, so the inferences about significance of the responses cannot be made.
- Finally, the robustness analysis could be of value.

The last chapter of this paper briefly summarizes the main findings, emphasizing on policy implications, and suggest directions for further analysis.

Chapter 7

SUMMARY AND CONCLUSIONS

The analysis in this research was devoted to the study of exchange rate channel of monetary transmission mechanism in transition economies of Central and Eastern European region with a special emphasis on the investigation of the response of external sector variables to monetary policy shocks. The analysis was conducted for Poland which is a representative example of transition economy of CEE region.

As the review of the literature has shown, the impacts of monetary policy shocks on economic variables have been studied in depth for developed economies and thus, the question that naturally arises is whether inferences about MTM that are true for market economies are valid for transition ones. Taking into account striking differences in economic environments in transition and developed countries [27] I argue that that the findings of the analysis of MTM that were obtained for developed economies, probably, do not hold in transition economies.

To investigate whether the findings of the literature on the MTM obtained for developed countries apply to transition countries, I address the following questions:

[27] Weak competition, insufficient development of banking and financial sectors, low levels of openness of the economies to international trade and capital flows, high degree of uncertainty, underdevelopment of market institutions, and improper legislation – these are some features that are uncommon for developed countries but very frequently observed in transition economies

- Do differences in development of financial and banking sectors, and differences in levels of economic integration between Western and Central and Eastern European countries give rise to discrepancies in monetary transmission in these countries?

- What is the relative strength of exchange rate and interest rate channels of monetary transmission in transition economies?

- How do external sector variables, such as trade balance, volumes of export and import, and export and import prices, respond to monetary policy shocks and what consequences does it have for country's competitiveness in international markets?

- Does monetary policy shocks transmitted via exchange rate and interest rate channels of MTM have similar impacts on economic activity (measured by GDP) in a country?

The empirical analysis in this thesis is based on VAR methodology – a standard tool in the literature on MTM. Due to non-stationarity in data VEC specification of VAR model was implemented. To determine monetary policy shocks I used recursive identification method suggested in Christiano et al. (1998). This method is based on the assumption that variables in the information set of monetary authorities are orthogonal to policy shocks. As an instrument of monetary policy I used the discount rate of NBP and, hence, monetary policy shocks were estimated as residuals from discount rate equation in VAR model.

The main findings of the performed analysis can be summarized as follows. First, a contractionary monetary policy shock leads to fall in industrial production and consumer prices. However, with respect to the latter there observed a temporary price puzzle that lasts for about 3 months. The response of CPI to a monetary policy shock is somewhat puzzling from theoretical point of view; however, the observed response dynamics does not contradict the empirical findings in the VAR literature for developed countries.

Second, both interest rate and exchange rate respond positively to monetary policy shock, with the magnitudes of the responses being not significantly different. This implies that both channels of monetary transmission are relatively equal in strength. Observed outcome confirms the hypothesis that weakness of credit channel of monetary transmission in transition countries, caused by underdevelopment of banking sectors, is compensated by relative strength of interest and exchange rate channels of MTM but because of low openness of transition countries to international trade and capital flows exchange rate channel does not dominate in strength the interest rate one as it happens in developed market economies.

Third, the responses of export and import prices to monetary policy shock suggest that after a policy contraction terms of trade improve implying that nominal trade balance should improve. Indeed such reaction of nominal trade balance is observed. An interesting finding of the analysis that contrasts with outcomes for developed countries is a temporary export price puzzle i.e., increase in export prices in response to contractionary monetary policy shock. As was found for developed economies (in particular by Smets and Wouters (1999) for Germany) both export and import price indexes decline immediately after a policy tightening, with a decline in import price index being stronger as compared to the decline in export price index.

Finally, the investigation of the responses of volumes of exports and imports to monetary policy shock shows that initially positive reaction of real exports dominates the response of real imports and thus, real trade balance improves. However, in the longer time span situation reverses i.e., imports improve while exports deteriorate and, hence, real trade balance worsens. This outcome differs from a common observation for developed countries i.e., that after a contractionary monetary policy both real exports and imports deteriorate, with a reaction of the former being stronger, that on net leads to worsening of real trade balance

The empirical findings discussed in the above two paragraphs are in line with the hypothesis that low level of economic integration between transition economies of CEE region results in delayed substitution effects that, in consequence, provokes unexpected (not predicted by the theory) dynamics in the reaction of economic variables to monetary policy shock.

The obtained results beget two important policy implications. First, monetary policy shocks pervaded via interests rate and exchange rate channels of monetary transmission differently influence the main indicator of economic activity in the country, GDP. While shocks transmitted via interest rate channel negatively influence industrial production and thus GDP. Shocks transmitted via exchange rate channel have their most impact on external sector variables and influence nominal and real trade balances. Since positive reaction of the former prevails almost all the time after a policy contraction, one may concluded that shocks pervaded via exchange rate channel positively influence GDP.

Second important policy implication, hypothesized earlier, is that in transition economies (Poland in this particular study) policy contraction does not alter international competitiveness of domestic producers in the short run (real trade balance does not deteriorates after policy contraction) and thus stabilization monetary policies may be implemented without causing serious threat for external sector developments.

The discrepancy between the obtained results and the findings of the literature on the MTM for developed countries gives rise to questions that can be a subject for further investigation and analysis. In particular it would be interesting to check whether the observed differences in the reaction of external sector variables to monetary policy shocks in developed and transition economies are indeed caused by low level of economic integration, currency substitution and some other factors that are common for transition economies but not present in developed ones.

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APPENDIX

Model 4.9

Vector Error Correction Estimates Sample(adjusted): 1995:03 2002:09 Included observations: 91 after adjusting endpoints Standard errors in ( ) & t-statistics in [ ]			
Cointegrating Eq:	CointEq1		
IP(-1)	1.000000		
CPI(-1)	-0.311969 (0.05657) [-5.51484]		
DR(-1)	0.859185 (0.25168) [3.41377]		
C	-4.390134		
Error Correction:	D(IP)	D(CPI)	D(DR)
CointEq1	-0.122223 (0.03081) [-3.96651]	-0.036685 (0.02456) [-1.49359]	-0.087244 (0.02863) [-3.04719]
D(IP(-1))	0.245056 (0.09599) [2.55283]	0.059672 (0.07652) [0.77986]	0.141969 (0.08919) [1.59170]
D(CPI(-1))	-0.119244 (0.12295) [-0.96988]	0.414212 (0.09800) [4.22661]	-0.079629 (0.11424) [-0.69706]
D(DR(-1))	0.099394 (0.10071) [0.98696]	0.178435 (0.08027) [2.22283]	-0.178072 (0.09357) [-1.90304]
C	0.002719 (0.00158) [1.72566]	0.004188 (0.00126) [3.33485]	-0.007156 (0.00146) [-4.88875]
D(IP_EA)	0.020211 (0.13253) [0.15251]	-0.060249 (0.10564) [-0.57034]	-0.017406 (0.12314) [-0.14136]
D(RR_EA)	0.649649 (0.32253) [2.01422]	-0.016256 (0.25709) [-0.06323]	0.251266 (0.29968) [0.83844]
D9708_9804	0.009298 (0.00388) [2.39544]	0.004127 (0.00309) [1.33400]	0.014256 (0.00361) [3.95271]
D9911_0102	0.006893 (0.00377) [1.82884]	0.001314 (0.00300) [0.43739]	0.017243 (0.00350) [4.92386]

(continued on the next page)

R-squared	0.278416	0.320799	0.295635
Adj. R-squared	0.208017	0.254536	0.226916
Sum sq. resids	0.006450	0.004098	0.005569
S.E. equation	0.008869	0.007070	0.008241
F-statistic	3.954857	4.841265	4.302106
Log likelihood	305.6051	326.2412	312.2916
Akaike AIC	-6.518793	-6.972334	-6.665749
Schwarz SC	-6.270466	-6.724007	-6.417422
Mean dependent	0.004588	0.008024	-0.002473
S.D. dependent	0.009966	0.008188	0.009373
Determinant Residual Covariance		2.60E-13	
Log Likelihood		945.3179	
Log Likelihood (d.f. adjusted)		931.1028	
Akaike Information Criteria		-19.80446	
Schwarz Criteria		-18.97670	

Model 4.10

Vector Error Correction Estimates
Sample(adjusted): 1995:03 2002:09
Included observations: 91 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
IP(-1)	1.000000
CPI(-1)	-0.602551 (0.13043) [-4.61987]
MR(-1)	-0.609899 (0.47599) [-1.28132]
DR(-1)	1.705936 (0.50789) [3.35886]
@TREND(95:01)	0.002796 (0.00117) [2.39481]
C	-3.359066

Error Correction:	D(IP)	D(CPI)	D(MR)	D(DR)
CointEq1	-0.101418 (0.02763) [-3.67057]	-0.020245 (0.02241) [-0.90327]	-0.044702 (0.03487) [-1.28199]	-0.105959 (0.02459) [-4.30973]
D(IP(-1))	0.223800 (0.09633) [2.32333]	0.059745 (0.07814) [0.76461]	0.142173 (0.12156) [1.16953]	0.116055 (0.08571) [1.35396]

(continued on the next page)

D(CPI(-1))	-0.124817 (0.12286) [-1.01590]	0.430216 (0.09966) [4.31672]	0.041147 (0.15505) [0.26538]	-0.111617 (0.10933) [-1.02094]
D(MR(-1))	0.137293 (0.08083) [1.69864]	0.010773 (0.06556) [0.16432]	-0.457385 (0.10200) [-4.48409]	-0.079048 (0.07192) [-1.09909]
D(DR(-1))	0.071700 (0.10605) [0.67611]	0.179357 (0.08602) [2.08501]	0.349107 (0.13383) [2.60855]	-0.116403 (0.09436) [-1.23355]
C	0.003931 (0.00157) [2.50346]	0.004494 (0.00127) [3.52792]	-0.005390 (0.00198) [-2.71984]	-0.007011 (0.00140) [-5.01750]
D(IP_EA)	-0.035388 (0.13379) [-0.26450]	-0.064195 (0.10853) [-0.59151]	-0.231511 (0.16885) [-1.37114]	-0.052635 (0.11905) [-0.44212]
D(RR_EA)	0.676008 (0.32196) [2.09968]	-0.024119 (0.26116) [-0.09235]	0.357057 (0.40631) [0.87878]	0.257077 (0.28649) [0.89734]
D9708_9804	0.005475 (0.00349) [1.56853]	0.002537 (0.00283) [0.89589]	0.005494 (0.00441) [1.24725]	0.013261 (0.00311) [4.26927]
D9911_0102	0.004772 (0.00363) [1.31467]	-0.000125 (0.00294) [-0.04230]	0.012303 (0.00458) [2.68603]	0.019355 (0.00323) [5.99314]
R-squared	0.291869	0.309732	0.295564	0.366039
Adj. R-squared	0.213188	0.233036	0.217294	0.295599
Sum sq. resids	0.006330	0.004165	0.010082	0.005012
S.E. equation	0.008840	0.007171	0.011156	0.007866
F-statistic	3.709517	4.038413	3.776186	5.196454
Log likelihood	306.4614	325.5058	285.2859	317.0832
Akaike AIC	-6.515635	-6.934193	-6.050239	-6.749080
Schwarz SC	-6.239716	-6.658274	-5.774321	-6.473162
Mean dependent	0.004588	0.008024	-0.002070	-0.002473
S.D. dependent	0.009966	0.008188	0.012610	0.009373
Determinant Residual Covariance		2.68E-17		
Log Likelihood		1240.867		
Log Likelihood (d.f. adjusted)		1219.680		
Akaike Information Criteria		-25.81715		
Schwarz Criteria		-24.57551		

Model 4.11

Vector Error Correction Estimates Sample(adjusted): 1995:03 2002:09 Included observations: 91 after adjusting endpoints Standard errors in ( ) & t-statistics in [ ]				
Cointegrating Eq:	CointEq1			
IP(-1)	1.000000			
CPI(-1)	-0.225147 (0.30151) [-0.74672]			
ER(-1)	1.676418 (0.64677) [2.59200]			
DR(-1)	4.302085 (0.85923) [5.00691]			
C	-16.96439			
Error Correction:	D(IP)	D(CPI)	D(ER)	D(DR)
CointEq1	-0.027135 (0.00844) [-3.21650]	-0.009124 (0.00677) [-1.34764]	-0.022021 (0.02335) [-0.94309]	-0.030709 (0.00746) [-4.11500]
D(IP(-1))	0.168754 (0.10201) [1.65429]	0.032488 (0.08187) [0.39685]	0.240438 (0.28235) [0.85157]	0.039967 (0.09024) [0.44290]
D(CPI(-1))	0.104821 (0.12517) [0.83745]	0.446683 (0.10045) [4.44682]	-0.521717 (0.34644) [-1.50595]	0.049747 (0.11072) [0.44930]
D(ER(-1))	-0.086419 (0.04395) [-1.96609]	0.008590 (0.03528) [0.24352]	-0.055569 (0.12166) [-0.45676]	-0.036782 (0.03888) [-0.94599]
D(DR(-1))	0.079861 (0.10099) [0.79077]	0.175901 (0.08105) [2.17031]	0.444428 (0.27953) [1.58994]	-0.192715 (0.08934) [-2.15717]
C	0.002615 (0.00158) [1.65291]	0.004287 (0.00127) [3.37739]	0.005812 (0.00438) [1.32748]	-0.007480 (0.00140) [-5.34543]
D(IP_EA)	-0.130509 (0.14474) [-0.90169]	-0.063954 (0.11616) [-0.55058]	0.316449 (0.40061) [0.78991]	-0.127458 (0.12804) [-0.99549]
D(RR_EA)	0.500536 (0.32259) [1.55162]	-0.052073 (0.25889) [-0.20114]	-0.526052 (0.89287) [-0.58917]	0.138716 (0.28536) [0.48611]
D9911_0102	0.003563 (0.00331) [1.07557]	0.000202 (0.00266) [0.07588]	0.005672 (0.00917) [0.61862]	0.017327 (0.00293) [5.91296]

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D9708_9804	0.006151 (0.00359) [1.71434]	0.003211 (0.00288) [1.11521]	0.005536 (0.00993) [0.55739]	0.013942 (0.00317) [4.39248]
R-squared	0.284831	0.317640	0.120009	0.367247
Adj. R-squared	0.205368	0.241822	0.112232	0.296942
Sum sq. resids	0.006393	0.004117	0.048976	0.005003
S.E. equation	0.008884	0.007130	0.024589	0.007859
F-statistic	3.584434	4.189512	1.227380	5.223571
Log likelihood	306.0114	326.0300	213.3680	317.1700
Akaike AIC	-6.505745	-6.945715	-4.469627	-6.750989
Schwarz SC	-6.229826	-6.669796	-4.193708	-6.475070
Mean dependent	0.004588	0.008024	0.003758	-0.002473
S.D. dependent	0.009966	0.008188	0.024867	0.009373
Determinant Residual Covariance		1.19E-16		
Log Likelihood		1173.008		
Log Likelihood (d.f. adjusted)		1151.821		
Akaike Information Criteria		-24.34772		
Schwarz Criteria		-23.13368		

Model 4.12

Vector Error Correction Estimates
Sample(adjusted): 1995:03 2002:09
Included observations: 91 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1			
IP(-1)	1.000000			
CPI(-1)	-3.252025 (1.58374) [-2.05338]			
XP(-1)	2.908311 (1.48468) [1.95888]			
DR(-1)	11.71512 (2.18168) [5.36976]			
@TREND(95:01)	0.034201 (0.01008) [3.39300]			
C	-18.41138			
Error Correction:	D(IP)	D(CPI)	D(XP)	D(DR)
CointEq1	-0.009312 (0.00365) [-2.54839]	-0.003703 (0.00279) [-1.32681]	-0.019339 (0.00958) [-2.01968]	-0.014424 (0.00299) [-4.82559]

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D(IP(-1))	0.197958 (0.10574) [1.87211]	0.040296 (0.08076) [0.49897]	-0.076312 (0.27709) [-0.27541]	0.041356 (0.08650) [0.47813]
D(CPI(-1))	-0.085013 (0.13073) [-0.65030]	0.414119 (0.09984) [4.14775]	-0.036410 (0.34256) [-0.10629]	-0.152606 (0.10694) [-1.42707]
D(XP(-1))	0.043284 (0.04122) [1.05007]	0.010932 (0.03148) [0.34726]	-0.062974 (0.10801) [-0.58302]	0.060702 (0.03372) [1.80025]
D(DR(-1))	0.096865 (0.10633) [0.91096]	0.178906 (0.08121) [2.20298]	0.264291 (0.27864) [0.94851]	-0.178602 (0.08698) [-2.05333]
C	0.003692 (0.00163) [2.26215]	0.004475 (0.00125) [3.59010]	0.006401 (0.00428) [1.49672]	-0.006618 (0.00134) [-4.95732]
D(IP_EA)	-0.000368 (0.14123) [-0.00261]	-0.070458 (0.10786) [-0.65323]	0.090096 (0.37007) [0.24345]	-0.083335 (0.11553) [-0.72136]
D(RR_EA)	0.578768 (0.33869) [1.70882]	-0.035733 (0.25867) [-0.13814]	1.580919 (0.88752) [1.78128]	0.217893 (0.27706) [0.78646]
D9708_9804	0.004523 (0.00369) [1.22668]	0.003014 (0.00282) [1.07030]	0.000746 (0.00966) [0.07722]	0.013837 (0.00302) [4.58802]
D9911_0102	0.002559 (0.00368) [0.69515]	0.000593 (0.00281) [0.21099]	-0.000241 (0.00965) [-0.02496]	0.019416 (0.00301) [6.44670]
R-squared	0.210343	0.317649	0.123805	0.402568
Adj. R-squared	0.122603	0.241832	0.116450	0.336186
Sum sq. resids	0.007059	0.004117	0.048471	0.004723
S.E. equation	0.009335	0.007130	0.024462	0.007636
F-statistic	2.397355	4.189697	1.271687	6.064466
Log likelihood	301.5033	326.0307	213.8398	319.7834
Akaike AIC	-6.406665	-6.945729	-4.479996	-6.808427
Schwarz SC	-6.130747	-6.669810	-4.204077	-6.532508
Mean dependent	0.004588	0.008024	0.004594	-0.002473
S.D. dependent	0.009966	0.008188	0.024792	0.009373
Determinant Residual Covariance		1.46E-16		
Log Likelihood		1163.773		
Log Likelihood (d.f. adjusted)		1142.586		
Akaike Information Criteria		-24.12278		
Schwarz Criteria		-22.88114		

Model 4.13

Vector Error Correction Estimates Sample(adjusted): 1995:04 2002:09 Included observations: 90 after adjusting endpoints Standard errors in ( ) & t-statistics in [ ]				
Cointegrating Eq:	CointEq1			
IP(-1)	1.000000			
CPI(-1)	-3.040995 (1.40530) [-2.16395]			
MP(-1)	2.551097 (1.32509) [1.92523]			
DR(-1)	6.914632 (1.45243) [4.76074]			
@TREND(95:01)	0.025183 (0.00773) [3.25834]			
C	-11.76289			
Error Correction:	D(IP)	D(CPI)	D(MP)	D(DR)
CointEq1	-0.007544 (0.00611) [-1.23481]	-0.005102 (0.00469) [-1.08792]	-0.052011 (0.01308) [-3.97709]	-0.020616 (0.00505) [-4.07836]
D(IP(-1))	0.194539 (0.10808) [1.79989]	0.030485 (0.08296) [0.36748]	0.412101 (0.23135) [1.78131]	0.082221 (0.08942) [0.91945]
D(IP(-2))	-0.009450 (0.10708) [-0.08825]	0.033889 (0.08219) [0.41233]	-0.208074 (0.22920) [-0.90784]	0.120656 (0.08859) [1.36192]
D(CPI(-1))	-0.027094 (0.14926) [-0.18152]	0.406875 (0.11457) [3.55144]	-0.252105 (0.31949) [-0.78908]	-0.204325 (0.12349) [-1.65453]
D(CPI(-2))	0.106685 (0.15214) [0.70122]	-0.063037 (0.11677) [-0.53982]	0.040858 (0.32565) [0.12547]	0.061337 (0.12588) [0.48728]
D(MP(-1))	0.093724 (0.04864) [1.92679]	0.022979 (0.03734) [0.61548]	-0.168296 (0.10412) [-1.61641]	0.042827 (0.04024) [1.06416]
D(MP(-2))	0.007899 (0.05088) [0.15527]	-0.026011 (0.03905) [-0.66610]	-0.249032 (0.10890) [-2.28686]	-0.007927 (0.04209) [-0.18831]
D(DR(-1))	0.173625 (0.12369) [1.40366]	0.235816 (0.09494) [2.48383]	0.221069 (0.26476) [0.83498]	-0.309398 (0.10234) [-3.02325]

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D(DR(-2))	-0.070596 (0.11328) [-0.62320]	0.211445 (0.08695) [2.43189]	0.022226 (0.24247) [0.09166]	-0.080296 (0.09372) [-0.85674]
C	0.003493 (0.00194) [1.80055]	0.006217 (0.00149) [4.17601]	0.003541 (0.00415) [0.85296]	-0.008911 (0.00160) [-5.55264]
D(IP_EA)	-0.001917 (0.14317) [-0.01339]	-0.059776 (0.10989) [-0.54397]	-0.119514 (0.30645) [-0.39000]	-0.024970 (0.11845) [-0.21081]
D(RR_EA)	1.104226 (0.42255) [2.61323]	0.074079 (0.32433) [0.22841]	0.609675 (0.90445) [0.67408]	-0.181089 (0.34960) [-0.51799]
D9708_9804	0.002339 (0.00409) [0.57240]	0.001400 (0.00314) [0.44644]	0.009694 (0.00875) [1.10844]	0.015627 (0.00338) [4.62286]
D9911_0102	-0.001197 (0.00443) [-0.27040]	-0.001779 (0.00340) [-0.52375]	0.020324 (0.00947) [2.14562]	0.022251 (0.00366) [6.07716]
R-squared	0.274255	0.363344	0.284355	0.442237
Adj. R-squared	0.150115	0.254442	0.161943	0.346830
Sum sq. resids	0.006437	0.003792	0.029492	0.004406
S.E. equation	0.009203	0.007064	0.019699	0.007614
F-statistic	2.209234	3.336441	2.322920	4.635279
Log likelihood	301.8424	325.6532	233.3511	318.8991
Akaike AIC	-6.396498	-6.925628	-4.874469	-6.775535
Schwarz SC	-6.007638	-6.536768	-4.485610	-6.386676
Mean dependent	0.004680	0.007926	0.004295	-0.002500
S.D. dependent	0.009983	0.008181	0.021518	0.009421
Determinant Residual Covariance		9.09E-17		
Log Likelihood		1181.786		
Log Likelihood (d.f. adjusted)		1151.352		
Akaike Information Criteria		-24.23005		
Schwarz Criteria		-22.53574		

Model 4.14

Vector Error Correction Estimates
Sample(adjusted): 1995:04 2002:09
Included observations: 90 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
IP(-1)	1.000000
CPI(-1)	-0.012443 (0.13761) [-0.09042]

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NX(-1)	0.425486 (0.15182) [2.80259]			
DR(-1)	2.292857 (0.58995) [3.88653]			
C	-7.446022			
Error Correction:	D(IP)	D(CPI)	D(NX)	D(DR)
CointEq1	-0.030383 (0.01392) [-2.18265]	-0.005296 (0.01136) [-0.46614]	-0.001493 (0.06860) [-0.02177]	-0.056168 (0.01216) [-4.61775]
D(IP(-1))	0.321910 (0.11135) [2.89088]	0.038210 (0.09088) [0.42044]	-0.791597 (0.54873) [-1.44259]	0.076661 (0.09730) [0.78789]
D(IP(-2))	-0.083929 (0.10969) [-0.76516]	0.043604 (0.08952) [0.48708]	0.111034 (0.54052) [0.20542]	0.096080 (0.09584) [1.00247]
D(CPI(-1))	0.016246 (0.13622) [0.11927]	0.421066 (0.11117) [3.78755]	-0.226173 (0.67126) [-0.33694]	-0.126604 (0.11902) [-1.06368]
D(CPI(-2))	0.060362 (0.13752) [0.43895]	-0.043189 (0.11223) [-0.38482]	-0.831541 (0.67766) [-1.22707]	0.173955 (0.12016) [1.44769]
D(NX(-1))	-0.061373 (0.02223) [-2.76133]	-0.023415 (0.01814) [-1.29085]	-0.530488 (0.10952) [-4.84353]	0.020288 (0.01942) [1.04469]
D(NX(-2))	-0.000337 (0.02168) [-0.01552]	-0.018289 (0.01770) [-1.03348]	-0.468454 (0.10685) [-4.38405]	0.013546 (0.01895) [0.71493]
D(DR(-1))	0.134249 (0.11521) [1.16527]	0.205480 (0.09402) [2.18538]	1.206100 (0.56773) [2.12443]	-0.338074 (0.10067) [-3.35834]
D(DR(-2))	-0.016479 (0.10730) [-0.15358]	0.217079 (0.08757) [2.47884]	-0.078933 (0.52877) [-0.14928]	-0.110267 (0.09376) [-1.17606]
C	0.003144 (0.00182) [1.72502]	0.005958 (0.00149) [4.00485]	0.007060 (0.00898) [0.78597]	-0.009647 (0.00159) [-6.05693]
D(IP_EA)	0.031934 (0.13635) [0.23420]	-0.061369 (0.11128) [-0.55148]	-0.475345 (0.67192) [-0.70744]	-0.064050 (0.11914) [-0.53759]
D(RR_EA)	0.851934 (0.39388) [2.16294]	0.044870 (0.32145) [0.13959]	0.898419 (1.94097) [0.46287]	-0.259703 (0.34416) [-0.75459]

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D9708_9804	0.002795 (0.00361) [0.77467]	0.000593 (0.00295) [0.20143]	0.009853 (0.01778) [0.55408]	0.014377 (0.00315) [4.55957]
D9911_0102	0.000516 (0.00357) [0.14442]	-0.002680 (0.00291) [-0.91951]	0.026319 (0.01760) [1.49553]	0.019537 (0.00312) [6.26072]
R-squared	0.362918	0.368124	0.426283	0.453885
Adj. R-squared	0.253943	0.260040	0.328148	0.360470
Sum sq. resids	0.005651	0.003764	0.137220	0.004314
S.E. equation	0.008623	0.007037	0.042491	0.007534
F-statistic	3.330298	3.405907	4.343813	4.858828
Log likelihood	307.7059	325.9924	164.1647	319.8488
Akaike AIC	-6.526797	-6.933164	-3.336993	-6.796639
Schwarz SC	-6.137938	-6.544305	-2.948133	-6.407780
Mean dependent	0.004680	0.007926	-0.002280	-0.002500
S.D. dependent	0.009983	0.008181	0.051840	0.009421
Determinant Residual Covariance		3.52E-16		
Log Likelihood		1120.831		
Log Likelihood (d.f. adjusted)		1090.397		
Akaike Information Criteria		-22.89771		
Schwarz Criteria		-21.23117		

Model 4.15

Vector Error Correction Estimates
Sample(adjusted): 1995:03 2002:09
Included observations: 91 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1			
IP(-1)	1.000000			
CPI(-1)	-0.297956 (0.20786) [-1.43347]			
XV(-1)	0.325271 (0.16617) [1.95742]			
DR(-1)	2.058502 (0.52858) [3.89443]			
C	-7.540079			
Error Correction:	D(IP)	D(CPI)	D(XV)	D(DR)
CointEq1	-0.044876 (0.01362) [-3.29506]	-0.018256 (0.01083) [-1.68615]	-0.053240 (0.03350) [-1.58914]	-0.047253 (0.01236) [-3.82378]

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D(IP(-1))	0.330841 (0.11452) [2.88894]	0.089114 (0.09104) [0.97884]	0.038709 (0.28171) [0.13741]	0.117323 (0.10391) [1.12904]
D(CPI(-1))	-0.097956 (0.12369) [-0.79197]	0.406549 (0.09833) [4.13463]	-0.002649 (0.30426) [-0.00871]	-0.114570 (0.11223) [-1.02084]
D(XV(-1))	-0.108789 (0.05169) [-2.10454]	-0.042854 (0.04109) [-1.04282]	-0.077412 (0.12716) [-0.60878]	-0.021591 (0.04690) [-0.46031]
D(DR(-1))	0.077723 (0.10039) [0.77422]	0.169877 (0.07981) [2.12860]	0.621736 (0.24695) [2.51764]	-0.201120 (0.09109) [-2.20788]
C	0.003587 (0.00154) [2.32594]	0.004415 (0.00123) [3.60098]	0.006046 (0.00379) [1.59361]	-0.006651 (0.00140) [-4.75231]
D(IP_EA)	0.016719 (0.13292) [0.12578]	-0.066471 (0.10567) [-0.62904]	-0.033062 (0.32699) [-0.10111]	-0.046969 (0.12061) [-0.38942]
D(RR_EA)	0.564075 (0.32030) [1.76107]	-0.041037 (0.25463) [-0.16116]	0.588283 (0.78793) [0.74662]	0.208278 (0.29064) [0.71662]
D9708_9804	0.007249 (0.00364) [1.99342]	0.004178 (0.00289) [1.44534]	0.014669 (0.00895) [1.63989]	0.014218 (0.00330) [4.30907]
D9911_0102	0.005311 (0.00347) [1.53073]	0.001788 (0.00276) [0.64836]	0.018627 (0.00853) [2.18247]	0.017748 (0.00315) [5.63750]
R-squared	0.294471	0.339455	0.189850	0.343202
Adj. R-squared	0.216079	0.266061	0.169834	0.270224
Sum sq. resids	0.006307	0.003986	0.038165	0.005193
S.E. equation	0.008824	0.007015	0.021707	0.008007
F-statistic	3.756390	4.625104	2.109058	4.702838
Log likelihood	306.6289	327.5084	224.7163	315.4729
Akaike AIC	-6.519316	-6.978207	-4.719040	-6.713691
Schwarz SC	-6.243398	-6.702288	-4.443121	-6.437772
Mean dependent	0.004588	0.008024	0.008652	-0.002473
S.D. dependent	0.009966	0.008188	0.022879	0.009373
Determinant Residual Covariance		8.29E-17		
Log Likelihood		1189.509		
Log Likelihood (d.f. adjusted)		1168.322		
Akaike Information Criteria		-24.71038		
Schwarz Criteria		-23.49634		

Model 4.16

Vector Error Correction Estimates Sample(adjusted): 1995:04 2002:09 Included observations: 90 after adjusting endpoints Standard errors in ( ) & t-statistics in [ ]				
Cointegrating Eq:	CointEq1			
IP(-1)	1.000000			
CPI(-1)	-0.939279 (0.24418) [-3.84664]			
MV(-1)	0.527917 (0.20302) [2.60029]			
DR(-1)	0.421150 (0.28211) [1.49286]			
C	-3.445073			
Error Correction:	D(IP)	D(CPI)	D(MV)	D(DR)
CointEq1	-0.108736 (0.02493) [-4.36099]	-0.054369 (0.02080) [-2.61361]	-0.386757 (0.10492) [-3.68614]	-0.021028 (0.02586) [-0.81324]
D(IP(-1))	0.350039 (0.10505) [3.33213]	0.072281 (0.08764) [0.82473]	1.005881 (0.44205) [2.27549]	0.180091 (0.10894) [1.65310]
D(IP(-2))	0.131084 (0.10403) [1.26002]	0.024459 (0.08679) [0.28181]	0.103183 (0.43777) [0.23570]	0.175439 (0.10789) [1.62614]
D(CPI(-1))	-0.179008 (0.13749) [-1.30198]	0.335941 (0.11471) [2.92872]	0.244221 (0.57856) [0.42212]	-0.137538 (0.14258) [-0.96462]
D(CPI(-2))	0.014628 (0.13793) [0.10605]	-0.123862 (0.11508) [-1.07635]	-0.125763 (0.58042) [-0.21668]	0.194297 (0.14304) [1.35832]
D(MV(-1))	-0.028357 (0.02593) [-1.09379]	0.003372 (0.02163) [0.15590]	-0.824968 (0.10910) [-7.56183]	-0.011118 (0.02689) [-0.41352]
D(MV(-2))	-0.061137 (0.02415) [-2.53138]	0.012824 (0.02015) [0.63644]	-0.498548 (0.10163) [-4.90547]	-0.014379 (0.02505) [-0.57411]
D(DR(-1))	0.137986 (0.10921) [1.26347]	0.235209 (0.09111) [2.58145]	0.505817 (0.45957) [1.10064]	-0.314490 (0.11326) [-2.77676]
D(DR(-2))	-0.077590 (0.10013) [-0.77487]	0.213639 (0.08354) [2.55733]	0.245330 (0.42136) [0.58223]	-0.094438 (0.10384) [-0.90944]

(continued on the next page)

C	0.003590 (0.00172) [2.09244]	0.006382 (0.00143) [4.45905]	0.013380 (0.00722) [1.85332]	-0.008838 (0.00178) [-4.96773]
D(IP_EA)	0.023575 (0.12641) [0.18649]	-0.073743 (0.10547) [-0.69922]	0.139068 (0.53195) [0.26143]	-0.003706 (0.13110) [-0.02827]
D(RR_EA)	1.103406 (0.36992) [2.98285]	0.224979 (0.30862) [0.72899]	2.334635 (1.55662) [1.49981]	-0.037583 (0.38362) [-0.09797]
D9708_9804	0.010053 (0.00379) [2.65007]	0.004300 (0.00316) [1.35872]	0.038657 (0.01596) [2.42158]	0.010943 (0.00393) [2.78151]
D9911_0102	0.004625 (0.00353) [1.30971]	0.000361 (0.00295) [0.12245]	0.015080 (0.01486) [1.01484]	0.013584 (0.00366) [3.70931]
R-squared	0.429411	0.408605	0.592491	0.311037
Adj. R-squared	0.331811	0.307446	0.522786	0.193189
Sum sq. resids	0.005061	0.003523	0.089616	0.005443
S.E. equation	0.008160	0.006808	0.034339	0.008463
F-statistic	4.399678	4.039216	8.499919	2.639291
Log likelihood	312.6662	328.9718	183.3370	309.3927
Akaike AIC	-6.637027	-6.999374	-3.763045	-6.564282
Schwarz SC	-6.248168	-6.610515	-3.374186	-6.175423
Mean dependent	0.004680	0.007926	0.009537	-0.002500
S.D. dependent	0.009983	0.008181	0.049708	0.009421
Determinant Residual Covariance		2.35E-16		
Log Likelihood		1139.117		
Log Likelihood (d.f. adjusted)		1108.683		
Akaike Information Criteria		-23.30406		
Schwarz Criteria		-21.63752		