

Gottschalk, Jan; Moore, David

**Working Paper — Digitized Version**

## Implementing inflation targeting regimes: The case of Poland

Kiel Working Paper, No. 956

**Provided in Cooperation with:**

Kiel Institute for the World Economy – Leibniz Center for Research on Global Economic Challenges

*Suggested Citation:* Gottschalk, Jan; Moore, David (1999) : Implementing inflation targeting regimes: The case of Poland, Kiel Working Paper, No. 956, Kiel Institute of World Economics (IfW), Kiel

This Version is available at:

<https://hdl.handle.net/10419/47020>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# Kieler Arbeitspapiere

# Kiel Working Papers

Kiel Working Paper No. 956

Implementing Inflation Targeting Regimes –  
The Case of Poland

by

Jan Gottschalk and David Moore



Institut für Weltwirtschaft an der Universität Kiel  
The Kiel Institute of World Economics

ISSN 0342 - 0787

Kiel Institute of World Economics  
Düsternbrooker Weg 120  
D-24105 Kiel

Kiel Working Paper No. 956  
Implementing Inflation Targeting Regimes –  
The Case of Poland

by  
Jan Gottschalk and David Moore

October 1999

366 923 781

The authors themselves, not the Kiel Institute of World Economics, are solely responsible for the contents and distribution of each Kiel Working Paper.

Since the series involves manuscripts in a preliminary form, interested readers are requested to direct criticisms and suggestions directly to the authors and to clear any quotations with them.

## Contents

1. Introduction.....	1
2. Issues in Implementing Inflation Targets .....	2
2.1 General Considerations .....	2
2.2 Developing and Transition Economies.....	5
3. Polish Inflation and Monetary Policy in the 1990s.....	7
3.1 Inflation.....	7
3.2 Monetary Policy .....	9
3.3 The New Inflation Targeting Framework .....	11
3.4 Prerequisites for the New Framework .....	13
4. The Policy Instruments and their Effects on Inflation.....	17
4.1 A Multivariate Cointegration Analysis .....	19
4.2 An Impulse Response Analysis.....	25
5. Conclusions.....	37
Appendix .....	40
I. Sources and Graphs of the Data.....	40
II. Results of the Stationarity Tests .....	41
III. Cointegration Analysis - The five variable VAR .....	42
IV. Impulse Response Analysis .....	43
References .....	45

## **Abstract**

This paper assesses the prospects for the new Polish monetary policy strategy of inflation targeting. Regarding the general requirements for implementing an inflation targeting strategy it appears that Poland has made sufficient progress in reducing fiscal dominance and hardening budget constraints. The paper also finds that the exchange rate has played a dominant role as a policy instrument, with the linkages between the short-term interest rate and inflation remaining unclear. Given this uncertainty, modification of some details of the strategy – such as widening the target range or lengthening the target horizon – might be helpful (E52, E58, keywords: inflation targeting, transmission mechanism in Poland).

## 1. Introduction<sup>1</sup>

A number of industrialised economies have adopted inflation targets as a strategy for monetary policy over the past decade, including New Zealand, Canada, the United Kingdom, Sweden, Australia and Israel.<sup>2</sup> The apparent success of inflation targeting in these countries has sparked increasing interest from developing and transitional economies. The Czech Republic adopted an inflation targeting regime in early 1998<sup>3</sup>, and in September last year, Poland announced its intention of implementing an inflation target from 1999.

This paper assesses the prospects for the new monetary policy strategy in Poland. Section 2 discusses the requirements for implementing an inflation targeting strategy, both in general and in the cases of developing and transitional economies. Section 3 reviews the evolution of inflation and monetary policy in Poland since the changes of 1989, outlines the new framework for monetary policy, and considers whether the prerequisites for this framework are in place. Section 4 provides some empirical evidence on the links between the instruments of Polish monetary policy and inflation. Section 5 concludes, with an assessment of the new framework.

---

<sup>1</sup> We are grateful to Claudia Buch and Jörg Döpke for helpful comments. Any remaining errors are ours alone.

<sup>2</sup> Finland and Spain also adopted inflation targets prior to European economic and monetary union.

<sup>3</sup> Orłowski (1998) considers early experience with the Czech inflation targeting regime.

## 2. Issues in Implementing Inflation Targets

### 2.1 General Considerations<sup>4</sup>

There are two fundamental requirements for an inflation targeting strategy to be successful in any country.<sup>5</sup> First, the country must not be subject to “fiscal dominance”; that is, monetary policy must not be subordinated to fiscal requirements (see section 2.2).<sup>6</sup> Second, the authorities must not make firm commitments to target the level or path of any other nominal variable, such as the nominal exchange rate (or wages), since such commitments would in general be inconsistent with the inflation target.

Any country implementing an inflation targeting strategy must also resolve a number of operational and conceptual issues related to the specification of the target variable.

The first issue is which measure of inflation to target. Inflation-targeting countries often target some “underlying” or “core” variant of the consumer price index which excludes price movements directly due to policy changes (such as interest charges), or the effects of temporary supply shocks.<sup>7</sup>

---

<sup>4</sup> The literature on this topic has exploded over the past few years. See for example Debelle (1997), Haldane (1997), Bernanke et al. (1999).

<sup>5</sup> See for example Masson et al. (1997).

<sup>6</sup> Masson et al. make the more stringent claim that the central bank must have some degree of instrument independence. While this may be a highly desirable condition, it is not strictly necessary. In the United Kingdom, for example, the Bank of England has targeted inflation since 1992, but until 1997 did so without instrument independence – monetary policy decisions were made by the Chancellor of the Exchequer, while the Bank of England had only an advisory role.

<sup>7</sup> Debelle (1997) argues that any components of the CPI which are to be excluded from the inflation target should be specified ex ante rather than ex post, to safeguard the credibility to the target.

This issue is increasingly recognised as conceptual as well as definitional, particularly for small open economies. Ball (1998) argues that policy should target “long-run inflation”, adjusted for the effect of transitory exchange rate influences. Bharucha and Kent (1998) observe that targeting aggregate inflation may not necessarily be preferable to targeting non-traded inflation, since the optimal target depends on whether shocks are mainly demand and supply shocks or mainly exchange rate shocks. Bharucha and Kent show that targeting non-traded inflation allows central banks to tolerate larger exchange rate shocks, with an aggregate inflation target implying a greater interest rate response. On the other hand, the policy response to demand or supply shocks is greater for a non-traded inflation target.

Another fundamental issue is the level of the target. Industrialised inflation targeters typically aim at a rate in the neighbourhood of 2 per cent a year, consistent with price stability but allowing for quality biases in the CPI.<sup>8</sup> Also, given that monetary policy has only limited control over the inflation rate, targets are generally specified as a range. Narrow ranges are more likely to be breached on occasion, but may be perceived as reflecting a stronger commitment to the target.

The bandwidth is intimately related to the horizon for the target. A central issue is how quickly inflation is to be brought back to target following a shock. A narrow range may induce instrument instability if the horizon is short; the *mix* of monetary policy between the interest rate and the exchange rate also depends on the horizon, because exchange rate changes have a relatively fast effect on traded goods prices, while interest rate changes generally influence inflation via

---

<sup>8</sup> Economic arguments for a small positive rate of inflation include allowing real wage adjustment when nominal wages are rigid downwards (Akerlof et al. 1996). There is also a choice between targeting inflation or the price level; in practice, price level targets have been avoided because they imply that additional policy shifts are required to offset past errors, for example with overshoots requiring periods of deflation.



the output gap and therefore are slower to take effect. This implies that the horizon should be sufficiently long to take the burden of adjustment off the exchange rate, especially since excessive swings in the exchange rate can damage the traded goods sector. It also implies a potential tradeoff between the *variability* of inflation and the *variability* of output, even in the presence of a vertical long-run Phillips curve.<sup>9</sup>

Inflation targeting is complicated in other ways by the lags between policy actions and inflation outcomes. One implication is that inflation targeting must be forward-looking; more concretely, the central bank uses its *conditional forecast* of inflation as its intermediate target (Svensson, 1997a). In turn, this implies that the central bank must be able to forecast inflation reasonably accurately. It also implies a need for reliable linkages between the instruments of monetary policy and inflation outcomes, and for policy changes to have predictable effects on inflation.

Central bank accountability and transparency – the justification of monetary policy decisions in terms of the inflation target – are particularly important given the lags of policy.<sup>10</sup> Several inflation-targeting countries publish regular reports discussing the outlook for inflation; testimony of the central bank governor before parliament is also increasingly common. These processes are especially important when inflation is away from its target. Breaches of the target may be due to policy errors, or to shocks outside the control of the central

---

<sup>9</sup> Svensson (1997b) distinguishes between “strict” and “flexible” inflation targeting. Strict targeters (or “inflation nutters” in Mervyn King’s terminology) seek to minimise deviations of inflation from the target regardless of output costs, while flexible targeters seek to minimise (a weighted sum of) both inflation and output variability. Note that while the tradeoff between inflation variability and output variability exists for exchange rate shocks when the target horizon is short, it does not in the case of demand shocks. Svensson stresses that in the case of demand shocks, stabilising inflation also implies stabilising output.

<sup>10</sup> See Debelle (1997).

bank – but because of the long and variable policy lags, the cause of the breach may be unclear when agents assess the performance of the bank. This poses a risk to the credibility of the central bank and its capacity to influence inflation expectations. The risk is minimised when the central bank explains its policy actions in the context of the inflation outlook, because agents are encouraged to assess the performance of the bank *ex ante*, using a similar information set to the bank, rather than with the luxury of hindsight denied to the bank when the policy decisions have to be made.

## 2.2 Developing and Transition Economies

Developing countries may face additional impediments to inflation targeting, which must be dealt with as a precondition for the strategy to succeed. First, fiscal dominance is more likely to be a problem than in more advanced economies. Second, and more generally, soft budget constraints can also force monetary policy to be accommodative, particularly in transition economies. These problems imply that disinflation is likely to be more costly than in advanced economies. A third problem is that the authorities frequently lack an adequate analytical framework for forecasting inflation or for assessing the effects of adjustments to monetary policy.<sup>11</sup>

Fiscal dominance means that monetary policy is constrained by fiscal developments. Masson, Savastano and Sharma (1997) list the following general requirements for avoiding fiscal dominance: low or no public sector direct borrowing from the central bank; a broad revenue base for the government; domestic financial markets with sufficient depth to absorb debt issues;<sup>12</sup> and the

---

<sup>11</sup> This need not imply any lack of ability on part of the authorities; the new European Central Bank has faced a similar issue.

<sup>12</sup> Masson et al. note that shallow financial markets may be indicators of financial repression; they may also cause fiscal dominance if governments have limited access to alternative financing.

sustainability of any accumulation of public debt. Wagner (1998) observes that in the presence of fiscal dominance, central bank independence may be counterproductive by allowing the fiscal authority to avoid the responsibility for breaching an inflation target by passing the blame to the central bank.

The relative size of seigniorage is perhaps the most important indicator of fiscal dominance – inflation targeting will not be credible in countries where governments rely systematically and significantly on the revenues from the inflation tax.<sup>13</sup> Masson et al. note that developing countries generally rely much more on seigniorage than advanced economies. Between 1980 and 1995, average annual seigniorage in their sample of developing countries ranged from 1.4 per cent to 3 per cent of GDP, but was consistently less than 1 per cent of GDP in advanced economies.

Fiscal dominance implies that governments face soft budget constraints. More generally, soft budget constraints are inconsistent with an inflation target, whether they apply only to the fiscal authorities or extend to the enterprise sector. Soft budget constraints were an important feature of the centrally planned economies, and their hardening is an important aspect of the transition. Soft budget constraints typically take four main forms (Kornai, 1980). First, *price-making* firms can pass on cost increases to customers and consumers.<sup>14</sup> Second, the tax system may be soft, with no close relationship between a firm's before- and after-tax income. Third, firms may receive subsidies and state grants. Fourth, firms may receive soft credits – debt may be rescheduled easily, default may go unpunished, or customers may arbitrarily postpone payments.

---

<sup>13</sup> Seigniorage is the profit earned from issuing currency. The simplest measure of seigniorage is the change in the monetary base divided by nominal GDP.

<sup>14</sup> Raiser (1997) suggests that this can be more important on the input side, since output prices are not infinitely flexible even in the case of monopoly.

These various forms of soft budget constraint undermine the inflation target in different ways. Excessive subsidies can contribute to a fiscal dominance problem. Soft credits channelled through the banking sector can undermine bank soundness, placing pressure on the central bank to loosen monetary conditions and create credit to bail out troubled banks.

Special issues apply in the cases of those central European transition economies which aspire to join the European Union, and eventually to adopt the euro. The Maastricht convergence criteria on inflation, the exchange rate and long-term interest rates are directly relevant for the monetary policy of these countries. Orłowski (1998) suggests a strategy of inflation targeting for these countries for the next few years, with the aim of entrenching low inflation first and only then fixing the exchange rate to the euro.

### **3. Polish Inflation and Monetary Policy in the 1990s**

#### **3.1 Inflation**

Following initial price liberalisation in 1989 and the abolition of most price controls with the January 1990 “Big Bang” reforms, previously repressed inflation emerged strongly. Consumer prices increased by more than 1100 per cent in the year to January 1990.<sup>15</sup>

The initial stabilisation was successful, bringing inflation back to below 100 per cent by early 1991. The authorities then chose to continue disinflating at a more moderate pace, judging that the costs of further rapid disinflation would have been unacceptably high. Reasons included the weak fiscal position and significant structural rigidities, including widespread indexation. Although Poland

---

<sup>15</sup> Sachs (1993) reports that consumer prices increased by 80 per cent in the first two weeks of January 1990.

made major progress reducing its large fiscal imbalances by 1993, inflation became entrenched at around 30 per cent for several years.

Relative price adjustment was an important source of inflation through this period (Pujol and Griffiths, 1996).<sup>16</sup> Inflationary pressures were aggravated by pervasive wage-price indexation and the absence of hard budget constraints on unreformed enterprises.<sup>17</sup> Although the biggest shifts took place between 1989 and 1991, relative prices continued to adjust through the mid-1990s. Pujol and Griffiths also found that while the prices of Polish goods were generally below world prices, the degree of undervaluation varied greatly for different goods, implying considerable scope for further relative price adjustment.<sup>18</sup>

Pujol and Griffiths also estimated a mark-up model of inflation, finding that wages were much more indexed than prices, and that CPI inflation was driven mainly by wages and domestic producer prices. Pass-through of exchange rate adjustments was slow; Pujol and Griffiths found that the exchange rate had a weak *initial* impact on inflation, but that this impact was magnified by the high degree of indexation. The IMF (1997) found that the exchange rate was responsible for the reduction in inflation achieved since 1995; it also concluded that considerable indexation remained in the Polish economy.

---

<sup>16</sup> Wozniak (1998) stresses the role of increases in administered prices in driving relative price adjustment and the inflationary process.

<sup>17</sup> Coorey et al. (1997) discuss the importance of relative price adjustment in the inflation process in 21 transition economies. They argue that the tradeoff between growth and inflation worsens when relative price changes are important.

<sup>18</sup> Administered prices accounted for 10.6 per cent of the Polish CPI basket in 1997 (EBRD, 1998). The IMF (1997) puts this figure closer to 20 per cent; it includes not only goods with officially set prices (utilities, medicines and spirit alcohol) but also goods whose prices are strongly influenced by excise taxes (beer, wine, tobacco and liquid fuel and gasoline).

Poland made further progress in disinflation in the second half of the 1990s as the authorities continued to tighten monetary and fiscal policy. Disinflation was reportedly stronger than expected in 1998.<sup>19</sup> Inflation fell below 10 per cent in 1998 for the first time since the transition; consumer prices increased by around 6 per cent in the year to April 1999 (Graph 3.1).

### 3.2 Monetary Policy<sup>20</sup>

In the early stages of stabilisation, the Polish authorities used a fixed exchange rate to tame near-hyperinflation. Poland then shifted to a crawling peg arrangement to pursue more gradual disinflation, and over time has allowed increasing exchange rate flexibility.

In January 1990, against a background of near-hyperinflation, Poland abolished its old multiple exchange system and, after an initial devaluation, adopted a unified fixed exchange rate against the US dollar. Broad money (M2) growth was defined as the intermediate objective of monetary policy.

In May 1991, the zloty was devalued by 17 per cent against the dollar to avoid an excessive appreciation of the real exchange rate, which had become a concern as Poland's external position deteriorated. The authorities also shifted from a dollar peg to a basket peg.<sup>21</sup> In October, the fixed peg was replaced by a crawling peg regime, initially with a monthly rate of crawl of 1.8 per cent. Although this represented a shift to a more gradual path of disinflation, the exchange rate retained its nominal anchor role with the preannounced rate of

---

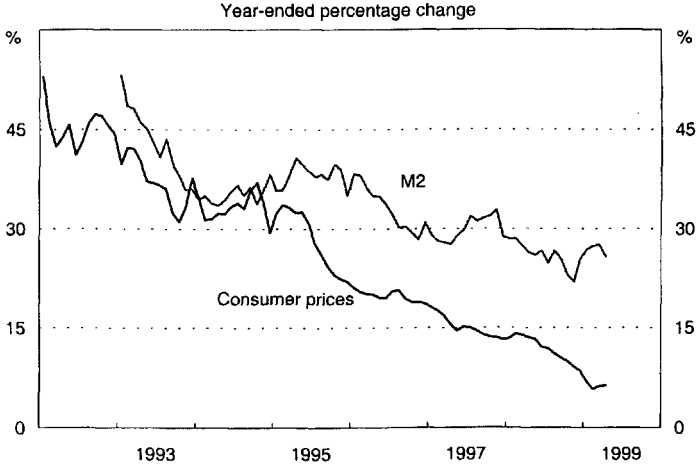
<sup>19</sup> IMF, *Poland – 1998 Article IV Consultation, Concluding Statement*, December 15, 1998.

<sup>20</sup> Kokoszcyński (1997) and the IMF (1997) review Polish monetary policy in the early and mid-1990s, while the OECD (1998) focuses on the conduct of policy over the past five years.

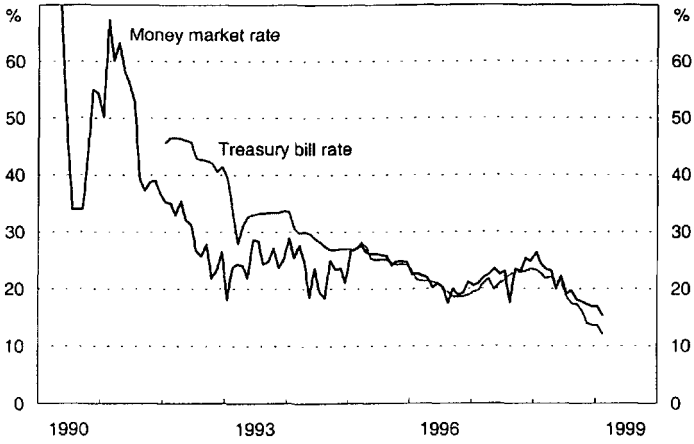
<sup>21</sup> The basket included the US dollar (45 per cent), Deutschemerk (35 per cent), pound sterling (10 per cent), French franc (5 per cent) and Swiss franc (5 per cent). The basket has since been modified with the introduction of the euro.

crawl substantially less than the expected change in (producer) prices. Restrictive fiscal and incomes policies also began to augment monetary policy as anchors for disinflation.

**Graph 3.1: Prices and Money**



**Graph 3.2: Short-Term Interest Rates**



The early 1990s also saw the initial development of indirect instruments for monetary policy.<sup>22</sup> The introduction of treasury bill auctions in May 1991, and later of one- and three-year bond issues, allowed the National Bank of Poland (NBP) to begin using open market operations as the main instrument of monetary policy from early 1993, and short-term money market interest rates as the operational<sup>23</sup> target. Interest rates were reduced steadily through the mid-1990s as inflation fell (Graph 3.2). The operational target of monetary policy has since shifted back and forth; the NBP adopted reserve money as its chief target in December 1995, but switched back to targeting short-term interest rates in February 1998.

The rate of crawl has been periodically reduced through the 1990s. Also, interest rates have become increasingly important in the monetary policy mix over the past few years. In 1996 the rate of crawl was still much less than inflation while real interest rates remained low; in 1997 the rate of crawl just exceeded inflation, while nominal interest rates were increased sharply. The NBP has also allowed an increasing degree of exchange rate flexibility. In 1995, the zloty was allowed to fluctuate within  $\pm 7$  per cent of its central parity. This range was expanded to  $\pm 10$  per cent in February 1998, and the monthly rate of crawl slowed to 0.8 per cent.

### **3.3 The New Inflation Targeting Framework**

The Monetary Policy Council (MPC) of the National Bank of Poland was formed in February 1998. The MPC announced in September 1998 its decision to shift to an inflation-targeting framework (MPC, 1998).

---

<sup>22</sup> Ugolini (1996) reviews the modernisation of the National Bank of Poland and its development of indirect instruments for monetary policy.

<sup>23</sup> As distinct from intermediate.



The main features of its strategy are:

- \* Targeting the official Consumer Price Index;
- \* Reduction of inflation to below 4 per cent by 2003;
- \* An inflation target for 1999 in the range of 8 to 8.5 per cent;
- \* Targets to be set for a time span of one year;
- \* Publication of a semi-annual *Inflation Report*;
- \* The “reference rate”<sup>24</sup> will be the main instrument of monetary policy.

The strategy is partly motivated by the goal of Polish entry into the European Union, and eventual adoption of the euro. For monetary policy, the Maastricht convergence criteria on inflation, the exchange rate and long-term interest rates are relevant – implying in particular a need to “reduce inflation to the level not exceeding 3-4% annually in a relatively short time”.<sup>25</sup>

In the medium term, this implies a need for the exchange rate to be allowed additional flexibility to vary with market conditions. In March 1999, the trading range for the zloty was further expanded to  $\pm 15$  per cent, and the monthly rate of crawl of the central parity reduced to 0.3 per cent. The MPC has foreshadowed a period in which the exchange rate will float freely, allowing it to adjust to an “equilibrium” level at which Poland can enter the European Exchange Rate Mechanism (ERM-II), and later EMU.

---

<sup>24</sup> The rate of interest on short-term open market operations.

<sup>25</sup> MPC (1998, p. 6).

### 3.4 Prerequisites for the New Framework

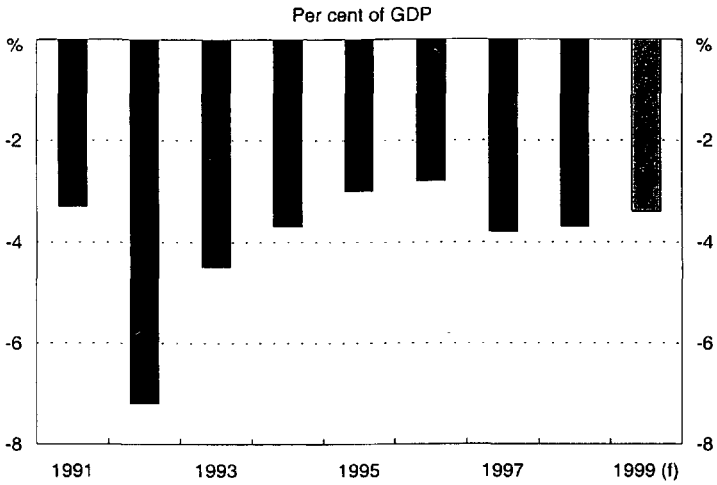
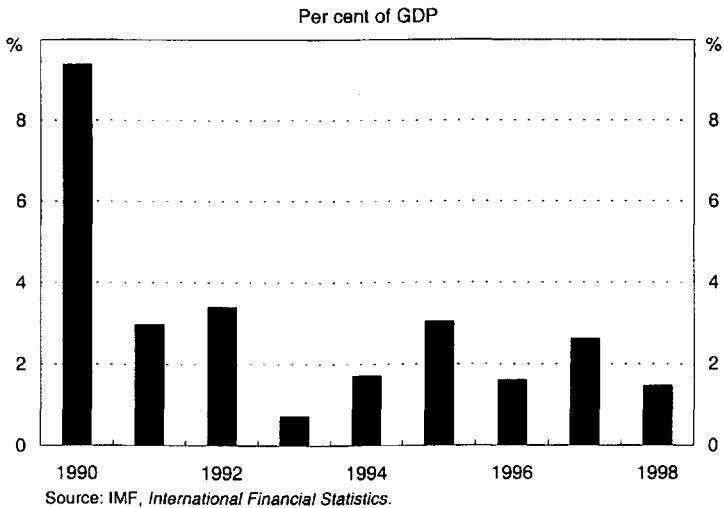
Section 2 argued that the following conditions should hold before Poland can successfully implement inflation targeting: absence of fiscal dominance, generalised hardening of budget constraints, and the capability of the authorities to forecast inflation and assess the impact of inflation of changes in monetary policy.

Fiscal dominance has greatly diminished in Poland and does not appear to pose a serious risk to the inflation target. The Polish authorities have turned around the major fiscal imbalances of the early 1990s; recent budget deficits have been close to 3 per cent of GDP (Graph 3.3). Public debt has fallen from over 70 per cent of GDP in 1994 to around 45 per cent in 1998.<sup>26</sup> Raiser (1997) argues that with the large reduction in the share of subsidies in general government expenditures, much of the inflation bias in fiscal balances disappeared in 1991. However, high social security expenditures, and more concerningly, growing tax leniency towards loss-making state-owned enterprises, have contributed to continuing budget deficits; much of the improvement in fiscal balances reflects strong private sector growth.

Importantly, seigniorage revenues are moderate and since the initial stabilisation, have trended slightly downwards through the 1990s (Graph 3.4). Average seigniorage revenues were equivalent to just under 2 per cent over the past three years – higher than in most advanced economies, but modest by the standards of developing and transition economies.

---

<sup>26</sup> IMF, *IMF Concludes Article IV Consultation with Poland*, March 11, 1999.

**Graph 3.3: General Government Financial Balance****Graph 3.4: Seigniorage**

There is also evidence that, on balance, indicates that budget constraints have hardened over the course of the transition. Raiser (1997) argues that a range of macroeconomic indicators are consistent with significant budget hardening. Raiser cites the increased competition from imports,<sup>27</sup> and large reductions in subsidies – the share of subsidies in government expenditure fell from 35 per cent in 1989 to less than 4 per cent in 1993 – as strong contributors to budget hardening.

However, Raiser notes that financial indicators cast some doubt on the extent of budget hardening. Real deposit rates were negative until 1994, although recent progress with disinflation has since led to further increases in real interest rates. Raiser also notes the disproportionately high share of credit to the public sector. Pujol and Griffiths (1996) argue that some sectors were continuing to evade hard budget constraints in the mid-1990s, placing the burden of tighter monetary policy onto the emerging private sector.<sup>28</sup>

The banking system appears healthy and is unlikely to undermine the inflation target. Raiser suggests that recent reforms have reduced the access of state-owned enterprises to soft bank credit, which would contribute not only to harder budget constraints but also to the health of the banking system. Polish banks have a relatively moderate bad debt burden compared with other central European transition (Table 3.1). The apparently healthy banking system implies that there is a low probability that excessive lender-of-last-resort lending would be required to shore up the system, and that there is no incentive to inflate away the value of bad loans.

---

<sup>27</sup> The import penetration ratio rose from 13 per cent in 1989 to over 22 per cent in 1994.

<sup>28</sup> This would imply that policymakers should wait to disinflate, if the new private sector grows faster than the old industrial sector.

**Table 3.1: Bad Loans**

	Per cent of total loans			
	1994	1995	1996	1997
Czech Republic	34.0	33.3	30.0	28.8
Hungary	17.6	10.3	7.2	3.6
Poland	28.7	20.9	13.2	10.4
Slovenia	22.0	13.2	14.3	12.3

Source: EBRD (1998).

However, there remain some general risks to the inflation targeting strategy, including the high degree of inertial inflation and indexation still prevalent in the Polish economy, and difficulties estimating the reaction of inflation to changes in monetary policy. The MPC (1998) has acknowledged these risks. The MPC concedes that high inflation over the past decade has become entrenched in the inflation expectations of households and firms, and that this will constrain monetary policy over the next few years. It also calls for wage and salary indexation mechanisms to be curbed, to reduce the cost of further disinflation.

Poland's recent inflation performance has been better than expected. One-off effects such as lower commodity prices have contributed to lower inflation, but cannot be relied upon to continue to deliver acceptable inflation outcomes. As these one-off effects fade, the problem of inflation inertia may re-emerge.

The analytical framework for forecasting inflation and assessing the impact of monetary policy is also critical to the success of the strategy, and is discussed below.

#### 4. The Policy Instruments and their Effects on Inflation

Central to any inflation targeting strategy is an understanding of the links between the instruments of monetary policy and the inflation outcomes. In the case of Poland, clarifying these links is complicated on the one hand by the high degree of structural change, especially in the early 1990s during the initial stabilisation period, and on the other hand by major revisions to the monetary policy strategy, so that at times either the exchange rate, the money supply or the short-term interest rate has been the main policy instrument. To add to these difficulties, the implementation of the inflation targeting framework represents another regime shift, which potentially invalidates past relationships between instruments and target variables. While these caveats need to be recognised, it does not follow that there is nothing to be learned from past experience. If a relationship is robust enough to put its imprint on a period characterised by substantial change, then there is a reasonable chance that this relationship will also carry over to the new policy regime. The empirical analysis presented here makes use of the VAR methodology to find such relations. The principal aim is to shed light on the link between the short-term interest rate, which is now the main policy instrument, and inflation.

The following analysis provides some evidence on these linkages through the mid- and late 1990s. The five-variable model includes the nominal effective exchange rate (NEER) and the three-month treasury bill rate (TBILL) as policy variables, plus industrial production (IP), nominal wages (WAGES), and the CPI (CPI).<sup>29</sup> All variables except the interest rate enter as logs. In addition, two intervention dummy variables are introduced. The first captures two large outliers in the price index in late 1993, which are probably due to price liberalisation measures; the other removes the influence of exchange rate turbulence in November 1998, presumably related to the crisis in Russia. The

---

<sup>29</sup> The graphs of the time series and the data sources are presented in Appendix I.

sample period is January 1993 to February 1999; this sample period was chosen to prevent the effects of the hyperinflation of the early 1990s from dominating the results. The long-run relationships between the variables of the system considered here are derived within Johansen's multivariate approach of cointegration analysis. This is followed by an impulse response analysis to investigate the dynamic structure of the system.

A possible limitation of this analysis is that variables other than those considered here could be relevant. One leading candidate is relative price variability, which previous work has shown to be important in explaining Polish inflation. This variable has been omitted here because it was more relevant in early stabilisation. Other candidates are a long-term interest rate and commodity prices. The former variable could help to gain an insight into the monetary transmission mechanism, while the latter could be an indicator of imported inflation. The drawback is that the five variable VAR is quite large as it is, especially given the short sample period. With the short-term interest rate and the exchange rate as policy instruments and output and consumer prices as target variables it includes already four indispensable variables. Also, the focus here is on the relationship between the policy instrument and inflation, which is why the wage variable is included to model domestic inflation determinants, whereas the exchange rate is intended to capture external influences on inflation. Given the data limitations and the purpose of this paper, the inclusion of relative price variability, the long rate or commodity prices did not seem practical.

Another consideration was to include the M2 money variable as a policy instrument, because at times it has had a prominent role in the Polish monetary strategy. But a pretesting exercise within a smaller money demand system consisting of money, prices, output and the interest rate showed that every tested specification of this model encountered substantial problems regarding the statistical properties of the system. The impulse response analysis also did not come up

with meaningful impulse response functions for the money variable. This finding does not suggest that money does not play a role in the transmission mechanism in Poland, but rather that with the adoption of different monetary strategies its role changed and a stable linkage between money and other variables did not come about.

#### 4.1 A Multivariate Cointegration Analysis

Before proceeding with the analysis of the long-run relationships<sup>30</sup>, univariate tests to establish the order of integration of the time series are computed. The results for the ADF and KPSS tests are presented in Appendix II. The ADF test tests the null hypothesis of non-stationarity, while the KPSS test has stationarity as the null hypothesis. With the exception of the treasury bill rate, where the evidence is not clear cut, all variables appear to be integrated of order one. In addition to the stochastic trend, there also seems to be a deterministic trend present in the series for wages, prices and money. Considering the transition from hyperinflation to one digit inflation rates, a finding of a deterministic trend in the rates of change of nominal variables is not implausible. But the power and size attributes of univariate stationarity tests are generally quite poor; in this sense this kind of analysis does not provide definite results, it rather gives a first idea about the dynamic properties of the time series at hand, indicating here the presence of a stochastic trend in all variables and possibly an additional deterministic trend in the nominal variables. Further evidence on these properties is provided by the multivariate analysis.

---

<sup>30</sup> Admittedly, a sample period covering only six years is not exactly what is typically meant by the long-run in the context of cointegration analysis. But it is hardly an alternative to wait until the sample period covers 15 years or more. Also, there is evidence that the time series contain a stochastic trend and this means that the concept of cointegration analysis is appropriate.



As a first step, the specification of the five variable VAR needs to be determined.<sup>31</sup> Reimers (1991) suggests using order selection criteria to establish the lag order, and recommends in particular the Schwarz criterion. According to this criterion, a lag order of one is appropriate. But this leaves substantial problems with the assumption of a normal distribution of the residuals. To ensure that the residual properties are consistent with white noise at the one per cent significance level, a lag order of five is chosen. The corresponding test statistics for the misspecification of the residuals are shown in Appendix III.

The second question is whether a trend should be included in the cointegration space. The results of the univariate tests lend some support to such a specification. But the multivariate analysis shows that an inclusion of a time trend introduces dynamic instability into the system; regardless of the lag order some of the eigenvalues of the companion matrix lie outside the unit circle, which indicates the presence of explosive processes. This is also borne out by the impulse response analysis - the system does not return to a new equilibrium after a shock if a trend is included in the specification. As a consequence, no trend is allowed for.

The third step is to determine the cointegration rank. The statistics for the trace test and the maximum eigenvalue test are given in Appendix III. At the one per cent significance level, both tests suggest the presence of two cointegration relationships, while at the five per cent level they suggest a rank of three. Because the eigenvalues of the companion matrix strongly suggest three common trends and thus two cointegration relations, a rank of two is imposed.

To attain two unique cointegration vectors, one identifying restriction is needed for each vector. Such restrictions are not testable and are ideally derived from theory. In the context of this paper this poses a considerable challenge. Theoretically motivated relationships between the variables considered here can be

---

<sup>31</sup> For the cointegration analysis CATS for RATS has been used.

derived from a large number of macroeconomic models. The cointegration vectors could include for example a central bank reaction function, which links the interest rate or the exchange rate to the other variables; or the interest rate could be linked via an IS-relationship to the output variable. Other possible relationships include a Phillips-curve-type relation between wages and prices, or there could be a cointegration vector modelling the wage bargaining process including wages, prices, output and possibly the exchange rate as well. This multitude of possible long-run relations implies that the imposition of exclusion restrictions to identify the cointegration vectors remains to some degree arbitrary. This is why another path is chosen here. Attention will focus on the cointegration space, which has been identified already by the imposition of the rank restriction, while the cointegration vectors remain unidentified.

A first step is to test whether any variable can be excluded from the cointegration space. This hypothesis is rejected for all variables present in the system. While this finding supports the choice of the variables, it is also useful because it establishes that the interest rate is linked to the price level in a long-run equilibrium, even though the exact nature of this relationship remains unresolved.

A second step is to test whether any of the variables is weakly exogenous. Only the exchange rate is found to be weakly exogenous at the five per cent significance level. At the one per cent significance level the interest rate and the wage variable are also weakly exogenous. The finding that the exchange rate and the interest rate are not endogenously determined supports the notion that these two variables have been under the control of the monetary authorities, which would confirm their role as policy instruments.

A final step within the cointegration analysis is to investigate the dynamic adjustment structure of the system. To facilitate the following discussion, consider the general vector error-correction model of the form:

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + \dots + \Gamma_{k-1} \Delta z_{t-k+1} + \Pi z_{t-k} + u_t$$

The vector  $z_t$  contains the five variables of interest here. For the following, the matrix  $\Pi$  is of special interest. This matrix can be factorised so that  $\Pi = \alpha\beta'$ ;  $\Pi$  has rank  $r$ , where  $r$  represents the number of cointegration vectors. The matrix  $\beta'$  contains the long-run coefficients, while the matrix  $\alpha$  determines to what extent each variable adjusts to a given disequilibrium in the long-run relations. The term  $\beta' z_{t-k}$  represents the cointegration relationships in the multivariate model.

To illustrate the adjustment mechanism to a disequilibrium, suppose that the system, being in equilibrium, is disturbed by a one percentage point increase of the interest rate. This induces a disequilibrium in the long-run relationships given by  $\beta' z_{t-k}$ . Adjustment takes place via an error-correction mechanism: the variables  $\Delta z_t$  are linked to the long-run relations via the adjustment coefficients given in the  $\alpha$  matrix, so that each variable  $\Delta z_t$  adjusts to the interest rate shock until the system has moved back to equilibrium and all long-run relations are satisfied again. This adjustment mechanism is summarised in the  $\Pi$ -matrix, which is said to give the combined cointegration effects. Each row of the  $\Pi$ -matrix gives the reaction of the variable in the corresponding row of the  $\Delta z_t$ -vector to a unit deviation of each variable in the system from its equilibrium value.

Note that this reaction corresponds to an impact effect and does not give the long-run response of the variable to a shock. There are two reasons for focusing on the  $\Pi$ -matrix instead of analysing the  $\alpha$  and  $\beta$  vectors. First, the rows of the  $\Pi$ -matrix are identified even when the  $\alpha$  and  $\beta$  vectors remain unidentified. Second, the combined cointegration effects shed light on two basic issues in an inflation targeting framework: they show which variables affect inflation in general and they give evidence on the interest rate effects on the inflation

rate in particular. Table 4.1 shows the  $\Pi$ -matrix and the corresponding t-values for the system considered here.<sup>32</sup>

The combined cointegration effects on the inflation rate are given in the last row. It becomes apparent that an interest rate hike slows down inflation, as does an appreciation of the exchange rate. This underlines that the interest rate has not been the only monetary policy instrument used by the Polish monetary authorities. A higher output level and higher wages have both significant positive effects on inflation. Finally, a higher price level itself slows inflation subsequently, corresponding to an error correction mechanism involving prices directly.

The impact effects of an interest rate hike are given in the second column of Table 4.1. The exchange rate appreciates and inflation slows. There is no significant effect on wages. Surprisingly, output rises. This last feature of the data has been visible in a number of pretesting procedures not reported here and turned out to be rather robust to a wide range of specifications. This point will be taken up again in the next section.

To conclude, the cointegration analysis has shown that there is a long-run link between the interest rate, which is to be the policy instrument of choice of monetary policy in Poland, and the price level, even though the exact form of this relation could not be obtained. The analysis of the combined effects has provided evidence that a rising interest rate exerts a dampening influence on inflation. In addition, the analysis shows that an appreciation of the exchange rate is effective as well with respect to reducing inflation. Both the output

---

<sup>32</sup> The stability of the long-run system has been evaluated using recursive estimation. Due to the short sample period this estimation technique was only feasible for a period beginning in 1997. The long-run part of the system turned out to be stable, but there are signs for instability in the short-run dynamics. Note that the  $\Pi$ -matrix is derived on the basis of the long-run relations, so that the stability result is relevant for this matrix.

variable and the wage variable contain information with respect to inflationary pressures emanating from the real economy. Prices are determined endogenously, so that after a price shock there is a tendency of the price level to return to the equilibrium level. Taken together, these results are quite encouraging for the inflation targeting framework.

**Table 4.1 - The Combined Effects**

$\Pi$	<i>TBILL</i>	<i>NEER</i>	<i>IP</i>	<i>WAGES</i>	<i>CPI</i>
$\Delta TBILL$	-0.207	-0.029	0.239	-0.215	0.089
$\Delta NEER$	0.470	0.188	-0.385	-0.048	0.441
$\Delta IP$	0.511	0.046	-0.621	0.641	-0.352
$\Delta WAGES$	0.218	0.224	-0.002	-0.624	0.926
$\Delta CPI$	-0.184	-0.107	0.108	0.166	-0.349
t-values for $\Pi$	<i>TBILL</i>	<i>NEER</i>	<i>IP</i>	<i>WAGES</i>	<i>CPI</i>
$\Delta TBILL$	-3.498	-1.080	3.903	-2.411	0.820
$\Delta NEER$	3.013	2.650	-2.391	-0.204	1.551
$\Delta IP$	3.176	0.634	-3.740	2.650	-1.201
$\Delta WAGES$	1.315	2.982	-0.012	-2.510	3.074
$\Delta CPI$	-4.464	-5.716	2.531	2.678	-4.650

## 4.2 An Impulse Response Analysis

The impulse response analysis is a useful extension of the above analysis, because it considers simultaneously the short- as well as the long-run structure of the system, whereas the cointegration analysis has its focus on the long-run properties of the system.<sup>33</sup> After a suitable identification of monetary policy shocks, impulse response functions can be generated which give a mapping of the adjustment path in time for each variable in response to such a shock.

For the following discussion of the identification strategy it will prove useful to outline briefly some of the technical background of the VAR analysis.<sup>34</sup> The objective of empirical analysis in general is to obtain an estimate of the following system of equations, which is assumed to represent the 'true' structure of the economy:

$$(1) \quad A_0 y_t = A(L)y_t + u_t ,$$

where  $y_t$  is a vector containing the economic variables,  $A_0$  is a matrix of impact multipliers,  $L$  is a lag-operator,  $A(L)$  contains structural polynomials and  $u_t$  gives the structural disturbances with the covariance matrix  $\Sigma_u$ . This system cannot be directly estimated, because there are not enough observations to obtain estimates for  $A_0$ . This is where the need for identifying restrictions comes in.

---

<sup>33</sup> Note though that the tests for stability (previous footnote) show problems with the stability of the short-run parameters. This is not much of a problem as long as interest centres on the long run. But it is a potential problem when the short-run dynamics are considered as well. This finding introduces some additional uncertainty regarding the robustness of the results and needs to be taken into account when the impulse response functions are presented.

<sup>34</sup> The following discussion draws heavily on Dale and Haldane (1993).

The structural VAR analysis takes as a starting point the reduced form of (1), which can be estimated simply with OLS:

$$(2) \quad y_t = A_0^{-1}A(L)y_t + A_0^{-1}u_t = A^*(L)y_t + e_t ,$$

where  $e_t$  is a vector of reduced form disturbances. In addition, an estimate of the covariance matrix of the reduced form errors  $\Sigma_e$  can be obtained. Note that (1) and (2) imply that

$$(3) \quad \Sigma_e = A_0^{-1}\Sigma_u A_0^{-1} .$$

As a next step, attention shifts to the moving average form of (2):

$$(4) \quad y_t = C(L)e_t \quad \text{with } C(L) = (I - A_0^{-1}A(L))^{-1} .$$

The matrix  $I$  denotes the identity matrix. The matrix  $C(L)$  is of particular interest, because it gives the path of the endogenous variables as a function of past structural disturbances. The information contained in this matrix allows it to trace out the response of the system to a structural disturbance, in other words  $C(L)$  contains the impulse responses of the system. The problem is, of course, that  $A_0^{-1}$  is not known. The reduced form disturbances are of little help, because they are combinations of the structural disturbance and thus hard to interpret.

In the context of this paper, there are now two options to identify  $A_0$ . One option would be to proceed on the basis of the cointegration analysis, which has identified two cointegration relationships, which leaves three common trends to be identified. The problem is that – just like with the cointegration relationships – the identification of the common trends is not straightforward. Therefore, this paper follows a second option. Two identifying restrictions are made. The covariance matrix of the structural disturbances is assumed to be diagonal, imply-

ing that the structural shocks are orthogonal<sup>35</sup>, and the matrix  $A_0$  is assumed to be lower triangular. These two assumptions lead to the so-called Choleski factorisation of  $\Sigma_e$ . It can be shown that for this matrix there exists a unique lower triangular matrix  $P$  and a unique diagonal matrix  $D$  such that  $\Sigma_e = PDP'$ . Note the similarity of this decomposition with (3). The Choleski factorisation allows it to orthogonalise the reduced form innovations and to obtain the transformed residuals  $w_t \equiv P^{-1}u_t$ . For the impulse response analysis this implies:

$$(5) \quad y_t = C(L)PP^{-1}e_t = K(L)w_t .$$

The following analysis will consider the impulse response functions given by  $K(L)$ , with the respective shocks contained in the vector of orthogonalised disturbances  $w_t$ . This vector coincides with the true structural disturbances if  $u_t = A_0^{-1}e_t = P^{-1}e_t = w_t$ .<sup>36</sup> While the matrix  $P$  is unique for a given  $\Sigma_e$ , the covariance matrix itself depends on the ordering of the variables. Thus the order of the variables in the VAR is where the important choices regarding the identification are made.

For the empirical analysis at hand, the assumption that  $A_0$  is lower triangular is critical. This assumption imposes a recursive form on the contemporaneous correlations in the system, implying that if there is a high contemporaneous correlation between two reduced-form innovations, then the complete effect is assigned to the innovation that comes first in the ordering of the VAR.

---

<sup>35</sup> Note that this is a strong assumption. Given the five equation model it implies that the economy is driven by only five 'primitive' shocks, which are orthogonal to each other. If the number of true shocks were larger, the five identified shocks are linear combinations of the true underlying shocks and the assumption of orthogonality would not hold any more.

<sup>36</sup> Of course the assumption that the structural disturbances are orthogonal has to hold as well.



The estimates of the contemporaneous correlations shown in Table 4.2 suggest that the recursive identification scheme can be implemented here relatively straightforwardly. Of particular interest are the effects of shocks to the policy variables, taken here to be the exchange rate and the interest rate. It becomes apparent in Table 4.2 that the contemporaneous correlations of the reduced form innovations of the policy variables with those of the other variables in the system are generally quite low.

**Table 4.2 - The Correlation Matrix of the Reduced Form Residuals<sup>37</sup>**

NEER	TBILL	CPI	WAGES	IP
1.0000				
-0.0369	1.0000			
0.1270	-0.2387	1.0000		
-0.0303	-0.1732	0.4269	1.0000	
0.1227	0.1877	0.0131	0.3365	1.0000

In addition, a test for weak exogeneity in the context of the cointegration analysis has shown that the null hypothesis of weak exogeneity cannot be rejected for the exchange rate at the five per cent significance level and for the interest rate at the one per cent level. Both results are relevant for the ordering of the system. The exogeneity finding implies that neither variable is determined by the other variables in the system. From this it follows that it is appro-

---

<sup>37</sup> All computations in this section have been done with the help of the programme VAR.SRC, written for RATS and provided by Norman Morin. The results in Table 4.2 are computed for a lag order of one.

appropriate to put them first in the ordering, so that the causation runs from the policy variables to the non-policy variables.

The low contemporaneous correlation suggests that policy makers do not respond within the month to developments in the real economy. This reflects the fact that relevant statistics for the decision making process are available only with a time lag. The finding that the reduced form innovations of the policy variables are relatively uncorrelated with the other innovations in the system also ensures some robustness of the results with respect to the ordering. Putting the policy variables last, for example, does not change the basic shape of the impulse response functions.

Regarding the non-policy variables, the order is more subjective. However, experimenting with different orders showed that the results are not sensitive to this choice. The order indicated in Table 4.2 is chosen.

Notice also that the identifying assumptions restrict only the contemporaneous correlation matrix, while the correlations between higher lags of the variables remain unrestricted. This means that once the disturbances are identified, the impulse response functions are a suitable instrument to investigate the dynamic structure of the system, taking account both of direct and indirect effects.

Before presenting the impulse response functions, the specification of the VAR needs to be discussed. The crucial question is whether to estimate the system in levels or in first differences. The cointegration analysis has shown that cointegration relationships do exist, so the VAR will be estimated in levels.<sup>38</sup> The rank restriction will not be imposed. Such a restriction would introduce three permanent shocks (the common trends) and two transitory shocks into the

---

<sup>38</sup> Note that the cointegration analysis proceeds within an error-correction form of the VAR and that this form is only a reparameterisation of the VAR given in (2). So if the cointegration analysis shows that the variables in the system do cointegrate and the residuals of the system are stationary, then this holds also for the residuals of (2).

analysis, which should be analysed within the framework of a common trend analysis, but this is not attempted here.

Another issue is the lag length. For the cointegration analysis, a lag order of five has been chosen. Experimenting with different lag orders has shown that the basic form of the impulse response functions is insensitive to the lag order; while a low lag order gives very smooth shapes, higher lag orders add dynamics to these. But a computation of confidence bands shows that the dynamics are not precisely estimated. With a lag order of five the impulse response functions are quite jagged, pointing to an overparameterisation. This is why a lag order of one is imposed here, as originally suggested by the Schwarz criterion (and also by the Hannan-Quinn criterion). A more parsimonious specification conserves degrees of freedom and allows a sharper estimation of the impulse response functions.<sup>39</sup> The drawback is that the residuals display strong signs of non-normality (see Appendix IV), which is why a higher lag order has been employed in the context of the cointegration analysis in the first place. In this section the use of a bootstrapping procedure for computing the confidence bands is a feasible alternative to a higher lag order, because this procedure does not rely on the normality assumption.<sup>40</sup>

Figures 4.1 and 4.2 show the impulse response functions together with the respective 90% confidence intervals for the effects of an exchange rate and an interest rate shock on all variables in the system. These two shocks are assumed to represent policy innovations. The effects given by the impulse response func-

---

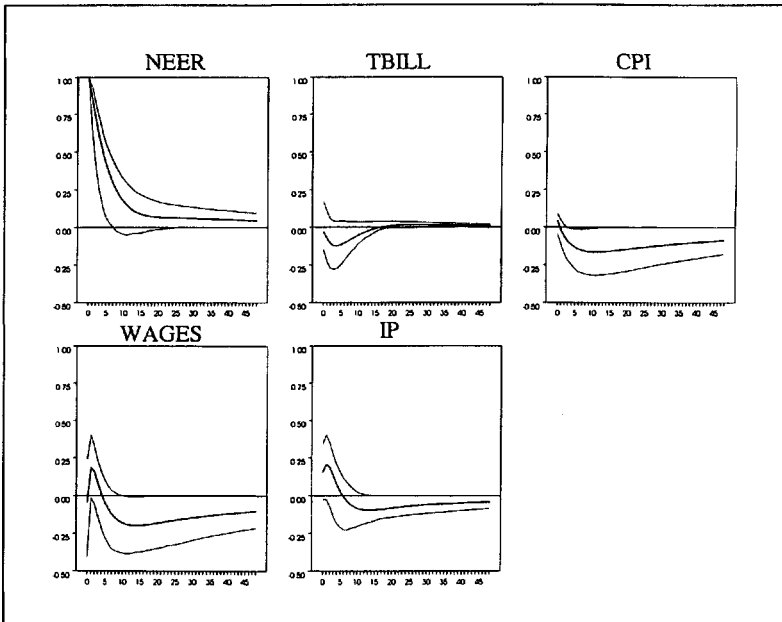
<sup>39</sup> Due to space constraints the results for different sample periods are not reported here. Variations of the sample period have been considered to gauge the effects of possible instability with respect to the short-run parameters. While the exact pattern of the impulse response functions may change, there is a basic shape common to all variations, which will be presented in the following.

<sup>40</sup> Note that a bootstrapping procedure implies that the confidence band does not need to be symmetric around the point estimates.

tions are measured for all variables as percentage changes except for the interest rate, where these effects are given in percentage points. Figure 4.3 shows the effects of a price shock, while the impulse response functions for the wage and output shock are given in Appendix IV.<sup>41</sup>

The impulse response functions for the exchange rate correspond well to those of a policy instrument. Note that the exchange rate shock corresponds to an appreciation of one percentage point.

**Figure 4.1 - The Effects of an Exchange Rate Shock**



<sup>41</sup> All shocks are unit disturbances to the orthogonalised disturbances  $w_t$ . The impulse response functions are mapped for 48 months.

Four features of Figure 4.1 are common to the impulse response functions obtained from different set ups of the VAR. First, the interest rate hardly reacts to the movement of the exchange rate. Second, the price level decreases. In fact, prices respond quite quickly to a shock to the nominal exchange rate, usually within a year. While this is a standard implication of most small open economy models in which traded goods prices rapidly return to world levels following an exchange rate shock, it is interesting in the Polish case because of earlier evidence of sluggish exchange rate pass-through.

**Figure 4.2 - The Effects of an Interest Rate Shock**

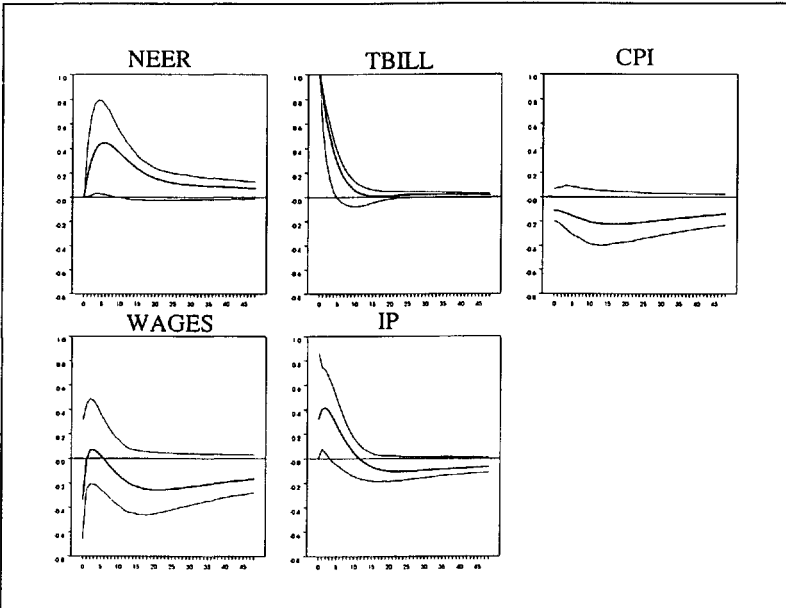
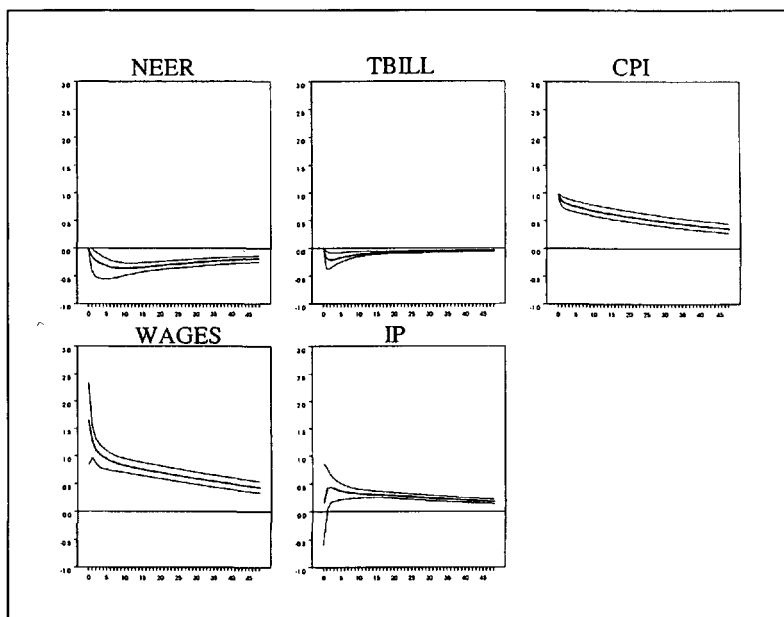


Figure 4.3 - The Effects of a Price Shock



The third observation is that the wage level declines slowly. Figure 4.3 indicates that wages respond strongly to price shocks; this suggests that wages do not respond foremost to the exchange rate movement itself but that wages eventually track the price movements induced by the appreciation.

The final typical feature is the decline of industrial production, but this occurs only after some time. The initial increase of output visible in Figure 4.1 is a feature of this particular specification of the VAR but is not common to other set-ups. Usually output reacts only with a lag to the exchange rate shock.

Considering the confidence intervals, it turns out that the price effect is significant, while the effect on industrial production is a borderline case. But these results need to be considered with some caution, because the small sample

size, the non-stationarity of the variables and the long forecast horizon (relative to the sample period) all tend to worsen the power and size attributes of the estimates of the confidence intervals, so that these should not be considered as being estimated precisely.<sup>42</sup> Even with this caveat in mind, the impulse response functions in figure 4.1 show clearly that the exchange rate is a powerful policy instrument that has visible effects on prices and output.

The effects of an interest rate shock are shown in Figure 4.2. The interest rate is raised by one percentage point. It becomes apparent that the price level declines in response to this interest rate hike. Even though this effect is not clearly significant here, it is nevertheless robust with respect to the specification of the VAR. An important observation in this context is that the finding of an interest rate shock triggering an appreciation turns out to be rather robust regarding the specification of the VAR, while the effect of an appreciation on the interest rate is usually not well defined. Recalling the significant negative effects of an appreciation on the price level given in figure 4.1, this suggests that the transmission of the interest rate shock on prices works at least to some extent via the exchange rate.

While this is not surprising, given that Poland is a small open economy, this nevertheless raises an important issue in the context of inflation targeting. If the exchange rate channel plays an important role, this implies that a substantial part of the adjustment burden will fall on the traded goods sector, even if the National Bank of Poland considers the interest rate to be its main policy instrument.

Note also that the NBP has chosen to target aggregate inflation. To the extent that exchange rate shocks play a major role, the interest rate will prove to be an effective instrument to reverse such shocks; but if inflationary pressures

---

<sup>42</sup> For a discussion of the properties of confidence intervals derived from different methods, see Griffiths and Lütkepohl (1990).

originates from the non-traded goods sector, this may require substantial interest rate responses, which may have adverse effects on the traded goods sector.

The concerns regarding the effectiveness of the interest rate as a policy instrument with respect to the non-traded goods sector are reinforced by the impulse response function of the output variable, which shows that an interest rate hike does not dampen output as expected, but instead output rises. This upward movement in Figure 4.2 is robust with respect to the specification of the VAR and is usually significant as well.<sup>43</sup>

An inspection of the plot of the time series in Appendix I gives some hints towards the origins of this unexpected positive correlation between industrial production and the interest rate. It becomes apparent that from early 1997 onwards both series have indeed moved into the same direction.<sup>44</sup> Apparently the NBP reacted to strong output growth by raising the interest rate, while the crises in Asia might have added to a tightening bias. Beginning in 1998, industrial production began to slow down and eventually declined markedly. But it remains unclear whether this was due to the interest rate effect or due to the influence of the Asian crisis and later the crisis in Russia. The fact that since early 1998 the NBP has reduced the interest rate considerably without stimulating output suggests that external influences have been decisive. This leaves substantial uncertainty about the extent monetary authorities can influence the output gap via the interest rate.

The effects of a one percentage point price shock are shown in Figure 4.3. One striking feature is the strong and swift reaction of wages. While it is not surprising that trade unions attempt to protect the real wages of their members, it is

---

<sup>43</sup> Recall that this effect showed up in the cointegration analysis too.

<sup>44</sup> Note that in the second half of the sample period no other time series tracks the output movement as closely as the interest rate.



nevertheless problematic in view of the inflation targeting framework, because price shocks are not easily reversed once they are part of the cost structure of the economy. This contributes to entrenched inflation expectations and a high degree of inertial inflation. The presence of inertia in prices is also borne out by their slow adjustment back to equilibrium. It has been noted earlier that indexation remains widespread in Poland, which probably accounts for this finding.

Industrial production rises in response to the price shock. While rising prices may signal demand pressures, this finding is also consistent with relative price adjustments being behind the price shock, so that this shock is equivalent to a positive supply shock. The persistence of the output response supports the latter interpretation. There is no strong policy reaction to the price shock; the monetary authorities allow a depreciation of the nominal exchange rate, so that international competitiveness is not adversely affected.<sup>45</sup> The authorities surely did not choose to fight this shock by tightening policy aggressively. To the extent that the price shocks are due to relative price adjustments the NBP may not have wished to interfere with this process. In fact, the price series does return to its base level without a strong policy intervention. This suggests that the inflation targets of the NBP have enjoyed some credibility in the past.

Note that the pursuit of a more aggressive monetary policy could have come with a high price. Because of the high degree of inertia and the fact that price shocks are quickly entrenched into the economy, an attempt to reverse a price shock more swiftly would have called for a substantial tightening of policy with adverse effects on the real economy. This last point underlines the importance of the horizon for the inflation target. Given the structural characteristics of the economy outlined here the horizon should be relatively long to avoid the over-

---

<sup>45</sup> The response of the interest rate is not well defined and depends on the particular specification of the VAR.

use of the exchange rate and to spread the adjustment burden between the traded and the non-traded sector.

Appendix IV shows the impulse response functions for a wage shock and an output shock. These are only of secondary interest here, so only a brief discussion will follow. The wage shock has apparently hardly any effects. The wage series returns quickly to its base value. Industrial production rises temporarily in response to the wage shock, which could be due to an income effect. If a specification with a higher lag order is chosen it becomes apparent that the wage shock leads to temporary price increases, but only after some time. The output shock conforms well to a demand shock. Here a tightening of monetary policy is visible. This holds in particular for the interest rate. This effect is usually also significant.

The results of the impulse response analysis are in broad agreement with those of the cointegration analysis. But it provides for a number of additional insights. The role of the exchange rate as a policy instrument is emphasised, while it becomes clear that the linkages between the interest rate and inflation are not very well understood. In particular, there remains substantial uncertainty as to the extent the interest rate works via the exchange rate channel to reduce inflation. This points to a potential risk that the exchange rate could be overused if the aggregate inflation target is met to a great degree by reducing traded goods inflation. To take the burden off the exchange rate and the traded goods sector, some flexibility in the inflation targeting strategy may be required. This could be achieved by extending the policy horizon and by widening the target range.

## 5. Conclusions

The conditions in Poland seem broadly favourable for the introduction of inflation targeting, if not yet ideal. Poland appears to have made sufficient

progress in reducing fiscal dominance and hardening budget constraints for these factors not to threaten an the inflation target seriously.

The likelihood that the strategy is successful could be improved by some curtailment of the high degree of wage and salary indexation, which would reduce the output costs of further disinflation. There is also a need for better understanding of the linkages between the instruments of monetary policy and the inflation target.<sup>46</sup> But this will be rather difficult to obtain during the current transition from the exchange rate to the interest rate as the main focus of monetary policy. In this uncertain environment, modification of some details of the strategy – such as widening the target range or lengthening the target horizon – might be helpful.

Some more specific comments on the strategy are in order. First, the NBP has chosen to target the Consumer Price Index rather than “core inflation”, which it is only now starting to calculate. The NBP bases its decision on the widespread public recognition of the CPI; it plans to provide detailed explanations when specific policy decisions apparently conflict with the direction of the discrepancy between the inflation target, and the observed or forecast level of inflation. It is debatable whether a CPI target with more misses and more explanations offers greater credibility than a core inflation target which is less well understood by the public but more often achieved.

The level of the targets seem appropriate. By specifying a path for disinflation – inflation of 8 to 8 ½ per cent in 1999, inflation below 4 per cent by 2003 – the

---

<sup>46</sup> Following its recent consultation with the Polish authorities, the IMF reported, “Directors noted the need to strengthen further the analytical framework for inflation targeting, especially to deepen the understanding of the relationship between policy-determined interest rates, monetary aggregates, and inflation.” (IMF, *IMF Concludes Article IV Consultation with Poland*, March 11, 1999)

NBP can provide guidance for inflationary expectations. New Zealand used a similar strategy when it introduced its inflation target.<sup>47</sup>

The specification of the range is more problematic. The NBP justifies its narrow range by the fact that its monetary targets (announced until 1998) were defined as fixed points, and that a wider band might not be regarded as credible – although it intends to gradually widen the tolerance interval in the future. In principle, this justification will not be valid if the NBP has less control over its inflation targets than its monetary targets. Breaches of a narrow target range could do greater damage to credibility later on.

That said, the NBP is unlikely to be harmed in the short term by this strategy. In the context of disinflation, breaches of the target on the downside will harm credibility far less than breaches on the upside. Such an outcome appears increasingly likely – the IMF recently forecast inflation of 7 per cent for Poland in 1999.<sup>48</sup>

The target horizon of one year may also be a little short – indeed the NBP foreshadows a lengthening of this horizon in the future. This horizon may reflect the recent primacy of the exchange rate as a policy tool. The interest rate channel generally takes longer to operate (evidence below suggests around twice as long in Poland) – a longer horizon could avoid over-reliance on the exchange rate instrument and so allow the non-traded sector to share the burden of adjustment to policy changes.

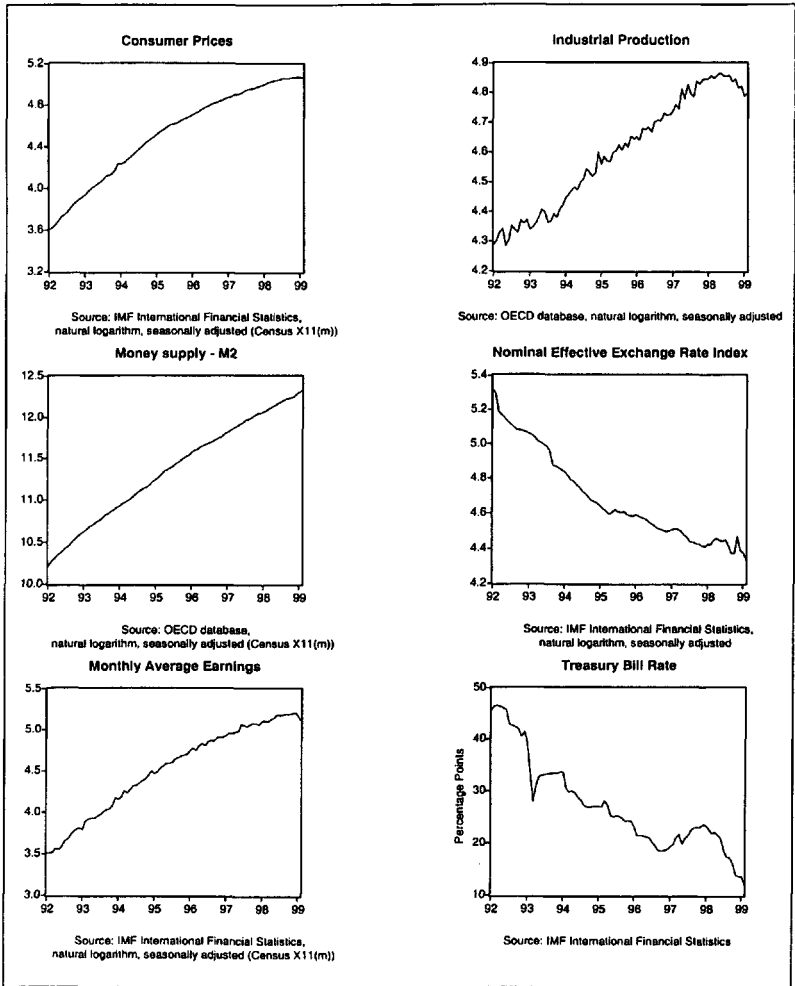
---

<sup>47</sup> The Reserve Bank of New Zealand's February 1991 *Monetary Policy Statement* specified a target range of 2 ½ per cent to 4 ½ per cent inflation by December 1991, 1½ per cent to 3 ½ per cent by December 1992, and 0 to 2 per cent by December 1993.

<sup>48</sup> IMF *World Economic Outlook*, September 1999.

## Appendix

### I. Sources and Graphs of the Data



Note: Series have been adjusted with Census X11(m) if necessary. A downward movement of the exchange rate corresponds to a depreciation. The index for industrial production is a volume index.

## II. Results of the Stationarity Tests

Variable	ADF t-statistic	KPSS $\eta$	Variable	ADF t-statistic	KPSS $\eta$
<i>TBILL</i>	-1.74 (c,t;4)	0.117 ( $\tau$ )	$\Delta$ <i>TBILL</i>	-6.24 <sup>***</sup> (c;0)	0.139 ( $\mu$ )
<i>NEER</i>	-2.16 (c,t;0)	0.228 <sup>***</sup> ( $\tau$ )	$\Delta$ <i>NEER</i>	-9.22 <sup>***</sup> (c;0)	0.375 ( $\mu$ )
<i>IP</i>	-0.42 (c,t;1)	0.179 <sup>**</sup> ( $\tau$ )	$\Delta$ <i>IP</i>	-13.83 <sup>***</sup> (c;0)	0.285 ( $\mu$ )
<i>WAGES</i>	1.49 (c,t;2)	0.267 <sup>***</sup> ( $\tau$ )	$\Delta$ <i>WAGES</i>	-10.65 <sup>***</sup> (c,t;1)	0.105 ( $\tau$ )
<i>CPI</i>	0.29 (c,t;0)	0.267 <sup>***</sup> ( $\tau$ )	$\Delta$ <i>CPI</i>	-8.18 <sup>***</sup> (c,t;0)	0.066 ( $\tau$ )
Memo Item: <i>M2</i>	-0.70 (c,t;0)	0.253 <sup>***</sup> ( $\tau$ )	$\Delta$ <i>M2</i>	-8.92 <sup>***</sup> (c,t;0)	0.076 ( $\tau$ )

Notes: All variables are in logs.  $\Delta$  is the first difference operator. The asterisks indicate a rejection of the null hypothesis at the 10% (\*), the 5% (\*\*), or the 1% (\*\*\*) level. The critical values for the ADF test statistics are taken from MacKinnon (1991). The brackets indicate the inclusion of a trend (t) and/or a constant (c) and the lag length. The lag length has been chosen by adding lags until a Lagrange Multiplier test fails to reject no residual serial correlation at the 5% level. Regarding the KPSS test,  $\tau$  denotes the null hypothesis of trend stationarity while  $\mu$  denotes stationarity around a constant. According to the Schwert formula with  $l = 8$  a lag truncation parameter of 7 has been chosen. For a discussion and the critical values see Kwiatkowski et al (1992).

### III. Cointegration Analysis - The five variable VAR

Misspecification tests: multivariate and univariate statistics

Test	Distribution	Multivariate Statistics	Univariate Statistics				
			TBILL	NEER	IP	WAGES	CPI
L-B(17)	$\chi^2(300)$	424.74 <sup>***</sup>					
LM(1)	$\chi^2(25)$	27.53					
LM(4)	$\chi^2(25)$	31.41					
Normality	$\chi^2(10)$	21.66 <sup>**</sup>					
Normality	$\chi^2(2)$		6.19 <sup>**</sup>	2.50	9.66 <sup>***</sup>	7.40 <sup>**</sup>	2.98
ARCH(5)	$\chi^2(5)$		6.64	0.91	9.80 <sup>*</sup>	2.49	3.93

Notes: L-B(17) is a Ljung-Box test for autocorrelation of order 17, LM(1) and LM(4) are multivariate Lagrange Multiplier tests of the null hypothesis of no first and fourth order autocorrelation. For a further discussion of the tests see Hansen and Juselius (1995), p. 72ff. The asterisks indicate a rejection of the null hypothesis at the 10% (\*), the 5% (\*\*) or the 1% (\*\*\*) level.

#### Johansen test for the cointegration rank

Eigenvalues	H <sub>0</sub> : rank ≤ r	Trace statistic	L-max statistic
0.655	r=0	146.57 <sup>***</sup>	73.42 <sup>***</sup>
0.417	r≤1	73.15 <sup>***</sup>	37.18 <sup>***</sup>
0.31	r≤2	35.97 <sup>**</sup>	25.58 <sup>**</sup>
0.099	r≤3	10.39	7.16
0.046	r≤4	3.23	3.23

Notes: The asterisks denote significance at the 10% (\*), the 5% (\*\*) or the 1% (\*\*\*) level. L-max is the maximum eigenvalue test. Critical values are taken from MacKinnon et al (1998). Note that the critical values have been derived under the assumption that no intervention dummies are present. The fact that two dummies are indeed used implies that the critical values really should be seen as an approximation and not as being exact.

#### IV. Impulse Response Analysis

Misspecification tests: multivariate and univariate statistics

Test	Distribution	Multivariate Statistics	Univariate Statistics				
			<i>TBILL</i>	<i>NEER</i>	<i>IP</i>	<i>WAGES</i>	<i>CPI</i>
L-B(18)	$\chi^2(425)$	424.62					
LM(1)	$\chi^2(25)$	54.84***					
LM(4)	$\chi^2(25)$	21.66					
Normality	$\chi^2(10)$	51.85***					
Normality	$\chi^2(2)$		16.23***	15.32***	5.35*	4.76*	11.63***
ARCH(1)	$\chi^2(1)$		38.75***	0.64	0.05	0.08	5.35**

Notes: L-B(17) is a Ljung-Box test for autocorrelation of order 17, LM(1) and LM(4) are multivariate Lagrange Multiplier tests of the null hypothesis of no first and fourth order autocorrelation. For a further discussion of the tests see Hansen and Juselius (1995), p. 72ff. The asterisks indicate a rejection of the null hypothesis at the 10% (\*), the 5% (\*\*), or the 1% (\*\*\*) level.



Figure AIV-1 - The Effects of a Wages Shock

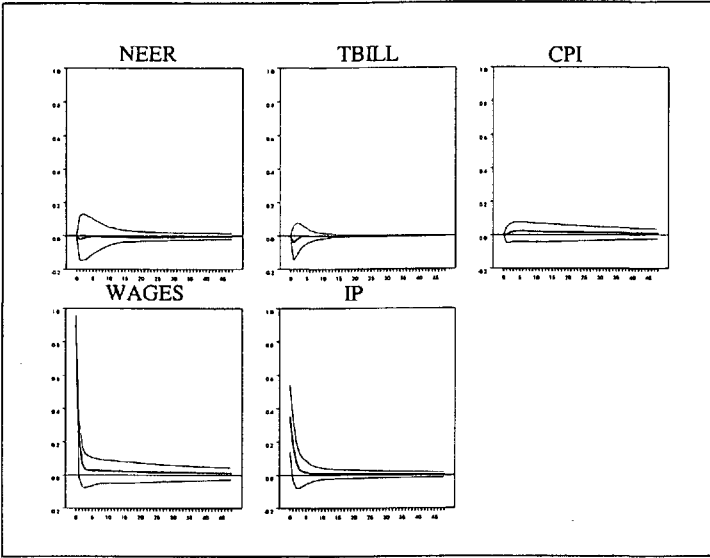
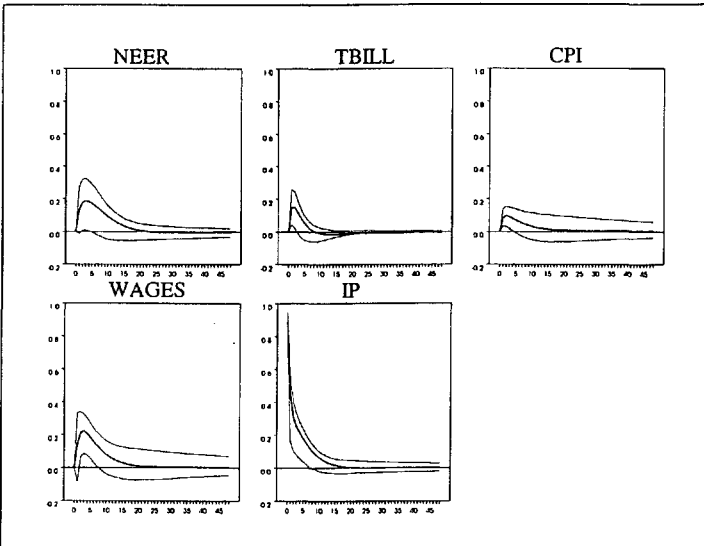


Figure AIV-2 - The Effects of an Output Shock



## References

**Akerlof, George, William Dickens and George Perry (1996)**, "The Macroeconomics of Low Inflation", *Brookings Papers on Economic Activity*, No. 1, pp. 1-59.

**Ball, Laurence (1998)**, "Policy Rules for Open Economies", NBER Working Paper 6760, October.

**Bernanke, Ben S., Thomas Laubach, Frederic S. Mishkin and Adam S. Posen (1999)**, *Inflation Targeting: Lessons from the International Experience*, Princeton University Press, Princeton, New Jersey.

**Bharucha, Nargis and Christopher Kent (1998)**, "Inflation Targeting in a Small Open Economy", Reserve Bank of Australia Research Discussion Paper 9807.

**Coorey, Sharmini, Mauro Mecagni and Erik Offerdal (1997)**, "Designing Disinflation Programs in Transition Countries: The Implications of Relative Price Adjustment", IMF Paper on Policy Analysis and Assessment No. 97/1, February.

**Dale, Spencer and Andrew G. Haldane (1993)**, "Interest Rates and the Channels of Monetary Transmission: Some Sectoral Estimates", Bank of England Working Paper Series, No. 18.

**Debelle, Guy (1997)**, "Inflation Targeting in Practice", IMF Working Paper No. 97/35, March.

**European Bank for Reconstruction and Development (1998)**, *Transition Report 1998*. London: EBRD.

**Griffiths, William and Helmut Lütkepohl, (1990)**, “Confidence Intervals for Impulse Responses from VAR Models: A Comparison of Asymptotic Theory and Simulation Approaches”, Working Papers in Econometrics and Applied Statistics, University of New England, No. 4 - March 1990.

**Haldane, Andrew G. (1997)**, “Designing Inflation Targets”, in P. Lowe (ed.), *Monetary Policy and Inflation Targeting*, Reserve Bank of Australia, pp. 74-112.

**Hansen, H. and K. Juselius (1995)**, “CATS in RATS: Cointegration Analysis of Time Series”, ESTIMA, Illinois.

**International Monetary Fund (1997)**, “Republic of Poland – Recent Economic Developments”, IMF Staff Country Report No. 97/33, April.

**Kokoszcyński, Ryszard (1997)**, “Monetary Policy in Poland: Strategies, Instruments and Transmission Mechanisms”, in Oesterreichische Nationalbank, *Monetary Policy in Transition in East and West: Strategies, Instruments and Transmission Mechanisms*, pp. 162-66.

**Kornai, Janos (1980)**, *The Economics of Shortage*, Amsterdam: North Holland Publishing.

**Kwiatkowski, Denis, Peter C.B. Phillips, Peter Schmidt and Yongcheol Shin (1992)**, “Testing the null hypothesis of stationarity against the alternative of a unit root”, in *Journal of Econometrics*, 1992, Vol. 54, pp.159-178.

**Lütkepohl, Helmut and Hans-Eggert Reimers (1992)**, “Impulse response analysis of cointegrated systems”, in *Journal of Economic Dynamics and Control*, 1992, Vol. 16, pp. 53-78.

**Masson, Paul R., Miguel A. Savastano and Sunil Sharma (1997)**, "The Scope for Inflation Targeting in Developing Countries", IMF Working Paper No. 97/130, October.

**MacKinnon, James G. (1991)**, "Critical values for Cointegration Tests", in: R.F. Engle and C. Granger (eds.), *Long-Run Economic Relationships*, Oxford University Press, Oxford.

**MacKinnon, James G., Alfred A. Haug and Leo Michelis (1998)**, "Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration", Department of Economics, University of Canterbury, Discussion Paper No. 9803.

**OECD (1998)**, *OECD Economic Surveys, 1997-98: Poland*, Paris.

**Orlowski, Lucjan T. (1998)**, "Monetary Policy Targeting in Central Europe's Transition Economies: The Case for Direct Inflation Targeting", CASE-CEU Working Paper 11, August.

**Pujol, Thierry and Mark Griffiths (1996)**, "Moderate Inflation in Poland: A Real Story", IMF Working Paper No. 96/57, June.

**Raiser, Martin (1997)**, "Soft Budget Constraints and the Fate of Economic Reforms in Transition Economies and Developing Countries", Kieler Studien 281, Institut für Weltwirtschaft an der Universität Kiel.

**Reimers, Hans-Eggert (1991)**, "Comparisons of Tests for Multivariate Cointegration", *Arbeiten aus dem Institut für Statistik und Ökonometrie der CAU Kiel* No. 58/1991.

**MPC (Monetary Policy Council) (1998)**, *Medium-Term Strategy of Monetary Policy (1999-2003)*, National Bank of Poland, Warsaw, September.

**Sachs, Jeffrey (1993)**, *Poland's Jump to the Market Economy*, MIT Press.

**Svensson, Lars E.O. (1997a)**, "Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets", *European Economic Review*, 1997, Vol. 41, No. 6, pp. 1111-1146.

**Svensson, Lars E.O. (1997b)**, "Inflation Targeting in an Open Economy: Strict or Flexible Inflation Targeting?", Reserve Bank of New Zealand Discussion Paper G97/8, November.

**Ugolini, Piero (1996)**, "National Bank of Poland: The Road to Indirect Instruments", IMF Occasional Paper 144, October.

**Wagner, Helmut (1998)**, "Central Banking in Transition Countries", IMF Working Paper No. 98/126, August.

**Wozniak, Przemyslaw (1998)**, "Relative Prices and Inflation in Poland, 1989-97: The Special Role of Administered Price Increases", World Bank Policy Research Paper 1879, February.