ACTA UNIVERSITATIS LODZIENSIS
FOLIA OECONOMICA 223, 2008

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INFLATION DYNAMICS IN THE "NEW" EU MEMBER STATE: POLAND 1998–2006

Abstract. The reduction of inflation to an average EU level is a necessary precondition for any new EU member state to join the Euro area. Inflation in Poland is analyzed by using the monetarist P-star model. It appears that in the Polish case the P-star model describes the Polish inflationary process reasonably well. However, adjustment to the equilibrium level (inflation target) is rather slow.

Key words: inflation, econometric modeling, long-term equilibrium price level.

1. INTRODUCTION

The objective of this paper is to analyze the inflation dynamics in the one of the new member states of the European Union – Poland.

The subject of inflation in the new European Union member states is important for two reasons. In general, the price stability (or the lack of it) is very important factor in facilitating the growth of an economy and promoting economic competitiveness (Fergusson 2005). Second, Poland's future membership in the EURO area – something which is required from all 12 new members – demands a low and stable inflation. Hence, it is very important to know which factors affect inflation and how and whether those factors are homemade or imported.

The new European Union members accession treaties stipulate the mandatory membership in the EURO area for all the new members – Estonia, Latvia, Lithuania, Poland, The Czech Republic, Slovakia, Hungary, Slovenia, Malta, the Greek part of Cyprus, Bulgaria and Romania.

However, the EURO area membership, albeit required, was not automatic on the accession. It is conditioned on the new members demonstrated ability to comply with the original stipulations of the Stability and Growth pact (SGP) and the turnover rate and inflation stability.

In essence, before joining the EURO, the new member states must:

a) Bring their inflation levels to a level differing no more than 1.5% point from the average EURO area inflation, as defined by the HCPI index.

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b) Maintain their budget deficits bellow 3% of GDP.

c) Maintain the public debt level under 60% of GDP.

d) To reform and open domestic financial sector so that it becomes competitive at least within the EURO area.

When these conditions are achieved, a new member state joins the transitory arrangement called ERM II. In this phase not only all the conditions specified in the previous paragraph must be observed, but the turnover rate vis a vis EURO cannot fluctuate more than 15% in either direction for at least 2 years. Only then a new member state can become a full fledged EURO state.

Some discussion of the overall issues related to the inflation dynamics in transformation economies and the inflation analysis in general follows in part II. Part III then provides the analytical survey of the P-star model. This model is then used to analyze the Polish inflationary dynamic in the immediately pre-accession and the post-accession periods. The actual estimates are then provided in part IV and conclusions are presented in part V.

2. INFLATION IN THE NEW MEMBER STATES AND POLAND

Of the 10 states which acceded to the European Union in May 2004, 7 (Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Hungary) have a common background of going through a transformation from central planning to market economies until mid- to late nineties.

And even if individual experiences somewhat differ, the most pronounced common features of transformation processes are a deep decline in output and a large increase in inflation, in some states reaching triple digit levels annually.

In the Polish case these phenomena of transformation recession and inflation were somewhat more intensive than in the most of other countries which later become the "new" EU members. Reasons can be traced to the protracted difficulties and failed "solutions" the Polish economy experienced in the 1970s and 1980s.

The analysis of the Polish economic dynamics in the 1990s and 2000s goes beyond the subject of this paper. However, as far as inflation dynamics and the related economic policies are concerned, two events are important.

First, the policy of the controlled turnover rate depreciation which was used to control inflation in the early to mid 1990s was replaced by the inflation targeting and the floating turnover rate regime in first half of 1998.

The second major factor affecting the Polish economy and economic policies was the launch of the EU accession process in March – November 1998 (Hallerberg and de Souza 2000). This process culminated in May 2004 with Poland joining EU as a full-fledged member.

It is therefore reasonable to consider 1997–1998 period as the major structural and behavioral break for the Polish economy, including the dynamics of the inflation processes.

For the reasons just elucidated this paper will analyze the dynamics of inflation in Poland for the period from 1998 till the end of 2006. This period coincides with the period when the NBP followed the inflation targeting strategy in the environment of a floating turnover rate regime.

However, this choice of the period for the analysis imposes a constraint on the choice of the variables for the empirical approach. There are only 36 quarters between 1998 and the end of 2006. Consequently, the application of the most up to date multiequation econometric techniques of the inflation analysis (Gollineli and Orsi 2002; Jansen 2004) was unfeasible.

Therefore, the single equation estimation technique was chosen, namely the P-star model originally developed by J. A. Tatom (1990). The model is specified in the following part.

3. INFLATION MODELING – THE P-STAR MODEL

As a theoretical concept, the P-star model reflects the monetarist approach to the economic analysis. It utilizes two basic ideas.

First is that for the every level of a money stock M there is a corresponding equilibrium price level denoted as P-star (P*). P* variable is calculated (not estimated) using the long term version of the equation of turnover (P*Y* = MV*). Here M is actual money stock, Y* is a long term "potential" GDP and V* is long term velocity. Both Y* and V* were obtained from the actual observations by using Hodrick-Prescott filter (underlying velocity V was calculated from the actual data by using the equation of turnover formula for V (i.e. V = P.Y/M)). In this approach (pioneered by Kool and Tatom 1994) Y* and V* are independent of M.

Second idea says that in the short term the actual price level P can differ from P*. But if such a difference obtains then the subsequent changes in P will be such that over time P converges to P*. The actual inflation dynamics is then determined by both the monetary stance – which determines P* and by the process of convergence of the actual P to P*.

In more formal terms, it is assumed that the monetarists equation of turnover holds in the long run, which implies:

$$p^*_t = m_t + v^*_t - y^*_t \qquad (1)$$

where the lower case letters in (1) indicate the logs of variables. y^*_t denotes the (log of) long run potential real output, determined in general by the technology

and the resource availability. v^*_t is then the (log of) equilibrium velocity, determined by the preferences of individual agents and the financial technology. It is assumed that both long run equilibrium values of y^*_t and v^*_t are independent of the current m_t.

The log of the actual price level at the period t (p_t) then may differ from its long run equilibrium level p^*_t due to a variety of current and past shocks.

The difference $p_t - p^*_t$ then constitutes the (domestic) price gap. Because of the assumption of a convergence of p_t toward p^*_t, p_t and p^*_t are cointegrated. That is, the domestic price gap p_t-p^*_t is stationary (no unit root) and we can model the dynamics of p_t as the error correction process:

$$Dp_t = \alpha_0(p_t - p^*_t) + \Sigma^N_{i=1} Dp_{t-i} \qquad (2)$$

but $Dp_t = p_t - p_{t-1}$ - i.e. Dp_t is the log difference of the p_t, that is the rate of inflation π_t. Therefore, we can rewrite (2) as:

$$\pi_t = \alpha_0(p_t - p^*_t) + \Sigma^N_{i=1} \pi_{t-i} \qquad (3)$$

Expression (3) now constitutes the theoretical inflationary process derived from the assumptions of the P-star model.

However, the (3) is not quite suitable for the empirical analysis due to the fact that observed inflations often display unit roots.

Following the reasoning in Tatom (1990) we can write (3) as:

$$D\pi_t = \alpha_0(p_t - p^*_t) + \Sigma^N_{i=1} \alpha_i D\pi_{t-i} \qquad (4)$$

where $D\pi_t$ is the first difference of inflation – the variable which is generally stationary (i.e. no unit roots). (Tatom's reasoning is straightforward but rather extensive. An interested reader is therefore referred to his excellent analysis.)

Expression (4) can be tested empirically. However, argument can be made that for an analysis of the inflation dynamics in small open economies like Poland the usefulness of the formulation like (4) may be limited. After all, the main economic factors determining prices in a small open economy are the trade and the turnover rate.

Recognizing this fact, Kool and Tatom (1994) extended the P-star type of analysis to economies of small, open countries. Their approach was then successfully applied by K. Wesche (1997), J. Pranskeviciute and A. Sperberga (2005) and others.

The C. J. M. Kool and J. A. Tatom (1994) extension of P-star model utilizes the well known conclusion of the monetary approach to the balance of payments that in the small open economy with no restrictions on trade and capital flows and with the fixed turnover rate the domestic money supply – and hence the domestic equilibrium price level – became endogenous.

In such an economy the domestic long run equilibrium price level equals to the world equilibrium price level P^{*f} adjusted by the ratio of the nominal to real turnover rate (Ex/ExR), where Ex is the nominal turnover rate and ExR is the real turnover rate. P^{*f} is calculated by applying the same methodology as in the case of P*, but using the relevantly defined foreign V^{*f}, Y^{*f} and M^{f}.

In the log terms, let us now define $p^{*EU}{}_t = \log ((Ex_t/ExR_t)P^{*f})$. $p^{*EU}{}_t$ is now the relevant equilibrium price level for the domestic economy. Hence, we can define the "foreign" price gap $(p_t - p^{*EU}{}_t)$.

The logic of P-star model implies that properties of the foreign price gap and the price setting behavior are the same as in the case of the closed economy (i.e. the domestic price gap). Hence, we can substitute foreign price gap for the domestic price gap in the equation (4), to obtain

$$D\pi_t = \beta_0 (p_t - p^{*EU}{}_t) + \Sigma^{N}_{i=1} \beta_i D\pi_{t-i} \qquad (5)$$

(5) describes the inflation dynamics in the theoretical P-star model for a small open economy with unrestricted trade, a perfect capital mobility and the fixed turnover rate. But it is important to note that if such an economy follows the free floating turnover rate regime, the (4) will theoretically apply. The reason is that under the free floating turnover rate a country preserves its monetary autonomy and hence an ability to determine its own long run price level.

In the real world, however, assumptions behind either (4) or (5) are seldom met exactly. Therefore, we surmise that the actual process will follow some combination of (4) and (5), with added impact of some exogenous variables which may affect the short term inflation behavior. Therefore, we combined (4) and (5) together to obtain

$$D\pi_t = \beta_0(p_t - p^*_t) + \beta_1(p_t - p^{*EU}{}_t) + \Sigma^{N}_{i=1} \gamma_i D\pi_{t-i} + \Sigma^{N}_{i=1} \delta_i DZ_{t-i} \qquad (6)$$

(6) is the general form of the P-star model inflation dynamics equation developed for the analysis of small open economies. Besides the domestic and foreign price gaps it includes lagged changes in inflation and the set of exogenous variables Z which may affect the short term inflation dynamics (like import or energy prices).

Theory assumes the coefficients β_0 and β_1 to be non-positive. If either of those is zero, (6) collapses in either (4) or (5). Other coefficients have no ex ante theoretical values and must be determined by the data.

Finally, in the context of this paper's analysis it can be argued that using (6) is unnecessary and the use of (4) amended by the above specified exogenous variables is sufficient. The thrust of this argument is that: a) the expression (5) assumes the fixed turnover rate regime; and b) by the 1998 the NBPmoved to a direct inflation targeting with float.

Table 1

Inflation dynamics in Poland 1998–2006

Year	Inflation Target	Actual CPI Inflation	Long Run Equilibrium (P*) Inflation	Inflation Expectations
1998	9.5–11	9.9	11.9	17.1
1999	9–7	8.7	10.0	10.1
2000	5.4–6.8	9.9	4.9	9.8
2001	6–8	4.6	4.5	10.2
2002	5	1.1	–2.0	3.5
2003	2–4	1.3	1.9	0.7
2004	1.5–3.5	4.5	2.7	2.1
2005	1.5–3.5	1.6	3.0	4.1
2006	1.5–3.5	1.2	3.0	0.9

All data in this table are annualized as of April 2007.

All numbers reported reflect the reality at the end of each corresponding year.

Inflation targets are announced 6 month at advance for the following year. Inflation expectations surveys are

conducted and announced for the 12 month horizon. Long run equilibrium (P*) inflation is calculated by using

P* model concepts elucidated in the text. Actual CPI inflation is from NBP database.

Sources: Inflation Targets, Inflation Expectations and Actual CPI inflation – NBP; National Bank of Poland) web site; Long Run Equilibrium (P*) Inflation – own calculations.

However, it remains ex ante unclear how "clean" the Polish Zloty float was in the 1998–2006 period. Therefore, the method of general to specific was used in the actual empirical work (see below). General formulation (6) was estimated first and more specific (4) (which is included in (6)) was estimated subsequently.

4. ESTIMATION RESULTS

4.1. Data

Data used in this analysis were obtained from public databases available from Eurostat, Polish National Bank and the Polish Statistical Office websites. Data are in quarterly frequency and cover the period 1997:1 to 2006:4. Due to the need to provide for a possible lag structure, the actual estimations are over

the period 1998:1 – 2006:4 – i.e. 36 quarterly observations for each variable.

The list of variables used in the estimation is in the Appendix 1. All variables were tested for unit roots, with results reported in Table 2. Those results include tests for first differences where the original variable has the unit root. All estimation procedures use variables in their I(0) (i.e. no unit roots) form only.

Table 2

Unit root tests (ADF)

A. Variables in levels			
Variable	Test Statistic	5% Critical Value	Unit Root
(P-P*) (2 lags)	–3.011	–2.956	No
(P- (EX/EXR)P^{EU}*) (5 lags)	–3.754	–2.963	No
CPIINF (6 lags)	–0.895	–2.959	Yes
IMPORTINF (6 lags)	–0.987	–2.959	Yes
ENERGYINF (2 lags)	–2.191	–2.947	Yes
B. Variables in first differences			
CPIINFD (3 lags)	–4.267	–2.950	No
IMPORTINF D (5 lags)	–4.540	–2.956	No
ENERGYINFD (0 lags)	–6.520	–2.942	No

All variables are in logs or (when relevant) the log differences. D at the end of variables in part B indicates the first difference of the corresponding variable in part A.

Source: As same as Table 1.

4. 2. The Estimation of P-star model

To estimate the P-star model, equation (6) was operationalized in the form:

$$D\pi_t = \sum^{2}_{i=1} \beta i(p_t - p^*_t) + \sum^{2}_{i=1} \phi i(p_t - p^{*EU}_t) + \sum^{4}_{i=1} \gamma_i D\pi_{t-i} + \quad (7)$$

$$+ \sum^{3}_{i=0} \delta_i IMOPRTINFD_{t-i} + \sum^{3}_{i=0} \psi_i ENERGYINFD_{t-i}$$

i.e the change in inflation in the current period is generally assumed to depend on 2 lags of both domestic and foreign price gaps, 4 lags of itself and the current value and 3 lags of each of the changes in import and energy prices inflations.

Second lag of both price gaps was included because of some past results in estimating P-star models (Wesche 1997, J. Pranskeviciute and Sperberga 2005). Possible significance of the second lag in price gaps can be justified as a consequence of the lags in the GDP reporting and hence the delayed information about P*'s in the immediately preceding quarters.

Several alternative money stocks (M1, M2, M3) and price indexes (CPI, GDP deflator) measures were tested in the construction of the P*'s (see the discussion above, part IIIa)). These were then used to construct price gap variables $(p_t - p^*_t)$ and $(p_t - p^{*EU}_t)$.

Of those, only the M2-CPI combination generated the price gaps with no unit roots – the characteristic required by the theory of the P-star model. Hence M2-CPI price gaps, both domestic and foreign, were used in the estimation of (7). Consequently, the change in the CPI inflation is the appropriate variable for the use in (7).

The changes in import price inflation (IMPORTINFD) and the energy price inflation (ENERGYINFD) were included to account for the possible outside shocks to domestic inflation processes. Lagged values of these variables are included to account for a (possible) time gaps between an exogenous shock to input prices (both general imports and energy) and the domestic CPI.

The number of lags to be included in initial estimates for changes in CPI inflation and changes in both import and energy inflations was determined individually for each time series by using the Akaike-Schwartz criterion.

The results of estimating (7) are reported in Table 3. All variables included are I(0) – i.e. no unit roots – hence the OLS is the appropriate estimation technique.

The full estimate (including all variables as specified above) is reported in column (a), Table 3. Only few variables are statistically significant. This indicates either an overdetermination or colinearity among explanatory variables.

Hence, the general to specific approach to the estimation of (7) was applied to determine only statistically significant variables. The result is reported in column (b) of Table 3.

It shows that:

a) only the first lag of the domestic price gap is statistically significant and has the right (i.e. the negative) sign.

b) The foreign price gap is irrelevant in the determination of the dynamics of domestic inflation (its coefficient is implicitly zero). This result is to be expected in the floating turnover rate environment (see above).

c) External shocks – both to imported and energy prices – have an expected positive impact on changes in the domestic CPI inflation.

d) Past changes in the domestic CPI inflation affect the current change, indicating a certain level of inflation inertia.

e) Durbin h-statistic (not reported) indicates no residual serial correlation.

f) Given the fact that estimates are in the first differences (except price gaps), the reported $R^2 = 0.57$ indicates that variables included in column (b) of Table 3 explain the inflation dynamics reasonably well.

To summarize, the P-star model provides a reasonably good explanation of the dynamics of inflation in Poland the 1998–2006 period.

However, one should mention that the estimated coefficient for the domestic price gap (–0.126) indicates the relatively slow adjustment of the actual to a long term inflation. Only about a half of the difference between the actual P and P* is reduced over 8 periods (i.e. 2 years). Moreover, the current changes in the inflation rate are rather sensitive to outside price shocks from imports and energy.

Table 3

Estimates for p* model

Variable Variables Only (b)	All variables	Statistically Significant (a)
Constant	0.001 (0.15)	
$(P-P^*)_{-1}$	–0.035 (0.44)	–0.126 (2.19)
$(P-P^*)_{-2}$	–0.009 (0.11)	
$(P-(EX/EXR)P^{EU}*)_{-1}$	– 0.004 (0.62)	
$(P-(EX/EXR)P^{EU}*)_{-2}$	–0.003 (0.51)	
$CPIINFD_{-1}$	0.099 (0.42)	
$CPIINFD_{-2}$	0.502 (2.31)	0.263 (2.39)
$CPIINFD_{-3}$	0.216 (1.19)	
$CPIINFD_{-4}$	–0.208 (1.20)	
IMPORTINFD	0.044 (1.02)	
$IMPORTINFD_{-1}$	0.089 (1.92)	0.059 (3.31)
$IMPORTINFD_{-2}$	–0.012 (0.25)	
$IMPORTINFD_{-3}$	–0.042 (1.13)	
ENERGYINFD	0.253 (2.77)	0.373 (6.27)
$ENERGYINFD_{-1}$	–0.025 (0.23)	
$ENERGYINFD_{-2}$	–0.109 (1.00)	
$ENERGYINFD_{-3}$	–0.021 (0.21)	
R**2	0.732	0.511

All variables are in logs or log-first differences (indicated by suffix D). The Numbers in parenthesis are the relevant t-statistics.

S o u r c e: own calculations.

5. CONCLUSION

The previous analysis indicates that the monetarist based P-star model approach to the analysis of the Polish inflation provides a reasonable description of the inflationary dynamics in Poland in the 1998–2006 period.

The ascendancy of the P-star model reflects well on the policy of the NBP. Inflation targeting regime implemented in Poland from 1998 was instrumental in stabilizing inflation in the last 8 years, as witnessed by the Table 1.

P-star model indicates that NBP should be able to set the monetary policy and the inflationary targets such that the conditions required to join the Euro area can be achieved.

However, the process of convergence of the actual CPI inflation to a long term P* equilibrium price level (which is the reflection of the monetary stance) is rather slow. Moreover, the significance of outside shocks like the recent run up of energy prices increases the remaining price instability.

Hence, even if the NBP appears to be well in control of the Polish inflationary process, the road to Euro will be slow and is likely to take several years.

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APPENDIX 1

DEFINITIONS AND DESCRIPTIONS OF VARIABLES

(P-P*)	Domestic price gap: the difference between the actual domestic price level P and the long run domestic equilibrium price level P*
(P- (EX/EXR)P^{EU}*)	Foreign price gap: the difference between the actual domestic price price level P and the long run foreign (EU15) equilibrium price level P^{EU*}, the latter adjusted by the nominal to real turnover rate ratio
CPIINF	CPI (consumer price index) inflation
IMPORTINF	Import prices inflation
ENERGYINF	Energy prices inflation

All variables are in logs or log differences. D at the end of variables (used in the text) indicates the first differences, except for EXPINFD, which is defined above.

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DYNAMIKA INFLACJI W NOWYCH KRAJACH CZŁONKOWSKICH UE: POLSKA 1998–2006

Redukcja inflacji do średniego poziomu UE stanowi dla niektórych nowych krajów członkowskich UE wymóg konieczny do ich wstąpienia do strefy Euro. Inflacja w Polsce jest analizowana przy zastosowaniu monetarystycznego modelu "P-star" (P*). Okazuje się, że w przypadku Polski model ten opisuje dynamikę inflacji w latach 1998-2006 nadspodziewanie dobrze. Jakkolwiek, dojście aktualnego wskaźnika cen towarów i usług konsumpcyjnych do poziomu długookresowej równowagi P* jest raczej powolne.

Słowa kluczowe: inflacja, modelowanie ekonometryczne, długookresowa równowaga poziomu cen.