Credibility effects on Inflation Dynamics : The case of Poland

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Abstract

This paper examines the role of monetary credibility in Poland's inflation dynamics by using a new hybrid Phillips curve with time-varying coefficients. We specify our model under State space form and estimate by using a Kalman filter approach. The results indicate that, before financial crisis, Poland's inflation dynamics is well described by lagged and future expected inflation with an important forward-looking behaviour predominance. Thus, the monetary credibility played a role in Poland's disinflation process because its effects seem to make inflation dynamics more forward-looking.

JEL Classifications: E31, E52, E58, C51.

Keywords: Inflation dynamics, Poland, new hybrid Phillips curve, credibility, Kalman filter.

1 Introduction

In this paper, we study the disinflation process in Poland before the financial crisis; in particular, we want to focus on the role of the monetary credibility to consolidate the achievement of this process. Poland started adopting a currency peg in 1990 to move to a crawling peg system in 1991 and to free float in 2000 after widening the band from ±7% in 1995 to 15% in 1999. The National Bank of Poland (NBP) exchange rate policy is accompanied by a direct inflation targeting strategy since 1998. This new strategy has been in fact successful in generating sustainable prices because it is devoted solely to lowering inflation in the early 2000s. The monetary credibility seemed to play however an important role in this disinflation process. In this context, it appears therefore interesting to assess monetary credibility effects on inflation dynamics. Indeed, the concept of monetary credibility refers directly to the private sector expectations. Blinder [2000] provides a very short and intuitive definition of credibility : « *a central bank is credible if people believe it will do what it says* ». Cukierman and Meltzer [1986] define in turn credibility as *« absolute value of the difference between policy-makers plans and the public's beliefs about those plans. »*

We define a new hybrid Phillips curve (as in Gali and Gertler [1999], Smets and Wouters [2003] or Christiano *et al.* [2005]) in order to assess credibility effects on inflation dynamics in Poland. We consider a version of basic Calvo [1983] price setting model and modify it by introducing passive prices adjustments (Christiano *et al.* [2005]) and Céspedes *et al.* [2005]). By using a Cobb-Douglas technology we determine that real marginal cost depends on real wage and real exchange rates (McCallum and Nelson [2005]; Lendvai [2005]). Moreover, from our new hybrid Phillips specification we assume that the inertia of all inflation determinants depend on monetary credibility index.

Although the monetary credibility is relatively easy to define, it is difficult to measure. However, there is no commonly accepted and used indicator of monetary policy credibility. Hutchison and Walsh [1998] and Cecchetti and Krause [2002] refer to the gap between inflation expectations of economic agents and the central bank's inflation

target to measure the credibility. While Bomfim and Rudebusch [2000] consider the weight attached to the central bank target in the formation of the private sector's long-term inflation expectations[1] as a proxy of the credibility. In line with Sidiropoulos *et al.* [2005] we retain long-term nominal interest rate differential as credibility indicator because of its sensitivity to market expectations regarding current and future policies.

To assess credibility effects on Poland's inflation dynamics, our empirical analysis focuses on two scenarios : for the first, we specify a new hybrid Phillips equation without credibility index while for the second scenario we assume that all coefficients' inertia, which are assumed time-varying are affected by the credibility index.

Our estimations results indicate that Poland's inflation dynamics is well described by lagged and future expected inflation. They point also to ambiguous effects of real marginal cost components. Therefore, the monetary credibility played a role in Poland's inflation dynamics probably due to inflation targeting strategy adopted since October 1998. Credibility effects seem thereby to make Poland's inflation dynamics more forward-looking.

The reminder of the paper is structured as follows : Section 2 presents briefly monetary and exchange rates policies over the last two decades. Section 3 sets up the theoretical model for explaining how do we determine the new hybrid Phillips curve in small open economy. In the section 4, we describe the empirical analysis and present some findings using two scenarios. Finally, the section 5 summarizes the main conclusions of the paper.

2 Monetary policy in Poland

Poland started its macroeconomic stabilization program when the Zloty[2] was pegged to a basket of currencies in 1990. This fixed anchor did not lead to decline rapidly the inflation, in addition it induced real appreciation and erosion of competitiveness. Therefore, a preannounced crawling peg was introduced in October 1991. Capital account liberalization led in 1994 and 1995 to large capital inflows, which forced the

[1] For details, see Lyziak *et al.* [2007].
[2] Literally meaning « *golden* », is the domestic currency of Poland.

authorities to widen the crawling exchange rate band in May 1996.[3] Upward pressure on the currency continued and in the early 1998, the national bank of Poland began to widen the band again.[4] The main raison for the gradual widening of the band was the effort of the monetary authorities to accommodate large capital inflows.

The implementation of the inflation targeting regime in Poland began during 1998. It still maintained an exchange rate band which was widened.[5] The primary goal of monetary policy was maintaining price stability.[6]

Since the early 1999, the direct inflation target strategy has been used in order to break through the inflation expectations, which were perceived as one of the main obstacles for the disinflation process. Indeed, monetary authorities need to establish its credibility because the stronger the impact of policy announcement on expectations, the easier it is for policy-makers to control inflation and to accommodate shocks to reach the objective of price stability. To make effective the disinflation process, Poland abandoned the exchange rate band and switched to a managed float in April 2000. Monetary authorities did not aim to set predetermined Zloty exchange rates against other currencies. It reserved however to right to intervene if it deemed this necessary in order to achieve the inflation target.

The NBP has pursued a continuous inflation target at the level 2.5% with a tolerance band of +/-1% since the early 2004. It maintained interest rates at a level consistent with the adopted inflation target by influencing the level of nominal short-term interest rates on the money market and the demand within the economy and the inflation rate.

In addition, as above mentioned, the monetary credibility can play an important role in implementing the inflation targeting policy. Through our empirical studies, we tend to evaluate the contribution of the credibility to consolidate the impact of the monetary policy on Poland's inflation dynamics.

[3] +/- 7%.
[4] +/-10% in February 1998, to +/-12.5% in October 1998, and finally to +/-15% in March 1999.
[5] +/-10% to +/-12.5%, and later to +/-15%.
[6] To make solid foundations for long-term economic growth and for adopting euro as domestic currency.

3 Theoretical model

This section outlines a closed economy new hybrid Phillips curve and its extension in open economy. We deduce the open economy extension by assuming that firms use imported goods as intermediate consumption goods.

3.1 Closed economy model

Our new Keynesian Phillips curve is based on individual firms' price setting. The model is a version of the Calvo [1983] staggered price setting model extended to incorporate backward-looking price setting by a fraction of firms [Gali and Gertler, 1999].

There is a continuum of monopolistically competing firms in the economy. Each firm faces a probability θ of not being able to readjust its price in a given period. This probability is constant across firms and over time. As in Gali and Gertler [1999], we assume two types of firms: a fraction $(1-\omega)$ who adjust their prices in a forward-looking way and a fraction ω, which follow instead some passive (backward-looking) updating rule in their price readjustment. These assumptions imply that the average price level p_t can be expressed as:[7]

$$p_t = \theta p_{t-1} + (1-\theta)\dot{p}_t \qquad (1)$$

Where $\dot{\mathbf{p}}_\mathbf{t}$ is a weighted average of prices readjusted in a forward-looking way, p_t^f and of prices readjusted following the passive updating rule p_t^b :

$$\dot{p}_t = (1-\omega)\, p_t^f + \omega p_t^b \qquad (2)$$

Forward-looking firms set their price to maximize their future flows of profits subject to the price setting rules. Denoting nominal marginal costs by mc_t^n and the time discount factor by β, the optimally readjusted price is:

[7] Lower case variables denote logarithm variables.

$$p_t^f = (1-\beta\theta)\sum_{k=0}^{\infty}(\beta\theta)^k E_t(mc_{t+k}^n) \quad (3)$$

Backward-looking firms follow the updating rule based on the formulation by Christiano *et al.* [2005] and Céspedes *et al.* [2005]. We assume that backward-looking updating rule for those firms that can not optimally adjust prices is given by:

$$p_t^b = p_{t-1} + \rho\pi^* + (1-\rho)\pi_{t-1} \qquad (4)$$

Where π^* the inflation is target[8] and ρ is a measure of monetary credibility. When $\rho = 1$, *i.e.*, the central bank is fully credible, firms therefore fix their price in respect to the previous price and the inflation target. The new hybrid Phillips curve can be expressed as:

$$\pi_t = \delta + \gamma^b \pi_{t-1} + \gamma^f E_t \pi_{t+1} + \lambda mc_t \quad (5)$$

The coefficients δ, γ^b, γ^f and λ are given by:

$$\delta = \frac{\rho\omega(1-\beta\theta)(1-\theta)}{\phi}\pi^*; \ \frac{\partial\delta}{\partial\rho} > 0$$

$$\gamma^b = \frac{\omega(1-\rho)(1-\theta)}{\phi}; \ \frac{\partial\gamma^b}{\partial\rho} < 0$$

$$\gamma^f = \frac{\beta\theta}{\phi}; \ \frac{\partial\gamma^f}{\partial\rho} > 0$$

$$\lambda = \frac{(1-\theta)(1-\omega)(1-\beta\theta)}{\phi}; \ \frac{\partial\lambda}{\partial\rho} > 0 \qquad (6)$$

Where $\phi = \theta + [1-\theta(1-\beta(1-\theta)(1-\rho))] \neq 0$.

Note that backward-looking price setting leads to inflation rate inertia. Indeed, when there is a positive fraction of backward-looking firms in the economy, the coefficient of lagged inflation rate is positive. For the case, where all firms are forward-looking, the hybrid Phillips curve (5) reduces to standard pure forward-looking new Phillips curve.

[8] In this context, we assume that this inflation target corresponds to the euro zone inflation rate.

In addition, according to equation (5) the nature of our Phillips ~~equation~~ depends on the degree of monetary credibility ρ (or indexing parameter). Indeed, when $\rho = 1$, the backward-looking firms adjust their prices, in respect to the inflation target. In this case, the hybrid Phillips equation (5) reduces to standard pure forward-looking process. When $\rho = 0$, we obtain the specification of Lendvai [2005] while the case $0 < \rho < 1$ corresponds to the new hybrid Phillips curve.

3.2 Open economy extension

In this study, we follow McCallum and Nelson [1999]. We assume that, imported goods are considered as intermediate consumption goods while all final goods are produced domestically. This hypothesis are motivated by several motivations: (*i*) the exchange rate pass-through on the general price level is incomplete in Poland; (*ii*) Poland's firms production process is dominated rather by imported factors than by capital ones

In order to take in account the impact of the exchange rate, we modify the definition of the real marginal cost in the new hybrid Phillips equation by considering a Cobb-Douglas production technology with two inputs (Lendvai, [2005]).[9]

$$y_t = \alpha l_t + (1-\alpha) y_t^m \qquad (7)$$

Where l_t corresponds to labour and y_t^m is an index of imported differentiated intermediate production goods. Note that y_t stands here for gross output and the parameter α is therefore the labor share in gross output.

By assuming the price of one unit of the imported composite good is $p_t^m + e_t$, the real marginal cost can be expressed as:

$$mc_t = \alpha w_t + (1-\alpha) q_t \qquad (8)$$

Where w_t stands for real wage and q_t is the real cost of a unit of the imported good. Substituting this expression into the closed economy hybrid Phillips curve (5) gives

[9] However, our Cobb-Douglas specification is a bit different from Lendvai's [2005] one because we assume here that the labour augmenting technology shock is equal to one.

$$\pi_t = \delta + \gamma^b \pi_{t-1} + \gamma^f E_t \pi_{t+1} + \lambda^l w_t + \lambda^m q_t \quad (9)$$

The expressions linking δ, γ^b and γ^f to the structural parameters are as in expression (6). Real unit labor cost and real exchange rate coefficients are defined as:

$$\lambda^l = \frac{\alpha(1-\theta)(1-\omega)(1-\beta\theta)}{\phi} \; ; \; \frac{\partial \lambda^l}{\partial \rho} > 0$$

$$\lambda^m = \frac{(1-\alpha)(1-\theta)(1-\omega)(1-\beta\theta)}{\phi} \; ; \; \frac{\partial \lambda^m}{\partial \rho} > 0 \quad (10)$$

4 Empirical Analysis

4.1 Data

In our empirical analysis, monthly data are used; the sample period is from January 2001 to October 2009. The sample covers periods of inflation targeting regime implementation, which started in the late 1990s. Hence, it allows to avoid the beginning of the transition process in the early 1990s and the post financial crisis, characterized by movements and turbulences.

First, the real exchange rate is deduced from the nominal exchange rate and the ratio of prices between Poland and euro zone. We use long-term interest rates differential as proxy for credibility index because it appears probably the variable most sensitive to market expectations regarding current and future policies. So, we retain the Maastricht criterion bond yields corresponding to long-term interest rates.[10] The inflation rate series corresponds in turn to monthly rate of change in harmonized index consumer price (basis 2005=100).[11] All previous variables stem from Eurostat Database.

Second, we use *Ipsos* survey data from national bank of Poland for inflation expectations data. It corresponds to the monthly expected of inflation from inflation expectations of private individuals. We retain the harmonized index of consumer prices

[10] It is used in addition as a convergence criterion for the Economic and Monetary Union (EMU) accession.
[11] Corresponding to overall index excluding alcohol and tobacco.

(HICP)[12] to determine the domestic general price level (source Eurostat). The nominal unit wage cost index[13] has been collected from the European commission, economic and financial affairs database. Therefore, we derive the real unit wage cost by deflating the nominal unit wage cost index regarding to harmonized index of consumer prices level. All these before mentioned variables are taken in logarithm except the long-term interest rates.

4.2 State space specification

Our empirical analysis focuses on two key features: First, the equation (9) shows that inflation dynamics is described by the new hybrid Phillips curve and depends on lagged inflation (backward-looking expectations), future expected inflation (forward-looking expectations) and on real marginal cost components.[14] However, coefficients of these variables seem to depend in turn on credibility index ρ_t. This latter is proxied by the long-term interest rates differential because of its sensitivity to market expectations regarding current and future policies.[15] Second, since the credibility index evolves over time?, therefore all coefficients of our new hybrid Phillips equation become time-varying. To perform our empirical analysis we distinguish, through the State space specifications two scenarios in order to show the role of the monetary credibility in Poland's inflation dynamics. In the first scenario, we do not include the credibility index in our specification while in the second, one the new hybrid Phillips curve equation will be enriched by introducing the credibility index. The specifications of both scenarios are estimated by means of a Kalman filter. The Kalman [1960, 1963] filter technique is extremely useful. It is adopted to estimate regression models with time-varying coefficients.[16] This class of models consists of two equations: the transition equation, describing the evolution of unobserved states variables and the measurement equation, describing how the observed data are generated from the states variables.

We define a linear State Space specification from the new hybrid Phillips curve (9) by the following system of equations:

[12] Basis 2005=100. Used by Governing Council for the purpose of assessing price stability.
[13] Basis 1999=100.
[14] *i.e.* The real unit wage cost and the real exchange rate.
[15] For more details, see Sidiropoulos *et al.* (2005).
[16] For more details on Kalman filter, see Harvey [1991] or Cuthbertson *et al.* [1992].

Measurement equation:

$$\pi_t = \begin{bmatrix} \delta_t & \gamma_t^b & \gamma_t^f & \lambda_t^l & \lambda_t^m \end{bmatrix} \begin{bmatrix} 1 \\ \pi_{t-1} \\ E_t\pi_{t+1} \\ l_t \\ q_t \end{bmatrix} + \varepsilon_t; \qquad \varepsilon_t \to N(0, \sigma_\varepsilon^2) \qquad (11)$$

States equation without credibility effects:

$$\begin{bmatrix} \delta_{t+1} \\ \gamma_{t+1}^b \\ \gamma_{t+1}^f \\ \lambda_{t+1}^l \\ \lambda_{t+1}^m \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \delta_t \\ \gamma_t^b \\ \gamma_t^f \\ \lambda_t^l \\ \lambda_t^m \end{bmatrix} + v_{t+1}^1; \qquad v_t^1 \to N(0, \sigma_{v^1}^2) \qquad (12)$$

States equation with credibility effects:

$$\begin{bmatrix} \delta_{t+1} \\ \gamma_{t+1}^b \\ \gamma_{t+1}^f \\ \lambda_{t+1}^l \\ \lambda_{t+1}^m \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & \phi_{16} \\ 0 & 1 & 0 & 0 & 0 & \phi_{26} \\ 0 & 0 & 1 & 0 & 0 & \phi_{36} \\ 0 & 0 & 0 & 1 & 0 & \phi_{46} \\ 0 & 0 & 0 & 0 & 1 & \phi_{56} \end{bmatrix} \begin{bmatrix} \delta_t \\ \gamma_t^b \\ \gamma_t^f \\ \lambda_t^l \\ \lambda_t^m \\ \rho_t \end{bmatrix} + v_{t+1}^2; \qquad v_t^2 \to N(0, \sigma_{v^2}^2) \qquad (13)$$

π_t is driven by an ARX(1)[17] process and time-varying coefficients, δ_t, γ_t^j ($j = b, f$) and λ_t^i ($i = l, m$), which follow in turn a random walk process. ρ_t is the credibility index (indexing parameter). The relation (11) is deduced from (9) *i.e.* the new hybrid Phillips curve and represents the measurement equation in the State space specification. The relation (12) and (13) are the transition equations without and with the credibility index respectively. These equations specify the dynamics of time-varying coefficients. ε_t and v_t^i are vectors of mean zero. These disturbance vectors are assumed to be serially independent.

According to equation (13) the higher the credibility index the lower the backward-looking time-varying coefficient then ϕ_{26} and is expected to be negative. On other hand, the higher the credibility index the higher the forward-looking time-varying coefficient

[17] Autoregressive with exogenous variables.

and ϕ_{36} is expected to be positive. In addition, the credibility index seems to affect directly all other time-varying coefficients comprising naturally those of real marginal cost components, *i.e.* the real unit wage cost and the real exchange rate.

4.3 Empirical results

This subsection reports the results of two scenarios previously presented regarding State space specification.

Inflation dynamics without the credibility index

Table 1 reports estimation results of equations (11) and (12), *i.e.* the new hybrid Phillips curve without credibility effects. $\hat{\delta}_t$ can be interpreted as the estimated time-varying mean of monthly inflation. $\hat{\gamma}_t^b$, $\hat{\gamma}_t^f$, $\hat{\lambda}_t^l$ and $\hat{\lambda}_t^m$ represent the lagged inflation, expected future inflation, real unit wage cost and real exchange rate estimated time-varying coefficients respectively.

We fix the values of initial states by calibrating all structural parameters used to determine time-varying coefficients. As we are in a monthly model, $\theta = 0.92$, prices are assumed to be fix on average for a year. In the theoretical literature, the used value of the subjective discount factor β is 0.99.[18] The parameter ω representing the proportion of backward-looking firms is arbitrary fixed to 0.6. About the credibility index, we fix its value to 0.5. In addition to the closed economy structural parameters, the open economy model includes the additional parameter α, which stands for labor's share in gross output. Following Lendvai [2005], we chose to calibrate this parameter to $\alpha = 0.7$.[19] The calibration of these structural parameters allow us to fix the following initial conditions for states values: $\delta_{1|0} = 0.001$, $\gamma_{1|0}^b = 0.02$, $\gamma_{1|0}^f = 0.92$, $\lambda_{1|0}^l = 0.002$ and $\lambda_{1|0}^m = 0.0006$.

According to our empirical results, it appears that Poland's inflation dynamics can be described by the new hybrid Phillips curve. Overall coefficients are significant at 10% level except for that of real unit wage cost. The future expected inflation coefficient seems to be the more important with 0.78 while the lagged inflation coefficient value is

[18] The theoretical plausible level.
[19] Ribon [2004] sets $\alpha = 0.5$ for Israeli data, while Gali and Lopez-Salido [2001] set $\alpha = 0.7$ and $\alpha = 0.75$ for Spanish data.

0.08. The Poland's inflation dynamics is therefore predominated over time by the expected future inflation giving birth to forward-looking behaviours predominance. These results seem to not be in line with Lyziak *et al.* [2007] conclusions. Indeed, during the transition process, Polish economic agents do pay attention to the inflation target while forming their expectations regarding the future movements of prices. Consequently, monetary policy seems to be credible among economic agents in 2000s.

Overall, the estimated new hybrid Phillips curve is relatively relevant. The sign of time-varying slope coefficient $\hat{\lambda}_t^l$ is in line with theoretical predictions (0.07) but it is not significant. In contrast, the coefficient $\hat{\lambda}_t^m$ is negative and significant. Accordingly, the real exchange rate depreciation induces a decline in current inflation rate because the inflation dynamics in Poland is support in large extent by domestic demand, therefore the weight of import prices in economic general prices is relatively low. However on the theoretical basis, in economic with important weight of import prices, a real exchange rate depreciation may increase the import prices and give rise to inflationary pressures.

Table 1: Estimation results 2001-2009.

$\hat{\delta}_t$	$\hat{\gamma}_t^b$	$\hat{\gamma}_t^f$	$\hat{\lambda}_t^l$	$\hat{\lambda}_t^m$
0.582**	0.088*	0.782***	0.070	-0.406**
[0.2859]	[0.0479]	[0.0445]	[0.1162]	[0.2135]

Notes : This Table reports the estimation results of new hybrid Phillips curve without credibility index (equations 11 and 12) in Poland. Root mean squared errors are reported in brackets [.].

Figures 1 and 2 display linear and normalized backward-looking versus forward-looking time-varying coefficients changes respectively. The increase of the one is often associated with the decrease of the other. Three main episodes can be clearly distinguished. After adopting the inflation targeting regime in Poland, from the early 2001 the forward-looking time-varying coefficient tends to rise shortly until August, 2003 probably due to monetary credibility gain from the new Policy orientation[20] adopted two ? before. Afterwards, it decreases gradually over the following twelve months. However, after Poland's European Union (EU) accession in May, 2004 the forward-looking coefficient dynamics tends to stabilize until October 2009 around of 0.78.

[20] Inflation Targeting Regime.

Figure 1: backward-looking and forward-looking time-varying coefficients.

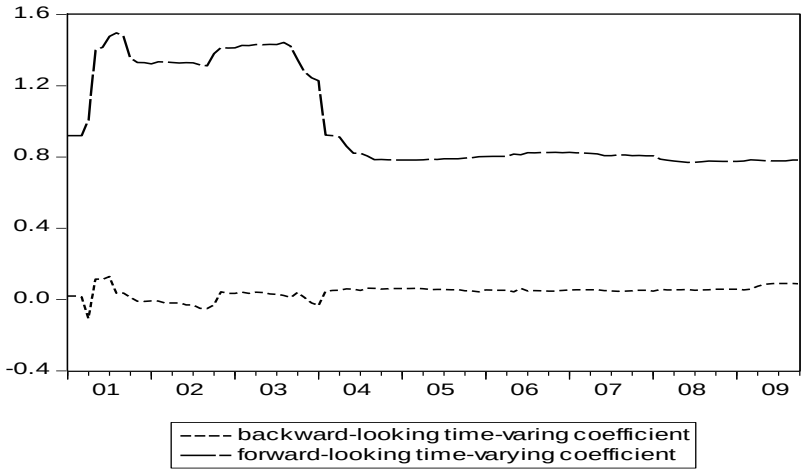
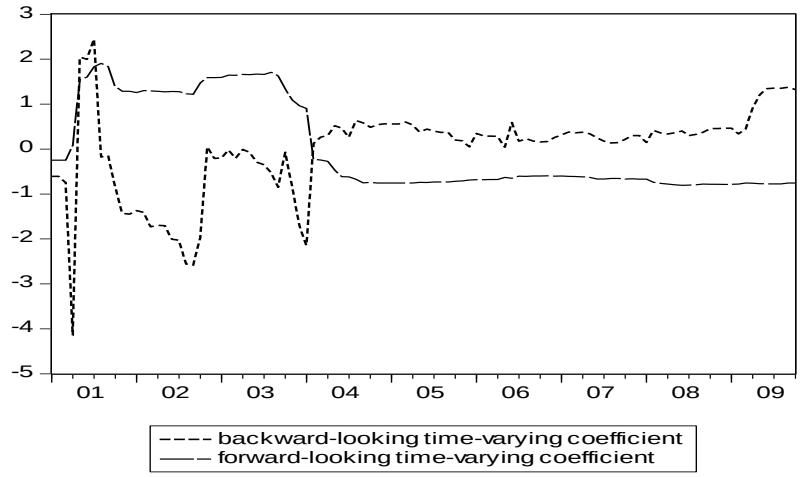


Figure 2: Normalized backward-looking and forward-looking time-varying coefficients.



Inflation dynamics with the credibility index

Now, we estimate equations (11) and (13) in order to show how does the credibility index affect the disinflation process in Poland, before and after its accession to European Union (2004). Table 2 reports estimation results. The five columns on left correspond thus to inflation dynamics time-varying coefficients.[21] By taking into consideration credibility effects, overall time-varying coefficients seem to be statistically significant except that for real unit wage cost. The weight of lagged inflation in the model passes from 0.08 to 0.07, while that of future expected inflation increases from 0.78 to 0.80. The

[21] Final states values.

introduction of the credibility index in the model tends to reinforce the weight of the future expected inflation, *i.e.* the forward-looking behaviors predominance. The backward-looking behavior is became thereby less important. The credibility index seems also to affect the significance level of time-varying coefficients because the root mean squared errors values decreased in the second scenario. The Polish monetary authorities seem to establish its credibility because the stronger the impact of policy announcement on expectations, the easier it is for policy-makers to control inflation and to accommodate shocks to reach easily the objective of price stability.

Table 2: Estimation results 2001-2009.

$\hat{\delta}_t$	$\hat{\gamma}_t^b$	$\hat{\gamma}_t^f$	$\hat{\lambda}_t^l$	$\hat{\lambda}_t^m$	$\hat{\phi}_{16}$	$\hat{\phi}_{26}$	$\hat{\phi}_{36}$	$\hat{\phi}_{46}$	$\hat{\phi}_{56}$
0.846***	0.079*	0.803***	-0.089	-0.645***	0.816**	-0.053*	0.096***	0.096	-0.621**
[0.2620]	[0.039]	[0.0408]	[0.1065]	[0.1956]	[0.3793]	[0.0302]	[0.0242]	[0.1324]	[0.2758]

Notes : This Table reports the estimation results of new hybrid Phillips curve with credibility index (equations 11 and 13) in Poland. Root mean squared errors are shown in brackets [.] and probability values in parenthesis (.).

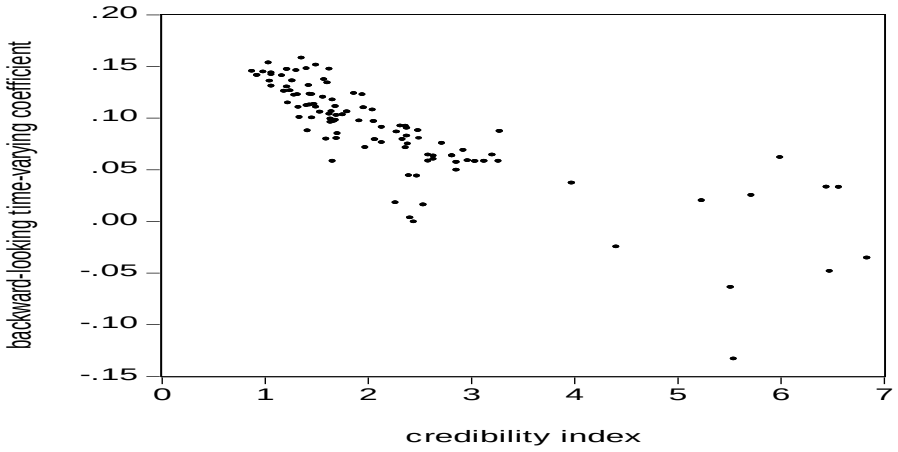
As in the first scenario, the second is also characterized by ambiguous effects of the time-varying slope coefficients $\hat{\lambda}_t^l$ and $\hat{\lambda}_t^m$. They seem to affect indirectly Poland's inflation dynamics. Only $\hat{\lambda}_t^m$ is statistically significant at 1% level. The evidence is that a real exchange rate depreciation tends to reduce current monthly inflation rate because the evolution of general prices level in Poland seems to be mainly support in large extent by domestic demand. By making comparisons between the two scenarios, the coefficient $\hat{\lambda}_t^l$ value changes the sign, however it remains non significant in both specifications. In contrast, the coefficient $\hat{\lambda}_t^m$ keeps negative and significant values which passes from -0.406 to -0.644 because of credibility effects.

What about different implications of credibility effects on overall Poland's inflation dynamics time-varying coefficients ? From the equation (13), constant coefficients $\hat{\phi}_{16}$, $\hat{\phi}_{26}$, $\hat{\phi}_{36}$, $\hat{\phi}_{46}$ and $\hat{\phi}_{56}$ represent the estimated credibility effects on mean varying of inflation, lagged inflation, future expected inflation, real unit wage cost and real exchange rate estimated time-varying coefficients respectively. In Table 2, we can observe that overall coefficients are statistically significant at 10% level except that for the real unit wage cost as in the first scenario. Consequently, most of coefficients' signs

are in line with theoretical predictions except that for the real exchange rate due probably to some Polish economy features as domestic demand predominance's.

Indeed, results show that estimated credibility effects on lagged inflation, *i. e.* backward-looking behavior are negative and significant ($\hat{\phi}_{26} = -0.053$). The Figure 3 gives an idea about negative correlation between the credibility index and the backward-looking coefficient. The evidence is that when the monetary credibility increases (*i. e.* corresponding to a decline in long-term interest rate differentials)[22] the degree of inflationary process persistence (inflation inertia) decreases, though weakly (Figures 5 and 6). This results confirm our theoretical predictions. According to Calvo and Vegh [1993] and Ball [1995], a well-known explanation for inflation inertia during disinflations is lack of monetary credibility.

Figure 3: backward-looking time-varying coefficient versus credibility index.

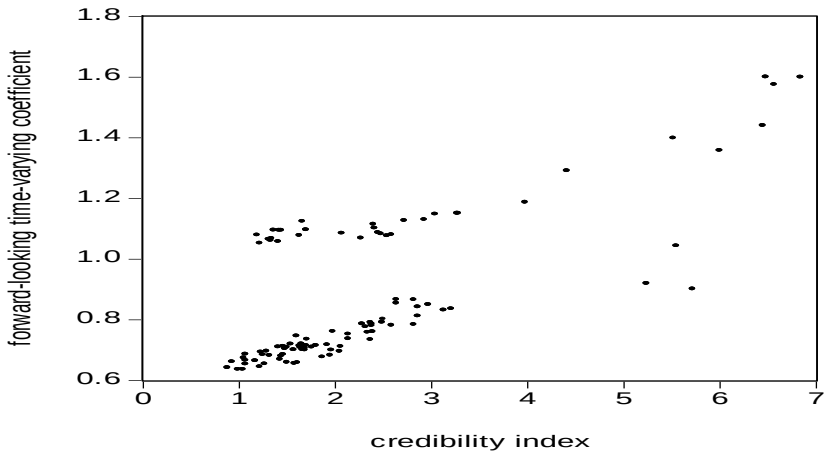


Our estimation results show that monetary credibility seems to affect directly (Table 2 and Figure 4) and significantly the inflation expectations of Poland's economic private agents ($\hat{\phi}_{36} = 0.096$). However, these effects seem to be slightly weak. The improvement of credibility leads economic agents to pay more attention to the monetary authorities announcement while forming their expectations regarding the future movements of prices. In the case of Poland, the evidence about the credibility improvement in the early 2000s comes probably from the inflation targeting regime adopted two years before associated with managed float exchange rate regime (April 2000). Therefore this disinflation program reinforces commitment to contain inflation volatility in spite of

[22] In absolute value obviously.

international capital inflows (Mamoudou, T. *et al.* [2009]). The Figure 4 displays the positive correlation between credibility index and forward-looking coefficient dynamics (see Table 3 for fitted correlation coefficient values).

Figure 4: forward-looking time-varying coefficient versus credibility index



In addition, the effects of monetary credibility on real marginal cost components provide ambiguous results. Indeed, credibility effects on real unit wage seem to be positive ($\hat{\phi}_{46} = 0.096$) but not significant. The sign of the estimated coefficient is in line with our theoretical predictions. In contrast, for the real exchange rate which translates external shocks on domestic economy, credibility effects are significant with unexpected sign ($\phi_{56} = -0.618$). However these findings may be plausible especially for the case of Poland. Indeed, the improvement of monetary credibility exacerbates the real appreciation of domestic currency and leads to worsening current account deficits and inducing an erosion of competitiveness. These factors may also lead to decline in output which implies inflationary pressures.

Table 3: Linear correlation coefficients 2001-2009.

	$\hat{\delta}_t$	$\hat{\gamma}_t^b$	$\hat{\gamma}_t^f$	$\hat{\lambda}_t^l$	$\hat{\lambda}_t^m$
ρ_t	0.031	-0.804	0.713	-0.344	0.026
	(0.322)	(-13.735)	(0.0445)	(-3.729)	(0.270)

Note : The values in brackets correspond to *t-Statistics*.

From the results of the above-mentioned two scenarios, it seems that the monetary credibility played an important role in Poland's disinflation process through the inflation dynamics time-varying coefficients behaviors. Empirical results appear

interesting in both scenarios. The monetary credibility affects significantly Poland's inflation dynamics, but its effects seem to be slightly weak.

Figure 5: backward-looking and forward-looking time-varying coefficients.

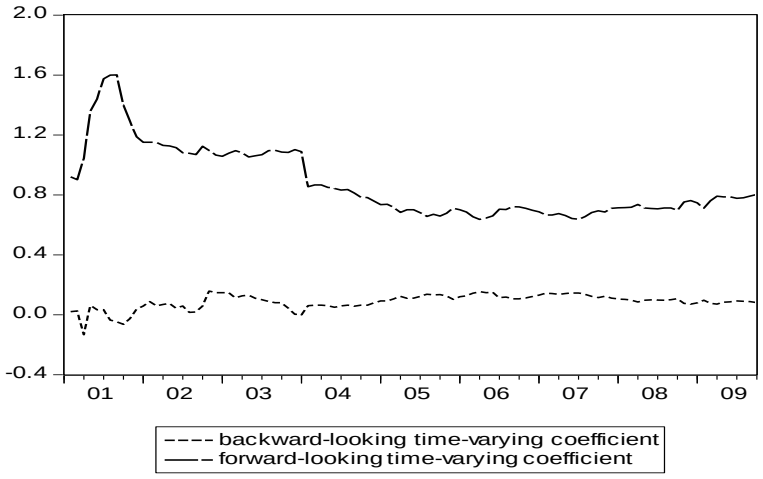
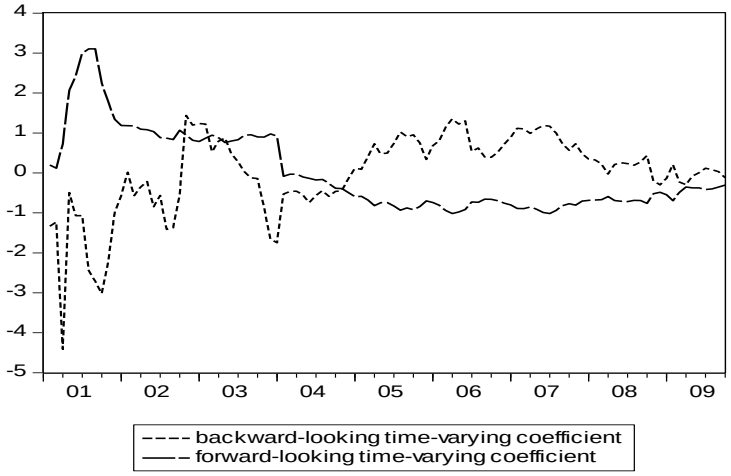


Figure 6: Normalized backward-looking and forward-looking time-varying coefficients.



Figures 5 and 6 display linear and normalized backward-looking versus forward-looking time-varying coefficients changes in the scenario with credibility index. We can observe that these ones are slightly different from Figures 1 and 2 respectively. In the case with credibility index the forward-looking time-varying coefficient dynamics is more important than that without credibility index. Further, it appears clearly that these differences are minor. We can remark notably that, when backward-looking time-varying coefficient decreases, the forward-looking coefficient increases in turn. Since Poland joined European Union (EU) in May 2004, the two coefficients appeared

stabilized over time, *i. e.* from the mid-2004 to October 2009. The main features of Figures 5 and 6 are that backward-looking and forward-looking dynamics appear more smoothed probably because of credibility effects.

5 Conclusions

In this paper, we have investigated credibility effects on Poland's inflation dynamics by using a new hybrid Phillips curve. The open economy extension of McCallum and Nelson [1999] that incorporates imported goods as intermediate inputs is also considered. The primary focus of paper is to show that coefficients of new hybrid Phillips curve are time varying because they depend on credibility index, proxied by the long-term interest rates differential. We specify our new hybrid Phillips curve under State space model with time-varying coefficients and estimate it by using a Kalman filter approach.

We implement two different scenarios: First, we estimate a simple new hybrid Phillips curve with time-varying coefficients. Results show that Poland's inflation dynamics is well described by lagged and future expected inflation. However, the forward-looking behaviour remains predominant over time in both scenarios. Empirical estimates point also to ambiguous effects of real marginal cost components in determining Poland's inflation dynamics. Second, by including credibility index as affecting the inflation dynamics through the time-varying coefficients, results suggest that the monetary credibility played a role in Poland's inflation dynamics. Credibility effects on backward-looking, forward-looking behaviours and real unit wage cost are consistent with our theoretical predictions. These effects seem to make Poland's inflation dynamics more forward-looking.

It can be inferred that the Poland's disinflation process of the last decade has been probably generated by the national bank monetary policy[23] credibility consolidated by the domestic factors as the demand dynamics. In addition, it has been also supported by a number of reforms designed to enhance product market competition, improve financial market liberalisation and make labour market more flexible.

[23] Because of reccurent changes in monetary and exchange rate policies.

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