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ESTIMATED NEW KEYNESIAN PHILLIPS CURVE IN LITHUANIA

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Abstract. The paper provides estimates for the New Keynesian Phillips curve (NKPC) in Lithuania. The paper considers the baseline NKPC and the hybrid NKPC, the latter accounts for inflation inertia. The analysis covers estimates for the closed economy case and the open economy extension. The estimates highlight the importance of the expected and the lagged inflation in the formation of inflation. The role of the real marginal cost is found to be limited in shaping the dynamics of inflation. The paper provides estimates for the structural parameters underlying the price setting in Lithuania. Estimates show that the implied price duration stands below the one reported for the euro area and the US. The evidence on the fraction of firms that adjust prices in a backward looking way is less conclusive.

Keywords: New Keynesian Phillips curve, price stickiness, real marginal cost, labour income share.

Jel classification: D40, E30

1. Introduction

New Keynesian Phillips curve (NKPC) models provide a framework to analyse inflation in a structural way. NKPC are the models that relate inflation to real economic activity, inflation expectations and, possibly, inflation inertia. The considered models are theory-based. They evolve from optimising behaviour of monopolistically competitive firms that set the prices in a constrained way. NKPC models, thus, incorporate nominal rigidities that can be analysed in more detail.

This paper considers a baseline NKPC model, where the real marginal cost and expected inflation govern the inflation, and a hybrid NKPC model, where the lagged inflation is accounted for, as outlined in Galí and Gertler (1999) and Galí et al. (2001). The paper covers a closed economy case and an open economy case. The latter economy extension introduces open economy effects by allowing for imported goods to be used in the consumption and in the production as in Leith and Malley (2007). Different economy setups render different real marginal cost measures. In a closed economy case real marginal cost is proxied by labour income share or equivalently by real unit labour cost, while in an open economy case real marginal cost is a combination of labour income share, real GDP and domestic costs/prices relative to import prices.

Estimates for hybrid NKPC in Lithuania are reported in Dabušinskas and Kulikov (2007). The authors provide estimates under real marginal cost proxies derived for a closed economy case (as in Galí and Gertler 1999, and Galí *et al.* 2001) and two open economy cases (one of them follows Leith and Malley 2007, the other one incorporates energy production factor). Baseline and hybrid NKPC for Lithuania are estimated in Mihailov et al. (2010). The authors consider closed and open economy cases, where the latter case accounts for terms of trade as in Galí and Monacelli (2005). The study of Mihailov *et al.* (2010) uses real GDP series to construct a measure of real marginal cost.

The purpose of this paper is to identify the role of inflation factors in Lithuania as suggested by NKPC models. The paper estimates baseline and hybrid NKPC models considering a closed economy case and an open economy case. The undertaken study estimates reduced-form parameters that represent the role of real marginal cost, lagged inflation and expected inflation in governing the inflation process. The paper also estimates structural parameters that underlie the price setting. One of the structural parameters is the fraction of firms that keep prices unchanged. This is a parameter used in Calvo (1983) price setting formulation, which is employed in the considered NKPC models. This parameter allows deducing an estimate of price duration that is often viewed as a price stickiness measure. The other estimated structural parameter is the fraction of firms that adjust prices following the backward looking rule of thumb. This parameter is used in the hybrid NKPC formulation to account for inflation inertia.

The paper is organised in the following way. Section 2 reconstructs a baseline and a hybrid NKPC in a closed economy; it also derives a measure for a closed economy real marginal cost. An open economy NKPC and a corresponding real marginal cost proxy is deduced in Section 3. Section 4 provides empirical evidence on the parameters for the considered NKPC in Lithuania. The main findings of the undertaken research are summarised in the concluding section.

2. NKPC in a closed economy

This section describes the economic setup that generates a baseline and a hybrid NKPC in a closed economy following Galí and Gertler (1999) and Galí *et al.* (2001). It is assumed a continuum of firms indexed by $j \in [0,1]$ acting in a monopolistically competitive market. Each firm is a monopolistic competitor producing a differentiated good Y_{jt} and selling it at time t for a nominal price P_{jt}. Each firm faces a constant-price-elasticity demand given by $Y_{jt} = \left(\frac{P_{jt}}{P_t}\right)^{-\varepsilon} Y_t$ where Y_t is an aggregate production output $Y_t = \left(\int_0^1 Y_{jt}^{\frac{\varepsilon-1}{\varepsilon}} dj\right)^{\frac{\varepsilon}{\varepsilon-1}}$, P_t is an aggregate price level $P_t = \left(\int_0^1 P_{jt}^{1-\varepsilon} dj\right)^{\frac{1}{1-\varepsilon}}$, ε and is a price elasticity of demand. Each firm uses labour input N_{jt} in production technology $Y_{jt} = A_t N_{jt}^{1-\alpha}$ [1] where A_t denotes a common technological factor and α is an elasticity of substitution between labour and capital, which is kept fixed in this economy.

Firms set the prices in a constrained way as in Calvo (1983). In particular, every period firm is allowed to adjust its price with a probability $1-\theta$. In other words, every period $1-\theta$ fraction of firms is allowed to change the price. The expected time that a price remains fixed is $\frac{1}{1-\theta}$. θ Is, thus, used to measure a price stickiness. In this setup the aggregate price level can be expressed as $P_t = \left((1-\theta)\left(P_t^*\right)^{1-\varepsilon} + \theta P_{t-1}^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}$ where P_t^* is the newly set price chosen by firms, which are allowed to adjust their prices in a period t. Log-linearization of the price index around a zero-inflation steady state implies that the aggregate price level evolves as a weighted average of newly set price level $\hat{p}_t^*$ and the price level observed in the previous period $\hat{p}_{t-1}$, in particular $\hat{p}_t = (1-\theta)\hat{p}_t^* + \theta\hat{p}_{t-1}$ where lower case letters under "^" denote log deviations of respective variables from their steady state values.

When prices are set with restrictions, optimal pricing involves the assessment of expected changes in economic environment during a foreseeable future. The firm, which under Calvo constraints is allowed to set the price at time t, picks up an optimal price P_{jt}^* so that to maximize the discounted stream of the expected future profits over the horizon during which the price is to prevail. Firm faces profit maximization problem $\max_{P_{jt}^*} E_t \sum_{k=0}^{\infty} (\beta\theta)^k \left(\frac{P_{jt}^*}{P_{t+k}} Y_{jt+k} - \frac{MC_{jt+k}}{P_{t+k}} Y_{jt+k}\right)$ subject to demand condition $Y_{jt} = \left(\frac{P_{jt}^*}{P_t}\right)^{-\varepsilon} Y_t$. Here β is a subjective discount factor, MC_{jt} is the nominal marginal cost. Solution to the firm's maximization problem and its log-linearization yields an optimal path for a newly set price chosen by firm under the Calvo constraints. The price is determined by a discounted stream of the expected future nominal marginal cost of the firm, or equivalently this price is a weighted average of the current nominal marginal cost and the expected future reset prices

$$\hat{p}_{jt}^* = (1-\beta\theta) m\hat{c}_{jt} + \beta\theta E_t \hat{p}_{jt+1}^*. \qquad (1)$$

It implies that in a limiting case when prices are set in a fully flexible way $(\theta = 0)$, the prices move in line with the current nominal marginal cost. When the price stickiness is introduced $(\theta > 0)$, the expected future developments of nominal marginal cost obtain the weight.

Calvo formulation of sticky price setting and the outlined economy setup leads to a variant of baseline NKPC, which relates current inflation to the current real marginal cost and to the inflation, which is expected to prevail in the next period

$$\hat{\pi}_t = \lambda m\hat{c}_t^r + \beta E_t \hat{\pi}_{t+1}. \qquad (2)$$

where $\hat{\pi}_t$ is inflation rate defined as $\hat{p}_t - \hat{p}_{t-1}$, $\lambda = \frac{(1-\theta)(1-\beta\theta)}{\theta}$, $m\hat{c}_t^r$ is a real marginal cost defined as $m\hat{c}_t - \hat{p}_t$.

[1] This production technology is equivalent to $Y_{jt} = A_t N_{jt}^{1-\alpha} K^{\alpha}$ where capital K is fixed.

Baseline NKPC relates current inflation to the current real marginal cost and to the expected inflation. Baseline NKPC does not capture, however, lagged inflation effects on the current inflation, which are often found as statistically significant. To account for inflation inertia Galí and Gertler (1999) suggest to assume that only a fraction of firms, which are allowed to reset their prices under the Calvo constraints, optimize their decisions as described in (1), while the rest of price resetting firms follow a backward looking rule of thumb $\hat{p}_t^b = \hat{p}_{t-1}^* + \hat{\pi}_{t-1}$ where $\hat{p}_t^b$ is a price level set by backward looking rule of thumb firms, $\hat{p}_{t-1}^*$ is a level of prices set by the firms, which were allowed to adjust their prices in the previous period (this includes both optimizing and rule of thumb firms). Taken together the described economy yields a variant of hybrid NKPC, which relates current inflation to the current real marginal cost, lagged inflation and the inflation, which is expected to prevail in the next period

$$\hat{\pi}_t = \tilde{\lambda} m\hat{c}_t^r + \gamma_b \hat{\pi}_{t-1} + \gamma_f E_t \hat{\pi}_{t+1} \qquad (3)$$

where:

$$\tilde{\lambda} = \frac{(1-\omega)(1-\theta)(1-\beta\theta)}{\theta + \omega(1-\theta(1-\beta))},$$

$$\gamma_b = \frac{\omega}{\theta + \omega(1-\theta(1-\beta))},$$

$$\gamma_f = \frac{\beta\theta}{\theta + \omega(1-\theta(1-\beta))},$$

ω – a fraction of firms adjusting prices according to backward looking rule of thumb.

The specification (3) implies that in a limiting case when all the firms, which are allowed to choose the prices, are forward looking $(\omega = 0)$, the hybrid NKPC falls into a baseline model. When there is some fraction of firms, which reset their prices according to the backward looking rule $(\omega > 0)$, the lagged inflation obtains the weight in governing present inflation.

In a given closed economy, where only labour input is used to produce the output, the total cost function is defined as $W_t N_{jt} = W_t Y_{jt}^{\frac{1}{1-\alpha}}$. Here W_t is a nominal wage and A_t is set to 1. Real marginal cost is then given by $MC_{jt}^r = \frac{1}{1-\alpha}\frac{W_t N_{jt}}{P_t Y_{jt}}$. Every firm faces the same real marginal cost, therefore the aggregate counterpart of the latter outcome is expressed as

$MC_t^r = \frac{1}{1-\alpha}\frac{W_t N_t}{P_t Y_t} = \frac{S_t}{1-\alpha}$ where S_t is a labour income share or equivalently real unit labour cost. Its log-linearization yields a relation, which implies that in a given closed economy the real marginal cost moves in line with the labour income share or equivalently with the real unit labour cost $m\hat{c}_t^r = \hat{s}_t$.

3. NKPC in an open economy

The following economy extension incorporates the open economy effects by allowing for imported goods to be used in the consumption and in the production as in Leith and Malley (2007). It is assumed that a consumption basket is a CES aggregate $C_t = \left(\chi\left(C_t^d\right)^{\frac{\sigma-1}{\sigma}} + (1-\chi)\left(C_t^m\right)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$ where $C_t^d = \left(\int_0^1 \left(C_{jt}^d\right)^{\frac{\varepsilon-1}{\varepsilon}} dj\right)^{\frac{\varepsilon}{\varepsilon-1}}$ and $C_t^m = \left(\int_0^1 \left(C_{jt}^m\right)^{\frac{\varepsilon-1}{\varepsilon}} dj\right)^{\frac{\varepsilon}{\varepsilon-1}}$ refer to the consumption of domestically produced and imported goods respectively, χ is a parameter representing the home bias in the consumption, and σ is an elasticity of substitution between the goods produced in the home country and abroad. The associated price indices of domestically produced and imported goods are given by $P_t^d = \left(\int_0^1 \left(P_{jt}^d\right)^{1-\varepsilon} dj\right)^{\frac{1}{1-\varepsilon}}$ and $P_t^m = \left(\int_0^1 \left(P_{jt}^m\right)^{1-\varepsilon} dj\right)^{\frac{1}{1-\varepsilon}}$ respectively, and the corresponding consumption price index is $P_t = \left(\chi^\sigma \left(P_t^d\right)^{1-\sigma} + (1-\chi)^\sigma \left(P_t^m\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$.

As in Leith and Malley (2007), imported goods are viewed as substitute for labour in the production technology $Y_{jt} = \left(\alpha_N N_{jt}^{\frac{\rho-1}{\rho}} + \alpha_{IM} IM_{jt}^{\frac{\rho-1}{\rho}}\right)^{\frac{\rho}{\rho-1}(1-\alpha)}$ where IM_{jt} is imports of goods used in the production of firm j, α_N and α_{IM} are the shares of labour and imported goods respectively in the production, and ρ is an elasticity of substitution between these inputs.

Similarly as in the home country, the consumers and the firms abroad use the imported goods in the consumption and in the production. The total

demand for goods produced by domestic firm j therefore is $Y_{jt} = \left(\frac{P_{jt}^d}{P_t^d}\right)^{-\varepsilon}\left(C_t^d + C_t^* + IM_t^*\right)$ where C_t^* and IM_t^* represent the foreign countries' imports of goods used for consumption and for production respectively.

The introduction of the imported goods into the consumption implies that the consumer prices and the domestically produced goods' prices evolve in a different way. This has an impact on the formulation of the baseline and the hybrid NKPC in the considered economy. In particular, since it is assumed that the firms are owned by the consumers, the nominal marginal cost of the domestic firms is deflated by the consumer prices rather than by domestically produced goods' prices. It follows that in the considered open economy the baseline NKPC is

$$\hat{\pi}_t^d = \lambda\left(m\hat{c}_t^r + \hat{p}_t - \hat{p}_t^d\right) + \beta E_t\hat{\pi}_{t+1}^d \qquad (4)$$

where:

$$\hat{\pi}_t^d = \hat{p}_t^d - \hat{p}_{t-1}^d,\ \lambda = \frac{(1-\theta)(1-\beta\theta)}{\theta},$$

and the hybrid NKPC is:

$$\hat{\pi}_t^d = \tilde{\lambda}\left(m\hat{c}_t^r + \hat{p}_t - \hat{p}_t^d\right) + \gamma_b\hat{\pi}_{t-1}^d + \gamma_f E_t\hat{\pi}_{t+1}^d \qquad (5)$$

where:

$$\tilde{\lambda} = \frac{(1-\omega)(1-\theta)(1-\beta\theta)}{\theta + \omega(1-\theta(1-\beta))},$$

$$\gamma_b = \frac{\omega}{\theta + \omega(1-\theta(1-\beta))},$$

$$\gamma_f = \frac{\beta\theta}{\theta + \omega(1-\theta(1-\beta))}.$$

Owing to the introduction of imported goods, the baseline NKPC and the hybrid NKPC include the current consumer and the current domestically produced goods' prices in addition to the other variables, which constitute the respective NKPC in a closed economy. The variables of prices enter the NKPC relations with the opposite signs, meaning that the NKPC deduced for the open economy embody the analogous relations deduced for the closed one.

Given the inputs used in the production, in the considered economy the firm is minimizing its cost function $W_t N_{jt} + P_t^m IM_{jt}$ subject to production technology constraint. An optimal solution to the cost minimization problem leads to a relation for the firm's real marginal cost. Using its log-linearized aggregate counterpart, a relation for labour income share in GDP $S_t = \frac{W_t N_t}{P_t^d Y_t^*}$, a relation for the share of imported goods in GDP $I_t = \frac{P_t^m IM_t}{P_t^d Y_t^*}$ as well as noticing that a relation between firms' production output and GDP is $Y_t = Y_t^* + \frac{P_t^m IM_t}{P_t^d}$ (here Y_t^* is GDP), the term that appears in the baseline and in the hybrid NKPC formulations (4) and (5) might be expressed as

$$m\hat{c}_t^r + \hat{p}_t - \hat{p}_t^d = \hat{s}_t - \frac{\alpha}{1-\alpha}\frac{I}{1-\frac{\alpha}{1-\alpha}I}\hat{y}_t^* -$$

$$-\left(\rho\frac{I}{1-\frac{\alpha}{1-\alpha}I}\frac{S}{S+I} - (\rho-1)\frac{I}{S+I}\right)\left(\hat{w}_t - \hat{p}_t^m\right)$$

$$+\frac{I}{1-\frac{\alpha}{1-\alpha}I}\left(\hat{p}_t^d - \hat{p}_t^m\right). \qquad (6)$$

Owing to undertaken rearrangements, the outcome (6), which is referred to open economy real marginal cost measure, distinguishes the role of labour income share in pricing behaviour envisaged in the NKPC. In addition to labour income share, the price setting behaviour appears to be influenced by real GDP and by relative costs (prices). Pricing is affected by the level of wages relative to import prices and the level of domestic prices relative to import prices. The specification of open economy real marginal cost measure encompasses a closed economy case. Once imported goods are not considered $(I = 0)$, the open economy real marginal cost measure falls into a respective proxy in a closed economy.

4. Empirical evidence

The baseline and the hybrid NKPC are estimated by undertaking an assumption of rational expectations of the firms, which reset the prices in a forward looking way. Forward looking firms use all the information available at time t so that all the expectation errors $e_t = \hat{\pi}_{t+1} - E_t\hat{\pi}_{t+1}$ are not correlated with the information used. This implies that the baseline and the hybrid NKPC estimations might be performed by employing the generalized method of moments.

The baseline and the hybrid NKPC are estimated using quarterly data from Eurostat. The data used in estimations is seasonally adjusted. Estimations are performed for the period starting from the fourth quarter of 1998 up to the fourth quarter of

2010. The variable of quarterly inflation is constructed as a logarithmic difference of GDP deflator. A demeaned inflation series serves as a proxy for inflation's deviation from its steady state value. In case of closed economy, real marginal cost is proxied by labour income share. Its deviation from a steady state value is computed by taking a logarithmic difference between labour income share and its sample average. In an open economy real marginal cost variable is constructed as a combination of labour income share, real GDP and relative costs/prices. Deviations of real GDP, wage level, import and domestic price level from their steady state values are computed as logarithmic differences between these variables and their respective smoothened counterparts. The latter ones are derived applying Hodrick-Prescott filter. Open economy real marginal cost computation also includes steady state values of labour income share and imported intermediate goods share in the nominal GDP. As a proxy for the values of imported intermediate goods the available data from external trade statistics is used. Imported intermediate goods share in the nominal GDP exhibited an upward trend during the considered period. Therefore, time-varying imported intermediate goods share as well as time-varying labour income share is used in the construction of the open economy real marginal cost measure.

Production technology parameter α is obtained by rearranging the steady state aggregate marginal cost formulation combining with a steady state relation between firms' production output and GDP and with steady state relation for open economy price mark-up $\mu = \frac{\varepsilon}{\varepsilon - 1} = \frac{P^d}{MC^r P}$, yielding $\alpha = 1 - \mu \frac{S + I}{1 + I}$. The price mark-up μ is assumed to be fixed at 1.2, and the value of elasticity of substitution between labour and imported goods is assumed to be fixed at 0.5.

Apart from fixed values of μ and ρ, structural parameters of the hybrid NKPC are estimated by fixing a discount factor value. This leaves only two structural parameters to be estimated, namely, the fraction of firms that keep prices unchanged and the fraction of firms that adjust prices following the backward looking rule of thumb. The discount factor value is set to 0.95.

Following rational expectations formulation, NKPC estimations can be carried out using the instruments dated at time t or earlier. The complete information dated at time t, however, might not be available for firms. Therefore all the estimations are performed by using lagged variables as the instruments. All instrument sets contain four lags of inflation, four lags of real marginal cost, one lag of import price inflation and one lag of unemployment rate. All these variables represent deviations from their respective steady state values.

Estimates for the baseline NKPC indicate a rather similar role of real marginal costs and expected inflation in shaping inflation in a closed and an open economy (Table 1). In both economies real marginal costs appear to be statistically significant, though the reduced-form parameters, representing the importance of these costs, are quite low. Such kind of finding is common in the New Keynesian literature.

The estimates show a highly important role of inflation expectations, as reflected by parameter β. This parameter stands at 0.94 in a closed economy and 0.95 in an open economy. The estimations yield statistically significant estimates for structural parameters representing a fraction of firms that keep prices unchanged. These parameters are 0.79 in a closed economy and 0.78 in an open economy. This implies a price duration of around 4.5-4.8 quarters. The implied duration is lower than that found for the euro area and the US as indicated by NKPC estimates show in Galí et al. (2001).

Hybrid NKPC estimates show that in addition to real marginal costs and inflation expectations the inflation is also governed by inertia (Table 2). The reduced-form parameters, reflecting the importance of lagged inflation, are of considerable size in a closed economy and an open economy. The magnitude of these parameters, however, is lower than that of the parameters corresponding to inflation expectations – one more result typical for the New Keynesian literature. Similarly as in the baseline case, the role of real marginal costs is found to be important in the hybrid NKPC, though the size of the parameters $\tilde{\lambda}$ appears to be low.

The hybrid NKPC analysis yields statistically significant estimates for the fraction of firms that keep prices unchanged in a closed economy and an open economy. These structural estimates are marginally lower than those obtained under baseline NKPC. The estimate for the fraction of firms that keep prices unchanged in a closed economy is 0.78, and the estimate in an open economy is 0.76. The estimates imply that a price duration under the hybrid NKPC amounts to around 4.1–4.5 quarters. The implied price duration is again lower than that in the euro area and the US as indicated by the hybrid NKPC estimates in Galí et al. (2001).

Table 1. Estimates for baseline New Keynesian Phillips curve (Source: made by author)

Closed economy: reduced-form estimates					
λ	0.069*	β	0.939**	J-statistic	6.651 (0.673)
Closed economy: structural estimates					
θ	0.790**	β	0.938**	J-statistic	6.651 (0.673)
Open economy: reduced-form estimates					
λ	0.075*	β	0.950**	J-statistic	7.218 (0.614)
Open economy: structural estimates					
θ	0.778**	β	0.949**	J-statistic	7.218 (0.614)

Notes: * indicates statistical significance at the level of 5%, ** – at the level of 1%; in the last column in the parenthesis p-values of J-statistics are reported.
Source: author's estimations.

Table 2. Estimates for hybrid New Keynesian Phillips curve

Closed economy: reduced-form estimates							
$\tilde{\lambda}$	0.042*	γ_b	0.269*	γ_f	0.617***	J-statistic	7.046 (0.532)
Closed economy: structural estimates							
θ	0.778***	ω	0.358			J-statistic	7.090 (0.628)
Open economy: reduced-form estimates							
$\tilde{\lambda}$	0.063**	γ_b	0.247**	γ_f	0.615***	J-statistic	7.231 (0.512)
Open economy: structural estimates							
θ	0.756***	ω	0.401*			J-statistic	7.145 (0.622)

Notes: * indicates statistical significance at the level of 10%, ** – at the level of 5%, *** – at the level of 1%; in the last column in the parenthesis p-values of J-statistics are reported.

The evidence on the structural parameter representing a fraction of firms that adjust prices according to the backward looking rule of thumb is less conclusive. The structural parameter ω is found to be statistically significant only in an open economy where this parameter stands at 0.40.

The obtained estimates for the fraction of firms that keep prices unchanged and the implied price duration stand close to the survey evidence, as reported by Virbickas (2009), though NKPC estimates yield somewhat lower frequency of price changes. According to the survey, which referred to the period of 2007, most of the firms in Lithuania – around one quarter – change the prices quarterly to half yearly, approximately one fifth of the firms change the prices once a year, and somewhat more than one tenth of the firms change the prices less frequently than once a year.

5. Conclusions

The paper investigates inflation formation in Lithuania employing NKPC framework. The paper reconstructs a baseline NKPC model as well as hybrid NKPC version, which accounts for inflation inertia, as in Galí and Gertler (1999) and Galí et al. (2001). The analysis considers a closed economy case and an open economy case by allowing for imported goods to be used in the consumption and in the production following Leith and Malley (2007).

The models allow examining the role of real marginal cost, lagged inflation and expected inflation in governing the inflation process. The adopted framework establishes a basis to investigate structural parameters that underlie the price setting.

The estimates indicate statistically significant role of real marginal cost in inflation formation in Lithuania, though the size of the parameters, representing the importance of this cost, is quite low. This is a common result in the New Keynesian literature. The inflation appears to be primarily driven by inflation expectations and, in the hybrid NKPC case, past inflation with the magnitude of parameters, reflecting the importance of lagged inflation, lower than that of the parameters corresponding to the expected inflation.

The analysis yields statistically significant estimates for the fraction of firms that keep prices unchanged, a Calvo (1983) parameter used in the considered models. These estimates range between 0.76 and 0.79. This corresponds to the price duration of around 4.1–4.8 quarters, lower than that found for the euro area and the US.

The conducted research provides less conclusive evidence on the fraction of firms that adjust prices according to the backward looking rule of thumb, a parameter used in the hybrid NKPC for-

mulation to account for inflation inertia. This parameter is found to be statistically significant only in an open economy case, where it stands at 0.40.

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