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A Scientific Inquiry on the Estimation of the Phillips Curve in the Baltic Region

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Countries in the European Union (EU) have experienced a number of economic problems in the aftermath of the Eurozone crisis, including high unemployment and inflation. However, there is still a lack of systematic analyses of these issues, especially in the context of the new EU member countries. This study aims to address this research gap. It examines an important topic in applied macroeconomics research—the Phillips curve—and chooses three Baltic countries, namely, Estonia, Latvia and Lithuania, as case studies. In other words, the main objective of this paper is to revisit the debate on the inflation–unemployment trade-off by estimating the new Keynesian Phillips curve (NKPC) in the Baltic region over the period of 1995–2013. The analysis was based on the generalized method of moments (GMM) procedure suggested by Gali and Gertler (1999). The novelty of the present study is that it applied the Gali–Gertler method to examine the trade-off relationship between inflation and unemployment in the Baltic countries. This study yielded some important findings. Firstly, it was found that inflation dynamics in the Baltic countries was largely determined by forward-looking behaviour, which means that firms located in the region had forward-looking price setting tendency and they paid due attention to the expected level of inflation. Secondly, the inflation dynamics did not seem to be determined by backward tendency and the firms in the region did not have backward price setting tendency. Thirdly, no significant trade-off relationship was detected between inflation rate and marginal cost. In other words, there was no significant negative association between the inflation rate and marginal cost in the Baltic countries.

Keywords: *Phillips Curve, Estonia, Latvia, Lithuania, Generalized Method of Moments.*

Introduction

In the aftermath of the Eurozone crisis that occurred in the late 2000s, many countries in the European Union (EU) have experienced a host of economic problems including unemployment and high inflation. Researchers who examined these problems have focused on the Western part of the Eurozone and mainly on such countries as Portugal, Italy, Spain and Greece. As a result, there is a lack of relevant and systematic analyses that focus on the Baltic countries. In other words, little research has been done on some important issues for engineering economics including the so-called 'trade-off relationship' between the unemployment rate and inflation rate.

Engineering economics represent an important subfield in a wider academic area of macroeconomics. According to a Harvard economist, Gregory Mankiw, the word "macroeconomics" appeared in the 1940s, when economies worldwide were recovering from the Great Depression of the 1930s (Mankiw, 2006). A theoretical foundation of the macroeconomic theory was developed by John Maynard Keynes (1936) who published the seminal book "General Theory of Employment, Interest and Money". As Mankiw argued, the Keynesian macroeconomic theory was largely based on an engineering perspective and it aimed to solve a host of problems caused by the economic depression in the 1930s. Since then, Keynesian economists have been motivated to generate and apply their theories to solve various economic problems (Mankiw, 2006).

However, Keynesian theories do not always provide sufficient explanations of some pertinent macroeconomic issues, especially those involving unemployment rates, interest rates and inflation rates. This is because Keynesian theories do not have sufficiently elaborated explanations concerning the interaction between these variables. Therefore, the proponents of Keynesian economics welcomed a theory of the trade-off relationship between inflation rates and unemployment rates put forward by William Phillips (Mankiw, 2006). An economist from the London School of Economics, Phillips made a significant contribution to the field of macroeconomics when, in 1958, he introduced the so-called "Phillips curve" that he claimed existed in the unemployment rates dynamics. In his theory Phillips proposed that a negative association exists between inflation and unemployment (Phillips, 1958).

William Phillips (1914–1975) qualified as an electrical engineer. However, he was deeply interested in applying engineering perspectives to viewing economic phenomena. Due to this interest, Phillips was able to detect certain similarities between macroeconomic theories put forward by economists and dynamic systems developed by electrical engineers (Laidler, 2001). It should be noted here that besides discovering the trade-off relationships between inflation and unemployment, Phillips invented the Phillips machine which, in essence, is a hydraulic macroeconomics model based on concepts from the system dynamics (Ryder, 2009).

Whilst enthusiastically welcomed by Keynesian economists, the Phillips curve theory was criticized and doubted by economists from other subfields of macroeconomics. For example, a prominent Chicago economist, Milton Friedman, argued that the trade-off relationship between unemployment and inflation can only be a temporary one because a permanent trade-off relationship between these variables is not possible. More importantly, he argued that the short-run Phillips curve should not be based on unanticipated levels of inflation rates but the inflation rate itself. Friedman defined the short-run period during which unanticipated levels of inflation rates persist as a time span from 2 to 5 years (Friedman, 1968).

The debate concerning the existence of a trade-off relationship between inflation rates and unemployment rates (or the Phillips curve) has proved to be not only a lasting one but also one of the most important theoretical disputes in the area of applied macroeconomics. This is because theoretical deliberations regarding the existence of the Phillips curve have important practical and policy implications. For example, if the Phillips curve is found to exist then the inflation rate in a country is expected to have a negative association with the unemployment rate. The implication is that policymakers in this country should recognize and give due considerations to the negative consequences of monetary policies aimed at controlling the inflation rate. In other words, if the central bank in this country decides to implement an expansionary monetary policy, the inflation rate would decrease. At the same time, according to the Phillips curve theory, the unemployment rate would rise.

Against this theoretical background, the present paper aims to examine an important scientific problem in the field of macroeconomics: the existence of a trade-off relationship between inflation rate and unemployment rate. The main research objective of this study is to revisit the Phillips curve debate by estimating new Keynesian Phillips curve (NKPC) in three European Union (EU) member countries situated in the Baltic region, namely, Estonia, Latvia and Lithuania, for the period of 1995–2013. With regard to the research method, the data were collected from the Eurostat database (2014). For the purpose of data analysis and computations of the NKPC, this study employed the generalized method of moments (GMM) approach suggested by Gali and Gertler (1999). A novelty of this study is that it is the first of its kind investigation that applies the Gali–Gertler (GG) method to examine the trade-off relationship between inflation and unemployment rates in the Baltic countries.

The GG method is rooted in the microeconomic theory according to which inflation dynamics can be explained by marginal costs and expected levels of inflation. In the NKPC approach, there would be a trade-off relationship between inflation rate and marginal cost. In other words, in order to explain changes in inflation rate, the GG method focuses on changes in marginal cost rather than on variations in the unemployment rate. To be more specific, the GG approach employs the price aggregation method given by the Calvo (1983) staggered price model and it incorporates the 'forward-looking' price setting behaviour to explain inflation dynamics.

Relationships between inflation rates and marginal cost in the Baltic countries are depicted in Figure 1. In the steady states, marginal cost is equal to labor income share (Gali & Gertler, 1999). The figure graphically represents the relationship between inflation (i.e., the natural log difference in GDP deflator) and marginal cost (i.e., the natural log of labor income share). As can be seen from the figure, there existed a strong trade-off relationship between inflation and marginal cost in Latvia. Several outliers can be found in the otherwise strong relationship between inflation and marginal cost in Estonia. In contrast, there was a weak negative association between inflation and marginal cost in Lithuania.

This article consists of five parts. Following this introductory section, a review of literature offers a brief discussion of studies on the Phillips curve theory including some relevant research done in the context of the Baltic countries. The article then proceeds to inform about the data collection approach and explains the research method. The subsequent section reports findings from the empirical analysis. This is followed by the concluding section.

Literature Review

The publication of William Phillips' (1958) seminal paper on the trade-off relationship between inflation rate and unemployment rate is an important milestone in the field of macroeconomics. Phillips used long time-series data on wage inflation rate and unemployment rate in the United Kingdom for the period of 1861–1957. He discovered a negative association between the inflation rates and unemployment rates in the country. This phenomenon has been known since then as the Phillips curve.

The discovery initiated an avid debate among economists concerning the existence of the trade-off relationship between inflation and unemployment. Gali and Gertler (1999) made an important methodological contribution to this dispute. They employed the generalized method of moments (GMM) approach to estimate the new Keynesian Phillips curve (NKPC) and used the data for the period of 1960Q1–1997Q4 in their study. The econometric technique proposed by Gali and Gertler is known as the Gali–Gertler (GG) method. In this method, the labor income share (LIS) acts as a proxy for the marginal cost in the trade-off relationship. The researchers concluded that there had been a significant positive association between the variables.

The GG method was applied to analyze the Phillips curve relationship in ten European countries, namely, Belgium, Spain, Denmark, France, Germany, Italy, the Netherlands, Sweden, Portugal and the United Kingdom, for the period of 1970Q1–1997Q4 (Gali *et al*., 2001). It was found that the Phillips curve relationship fitted well the time-series data for these European countries and that there was a significant positive relationship between the inflation rates and marginal costs. In a following study, Gali *et al*. (2005) re-tested robustness of the GG method by estimating the Phillips curve for the US data over the period of 1960Q1–1997Q4. Also, the researchers employed a different specification, such as the closed form estimation, or the full information maximum likelihood (FIML) method. Gali *et al*. (2005) concluded that the findings were consistent and robust.

Jondeaua and Bihan (2005) employed the GG method to estimate the new Keynesian Phillips curve for four European countries, namely, Germany, France, Italy and the United Kingdom, from 1970Q1 to 1999Q4. They discovered a significant trade-off relationship between the inflation rates and marginal product in these countries. Neiss and Nelson

(2005) estimated the new Keynesian Phillips curve in the United States, the United Kingdom and Australia for the period of 1960Q1–2000Q4. The researchers argued that the detrended GDP could be a poor proxy for the output gap because the detrended GDP would have a negative association with the inflation rates. However, the theory-based output gap had a positive and significant association with the inflation rates.

Focusing on a single European country, Scheufele (2010) estimated the new Keynesian Phillips curve in Germany for the period of 1973Q1–2004Q4. He found out that the inflation dynamics in Germany was mainly determined by the expected level of the inflation rate. On the other hand, the past inflation rate did not seem to influence the present level of inflation. Abbas and Sgro (2011) adopted the GG method to estimate the new Keynesian Phillips curve in Australia between 1959Q3 and 2009Q2. They concluded that the marginal cost did not seem to determine inflation dynamics in the country. They also maintained that Australia's inflation dynamics was mainly determined by the expected level of inflation in the future.

Mazumder (2011) used output gap to estimate the trade-off relationship between inflation rate and marginal cost in the United States for the period of 1956Q1–2009Q3. He concluded that the sign of the slope coefficient for the output gap depended on the covariance between the inflation rate and marginal cost. In a more recent study, Saman and Pauna (2013) estimated the new Keynesian Phillips curve in Romania during 2000Q1–2011Q4. The findings indicated that there was a trade-off relationship between the output gap and inflation rates. More importantly, Romania's inflation dynamics was determined by both the expected level of inflation rate in the future and the lagged level of inflation in the past.

Notwithstanding the availability of an extensive empirical research on the new Keynesian Phillips curve, a systematic analysis of this important topic in the context of the Baltic countries is lacking. A notable exception is a study conducted by Dabusinkas and Kulikov (2007), who estimated the trade-off relationship between inflation rates and marginal costs in the Baltic countries for the period of 1994Q4–2005Q3. The most important finding from their study was that the marginal cost did not seem to determine the inflation rates. In other words, inflation dynamics in the Baltic countries was determined by the inflation rate in the past and the expected inflation rate in the future.

Several researchers examined the issues pertaining to unemployment and labor market in the Baltic countries. In one such study, Berzinskiene and Juozaitiene (2011) assessed the impact of labor market on unemployment. More specifically, the researchers analyzed the active labor market measures and the passive labor market policies. They concluded that the labor market measures had a significant positive impact on the unemployment levels. Pilinkus and Boguslauskas (2009) investigated the impact of stock market price on unemployment rate in Lithuania. They found that the stock market dynamics had a positive impact on the unemployment rate.

Startiene and Remeikiene (2009) analyzed the influence of demographic factors on the relationship between unemployment rate and entrepreneurship in Lithuania. The researchers concluded that some demographic variables did not have a positive impact on the entrepreneurship and unemployment condition in the country. Krumplyte and Samulevicius (2010) conducted an interesting study on undeclared work in Lithuania. They defined undeclared work as an economic activity that is carried out in violation of legislative requirements for the purpose of tax avoidance. The researchers argued that a considerable segment of the Lithuanian economy could be classified as the shadow economy; the problem is that the undeclared work is not recorded properly in the official government statistics.

Focusing on Latvia, Kochetkov (2012) examined relationship between inflation rate and unemployment rate by estimating the natural rate of unemployment in the country. He concluded that there was a negative association between unemployment and inflation between 1999 and 2008. One of interesting findings in Kochetkov's study was that the natural rate of unemployment in Latvia could be as high as 16 percent. Degutis and Urbonavicius (2013) explored the determinants of well-being, including employment status, in Lithuania. The researchers concluded that employment status had a significant impact on subjective levels of well-being.

Among recent studies, Hayashi *et al*. (2014) estimated the NKPC in Sri Lanka from 2006 to 2015. The research team detected a significant positive relationship between the output gap and inflation rate in the 'forward-looking' Phillips curve and the 'hybrid' Phillips curve. Malikane and Mokoka (2014) assessed the NKPC for ten OECD countries for the period of 1995–2011. Their findings were contradictory. In the cases of Brazil and South Africa, the slope coefficient for the labor income share was negative and significant. In contrast, for the data on South Korea and Turkey the slope coefficient was positive and significant. In the context of Peru, Bazan-Palomino and Rodriguez (2014) examined the NKPC for the period of 2000–2012, and detected a significant and positive relationship between the income gap and inflation in the country.

Lie and Yadav (2015) assessed the NKPC in Australia between 1960 and 2007. They concluded that while the 'forward-looking' behavior dominated the NKPC in the country, the backward-looking component was also an important element in Australia's NKPC. Riggi and Santoro (2015) estimated the NKPC in Italy for the period of 1981–1998, and found a positive relationship between the output gap and inflation rate in the country.

As this review of literature indicates, the main problem of scientific analyses of the NKPC is a lack of consistency in the findings among studies done in different geographical and economic contexts. Malikane and Mokoka's (2014) study can serve as a typical example: the researchers discovered that the slope coefficient for labor income share was negative in two developing countries, however, it was positive in the context of the other two emerging economies. Up to now, there is no agreement among economists and researchers as to whether labor income share has a positive or negative association with inflation dynamics. Against such a backdrop, this study examines the trade-off relationship between inflation and unemployment in the context of three Baltic countries.

Methods and Data

The present study employed an econometric method suggested by Gali and Gertler (1999). It estimated the new Keynesian Phillips curve in three EU countries in the Baltic region, namely, Estonia, Latvia and Lithuania, over the period from 1995Q1 to 2013Q3. The number of observations was 75. This paper extends research done by Dabusinkas and Kulikov (2007), who estimated the baseline Phillips curve in the region for the period of 1994Q1–2005Q3. In the current study, we used updated data and estimated not only the baseline model but also the hybrid model of the new Keynesian Phillips curve.

In this analysis, the log difference of GDP deflator served as a proxy for inflation while the log of labor income share acted as a proxy for marginal cost. The labor income share was calculated as a ratio between total compensation to employees and Gross Domestic Product (GDP). The GDP deflator was calculated as a ratio between nominal GDP and real GDP. The source of data was Eurostat (2014).

In the first step of our analysis, the baseline NKPC was estimated for the three Baltic countries. This estimation was based on the following equation (Gali and Gertler, 1999):

$$\pi_t = \lambda_1 mc_t + \lambda_2 E_t\{\pi_{t+1}\} \qquad (1)$$

where π_t is the inflation rate in the current period, m_{ct} is the marginal cost, $E_t\{\pi_{t+1}\}$ is the expected level of inflation rate in the future period, λ_1 and λ_2 are the slope coefficients.

A serious obstacle to accurate estimations of the two slope coefficients is posed by a lack of systematic data on marginal cost. To deal with this problem, Gali *et al*. (2005) proposed using labor income share (LIS) as a proxy for marginal cost. Following this suggestion, the current paper assumed that:

$$mc_t = s_t \qquad (2)$$

where s_t is the labor income share. Therefore, equation (1) can be reformulated as:

$$\pi_t = \lambda_1 s_t + \lambda_2 E_t\{\pi_{t+1}\} \qquad (3)$$

In this study, two different types of estimation models were employed, namely, the reduced form model and the structural model. The estimation of the reduced form model of the baseline NKPC was based on equation (3). The estimation of the structural model of the baseline NKPC was based on the following two orthogonality conditions (Gali & Gertler, 1999):

$$E_t\{(\alpha\pi_t - (1-\alpha)(1-\alpha\beta)s_t - \alpha\beta\pi_{t+1})z_t\} = 0 \qquad (4.1)$$

$$E_t\{(\pi_t - (1/\alpha)(1-\alpha)(1-\alpha\beta)s_t - \beta\pi_{t+1})z_t\} = 0 \qquad (4.2)$$

where α and β are the structural parameters in the estimation model of the baseline NKPC. More precisely, α can be considered as the ‘rigidity parameter’ and β can be described as the ‘discount parameter’. It should be noted that the discount parameter must be equal to the slope coefficient of the expected level of inflation rate in future:

$$\lambda_2 = \beta \qquad (5.1)$$

The slope coefficient of the marginal cost can be calculated as:

$$\lambda_1 = \frac{(1-\alpha)(1-\alpha\beta)}{\alpha} \qquad (5.2)$$

In the current estimation of the baseline NKPC, the instrument variables consisted of one lag of the marginal cost, the consumer inflation, the GDP deflator inflation and the log GDP.

In the second step of our analysis, the hybrid NKPS was estimated for the three Baltic countries. The difference between the baseline NKPC and the hybrid NKPC lies in the discrepancies between the model specifications. The estimation model for the hybrid NKPC incorporated both the expected value of inflation rate in the future and the lagged value of inflation rate in the past. In contrast, the baseline NKPC included only the expected inflation rate in the future. The hybrid NKPC estimation was based on the following equation:

$$\pi_t = \lambda_1 mc_t + \lambda_2 E_t\{\pi_{t+1}\} + \lambda_3\pi_{t-1} \qquad (6)$$

where π_{t-1} is the lagged value of the inflation rate in the past and λ_3 is the slope coefficient. In other words, the hybrid NKPC model includes two directions of the inflation dynamics: λ_2 is a forward indicator to measure the effect of expected inflation rates in the future while λ_3 is a backward indicator to measure the effect of lagged inflation rate in the past.

As in the baseline NKPC estimation, marginal cost cannot be assessed from equation (4). In the estimation of the hybrid NKPC, labor income share can be used as a proxy for marginal cost (Gali & Gertler, 1999). Therefore, equation (4) can be transformed into:

$$\pi_t = \lambda_1 s_t + \lambda_2 E_t\{\pi_{t+1}\} + \lambda_3\pi_{t-1} \qquad (7)$$

For computations of the hybrid NKPC, Gali and Gertler (1999) proposed considering the following orthogonality conditions:

$$E_t\{(\delta\pi_t - (1-\alpha)(1-\alpha\beta)(1-\gamma)s_t - \alpha\beta\pi_{t+1})z_t\} = 0 \qquad (8.1)$$

$$E_t\{(\pi_t - (1/\delta)(1-\alpha)(1-\alpha\beta)(1-\gamma)s_t - (1/\delta)\alpha\beta\pi_{t+1})z_t\} = 0 \qquad (8.2)$$

where γ and δ are the structural parameters. Some researchers cautioned about possible problems that can arise when these orthogonality conditions are applied to estimate the NKPC (Oreng, 2003; Rao & Paradiso, 2011). For example, Rao and Paradiso (2011) warned that there could be a singular matrix problem when the expected inflation rate ($E_t\{\pi_{t+1}\}$) is replaced with the actual level of inflation rate in one period ahead (π_{t+1}). Since no systematic data are available on the forecasted inflation rate in the Baltic countries, the current paper modified the orthogonality conditions into:

$$E_t\{(\alpha\pi_t - (1-\alpha)(1-\alpha\beta)s_t - \alpha\beta\pi_{t+1} - \gamma\pi_{t-1})z_t\} = 0 \qquad (9.1)$$

$$E_t\{(\pi_t - (1/\alpha)(1-\alpha)(1-\alpha\beta)s_t - \beta\pi_{t+1} - (\gamma/\alpha)\pi_{t-1})z_t\} = 0 \qquad (9.2)$$

In this modified version, γ is the structural parameter to measure the ‘backwardness’ of the firms’ price setting behavior in the Calvo (1983) model. The slope coefficient for the lagged value of inflation rate in the past can be expressed as:

$$\lambda_3 = \frac{\gamma}{\alpha} \qquad (10)$$

In the estimation of the hybrid NKPC, the instrument variables consisted of one lag of the marginal cost, the consumer inflation, the GDP deflator inflation and the log GDP.

Empirical Findings

The findings from the reduced form model of the baseline new Keynesian Phillips curve (NKPC) are presented in Table 1. In this model specification, different econometric procedures were used to estimate the NKPC, namely, the ordinary least squares (OLS), the two-stage least squares (2SLS) and the generalized method of moments (GMM). The three analyses yielded consistent results: they indicated that inflation dynamics in the Baltic region was determined by the forward-looking behavior. To be more specific, in the case of Estonia, the outcomes of the three procedures suggested that the inflation dynamics was determined by the expected level of inflation in the future. Similarly, in Lithuania, the results of the three analyses indicated that the future inflation level influenced the current level of inflation. In the case of Latvia, the OLS method indicated that the marginal cost determined the inflation level; however, the outcomes of the 2SLS and GMM methods indicated that the future inflation level determined the current level of inflation rate.

Table 2 demonstrates the findings from the structural model of the baseline NKPC. In this estimation, two types of the orthogonality conditions were assessed. The first and the second orthogonality condition models produced consistent findings. The findings from the structural model confirmed the findings from the reduced form model that inflation levels in the Baltic countries were determined by the forward-looking behavior. To be more specific, in the case of Estonia, the findings from the two orthogonality condition models suggested that the inflation rate was determined by the future inflation rate. Similarly, in the case of Latvia, the current level of inflation was found to be determined by the future level of inflation. In Lithuania, the second orthogonality condition model suggested that the inflation level was determined by the future level of inflation, while the first orthogonality condition model implied that the future inflation did not influence the inflation dynamics.

The findings from the reduced form model of the hybrid NKPC are reported in Table 3. In this model specification, three approaches, namely, the OLS, 2SLS and GMM were used for the estimation. Despite some minor discrepancies, the findings from the reduced form model allowed to conclude that inflation dynamics in the Baltic countries was mainly determined by the forward-looking behavior. In the case of Estonia, the outcome of the OLS procedure indicated that the inflation level was determined by the future and past levels of inflation. In Latvia, the outcome of GMM procedure revealed that the inflation level was determined by the future inflation rate, while the OLS approach indicated that the inflation rate was determined by the marginal cost. In the case of Lithuania, the current inflation rate was found to be determined by neither the future inflation level nor the past inflation.

Table 4 shows the findings from the structural model of the hybrid NKPC. In this model specification, two types of orthogonality conditions were used for estimation. Apart from some minor discrepancies, the findings indicated that inflation dynamics in the Baltic region was determined by the forward-looking behavior. More specifically, in the case of Estonia, the second orthogonality condition model indicated that the current inflation level was determined by the future inflation rate. In Latvia, as the results of the second orthogonality condition model indicated, the inflation rate was determined by both the future inflation rate and the past inflation rate. In the case of Lithuania, the inflation rate was determined by neither the future nor the past levels of inflation.

In short, the main empirical finding of the present study was that inflation dynamics in the Baltic countries seemed to be largely determined by the forward-looking behavior but not by the backward-looking behavior. The findings also revealed that there was no significant trade-off relationship between the inflation rates and marginal costs in the region.

Conclusion

This study aimed to estimate the NKPC in three Baltic countries. For this purpose, it employed the GMM approach suggested by Gali and Gertler (1999). The findings could be summarized as follows. Firstly, the results of empirical analysis clearly indicated that inflation dynamics in the three EU countries in the Baltic region was largely determined by the forward-looking behavior. This means that firms located in the region are likely to have a forward-looking price setting tendency. Also, they need to pay close attention to the expected level of inflation rate in the future. Secondly, our empirical analysis indicated that inflation dynamics in the Baltic countries was not determined by the backward-looking behavior. In other words, firms in the region do not seem to have a backward-looking price setting behavior and, therefore, they can disregard the lagged level of past inflation rate. Thirdly, the findings indicated that there was no significant trade-off relationship between the inflation rate and marginal cost in the region. In other words, no significant negative association was found to exist between the inflation rate and marginal cost in the Baltic countries. An implication of this finding is that the marginal cost is not likely to have a strong influence on the level of inflation in these countries.

As a conclusion, the current study has detected the existence of the NKPC relationship between the inflation rate and marginal cost in the three Baltic countries. This means that inflation dynamics in these countries had a trade-off relationship with marginal costs. In other words, the inflation dynamics seems to be determined by the firms that adopt the ‘forward-looking’ behaviour rather than those practicing the ‘backward-looking’ approach.

Some important implications for future practice can be drawn from the findings of the current analysis. First of all, policymakers in the Baltic countries may want to be aware of the ‘forward-looking’ orientation of the firms located in the region. In other words, the expected level of inflation is likely to have a strong impact on the current level of inflation. Therefore, if policymakers need to control the inflation rate in their country they would need to give a serious consideration to the expected level of inflation. Secondly, economic planners need to be aware that the past levels of inflation are not likely to influence the current levels of inflation in the Baltic countries. This means that firms located in the region do not have a strong tendency for the backward orientation. Therefore, their managers are not likely to set price levels according to the time-path of inflation rates. Finally, the policymakers need to consider the fact that marginal cost does not determine inflation rates in the region. Thus, if firms experience an increase in marginal costs, their managers are not likely to increase price levels.

This article focused on the EU countries situated in the Baltic region. Future research needs to be extended to other EU regions and include the Visegrad countries as well as countries located in Central and Southeast Europe. Various research methods could be employed in these studies. For example, an alternative approach to the one adopted in the current study has been proposed by Benati (2015) and it is based on the structural VAR method to assess the trade-off relationship between inflation rate and unemployment rate. Focusing on wider economic and geographical areas and using the latest methods and techniques is a promising research vector for future studies on the New Keynesian Phillips curve.

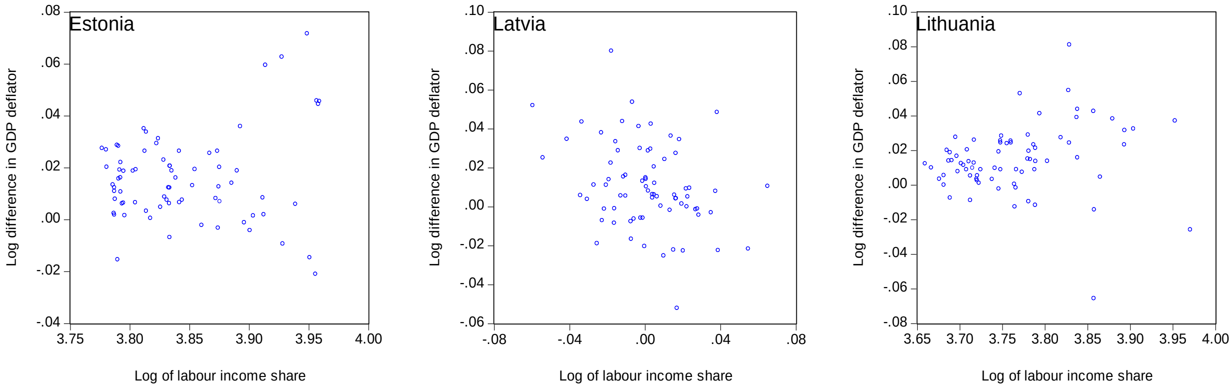

Figure 1. Inflation and labor income share in the Baltic countries

Table 1

Reduced form model of the baseline NKPC

Countries	Variables	*Ordinary least squares*	*Two stage least squares*	*Generalized method of moments*
Estonia	*Constant*	*-0.111 (0.130) [-0.852]*	*-0.021 (0.170) [-0.125]*	*0.011 (0.096) [0.121]*
	λ_1	*0.031 (0.033) [0.920]*	*0.005 (0.044) [0.120]*	*-0.003 (0.024) [-0.138]*
	λ_2	*0.444 (0.109) [4.074]****	*0.721 (0.379) [3.462]****	*1.117 (0.152) [7.338]****
Latvia	*Constant*	*0.411 (0.163) [2.506]***	*-0.043 (0.323) [-0.134]*	*-0.137 (0.125) [-1.091]*
	λ_1	*-1.108 (0.442) [-2.453]***	*0.011 (0.086) [0.190]*	*0.039 (0.033) [1.187]*
	λ_2	*0.149 (0.114) [1.205]*	*1.237 (0.679) [1.826]**	*0.222 (0.115) [1.924]**
Lithuania	*Constant*	*-0.137 (0.125) [-1.096]*	*-0.232 (0.192) [-1.205]*	*-0.240 (0.162) [-1.481]*
	λ_1	*0.039 (0.033) [1.187]*	*0.060 (0.050) [1.195]*	*0.063 (0.043) [1.470]*
	λ_2	*0.222 (0.115) [1.924]**	*1.201 (0.487) [2.467]***	*1.138 (0.275) [4.126]****

Notes: numbers in the parentheses indicate standard errors while numbers in the brackets indicate the *t*-statistics.
For the two-stage least squares (2SLS) and the generalized method of moments (GMM) procedures, the instrument variables were one lag of the labour income share, the consumer inflation, the deflator inflation and the log GDP.
*** indicates significance at the 1 percent level; ** indicates significance at the 5 percent level; * indicates significance at the 10 percent level.

Table 2

Structural model of the baseline NKPC

Countries	Variables	*Orthogonality condition 1 (Equation 4.1)*	*Orthogonality condition 2 (Equation 4.2)*
Estonia	α	*0.836* *(0.115)* *[7.654]******	*0.829* *(0.115)* *[7.723]******
	λ_1	*-0.004* *(0.005)* *[-0.779]*	*-0.004* *(0.006)* *[-0.734]*
	λ_2	*1.131* *(0.146)* *[7.700]******	*1.123* *(0.148)* *[7.729]******
Latvia	α	*0.902* *(0.189)* *[4.771]******	*0.926* *(0.192)* *[4.811]******
	λ_1	*-0.002* *(0.007)* *[-0.305]*	*-0.001* *(0.0067)* *[-0.212]*
	λ_2	*1.110* *(0.234)* *[4.744]******	*1.080* *(0.226)* *[4.716]******
Lithuania	α	*0.639* *(0.654)* *[0.975]*	*0.933* *(0.190)* *[4.885]******
	λ_1	*-0.004* *(0.067)* *[-0.061]*	*-0.007* *(0.009)* *[-0.739]*
	λ_2	*1.565* *(1.411)* *[1.108]*	*1.082* *(0.261)* *[5.263]******

Notes: numbers in the parentheses indicate the standard errors and numbers in the brackets indicate the *t*-statistics. The instrument variables were one lag of the labour income share, the consumer inflation, the deflator inflation and the log GDP.
*** indicates significance at the 1 percent level.

Table 3

Reduced form model of the hybrid NKPC

Countries	Variables	*Ordinary least squares*	*Two stage least squares*	*Generalized method of moments*
Estonia	*Constant*	*-0.050* *(0.125)* *[-0.393]*	*-0.055* *(0.240)* *[-0.244]*	*-0.060* *(0.207)* *[-0.241]*
	λ_1	*0.014* *(0.033)* *[0.440]*	*0.014* *(0.615)* *[0.220]*	*0.015* *(0.054)* *[0.287]*
	λ_2	*0.287* *(0.117)* *[2.436]****	*1.611* *(1.694)* *[0.951]*	*1.646* *(1.182)* *[1.391]*
	λ_3	*0.314* *(0.111)* *[2.763]******	*-0.484* *(1.583)* *[-0.305]*	*-0.565* *(1.241)* *[-0.415]*
Latvia	*Constant*	*0.379* *(0.167)* *[2.216]****	*0.278* *(0.566)* *[0.492]*	*0.266* *(0.434)* *[0.612]*
	λ_1	*-1.100* *(0.045)* *[-2.222]****	*-0.074* *(0.149)* *[-0.495]*	*-0.070* *(0.115)* *[-0.615]*
	λ_2	*0.102* *(0.127)* *[0.809]*	*1.246* *(0.874)* *[1.425]*	*1.265* *(0.465)* *[3.117]******
	λ_3	*0.125* *(0.117)* *[1.069]*	*-0.562* *(0.921)* *[-0.545]*	*-0.497* *(0.835)* *[-0.594]*
Lithuania	*Constant*	*-0.101* *(0.130)* *[-0.777]*	*-0.009* *(0.466)* *[-0.021]*	*-0.070* *(0.257)* *[-0.115]*
	λ_1	*0.029* *(0.034)* *[0.852]*	*0.001* *(0.123)* *[0.009]*	*0.006* *(0.069)* *[0.095]*
	λ_2	*0.178* *(0.135)* *[1.383]*	*0.425* *(1.526)* *[0.279]*	*0.452* *(0.798)* *[0.565]*
	λ_3	*0.143* *(0.129)* *[1.109]*	*0.918* *(1.745)* *[0.526]*	*0.886* *(1.003)* *[0.853]*

Notes: numbers in the parentheses indicate the standard errors and numbers in the brackets indicate the *t*-statistics. For the two-stage least squares (2SLS) and the generalized method of moments (GMM) procedures, the instrument variables were one lag of the labour income share, the consumer inflation, the deflator inflation and the log GDP.
*** indicates significance at the 1 percent level; ** indicates significance at the 5 percent level.

Table 4

Structural model of the hybrid NKPC

Countries	Variables	*Orthogonality condition1 (Equation 9.1)*	*Orthogonality condition 2 (Equation 9.2)*
Estonia	α	*0.575* *(0.667)* *[0.946]*	*0.999* *(0003)* *[286.988]****
	γ	*-0.343* *(0.641)* *[-0.535]*	*1.255* *(0.829)* *[1.529]*
	λ_1	*-0.004* *(0.125)* *[0.035]*	*-0.003* *(0.009)* *[-0.306]*
	λ_2	*1.720* *(1.556)* *[1.110]*	*1.370* *(0.737)* *[1.857]**
	λ_3	*-0.596* *(1.718)* *[-0.347]*	*1.256* *(0.826)* *[1.530]*
Latvia	α	*0.616* *(0.523)* *[1.776]*	*0.991* *(0.004)* *[232.181]****
	γ	*-0.099* *(0.617)* *[-0.161]*	*1.002* *(0.287)* *[7.555]****
	λ_1	*0.0008* *(0.005)* *[-0.140]*	*-0.0004* *(0.001)* *[-0.293]*
	λ_2	*1.622* *(1.383)* *[1.172]*	*1.260* *(0.327)* *[3.875]****
	λ_3	*-0.161* *(0.448)* *[-0.162]*	*1.023* *(0.283)* *[3.605]***
Lithuania	α	*2.430* *(2.863)* *[0.845]*	*1.002* *(0.002)* *[351.496]****
	γ	*2.317* *(3.991)* *[0.580]*	*0.011* *(0.468)* *[0.806]*
	λ_1	*-0.014* *(0.001)* *[-1.213]*	*-0.014* *(0.011)* *[-1.205]*
	λ_2	*0.410* *(0.483)* *[0.848]*	*0.378* *(0.468)* *[0.806]*
	λ_3	*0.953* *(0.571)* *[1.667]*	*0.011* *(0.553)* *[0.002]*

Notes: numbers in the parentheses indicated the standard errors and numbers in the brackets indicate the *t*-statistics. The instrument variables were one lag of the labour income share, the consumer inflation, the deflator inflation, the log GDP.
*** indicates significance at the 1 percent level; ** indicates significance at the 5 percent level; * indicates significance at the 10 percent level.

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