Inflation Dynamics in Pakistan: Forward-looking or Backward-looking?

Abstract  For a country with a modest open economy like Pakistan, the significance of outlooks in determining inflation dynamic forces is investigated in this paper. For the years 1972 to 2014, the study examines the New Keynesian Phillips Curve (NKPC) in both conventional and hybrid variants. The output gap and labor income are two indicators of economic growth. The Dicky Fuller test are used to check for variable stationarity, and the model's long-run parameters were determined using the generalized method of moments. The outcomes of the study demonstrate that the NKPC model appropriately describes inflation dynamics in Pakistan and is data-driven. The production gap was found to be an ineffective proxy for evaluating economic activity, although worker income shares appeared to be highly positive.

Introduction

Phillis (1958) investigated the link between rates of pay and unemployment in the U.S and discovered as when labor demand is strong; workers negotiate for larger nominal wages, which is expressed in inflation. As a result, he claimed that inflation and unemployment are inversely proportionate or that inflation and output have a positive relationship. This statement inspired the creation of the "Phillips Curve." The curve arose as a backbone to support Keynes' position, but it was quickly discovered to be unsuitable for policy implications because it lacked any micro foundation and was only reliant on observations. Milton Friedman (1968) argued that in many circumstances, keeping output above potential can only be achieved by rising inflation and no reduction in unemployment. Stagflation in the U.S and several other advanced countries in the 1970s backed up this assertion, which resulted in higher inflation and unemployment, and therefore the Phillips Curve failed practically. According to Lucas (1972;
Sargent and Wallace (1975), traditional Phillips curves failed due to expectations measurement errors, necessarily rational expectations, as market participants are competent to alter their prices in response to any financial policy adjustment.

Addressing the real nature of short-run inflation dynamics is crucial for optimum monetary policy implementation. Disinflation can be produced at no cost by a credible monetary policy if inflation is dominated by the forward-looking phenomenon and has little or no dependence on the prior era (Vasicek 2011). In the last two decades, the NKPC has been a hot topic of research and controversy due to its importance and relevance in both theory and practice. The NKPC plays a crucial role in monetary policy formulation due to its microeconomic foundation and the critical function of reasonable expectations. As a consequence, this has been put to the test and is being studied in the literature (Abbas et al., 2016). The recent trend toward a monetary policy based on inflation targeting has heightened the requirement for a thorough understanding of the inflationary process. As a result, NKPC estimates are a key instrument for monetary policy implementation in an inflation-targeting developing economy like Pakistan, where higher inflation leads to decreased buying power and thus poverty (Khan et al. 2019). Many researchers (such as Gali and Gertler 1999; Gali et al. 2001; Sbordone 2002, 2005, 2007); Guay and Pelgrin 2004; Kurmann 2004; Fanelli 2008; Fanelli and Palomba 2011; Mavroeidis 2004; Rudd and Whelan 2005; Rudd and Whelan 2007; Linde 2005; Bouget al. 2006; Plessis and Burger 2006; Mature et al. 2006 One of the most crucial aspects of the subject is determining how to value it (Satti et al. 2007). The extant literature uses either the Generalized

Method of Moments (GMM), Maximum Likelihood (ML), or Vector Auto Regression (var) estimate techniques, although each yields distinct findings. Although the most commonly used technique is GMM, which has several advantages such as being relatively easy to use, it can sometimes produce biased findings for small samples, and choosing instrumental variables, 3 is also a challenging task (Stock et al. 2002).

Despite the importance of literature, NKPC proofs in poor nations are quite short. To our knowledge, this topic has received only a cursory mention in Pakistan. As a result, assessing NKPC is necessary since it has various policy consequences in terms of the disinflationary policy. In this work, we add to the empirical literature by examining how well the NKPC may explain Pakistan's inflation patterns. Using Gali and Gertler, this work uses the standardized method of moments to determine standard and hybrids NKPC in both decreased and structural variants for Pakistan from 1972 to 2014. (GMM). The study also focuses on determining how many period prices in Pakistan stay rigid using structural characteristics. Although the choice of explanatory variable has been hotly disputed, we have taken both the production gap and income into account. The rest of the investigation is organized as follows. The literature review on the new Keynesian Phillips curve is summarized in the next section. The model’s quick formulation is examined in Section 3. Section 4 delves into the debates regarding econometric methods for calculating NKPC. The definitions of the variables used are found in Section 5. The sixth section sheds some light on data description. Section 7 discusses the empirical findings in-depth, while section 8 wraps things up.
Discussion on Literature

Gali and Gertler (1999) calculated the NKPC for the first time in America, indicating that the model accurately describes US data and that forward-looking behaviour is more meaningful than backward-looking behaviour. According to Calvo's staggering wages and price-fixing model, 60–80 percent of enterprises establish their prices for a certain period of time with a forward-looking perspective. Gali et al. (2001) came to the same results for the Eurozone using the income share of labour rather than the productivity difference. In both the basic and hybrid NKPC versions, the coefficient of labour income share remained positive significant. The anticipated inflation coefficient was observed to be extremely larger than the delayed inflationary coefficient. NKPC was determined to be the best model for describing inflation dynamics, confirming the previous findings. However, several scholars (e.g., Rudd and Whelan 2005; Linde 2005; Kurmann 2004; Fanelli 2008, and Boug et al. 2006; and others) disagreed with GG's findings and critiqued it in three ways. The first was the explanatory variable (labor income share), the second was the GG analytical approach (GMM), and the third was the model formulation.

The NKPC properly represents inflation dynamics, as per Sbordone (2002), and forward-looking behavioral is now more important than backward-looking attitude. Her results were in line with GG's. Another edition of her study demonstrated that the optimal driving factor for predicting inflation dynamics is predicted upcoming marginal cost. Simply put, replacing labor income share (LIS) for the output gap when assessing real marginal costs produces radically different results, and backward-looking behavior becomes more relevant (Plessis and Burger 2006). According to Sbordone 2002, the The NKPC accurately represents inflation dynamics, with forward-looking behaviour taking precedence over backward-looking behaviour. Her findings corroborated GG's. Her paper turned out to be from a different edition. In Japan, a shift in real marginal cost is necessary, and the "labour share adjustment approach" can help NKPC improve its results (Muto 2006). Survey data was utilised to generate the standard and hybrid versions of the NKPC using GMM in another study (Brissimis and Magginas 2008), and it was observed that forward-looking behaviour is required for the model to match the dataset. African evidence (Maturu et al. 2006; Kenya; Plessis and Burger 2006; South Africa) backs up NKPC and GMM. The enlarged open economy form of NKPC further demonstrates the importance of forward-looking behaviors, and that GMM can be used to confidently anticipate inflation trends (see, for instance, Plessis and Burger 2006; for south Africa and Rumler 2006; for Austria). Despite the fact that GMM has a weak identification problem, the Hansen J-test overcomes it, and forward-looking behavior dominates for Chile, demonstrating that GMM is a reliable tool for forecasting inflation dynamics (Cespedes et al.2005.

Rudd and Whelan (2005), in comparison to the earlier outcomes, criticized GG's model for missing one more parameter and said that GMM is not an appropriate tool for assessing inflation dynamics. They believe that forward-looking conduct becomes less important than backward-looking behavior whenever it comes to pricing. The instrumental Variable approach was proposed as a reliable tool for evaluating inflation dynamics. Linde (2005) questioned GG's findings and advised that the Maximum Likelihood method be used.
to measure inflation dynamics. He highlighted out here that GMM is prejudiced, and he stated that both forward and backward-looking behaviors are crucial. **Tillmann (2009)** made a similar point, saying that the model which is based on Calvo (1983) fails to grasp true forward-looking behaviors as well as previous research. The study by **Arlt and Plasil (2005)**, which rejected GMM and employed co-integration analysis, backed up these claims. They found that NKPC does not match Czech Republic data and is a poor approximation of inflation dynamics. Kurmann (2004) used labor income share as the explanatory variable and found mixed findings using Maximum Likelihood (ML). Evidence from an open economy (Lieth and Malley 2007; Lieth and Malley 2007; Lieth and Malley 2007; Lieth

The debate over the NKPC raged on, with several studies supporting or opposing the NKPC for different countries. According to some research (**Dabusinskas and Kulikov 2007**), the real marginal cost has little impact on inflation, and the results are the same whether the wage income ratio or the wealth gap is used (**Fanelli, 2008**). The inadequate recognition and limited sample biases are prevalent problems.is common in GMM (**Mavroeidis 2004-1; Linde 2005; Kleibergen and Mavroeidis 2009; Tillmann 2009; Danískova and Fidrmuc 2011; etc**.), although some research indicate that the Hansen J-test can solve this problem. **Vasicek (2011)** examined panel data for four nations to overcome GMM’s small sample bias and discovered that forward-looking behavior was less important. When the data is stationary, all of the approaches stated above, including GMM, are applied. VAR and co-integration analysis are used in the situation of non-stationarity or difference stationarity (**Fanelli, 2008; Juselius 2008**; and Boug et al. 2006, 2011). Every VAR-based investigation suggests that the NKPC’s backward-looking component is more relevant.

**Ochoa, M. et al. (2005)** estimated standard and hybrid versions of NKPC for Chile for the period 1990-2004. They analyzed both the standard and hybrid form for two special caseslike for freely mobile capital and for firm-specific capital. Instead of using output gap, they took real marginal cost as the best determinant of inflation. Following Gali and Gertler, they used quarterly data and applied GMM for estimating NKPC. Results for all cases indicate that forward-looking behavior in Chile is dominant and completely supports Gali and Gertler’s NKPC. Almost 60% of firms use rational expectation rules to set prices, and the rest use backward-looking role of thumb.

**Sanchez, D. A. (2006)** followed Gali and Gertler and estimated NKPC for Japan and concluded that NKPC is a good approximation of inflation dynamics in Japan. Taking sample size from 1972 to 2005 (quarterly data) and measuring real marginal cost from unit labor cost, he applied the GMM technique. He obtained very similar results to Gali and Gertler. First, a one percent change in the unit labor cost per hour leads to a 0.424 percent change in inflation, which shows that Japanese firms adjust their prices after two to four quarters, reflecting a very low degree of price stickiness.

Maana I. et al (2006) tested the New Keynesian Phillips curve to determine whether it is compatible with Kenyan data. For this purpose, he followed Gali and Gertler and derived NKPC from Calvo’s (1983) staggered wages and price settings. They took monthly data from 1997 to 2005, applied GMM as an estimation technique and found very supportive results for hybrid NKPC in Kenya. The forward-looking behavior remains dominant uponbackward-looking
behavior. Sixty percent of firms use future rational expectations method, and the remaining use the simple rule of thumb. The degree of nominal rigidity is in between 0.7 to 0.8 implies that prices remain rigid for three to five months in Kenya.

Crichton, D. R et al (2006) studied inflation dynamics in Malaysia from 1991:Q1 to 2006:Q1. He estimated hybrid NKPC through GMM and concluded that fit is good for hybrid version and forward-looking behavior dominates, as stated by Gali and Gertler. The coefficient value for the output gap is very small (mean not a good driving variable for inflation). Backward-looking behavior also plays an important role.

Rumler, F (2006) measured the NKPC model for Austria. According to him, the NKPC model is formulated for a close economy, and Austria is a freely open economy, so to measure inflation, they first extended the model for an open economy and then measured for different specifications. He concluded that the model explained inflation quite well since 1980. And the average price stickiness in Austria lasts for about ten months. He further stated that almost 30% to 50% of firms use backward-looking roles to adjust their prices.

Nemec, I D and Sevcik, B. P (2010) estimated hybrid NKPC for the Czech Republic with two ways; GMM and Bayesian DSGE model. They concluded that curve fits the data well and provides a good approximation of inflation dynamics in Czech Republic. They also found forward-looking behavior dominant for quarterly data, but for yearly data, its value slightly decreased.

Tillmann, P (2005) criticized that GMM is likely to give poor results and followed Kurmann (2004) and studied for Euro area. Anyhow when the lagged inflation enters the model, its fit improves. He found that the duration of price stickiness depends upon the slope factor directly. A higher value of the slope factor will lead to the stickiness for more quarters. The results of this paper agree with those of Rudd and Whelan (2004).

Kichian, M. et al. (2005) used a robust identification technique instead of using GMM to measure the new Keynesian Phillips curve for US and Canada. Based on Gali and Gertler, they studied two variants of the model: rational expectation assumption and survey-based inflation expectations. They concluded that results based on these two variants differ sharply from each other in three ways. First, they faced difficulties in the identification of variables. Second, backward-looking behavior dominates and, third, duration of prices adjustments. They found a very little support of NKPC for US data, but with Canadian data, it seems at odds.

Josef and Miroslav (2005) stated that different methods are used to estimate the validity of NKPC, but none of them seem to be practically applicable for Czech Republic. Instead of using GMM or any other econometric technique which is being used in the previous literature, they used Demery and Duck (2002) method. This technique relies on easy tests based on co integration analysis and does not estimate parameters of NKPC directly. The results of this test provided no evidence upon which we can say that NKPC is compatible with Czech Republic data, and the model fails to explain inflation dynamics properly. They suggested that this model is not a good way of predicting inflation and formulation of monetary policy.

Linde, J (2005) criticized the econometric technique (GMM) of GG, that these outcomes are the product of description partiality. GMM is likely to
give biased and imprecise results, and using single equation estimation methods are not too informative. Linde pointed out two flaws with GMM; first, this technique gives biased results for small sample size, and second, this bias varies with the behavior of policies, i.e. with a variation in the monetary policy the coefficients estimates of GMM will also change, but the true parameters do not vary.

Swensen, A. R et al (2006, 2012) state that the choice of econometric technique for estimating NKPC is an area of great debate. They found from different misspecification tests that standard NKPC measured with GMM or two stages least square (2SLS) is at odds with Norwegian data. And forward-looking factor has no importance. They established a new standard NKPC model consisting only of backward-looking terms and claimed that the model is stable and its forecasting power is more than that of purely forward looking terms even if there is a major change in the monetary policy. They claimed that previous literature (which supports GG’s NKPC) needs to reevaluate using the cointegration methods and cointegration VAR tests.

Juselius, M (2008) directly objected to the standard NKPC model and rejected it on the basis of his study. Testing NKP model for Euro area (1970:1-2003:4, quarterly data) and the US (1960:1-2005:2, quarterly data), he followed Johnson and Swensen (1999, 2004) and used cointegration VAR method. The results show that co-integration limitations are met when real marginal cost is assessed from labour income share in the Eurozone, but not in the United States, weakening the model’s robustness. The researcher further mentions two drawbacks of this method; first, it does not work for stationary data; second, in case of endogeneity problem in driving variable, it gives biased results.

In response to the above criticism upon the first paper, Gali and Gertler (2005) answered to Linde and many other researchers through hybrid New Keynesian Phillips curve. They proved that these claims are plainly incorrect. Again the estimated results showed that forward-looking behavior is dominant, and GMM is a robust method for measuring it. GG pointed out that Linde used detrended GDP instead of real marginal cost, which gives inappropriate signs and results. And due to the presence of error terms in hybrid NKPC, we cannot use the NLS (i.e., in case of endogeneity problem, we only use GMM). Instead, GG used an NLIV estimates to measure the NKPC, which gave the same results as were in GG (1999) and strictly rejected Linde’s claim of the importance of backward-looking behavior. Linde’s criticism can also be cleared by Sbordone 2002, who got the same results as GG by using the Maximum Likelihood estimation technique. They also used detrended log GDP and compared the results with those of real marginal cost. The results were clearly in contradiction to each other which states that using detrended log GDP as the best determinant of inflation dynamics is an inappropriate choice. They suggest that NLIV and GMM give almost the same results and are robust upon least-square estimates.

**Analytical Model**

We received NKPC from a monopolistic competitive market in a profit-maximizing corporation, according to Gali and Gertler (1999), because enterprises in the market manufacture distinct items but confront the same sort of 1. According to this study, GMM has a weak identification difficulty, but ML necessitates forcing a variable to be fully observable. As a result, in these circumstances, a limited information
approach is the best option. 2 "ei 0" means that the error term is not equal to zero. Price modifications are subject to six restrictions. Each period, a small number of enterprises (1x) in the market establish prices, while the rest of the market remains unchanged. All enterprises are considered to have a constant price elasticity of demand. Staggered wages and price setting, according to Calvo (1983), means in any given time, every unit faces the likelihood (1 – 𝜃) of adjusting their pricing, while other firms face the probability (𝜃). Every business determines the best price level to optimize its current and future profits throughout time (Abbas 2012). Inflation is linked to real marginal cost and predicted upcoming inflation that occurs in conventional or baseline models. The equation’s mathematical version is shown below3.

\[ \pi_t = \beta E_t \pi_t + 1 + \lambda \text{rmc} \]  
\[ \lambda = (1 - \theta) (1 - \beta \theta) \theta^{-1} \]

The above equation is referred to as the NKPC standard or baseline model. We considered the real marginal cost and the production gap as inflation driving factors to compare the power of identifying the inflation dynamics of both variables, based on existing studies. As per Gali and Gertler (1999), there are two sorts of players in any economy: forward-looking (those who choose their prices purely rational expectations) and backward-looking (those who select the prices based on simple Rule of thumb). As a consequence, present inflation is influenced by both upcoming and postponed inflation (see for illustration, Further and Moore, 1995). As a result, in order to achieve inflation persistence, we must also consider lagged inflation. A modified version of NKPC has been developed for this purpose.

Current inflation is linked to predicted further inflation, lagged inflation, and expected future real marginal cost in the hybrid version of NKPC. Fraction w, on the contrary, by selecting the prices it utilizes the backward-looking rule of thumb. The mathematical form of HNKPC obtained is shown below (for a calculation, see Gali and Gertler, 1999).

\[ \pi_t = \lambda \text{rmc} + \gamma^f E_t\{ \pi_t + 1 \} + \gamma^b \pi_t - 1 \]  
Where,
\[ \lambda = (1 - w)(1 - \theta)(1 - \beta \theta) \theta^{-1} \]
\[ \gamma^f = \beta \theta \theta^{-1} \]
\[ \gamma^b = w \theta^{-1} \]
\[ \theta = \theta w \{1 - \theta(1 - \beta)\} \]

The coefficients for organizations that use forward-looking and backward-looking conduct, respectively, are f and b. If b=0, every unit is forward-looking, then hybrid model becomes the baseline model.

**Variables and their Measurement**

In the literature, there has been a lot of discussions on which explanatory variables should be used in the NKPC model. To achieve our goals, we constructed both variables, real marginal cost, and output gap, in the following manner:

**Measurement of Real Marginal Cost (rmc)**

In the literature, there has been a lot of discussion on the explanatory variables to use in the NKPC model. We have constructed both variables, real marginal cost, and output gap, in the following manner to achieve our objectives:

\[ y_t = A_t K^{ak} A^{an} \]  
\[ M_C = \frac{s_t}{\sigma_n} \]

This can also be written as

\[ M_C = \frac{w_t}{p_t} \cdot \frac{1}{\partial y_t / \partial N_t} \]

Where,
\[ S_t = \frac{W_t N_t}{P_t y_t} \]

As the real marginal cost is the ratio of real pay rate to labor's marginal product that is represented as,
\[ MC = S_t \quad (6) \]

**Measurement of Output Gap**

The percentage difference among the actual and prospective quantity of production was used to compute this variable. The variable's mathematical form is as follow
\[ OG = \frac{(Y - Y_{pot})}{Y_{pot}} \times 100 \quad (7) \]

The actual level of output (or yearly GDP) is represented by "Y," while the prospective level of output is denoted by "Spot."

**Econometric Tool**

One of the most crucial aspects of the subject is determining how to value it (Satti et al. 2007). The extant literature uses either the Generalized Method of Moments (GMM), Maximum Likelihood (ML), or Vector Auto Regression (VAR) estimate techniques, although each yields distinct findings. Although the most commonly used technique is GMM, which has some advantages such as being simple to use, it can produce biased results in small samples and choosing instrumental variables can be difficult (Stock et al. 2002), and it also has the problem of weak identification (Tillmann 2009; Linde 2005; Mavroeidis 2004; Kleibergen and Mavroeidis 2009; Daniskova and Fidrmuc 2011).

Gali and Gertler (1999), Gali et al. (2001), and Brissimis and Magginas (2008) used GMM to estimate conventional and hybrid versions of NKPC and discovered that forward-looking behavior is critical, and GMM is the best method for estimating NKPC. GMM is also supported by evidence from Africa (Maturu et al. 2006; Kenya; Plessis and Burger 2006; South Africa). The results of Jondeau and Bihan (2003)'s comparison of GMM and ML for the US and UK show that GMM is easier to utilize than other approaches. Although some GMM users have identified a difficulty with poor identification, the Hansen J-test solves this issue, demonstrating that GMM is a reliable tool for estimating inflation dynamics (Cespedes et al., 2005). Satti et al. (2007) and Saeed and Riaz (2012) employed GMM in Pakistan and found evidence in support of GG, recommending GMM as the optimum technique.

However, some scholars question the validity of GMM and propose other econometric methodologies. They mentioned a number of issues, including poor instrument identification and a small sample bias. Some economists believe it is an ineffective method for assessing the NKPC model. Only well of these is Rudd and Whelan (2005, 2007), who suggest that GG's technique is inclined to give biased results for a limited sample. They contended as GMM is unable to fully represent inflation dynamics as previously described in the literature, and they proposed the instrumental variable approach as a valid method of examining inflation dynamics, within which he observed that backward-looking attitude is much more important. GMM is typically plagued by a deficiency of recognition and a small population bias (Tillmann 2009; Linde 2005; Mavroeidis 2004; Daniskova and Fidrmuc 2011). Vasicek (2011) used panel data for four nations to overcome the small sample bias and discovered that forward looking behavior was less influential. VAR and co-integration analyses are preferred in Europe (Fanelli 2008; Juselius 2008; and Boug et al. 2006, 2011).
**Data Descriptions**
For the period 1972-2014, the analysis uses both annual and quarterly data. Annual inflation ($\pi$) was computed using world development indicators (WDI) as a percent change in the annual GDP deflator, while quarterly inflation was calculated using international financial statistics (IFS). The annual employment level ($Y$) was derived from a Pakistani economic survey conducted in 2015. From data from the International Labor Organization, the annual pay level ($W$) was calculated (ILO). The quarterly rate of interest ($I$) was given by IFS, and the yearly interbank call rate was given by WDI (often known as interest rate). Taking data from the World Development Index, CPI inflation was estimated as a percent difference in the yearly consumer price index (WDI).

**Empirical Results**
The information gathered from various sources was first tallied and reorganized. The stationarity of all variables is tested. At the level, inflation and interest rates are stationary, although the output gap and real marginal cost (labor share of income) are stationary at the first difference. The covariance matrix method was employed to discover endogeneity. The empirical values of joint correlation demonstrate a high level of endogeneity, and GMM is thought to be the best tool for data analysis. By substituting the explanatory variable for annual and quarterly data, the baseline and hybrid versions of the NKPC model are assessed.

**The Baseline Model**
The output gap and real marginal cost were used as determining forces in the case of inflation in this version of the New Keynesian Phillips curve, which was constructed using reduced and structural parameters.

**Reduced form Evidence**
First, using the quarterly data, equation (1) has been approximated in reduced form. The total slope of the coefficient on the output gap is calculated by this method. As instrumental variables, 4 lags of inflation, interest rate, and output gap are used in this model. Following are the predicted outcomes:

$$\pi_t = 1.00628E_t\pi_{t+1} - 0.00618(og)$$

(0.0200)5 (0.0111)

Output gap's slope coefficient is negative and statistically negligible (see Table 1 for results). This, unsurprisingly, backs up empirical research (Gali and Gertler 1999; Gali et al. 2001; Sbordone 2002; Satti et al. 2007).

The J-statistics (0.0607) verifies the model's validity, and the R-square (0.835) represents that eighty three percent of the difference is explained, indicating that the model is credible. The coefficient of inflation's forward-looking behavior is large, indicating the significance of predicted inflation. According to the findings, Pakistan's production gap is not the greatest predictor of inflation.

For the same sample size, we approximated equation (1) again, and the findings are displayed below:

$$\pi_t = 0.92112E_t\pi_{t+1} - 0.00052(og)$$

(0.0513) (0.00018)

The output gap coefficient is statistically insignificant and has a negative sign with a p-value of 0.07. The J-statistics are insignificant once more, confirming the model's validity. The forward-looking behavior coefficient is once again quite high, and inflation dynamics are forward-looking, as opposed to Lieth and Malley's (2007). Both estimates suggest that the output gap is ineffective in explaining Pakistan's inflation dynamics.
inflation patterns. These findings contradict those of Plessis and Burger (2006), who claimed that when the output gap is included in the model, backward-looking behavior becomes dominant, and they also clarify Kurmann's criticisms (2004).

Table 1. The Baseline Model Parameters

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<th>β</th>
<th>λ</th>
<th>J-Statistics</th>
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<td>Quarterly data (reduce form)</td>
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<td></td>
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<td></td>
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<td>(0.0202)</td>
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<tr>
<td>Annual Data (Structural form)</td>
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Authors' own calculations are used as a source. The level of significance as a P-value of 0.05. The P-values are shown in parenthesis. B, are the predicted inflation coefficients, explanatory variable, and nominal rigidity degree, respectively. The validity of instruments has been checked using J-statistics. The validity of instruments was checked using J-statistics with a significance level of 0.05.

The production gap was then replaced with real marginal cost, and Equation (1) was estimated in simplified form for annual6 data for the same sample period. Two delays were used using the instrumental variables inflation, CPI inflation, real marginal cost and money market rate. The following are the outcomes:

$$\pi_t = 0.90945E_t \pi_{t+1} + 0.02141(rmc)$$

(0.0572) (0.00869)

This time, the true marginal cost coefficient is positive and as well as statistically significant. Once again, the forward-looking behavior coefficient is close to one and statistically significant. As Gali and Gertler (1999), Gali et al. (2001), Sbordone 2002 and Abbas and Sgro demonstrate, real marginal cost explains inflation patterns well (2011). Inflation and real marginal cost are linked in a dynamic way; any increase in real marginal cost leads to increased inflation in the future, and likewise (Satti et al. 2007).

Structural form Evidence

To identify the economy's deep structural parameters, we must first estimate the model's structural parameter. This would aid us in determining the economy's nominal rigidity. The only true marginal cost has been employed to estimate structural parameters, which is validated by prior results. The following are the estimated outcomes:

$$\pi_t = 0.89945E_t \pi_{t+1} + 0.02340$$

$$\theta = 0.8935$$

The results do not change when estimating the reduced form or structural form of the model using the output gap or real marginal cost, and the forward-looking coefficient remains dominant in both cases. With a value of 0.8935, prices are stable for 9 quarters, indicating that nominal rigidity is quite high in Pakistan,
compared to 2 to 3 quarters in the Israeli economy (Ribon 2004), and most enterprises are forward-looking. Therefore, the traditional version of the model well captures inflation dynamics in Pakistan, with real marginal cost serving as the most effective driving component for predicting inflation.

The Hybrid Version
Each economy possesses two sorts of players, as per Lanne and Luoto (2013): forward-looking agents (those who determine their prices associated with future forecasts) and backward-looking agents (those who determine their prices based on historical expectations) (those who set their prices based on simple Rule of thumb). As a result, both future and delayed inflation play a part in determining current inflation (Fuhrer and Moore 1995). As a result, in order to achieve inflation persistence, we must additionally consider lagged inflation to determine the impact of lagged inflation in determining inflation in Pakistan.

Reduced form Evidence
The true marginal cost is first calculated using Equation (2). Instrumental variables such as inflation, output gap, CPI inflation, marginal cost and money market rate have been analyzed using two lags. The following are the outcomes:

\[ \pi_t = 0.8833 \pi_{t-1} + 0.0044 + 0.1596 \pi_{t-1} \]

The results reveal that lagged inflation enters insignificantly, although being favorable, and has little impact on forward-looking behavior. Positive actions are the best driving variable, with real marginal cost being significant. The output gap is also computed using equation (2), but the findings are the same as before. The forward looking conduct is not only dominant, but also statistically significant in each case. See Table 2 for more information on the anticipated value.

Structural Form Evidences
After estimating the reduced form parameters, the hybrid model for structural form parameters must be estimated. The study got the following results for estimating equation (2) using the driving factor is real marginal cost, and the instrumental variables have two lags

\[ \pi_t = 0.8833 \pi_{t-1} + 0.0058(rmc) + 0.1596 \pi_{t-1} \]

\[ \theta = 0.8935 \]

The genuine marginal cost is not only positive, but also statistically significant once again. As is customary, lag inflation is positive but minor, and price determination is heavily influenced by forward-looking behavior. The nominal stiffness is high, and it is the same as in the baseline model.

Table 2. The Hybrid Version Parameters

<table>
<thead>
<tr>
<th></th>
<th>( r^f )</th>
<th>( r^b )</th>
<th>( \theta )</th>
<th>( \lambda )</th>
<th>J-statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Annual data (reduce form)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Gap</td>
<td>0.7733</td>
<td>0.2199</td>
<td>-</td>
<td>-0.0001</td>
<td>0.853</td>
</tr>
<tr>
<td></td>
<td>(0.0016)</td>
<td>(0.3313)</td>
<td></td>
<td>(0.4792)</td>
<td></td>
</tr>
<tr>
<td>Marginal Cost</td>
<td>0.8833</td>
<td>0.1596</td>
<td>-</td>
<td>0.0044</td>
<td>0.0896</td>
</tr>
<tr>
<td></td>
<td>(0.0026)</td>
<td>(0.5601)</td>
<td></td>
<td>(0.0502)</td>
<td></td>
</tr>
<tr>
<td>2) Annual Data (structure form)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Robustness of Results

We have replaced predicted inflation with lagged inflation in equation (1) and made the standard NKPC entirely backward-looking to test our conclusions, in addition to earlier literature. To ensure the validity of our findings, we calculated annual data for the sample period. The data findings both for equations are listed below:

\[
\pi_t = \beta E_t \pi_{t-1} + 0.01269(rmc)
\]

\[
P - value(0.3339)
\]

\[
\pi_t = \beta E_t \pi_{t-1} - 0.00025(OG)
\]

\[
P - value(0.5334)
\]

In each of these examples, explanatory factors are statistically negligible, implying that the NKPC model is incompatible with merely lagged inflations and that inflation in Pakistan is almost always forward-looking (Maturu et al. 2006; Plessis and Burger 2006; Jondeau and Bihan 2003). When firms in underdeveloped economies like Pakistan set their pricing for a specific time, they adopt rational expectations (Sattl et al, 2007; Abbas and Sgro 2011; Saeed and Riaz 2012). The higher the degree of nominal rigidity, the longer it will take for prices to stabilize.

Conclusion

The purpose of this research was to examine just how much the NKPC could describe inflation trends in a closed economy in Pakistan. The study employed the generalized method of moments to calculate conventional and hybrid NKPC both in reduced and structural variants for Pakistan from 1972 to 2014, following Gali and Gertler (1999). (Annual and quarterly). The production gap and labor income share are two indicators of economic growth. The unit root test is used to check for stationarity of variables in this study. Apart from the marginal cost and output gap, all variables are level stationary. We created a covariance matrix to check for endogeneity. Endogeneity can be seen in the joint values.

First, the production gap was evaluated using the reduction form pure forward-looking model for both annual and quarterly data. Expected inflation predominate in both circumstances, and OG became unimportant in explaining inflation trends in Pakistan. The next experiment used MC instead of OG and found a statistically significant positive coefficient. Moreover, lagged inflation was introduced into the hybrid version of the NKPC, which was positive but statistically insignificant both for output gap and real marginal cost. Forward-thinking behavior dominated the entire estimation. The model's deep structural parameters revealed that nominal rigidity is exceptionally strong in Pakistan, with prices remaining steady for over nine quarters. A pure backward-looking NKPC was also created for the robustness of our results, which verified the study's findings.

Because no panel estimation of the model has been done in the empirical work on NKPC, future studies should focus on regional estimation of the model. Furthermore, because no attempt has been made to disaggregate level data, the compatibility of NKPC can be assessed for
sectoral or firm-level data as well. In future studies, deficit-based phenomena must also be taken into account. As emerging countries struggle with a balance of payments deficit and currency depreciation, local costs of products are rising.
References


Inflation Dynamics in Pakistan: Forward-looking or Backward-looking?

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