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INFLATION DYNAMICS AND NEW KEYNESIAN PHILLIPS CURVE: AN OPEN ECONOMY PERSPECTIVE FOR PAKISTAN

Abstract:

The study has tested the empirical validity of the open economy New Keynesian Phillips curve (NKPC) model with Pakistan's data over the period 1972 to 2012. The estimates of the open economy hybrid NKPC reveal that although both the lagged period inflation and future inflation are statistically significant but the coefficient of lagged period inflation is quantitatively larger than the expected inflation which means that the price setting behavior is dominantly backward looking in Pakistan. Furthermore, the output gap has proved to be inflation forcing variable in the country. Finally, the inflation dynamics of Pakistan seem to be strongly influenced from the external factors like terms of trade and trade openness. The findings of the study suggest that the open economy NKPC can be used as a benchmark model for understanding the inflation behaviour in Pakistan.

***JEL classification*:** C13; C32;E31.

***Keywords*:** New Keynesian Phillips curve;Inflation dynamics;Terms of trade; Trade openness.

1. Introduction

In recent years, the upkeep of price stability has transformed into a plain undertaking for many central banks including the State Bank of Pakistan. Price stability requires a plausible monetary arrangement that would reduce consistency and changeability of inflation through mooring its expectations. This is vital because it diminishes the expense of bringing down inflation (in overheating periods) in terms of real national output, and it offers the basis for wide range of economic activities and people's livelihood.

The New Keynesian Phillips Curve (NKPC) is emerged as a reaction to the criticism that the Keynesian macroeconomics needs micro-foundations. The element of theoretical microeconomic underpinnings makes the NKPC not only to competently elucidate price rigidity but also to become useful framework for

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monetary management in an economy. The standard NKPC demonstrates relationship between current inflation, future expected inflation and real marginal cost or output gap. Gali and Gertler (1999) developed the hybrid NKPC by adding lagged inflation in the standard NKPC. The thought is to let inflation influenced from a blend of expected future inflation and lagged inflation. The key notion behind the NKPC is that it is either expensive, or somehow troublesome, to change prices frequently. This could be due to some kind of menu costs of changing prices. Later on the studies such as Balakrishnan and Lopez-Salido (2002), Batiniet. al. (2005), Galí and Monacelli (2005) and Mihailov et.al.(2011) have highlighted the significance of acquainting open economy perspectives with the closed economy model of the NKPC. In their perception, the external factors are pertinent inflation drivers as well, hence, this ought to be considered when evaluating the NKPC model.

Inflation rate has been fluctuating between single and double digits since 1970 in Pakistan (see table 1). In the 1970s its average crossed the figure of double digits, in the 1980s the average fell to 7.2 percent and in 1990s it rose again to almost 10 percent. Nonetheless, during early three years of 21st century, inflation rate was relatively low in Pakistan but during the period 2004-05 to 2010-11 a steady increase has been observed in this rate. Since 2011-12, we have been experiencing a slight fall in inflation rate in the country. On the whole, inflation has become a hot debated issue in the country (see table 1).

Table 1:Trends in CPI and WPI Based Inflation (1970-71 to 2012-13)

Year	CPI	WPI	Year	CPI	WPI
1970-1974	12.76	13.25	**2004-05**	7.44	8.49
1975-1979	10.51	11.17	**2005-06**	9.06	8.70
1980-1984	8.43	9.59	**2006-07**	7.92	8.50
1985-1989	6.10	6.86	**2007-08**	7.60	8.20
1990-1994	10.54	11.57	**2008-09**	20.29	25.38
1995-1999	8.89	8.93	**2009-10**	13.65	7.20
2000-01	4.41	4.08	**2010-11**	13.88	21.36
2001-02	3.54	4.46	**2011-12**	11.92	10.4
2002-03	3.29	3.10	**2012-13**	7.7	7.92
2003-04	4.57	6.40			

Source: *Pakistan Economic Survey* (Various issues).

CPI: Consumer price index, WPI: Wholesale price index,

Note: All values are averaged over five years up to figures for 1999.

Pakistan has been on the track of trade liberalization by reducing quantitative restrictions and rationalizing the tariff structure since 1980s. It can be seen from table 2 that tariff rates in Pakistan have been reduced from 225 percent in 1987-88 to 30 percent in 2012-13 which is an important indicator of a steady integration of Pakistan's economy with the rest of the world.

Table2: Tariff Reduction Schedule in Pakistan (1987-88 to 2012-13)

Year	Maximum Tariff Rate	Year	Maximum Tariff Rate*
1987-88	225	2000-01	35
1988-89	125	2001-02	30
1989-90	125	2002-03	25
1990-91	95	2003-04	25
1991-92	90	2004-05	25
1992-93	90	2005-06	25
1993-94	80	2006-07	25
1994-95	70	2007-08	25
1995-96	65	2008-09	35
1996-97	65	2009-10	35
1997-98	65	2010-11	35
1998-99	45	2011-12	35
1999-2000	35	2012-13	30

Source: Federal Board of Revenue, Pakistan; World Trade Organization (WTO).

*Luxury automobiles and alcohol continue to carry tariffs up to 425 percent.

As Pakistan constitutes a suitable case for small open economy, therefore, the present study aims to investigate the inflation dynamics in the country using the open economy NKPC model. This exercise will lead to formulate suitable economic policies for curbing the inflation rate in Pakistan. The present study is the pioneer in estimating the open economy NKPC in the context of Pakistan.

Rest of the study is structured as follows: section 2 presents brief literature review on the empirical validity of the NKPC; section 3 illustrates the theoretical framework that yields the open economy NKPC along with data and econometric methodology used in the study; section 4 reports the empirical results; and final section concludes the study with some policy recommendations.

2. Literature Review

A significant number of researchers devoted their efforts to check the validity of the NKPC in the context of developed and developing countries. However, all such endeavors have provided mixed evidence regarding the use of this curve as a valid framework for examining the inflation dynamics. For example, Gali and Gertler (1999), Balakrishnan and Lopez-Salido (2002), Leith and Malley (2003), Batiniet. al., (2005), Galiet. al.(2005), Galí and Monacelli (2005), Suzuki (2006), Sbordone (2007), Dua and Gaur (2009), Krznar (2011), Mihailov et.al.(2011), and Abass(2012) provide empirical evidence in favor of the NKPC. Whereas, the studies by Linde (2005), Dufour et.al. (2006), Rudd and Whelan (2007) and Bjornstad and Nymoen (2008) demonstrate the poor ability of the NKPC to give a reasonable depiction of the inflation episodes in various countries. Consequently, while the NKPC is contended to turn into the workhorse model for portraying short run fluctuations in inflation by a few researchers, there is still a continuous level headed discussion about its merits.

In Pakistan so far only two significant attempts have been made to analyze the fluctuations in inflation using the closed economy NKPC model. In this regard, the first study is conducted by Sattiet. al. (2007) and the findings of the study indicate the consistency of the NKPC model with Pakistan's data. However, it is beset with certain limitations that raise some doubts on the findings of the study. Firstly, the authors do not mention how they have generated the expected inflation. The expected inflation is either constructed or some proxy is used for it but despite the fact that it is one of the main variables in the NKPC no discussion regarding the construction of this variable has been incorporated in the study. Secondly, the SAP of the IMF was initiated in Pakistan in 1987-88 under which different trade and financial reforms were introduced in the economy. Therefore, there is a chance that a structural change has taken place in the country. But the study does not incorporate this aspect of the economy. In the presence of any structural shift in the data, the GMM estimation technique may yield misleading results. Thirdly, the estimates are inferred from a closed economy context, whereas, Pakistan is a small open economy which makes it pertinent to incorporate foreign sector inflation drivers in the NKPC model.

While in their study on a quarterly sample from 1970:1 to 2010:4, Saeed and Khalid (2012) show that output gap does not appear significant and interestingly the coefficient of lagged inflation is larger than the expected inflation which predicts that in Pakistan the adaptive expectation inflation behavior is dominant. However, this study is also plagued with the same problems which we have discussed in case of Sattiet. al. Thus, on one hand we find the dearth of literature on this topic in the context of Pakistan while, on the other hand, the existing studies suffer from serious methodological problems due to which their findings cannot be relied upon. Therefore, we find it productive to implement the NKPC model incorporating all the deficiencies of the previous studies in order to provide more reliable estimates for dynamics of inflation in Pakistan. Thus, the present study is an attempt in this direction.

3. Analytical Framework

3.1. The Open Economy NKPC: Model Specification

Since Pakistan is a small open economy- an economy that is, particularly, profoundly subject to imports – the present empirical investigation broadly alludes to the hybridNKPC model of Gali and Monacelli (2005) which takes into consideration the open economy characteristics. The hybrid NKPC model given by Gali and Gertler (1999) and Galiet. al.(2001)

$$®_t = {}_f\mathrm{E}_t\{®_{t+1}\} + {}_b®_{t-1} + ¥\mathrm{Y}_t + e_t$$

shows that current period inflation $®_t$ depends upon the expected future inflation $E_t®_{t+1}$, the output gap (used as a proxy for real marginal cost) Y_t and lagged inflation $®_{t-1}$. In the model (1) random error term is represented by e_t, whereas ${}_f$, ${}_b$ and ¥ are plausibly stochastic parameters. Some structural parameters play their role in determining the values of these parameters as:

$${}_f = \frac{\quad}{¤} \quad , \qquad {}_b = \frac{\mu}{¤}, ¥ = \frac{(1-\mu)(1-\quad)(1-\quad)°}{¤} \qquad \text{and}$$

$$¤ = \quad + \mu[1-\quad(1-\quad)].$$

where the parameters θ, β, and ω represent degree of price stickiness, discount factor and degree of price backwardness respectively.

As far as an open economy model is concerned, it can safely be stated that domestic inflation and imported inflation are combined in current period inflation as:

$$®_t = ®_{d,t} + ®_{m,t} \qquad (2)$$

Imported inflation may materialize due to fall in the external value of domestic currency (i.e., exchange rate appreciation) or increase in foreign price level. The effect of both of these is well incorporated in the variable terms of trade which is a ratio of export price index to import price index. First differencing the terms of trade variable reflects a change in relative prices of imports[1], and it might be translated as a measure of imported inflation, so expression (2) may assume the form:

$$®_t = ®_{d,t} + \sim \Delta TT_t \qquad (3)$$

Since, the domestic inflation takes after the same process as that of (1):

$$®_{d,t} = {}_f\mathrm{E}_t\{®_{d,t+1}\} + {}_b®_{d,t-1} + ¥\mathrm{Y}_t + u_t \quad (4)$$

Now, by inserting expression (4) in equation (2), we get:

$$®_t = {}_f\mathrm{E}_t\{®_{d,t+1}\} + {}_b®_{d,t-1} + ¥\mathrm{Y}_t + \sim\Delta TT_t + u_t \quad (5)$$

In view of Romer's (1993) hypothesis small open economies experience low inflation. This is due the impact of trade openness on the slope of the Phillips curve and the weights assigned to output stabilization. Thus, trade openness has significant impacts on inflation. Considering this, we have also incorporated the variable trade openness in the model (5) as an explanatory variable. Thus, for accomplishing its empirical task, the study has estimated the following open economy version of the NKPC [2]in section 4:

$$®_t = {}_f\mathrm{E}_t\{®_{d,t+1}\} + {}_b®_{d,t-1} + ¥\mathrm{Y}_t + \sim\Delta TT_t + °TO_t + u_t$$

where TO_t represents trade openness.

3.2. Data Description and Econometric Methodology

The NKPC estimates reported in the study are based on annual time series data over the period of 1972 to 2012 which have been gathered from different sources, namely, International Financial Statistics database, Pakistan Economic Survey (various issues) and World Development Indicators (WDIs) database. In the study, inflation rate has been measured by the growth rate of consumer price index (CPI). For expected inflation rate one period ahead we have used growth rate of inflation as its proxy. The output gap is calculated by using the Hodrick-Prescott (HP) filter. Terms of trade variable is calculated as the ratio of import prices to export prices i.e.

$$TT_t = \frac{P_t^M}{P_t^X} \quad (7)$$

We have used first difference of logarithm of TT for estimating equation (6). As far as the variable trade openness (TO) is concerned, we have used its commonly used measure i.e., sum of imports and exports divided by GDP. This ratio generally reveals the degree of a country's openness to world trade. The time series trade openness is logarithmic.

Most of the studies in present area of research have used the GMM technique for estimation task. The present study besides this technique also

employs two other alternative techniques, namely, the ordinary least squares (OLS) and the two stages least squares (2SLS) to estimate the models.

4. Results and Discussion

As a preliminary step, stability analysis is performed by applying the Chow breakpoint stability test. The break- point is taken at 1988 when structural adjustment program (SAP) was launched in Pakistan under the IMF terms and conditions. Results of the Chow test reported in table 3 indicate that we fail to reject our null hypothesis of no structural break in the data at 5 percent level of significance and we can say that all the time series remained structurally stable during the sample period of the study. Thus, there is no evidence of structural instability in any of the time series used in the study.

Table 3: The Chow Test for Structural Stability

Variable	F-Stat.	Prob. F (1, 40)	Decision
INF	0.098	0.761	Do not reject H_o at 5% level of significance.
Y	0.299	0.588	Do not reject H_o at 5% level of significance.
ΔTT	0.371	0.515	Do not reject H_o at 5% level of significance.
TO	0.137	0.664	Do not reject H_o at 5% level of significance.

Stationarity is a key concept underlying the time series empirical analysis. The study has employed the Dickey-Fuller generalized least squares (DF-GLS) test for checking the stationarity properties of the time series, and results are reported in table 4. It is obvious that all the time series are stationary at level except trade openness which is stationary at first difference. This finding forces us to use first difference form of *TO* while estimating the model (6) so that all the variables have same order of integration i.e. I(0).

Table 4: Dickey-Fuller GLS Unit Root Test (1972-2012)

Variable	Level	First Difference	1%	5%	10%	Order of Integration
INF	-4.078	--	-3.770	-3.190	-2.890	I(0)

Y	-5.915	--	-3.770	-3.190	-2.890	I(0)
ΔTT	-5.541	--	-3.770	-3.190	-2.890	I(0)
TO	-1.284	6.072	-3.770	-3.190	-2.890	I(1)

4.1. Dynamics of Inflation in Pakistan and the Closed Economy Hybrid NKPC

We begin our main empirical task by estimating the closed economy hybrid NKPC given in equation (1). Results obtained from all the three estimation techniques reveal that both the expected inflation and the lagged period inflation are statistically significant. The significant coefficient of the lagged period inflation reflects the persistence of inflation dynamics in Pakistan. However, the coefficient of lagged inflation is quantitatively larger than the coefficient of expected inflation (see table 5). This implies that the economic agents are more backward looking than forward looking in Pakistan.

Table 5: Reduced form Estimates of the Hybrid NKPC
Dependent Variable: INF

Regressor	**OLS**[3]	**2SLS**	**GMM**
C	-5.692 (-1.599)	-4.841 (2.718)	0.822 (0.553)
EINF	0.358*** (8.443)	0.373*** (2.856)	0.491*** (21.02)
INF(-1)	0.426*** (3.944)	0.527*** (3.851)	0.584*** (8.057)
Y	0.222*** (3.005)	0.505** (2.00)	0.237*** (5.129)
R^2	0.894	0.648	0.781
Adjusted R^2	0.871	0.602	0.752
J-statistic (Prob)			0.801
Durbin-Watson stat.	1.872		

Notes: [1]Figures in the parentheses are t values.
[2]** significant at 5% ; *** significant at 1% .
[3]Instrument Specification: 2SLS: INF (-2 to-3), EINF (-1 to-2), BD, Cons.[4]
GMM: EINF (-1 to -2), INF (-2), Y (-1 to -2),BD.

Earlier, in case of Pakistan, Saeed and Khalid (2012) find that the backward looking inflation is quantitatively more important than the forward looking inflation while Sattiet. al.,(2007) show that inflation is mainly determined by expected future inflation. Both of these studies employed the GMM estimation technique. However, using the three alternative techniques including the GMM technique our results suggest that in Pakistan inflation behavior is predominantly backward looking. It contradicts the supposition that people in developing countries are forward looking while making the economic decisions.[5] Thus, both the expected inflation and the lagged period inflation play an important role in

determining the inflation, hence, inflation is a hybrid phenomenon in Pakistan. According to Paloviita (2006) in a low inflation country the forward looking expectations about inflation usually dominate, while in a high inflation country the backward looking inflation behavior is the one that dominates.

In contrast to the findings of Sattiet. al., and Saeed and Khalid, Pakistan's inflation is sensitive to changes in the output gap (see table 5). This result is consistent with the NKPC theory which suggests that there is a positive relationship between inflation and output gap (Scheibe and Vines, 2005). This finding implies that excess demand pressure has a statistically significant impact on current period inflation in Pakistan. Intuitively, higher output gap is associated with an increase in marginal costs which translates into price pressure. Overall, we see that inflation dynamics can be well explained by using the closed economy hybrid NKPC in case of Pakistan.

4.2. Inflation Dynamics in Pakistan and Estimates of the Open Economy NKPC

In order to capture the influence of both internal and external factors on the domestic inflation, the open economy NKPC has been estimated and results are reported in table 6. The coefficients of EINF, INF (-1) and Y are again found to be significant and the nature of relationship which these variables have with the current period inflation is same as we have discussed in case of the closed economy hybrid NKPC. It implies that domestic factors do have their important role in inflation determination irrespective of the fact whether the economy set up is closed or open for Pakistan. Moreover, we find that the inflation process is predominantly backward looking even in open economy version of the NKPC in Pakistan. The variable changes in terms of trade is having a significant positive effect on inflation which implies that the theoretical notion of imported inflation is valid in case of Pakistan. We know that Pakistan's imports are mainly concentrated in food group, machinery group, petroleum group and raw materials. Thus, an increase in the prices of items included in these groups will certainly make terms of trade adverse to Pakistan leading to generate food inflation on one hand and general inflation through increase in the cost of production on the other hand.

Table 7: Reduced Form Estimates of the Open Economy NKPC
Dependent Variable: INF

Regressor	OLS	2SLS	GMM
C	10.174**	14.673***	4.522
	(2.443)	(5.794)	(1.606)
EINF	0.393***	0.346***	0.456***
	(11.397)	(14.619)	(21.53)
INF(-1)	0.636***	0.581***	0.676***
	(4.643)	(11.584)	(6.602)
Y	0.139*	0.162***	0.276***
	(1.768)	(5.493)	(5.674)
Δ TT	0.102***	0.186*	0.218**

	(4.192)	(1.897)	(2.293)
ΔTO	0.814** (2.293)	-0.672*** (-5.501)	-0.153*** (-3.425)
R-squared	0.889	0.666	0.782
Adjusted R-squared	0.861	0.610	0.744
J-statistic (Prob)			0.784

Notes: [1]Figures in the parentheses are t values.

[2] ***, **,* denote statistical significance at 1percent, 5 percent and 10 percent levels respectively.

[3]Instrument specification: 2SLS: INF (-2 TO -3), EINF (-1 TO -3), BD, CONS, POP.[6]

GMM: EINF (-1 TO -2), Y (-1 TO-2), BD, CONS, POP.

The coefficient of the variable changes in the trade openness is statistically significant but it carries theoretically incorrect sign only in case of the OLS technique. The incorrect positive sign of the variable ΔTO can be attributed to the fact that the OLS technique is likely to provide inconsistent result in the presence of the endogeneity problem. This argument gets further support from the finding regarding the nature of association between INF and ΔTO under the other two techniques, the 2SLS and the GMM which have abilities to yield consistent results even in the presence of the endogeneity problem. Both these techniques yield a statistically significant coefficient of ΔTO with negative sign. This finding supports the results of Ashra (2002), Hanif and Batool (2006) and Mukhtar(2010) that trade openness is negatively associated with inflation in Pakistan. Overall, the open economy NKPC model has proved to be successful in presenting important domestic and foreign drivers of inflation for Pakistan. Therefore, the open economy NKPC framework is adequate to approximate inflation dynamics empirically in the country.

5. Conclusion and Policy Implications

As Pakistan is a typical open economy, therefore, the present study attempts to investigate to what extent dynamics of inflation in Pakistan are well described within the framework of the open economy New Keynesian Phillips Curve (NKPC). The findings of the study reveal that open economy specification of the NKPC has the ability to explain the dynamics of inflation in Pakistan. Furthermore, the backward looking component of Pakistan's inflation is relatively more important than the backward looking component. Output gap has also been proved to be significant determinant of inflation in the country. The external factors, namely, terms of trade and trade openness have emerged as equally relevant inflation drivers along with the domestic factors. Thus, the overall findings in the study indicate that an open NKPC specification is relevant for Pakistan. We agree that extending the NKPC to include open economy factors is important since new channels that affect inflation dynamics arise with the opening of the economy to the rest of the world and these should be considered especially if one is to model inflation dynamics of a small open economy like Pakistan.

Policy implications of the study are straight forward. *Firstly*, the inertial inflation and the expected inflation both highly affect inflation, explaining high inflation persistence. Thus, one of the major objectives of the monetary policy should be to control inflation expectations in Pakistan because controlling expectations is the first step in managing inflation. *Secondly*, the present study has shown that trade openness significantly and negatively affects inflation rate in Pakistan. This finding advocates that more attempts should be made to increase the degree of trade integration with the world. In this regard, different domestic barriers to trade should be eliminated and effective measures should be taken to establish and strengthen trade links with maximum number of countries.

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[1] Following Gali and Monacelli (2005) we have used inverse definition of terms of trade i.e.it is a ratio of import prices to export prices.

[2] Unlike the closed economy case, there is still no standard open economy NKPC model that one can refer to.

[3] The use of the OLS technique to estimate the NKPC in the presence of endogeneity problem is just to see to what extent the results from this technique differ from those of the 2SLS and the GMM techniques. As the findings from all the three techniques do not differ drastically, therefore, we can say that the endogeneity problem is not so severe to significantly affect the OLS estimates in the study.

[4] Aggregate consumption

[5] For more details see Sati et. al. (2007)

[6]Total Population.