A Real Exchange Rate based Phillips Curve Model for Pakistan

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Abstract

In this paper an open-economy version of a Phillips curve for Pakistan is estimated over the period 1973-2008. The question whether real exchange rate affect the inflation in Pakistan is addressed in this framework. The main finding is that real exchange depreciations are inflationary in Pakistan. Moreover, it is also find out that exchange rate regime changes also explain this inflation.

Keywords: Augmented backward looking Phillips-curve model, Real exchange rate, Time lag effect, regime shifts

1. Introduction

High and persistent inflation is one of the central problems facing by most of the countries today. It results in a series of macroeconomic implications in an economy in form of contraction in savings, investments, exports and growth which ultimately leads to the macroeconomic instability (Abidemi and Maliq, 2010; Korkmaz, 2010). Therefore, knowledge about the factors originating inflation become one of the major challenges for the central banks to implement monetary policy effectively (Cheng and Tan, 2002; Haque and Qayyum, 2006).

A series of literature existed on the forces affect inflation however the empirical results are mixed and still seems to be in the data. Some studies analyzed inflation in a monetarist framework whereas others used a structuralist approach for its modeling. Hossain (1989), Khan and Qasim (1996), Bagliano and Morana (2003) and Kemal (2006) concluded that monetary (demand side) factors play a dominant role in the determination of inflation. Whereas, others find out that inflation is influenced by the non-monetary (supply side) factors (Hossain and Akhtar, 1986; Naqvi *et al.*, 1994; Goldfajn and Werlang, 2000; Gerlach and Yiu, 2004; Gachet, *et al*., 2008).
In the same scenario the transformation effects of exchange rate (nominal or real) depreciation on inflation is also become a hot issue for the researchers and policy makers (Choudhri and Hakura, 2006). Being a relative price exchange rate plays an important role in the macroeconomic stabilization of the open economies (Calvo, *et al.*,, 1995). Exchange rate oscillations pass on to the domestic prices through aggregate demand and supply side channels. On the supply side, fluctuations in the exchange rate affect imported goods prices either consume or enter the production chain through both direct and indirect channels. (Volkan *et al.*, 2007; Barhoumi, 2006; Lim and Papi, 1997; Liu and Tsang, 2008; Achsani, *et al*., 2010). On one side a depreciation/devaluation of the domestic currency exchange rate directly results in the higher imported goods prices. Indirectly, the potentially higher cost of imported inputs associated with exchange rate depreciation increases marginal cost of production and indirectly leads to higher prices of domestically produced goods. Similarly, on the demand side, a rise in the foreign demand for domestic country exports may bid up the price level and cause inflation.

However, when coming towards the modeling of exchange rate and inflation, the main question which arises in front of the researchers is how to model it. Although, in this regard the traditional Phillips (1958)[3] curve works as a standard tool for the explanation of the inflation dynamics and assessment of policies effectiveness particularly in the developing countries (Gruen, 1999; Gerlach, 2007).

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[3] The standard Phillips curve is developed by Phillips (1958) for examining the influence of economic activity on the general level of prices in terms of relationship between unemployment and nominal wages in the United Kingdom. Phillips(1958) found out an inverse relationship between the two variables i.e. A reduction in unemployment is related to the higher inflation and vice versa.

However, an important critique on the conventional Phillips-curve model is that it fails to cover the problems whether to use a closed or open economy setups and whether to use a backward or forward looking frameworks to model inflation and these are still remain open questions for the policy makers (Herz and Roger, 2005). This shows that despite the interest in the use of Phillips curve is on the rise, the empirical studies have not solved these puzzles yet and an agreed upon Phillips curve has yet to be reached (Mankiw, 2001).

The objective of this study is to investigate the impact of the real exchange rate depreciation on the inflation in Pakistan. For this purpose a three versions Phillips curve approach based on the closed and open economy backward looking models of Ball (1997, 1998) have been adopted. The literature is lacking in this type of empirical analysis except the only notable work of Cooray (2008) who also used a simple closed and open economy frameworks to model inflation for Sri Lanka. In his closed economy model Cooray (2008) used money supply, real GNP and lag of inflation as explanatory variables. Whereas, in his open economy model he also included two additional variables i.e. nominal exchange rate and import price. His main conclusion was that the open economy model is the right framework to model inflation for the Sri Lankan economy as the supply side factors play a dominant role. However, unlike Cooray (2008) in this study a Phillips curve approach has been used for explaining the dynamics of inflation into closed and open economy setups for Pakistan. Another difference with Cooray (2008) is that instead of using the nominal exchange rate and import prices for the incorporation of the supply side effects in our model we include only real exchange rate in our model for capturing the import channels effects on inflation.

Another work in line with this study in the literature is of Dua and Gaur (2009) who applied both a backward and forward looking Phillips-curve models for determining inflation in eight Asian countries[4] by using quarterly data. They used an instrumental variable approach for estimating the inflation. They included both the domestic and foreign demand and supply side factors[5] in their model. They concluded that in developed countries demand side factors can be used more effectively for tackling inflation, whereas in developing countries both demand and supply side factors play its role. However, the study is also different from their work because it is undertaking just for a single developing country Pakistan by using annual data. This type of empirical analysis is important for Pakistan because so for a limited number of studies used a Phillips curve approach for modeling inflation (Hasan, 1990; Malik *et al.*, 2007; Satti *et al.*, 2007; Zaman *et al.*, 2011).

Hasan (1990), Malik *et al.*, (2007) and Zaman *et al.*, (2011) adopted the traditional Phillips-curve model for studying the relationship between the inflation and unemployment. On the other hand, Satti *et al.*, (2007) modeled inflation and output gap by using a hybrid forward looking Phillips curve approach. However, all the above works carried out so for Pakistan limited their works to a closed economy setups. This is quite interesting by looking to the increased application of different variants of Phillips curve for measuring inflation all over the world. Also the significance of the foreign factors like exchange rate in determination of inflation cannot be ignored for a dependent economy like Pakistan with exports and imports shares of 15222.9 and 32,059.4 million dollars during 2007-2008 (Economic Survey of Pakistan, 2008). All the above discussion shows that the existing Phillips curve based studies are not enough and there is a need to carry out a broader empirical work for modeling inflation in Pakistan.

This paper updates the previous Phillips curve contributions for measuring inflation in general and specifically for Pakistan in several aspects. First, the interaction between the real exchange rate and inflation for Pakistan has been examined in a Phillips curve modeling approach based on the standard backward looking models of Ball (1997, 1998). Second, a closed and open economy Phillips curve approaches has been carried out for the determination of inflation. Third, two the impact of the two regime shifts occurred during the study has also been examined in the determination of the inflation in Pakistan. Lastly, the sample data consist of annual data and covering a larger sample period i.e. 1973-2008. The main conclusion of the study is that real depreciations are inflationary in Pakistan. Moreover, the study also uncovered the positive relationship between the exchange rate systems switches and inflation of Pakistan.

[4] The eight Asian countries are Japan, Korea, Hong Kong, Singapore, Phillippines, Chaina Mainland, India and Thailand.

[5] The demand and supply side factors they used in their models are output gap, nominal exchange rate, imported inflation, index for food production, productivity growth, differential between wage inflation and global oil price shock.

The rest of the paper is structured as follows. In part-2, the theoretical model is laid out. Empirical results are presented in part-3. In part-4, the study is concluded.

2. Data and Sample Size of the Study

For the empirical investigation data has been collected from the international financial statistics, Pakistan economic survey various issues and fifty years statistics of the State Bank of Pakistan. The time period of the study is from 1973 to 2008. For the computation of both the domestic and foreign (Pakistan and USA) prices, consumer price indexes of the both countries are used. For transforming the nominal data into real form the consumer price index of 1976 is used as a base period. The definitions of the variables used in the study are as follow:

- $CPI = S_d\,(CPI)^d\,t + S_m\,(CPI)^m\,t$. Here, CPI^d stands for the index of the domestic goods prices and CPI^m is an index of imported goods prices. Whereas, $S_d = (1 - S_m)$ is the share of domestically produced goods in the CPI and S_m shows the imported goods share.
- Inflation : is defined as the average annual percentage change in consumer price index[6] i.e. $\pi_t = (CPI_t - CPI_{t-1}) / CPI_{t-1}) * 100$. It is used in nominal form. For computation, inflation is transformed into deviation form by taking the difference between actual inflation rate (π_t) and targeted inflation rate (π^*_t) i.e. $\pi^g_t = \pi_t - \pi^*_t$.
- Gross Domestic Product (GDP): The GDP is the current data at market prices. For computation, GDP is converted into real form and log of it has been taken. After that it is transformed into deviation form i.e. $y^g_t = 100^* (y_t - y^*_t)$ by taking the difference between the actual GDP (y_t) and potential GDP (y^*_t) and multiplied with a factor 100.
- Money Supply (M_2): Broad money supply is used to measure money supply. For computation nominal money supply is converted into log real form. After that the deviation between the actual (m_t) and targeted (m_t^*) money supply has been taken i.e. $m^g_t = m_t - m_t^*$ and multiplied with 100.
- Exchange Rate: Nominal exchange rate is transformed into growth form i.e. $e_t = (NER_t - NER_{t-1}) / NER_{t-1} * 100$. After that it is converted into real form after adjusting for inflation between the domestic and foreign countries i.e. $q_t = e_t + (\pi^{us} - \pi^{pk})$. Real exchange rate is also used in deviation form by taking the difference between the actual and targeted real exchange rates i.e. $q^g_t = q_t - q_t^*$. Whereas, NER stands for nominal exchange rate.

Hodrick Prescott(HP) filter method is used for obtaining the cyclical components of the data. Statistical package Eviews.6 is used for the computation of the results.

3. Model Specification

Whether real exchange rate plays any role in the determination of inflation in Pakistan? This question has been addressed in the framework of a Phillips curve approach. First, a closed economy Phillips-curve model has been constructed where only two domestic variables i.e. output gap and money supply gap are included in the model. After that the closed economy model has been extended to an open economy model by putting an additional variable real exchange rate into it. Finally, another model has been designed where two macroeconomic[7] structural (regime) shifts occurred during the study period have also been included in the model.

The closed economy model has been developed on the basis of the backward looking closed economy benchmark Phillips-curve model produced by Ball (1997). Ball (1997) developed a closed economy backward looking Phillips-curve model in which he used lagged output gap and lagged inflation as explanatory variables. For constructing the closed economy model, Ball(1997) closed economy baseline model is calibrated and extended in several aspects. The model is written as under:

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[6] For measuring inflation different price indices i.e. consumer price index (CPI), whole sale price index (WPI), sensitive price index (SPI) and Gross Domestic Product (GDP) deflator are published in Pakistan. However, in this study the main focus is on CPI for measuring the impact of inflation on households as it is closely represents the cost of living (Salam, *et al*, 2006).

[7] During 1973-2008, different structural shifts i.e. political, economic etc. occurred in Pakistan. However, as the main focus here is on the role of real exchange rate in the determination of inflation, hence only two structural(regime) shifts a movement from fixed to managed float and from managed float to floating exchange rate systems have been considered in this study.

$$\pi^{g}{}_{t} = \alpha_0 + \alpha_{y^g}(Y^{g}{}_{t}) + \sum_{t=1}^{i} \alpha_{m^g,i}\,(m^{g}{}_{t-i}) + \sum_{t=1}^{j} \alpha_{\pi^g,j}\,(\pi^{g}{}_{t-j}) + D_{Inf\,1} + D_{Inf\,2} + \varepsilon_{\pi^g}{}_{t} \quad (1)$$

Whereas, ($D_{Regm\,1} = 0,\ D_{Regm\,2} = 0\ and\ q^{g}{}_{t} = 0$) i = 1 to 2. j = 1 to 2

Equation (1) is the augmented closed economy Phillips-curve model used in this study. Unlike Ball (1997) the model is constructed so that here changes in inflation gap ($\pi^{g}{}_{t}$) are depends on output gap ($Y^{g}{}_{t-j}$), money supply[8] gap ($m^{g}{}_{t-i}$), lags of inflation ($\pi^{g}{}_{t-j}$), two dummy variables ($D_{Inf\,1}$ and $D_{Inf\,2}$) and a white noise shock ($\varepsilon_{\pi^g}{}_{t}$). Also output gap is included in the model only contemporaneously. However, the money supply gap is included in the model with time lags. Similarly, the two dummy variables $D_{Inf\,1}$ and $D_{Inf\,2}$ are included in the model for capturing the effects of the two higher inflation periods of 1974 and 1975 where Pakistan economy has seen two episodes of high inflation rates where annual changes in the consumer price index has exceeded 25 percent i.e. 26% and 30% respectively. The dummy variable $D_{Inf\,1}$ is included in the model so that it takes the value of 1 for the year 1974 and 0 otherwise. Similarly, $D_{Inf\,2}$ is included in the model so that it takes the value 1 for the period 1975 and 0 otherwise. The inclusion of dummy variables in the model for Pakistan is important for getting a well behaved model which satisfies the diagnostic tests, which are weak due to the small sample size. Whereas, the constraints $D_{Regm\,1} = 0,\ D_{Regm\,2} = 0$ and $q^{g}{}_{t} = 0$ show that the real exchange rate (q^{g}) and regime shifts are not considered in the model. The random term represents the impact of an unobserved shocks on the economy. Whereas, α_0 represents the intercept term in the model. The key feature of the model is that it shows that the monetary policy affects inflation through two channels i.e. via change in output gap and money supply gap.

After that to unveil the relationship between the real exchange and inflation an extended version of the open economy backward looking model proposed by Ball (1998) has been used. For developing the open economy model, Ball (1998) augmented his closed economy backward looking Phillips-curve model with the inclusion of an additional variable i.e. lagged real exchange rate. In Ball (1998) model real exchange rate has been included indirectly where an increase in it represents appreciation. Like equation (1), for constructing our open economy, Ball (1998) open economy Phillips-curve model is adjusted in the following manner.

$$\pi^{g}{}_{t} = \alpha_0 + \alpha_{y^g}(Y^{g}{}_{t}) + \sum_{t=1}^{i} \alpha_{m^g,i}\,(m^{g}{}_{t-l}) + \sum_{t=1}^{j} \alpha_{q^g,j}\,(q^{g}{}_{t-j}) + \alpha_{\pi^g}(\pi^{g}{}_{t-1}) + D_{Inf\,1} + D_{Inf\,2} + \varepsilon_{\pi^g}{}_{t} \quad (2)$$

Whereas, ($D_{Regm\,1} = 0$ and $D_{Regm\,2} = 0$) Whereas, i = 1 to 2 j =1 to 2

Equation (2) stands for the open economy Phillips-curve model used in this study. Here, the constraint ($q^{g}{}_{t} = 0$) is relaxed which shows that real exchange rate has been included in the model. Like Ball (1998) we include the lagged real exchange rate in the model with lags. However, it is included in the model so that an increase in it stands for depreciation/devaluation. Whereas, ($\pi^{g}{}_{t-1}$) shows the lagged affect of inflation.

Finally, as during the study period two regime shifts occurred, we also include two dummy variables i.e. D_{Regm1} and in the open economy model for examining its influence on Pakistan inflation. Whereas, the first regime shift occurred during 1982 when the State Bank of Pakistan (SBP) moved from a fixed to managed float exchange rate system. And, the second shift occurred during 2000, when a full float exchange rate system is adopted by the SBP. The model designed is as under:

[8] Money supply gap in addition with output gap has been included in the model because as a matter of fact Pakistan is an economy with complex macroeconomic and weak financial structures. Hence I controlled for the extra effects not captured by the standard Phillips curves. Also with the exclusion of money gap, the estimates in all the models turn out to be economically unpalatable.

$$\pi^{g}{}_{t} = \alpha_0 + \sum_{t=0}^{i} \alpha_{y^g,j}(Y^{g}{}_{t-i}) + \sum_{t=1}^{j} \alpha_{m^g,j}(m^{g}{}_{t-j}) + \sum_{t=1}^{k} \alpha_{q^g,k}(q^{g}{}_{t-k}) + \alpha_{\pi^g}(\pi^{g}{}_{t-1}) + D_{Inf\,1} + D_{Inf\,2} + \alpha_{Regm\,1}\left(D_{Regm\,1}\right) + \alpha_{Regm\,2}\left(D_{Regm\,2}\right) \quad 3$$

Whereas, $\begin{pmatrix} 1 \text{ for } D_{Regm\,1}, & 0 \text{ otherwise} \\ 0r & \\ 1 \text{ for } D_{Regm\,2}, & 0 \text{ otherwise} \end{pmatrix}$ i = 0 to 1 j = 1 to 2 k = 1 to 2

Equation (3) is an open economy Phillips-curve model with regime shifts. Both the dummy variables are included in the model so that D_{Regm1} takes the value of 1 for the full period of second regime (1982-1999) and 0 for the rest of the period. Similarly, D_{Regm2} takes the value of 1 for the full period of third regime (2000-2008) and 0 otherwise.

4. Why the Backward Looking Phillips-curve model

In recent years many researchers used a pure and hybrid[9] variants of the micro-founded expectations based New Keynesian Phillips Curve(NKPC) for modeling inflation (Clarida *et al.*,,1999; McCallum, 2001; Kozicki and Tinsley, 2001; Plessis and Burger, 2006, Kim and Kim, 2008). This strand of studies criticized backward looking Phillips-curve models on the ground of Lucas (1976) critique that as during a policy shifts the parameters of the backward looking models are unstable, hence the results obtained might be misleading and unreliable. However, Mankiw (2000), mentioned that although NKPC theoretically looks attractive fails when subject to empirical data because it does not take into account the lagged effect of inflation. Inflation is a persistent phenomenon and NKPC has trouble with generating this degree of inflation persistence (Fuhrer and Moore, 1995). Similarly, Engle, *et al.*, (1983), Fuhrer and Estrella (1999), Rudebusch (2005) provided evidences that a backward[10] looking model which explained inflation from macroeconomic perspective perform better and appear to be fairly stable than a forward looking model during a regime shift and Lucas(1976) critique is an empirically testable hypothesis. Their views are further supported by Jess *et al.*,, (2003) who mentioned that backward looking rules contribute to protect the economy from embarking on expectations driven fluctuations.

5. Inflation Situation in Pakistan

The inflation rates show that inflation accelerated considerably in Pakistan during the study period. It shows a sharp upward trend and increased from 9.68% in 1973 to 30% and 26% during 1974 and 1975 which was the biggest rise of inflation in the history of Pakistan. The two main reasons for that were the 1973 world oil price hike and nationalization policy of the economy during Zulfiqar Ali Bhutto government, the then Prime Minister of Pakistan (Jones and Khilji 1988)

After that it stood at 11.12% in 1982 and decreased to 5.61% with a decline of 49.55% in 1983. During 1991 it was peaking at 12.66% showed an increase of 109.60% in comparison to 6.04% inflation rate in 1990. The average inflation rate was 7.4% over the period 1982 to 1993. The low public expenditures and reversal of nationalization policy helped in lowering inflation rate. During 2003 it declined and touched its historical low level of 3.1% with a decline of 12.42% against 3.54% in 2002. Tight monetary and fiscal policies of State Bank of Pakistan and government helped in creating that low inflation environment in the country (Khan and Schimmelpfennig, 2006). However, during 2008, inflation again surged to 12% with an increase of 54.44% as compared to 7.7% of 2007. A rise in import prices were the main reason behind that sharp shoot up of inflation (Khan and Gill, 2010). In short during 1973-2008 the country experienced double digit inflation in 15 out of 36 years with a highest and lowest levels of 30% and 3.1% during 1974 and 2003 respectively. For detail see figure. 1 in appendix.

[9] A hybrid NKPC model contains both backward and forward looking components whereas, in a pure NKPC model there is no backward looking component.

[10] Instead of using a pure backward looking model like Ball (1997, 1998) in which he included only lags of all the variables an augmented backward looking Phillips curve model is used where in addition with lags some variables have also been included contemporaneously.

6. Empirical Strategy

The estimation section is divided so that first in table 6.1 results are computed for the closed economy Phillips-curve model. After that real exchange rate (q^g_t) has been included in the model and results are derived for the open economy Phillips-curve model which are given in table. 6.2. Finally, both the dummy variables ($D_{Regm\ 1}$ and $D_{Regm\ 2}$) represents the two regimes shift are also included in the model for examining its role in the determination of inflation. The results are given in table. 6.3.

Table. 6.1 : Estimation Results for the Closed Economy Phillips-curve model [OLS Estimation, 1973-2008]

Adjusted Sample: 1975-2008		
Parameters	Estimates	Standard Error
y^g_t	0.197717**	(0.077027)
m^g_{t-1}	0.295523***	(0.075827)
m^g_{t-2}	-0.226018**	(0.083264)
π^g_{t-1}	0.333084***	(0.101261)
π^g_{t-2}	-0.191623**	(0.085219)
$D_{Inf\,2}$	4.661781**	(1.509639)
R^2	0.55	
$AdjR^2$	0.45	
DW	1.62	

- The asterisks "*" , "**" , "***" stand for 90%, 95%, and 99% confidence level.
- The regressions results given in the table are the best obtained results on the basis of post diagnostic tests i.e. Q-statistic, LM test and CUSUM stability test.
- Newy-West HAC is applied for obtaining heteroskedsticity and autocorrelation consistent standard errors.
- Insignificant variables including the intercept are dropped from the model.

Table. 6.1 shows the estimation results computed for the closed economy Phillips-curve model. The results show that y^g_t turned out positively significant. This shows that an increase in y^g_t also increases $\pi^g{}_t$ in Pakistan through production cost channel etc. Another variable included in the model is m^g_t. Although m^g_t influence $\pi^g{}_t$ indirectly via y^g_t , however, it is included in the model separately for capturing its direct effects on $\pi^g{}_t$. It is found that m^g_t has a significant impact on inflation but with lags[11]. At first lag (m^g_{t-1}) it shows a positive relationship with $\pi^g{}_t$ and at second lag (m^g_{t-2}) it turned negative. However, its overall impact on $\pi^g{}_t$ is positive i.e. 0.295523 and -0.226018. The results show that an increase in m^g_t also rise $\pi^g{}_t$ via consumption channel and vice versa. This result is similar to Chen (2009) who for Chinese economy found that money supply affect inflation with a time lag. Similarly, $\pi^g{}_t$ is also influenced by its own lags i.e. π^g_{t-1} and $\pi^g_{t-2.}$ However, at π^g_{t-1} it show a positive relationship with π^g_t and at π^g_{t-2} it remained negative. However, its overall impact on π^g_t is positive. i.e. 0.333084 and - 0.191623. This past effect of inflation can be useful for setting monetary policy as mentioned by Rangasamy (2009). Furthermore, $D_{Inf\,2}$ is a dummy variable for the high inflation period, 1974. It also shows a positively significant relationship with $\pi^g{}_t$. However, the dummy variable for the first high inflation period i.e. $D_{Inf\,1}$ (1975) is dropped from the model after founding it insignificant. The value of the adjusted R^2 shows that 45% of the variation in π^g_t is explained by all the explanatory variables included in the model. However, the Durbin Watson (DW) statistic value is only 1.62 which shows that there might be some missing variables in the data. This result is also supported by the Q-statistic and CUSUM stability test i.e. CUSUM and CUSUM squares. However, the LM test shows that these results are reliable.

[11] The lag length for all the variables are although selected on the basis of Akaike Information Criterion, however the two spike dummy variables stand for the two high inflation periods also didn't allow to add more than two lags in all the models.

Table. 6.2:Estimation Results for the Open Economy Phillips-curve model [OLS Estimation, 1973-2008]

Adjusted Sample: 1975-2008		
Parameters	Estimates	Standard Error
y^g_t	0.207597**	(0.098265)
m^g_{t-1}	0.308495***	(0.094078)
m^g_{t-2}	-0.219889**	(0.112765)
q^g_{t-1}	0.098904	(0.092627)
q^g_{t-2}	0.145868*	(0.076404)
π^g_{t-1}	0.321538*	(0.186362)
D_{Inf2}	4.394152**	(1.767120)
R^2	0.67	
$AdjR^2$	0.53	
DW	1.76	

- The asterisks "*" , "**" , "***" stand for 90%, 95%, and 99% confidence level.
- The regressions results given in the table are the best obtained results on the basis of post diagnostic tests i.e. Q-statistic, LM test and CUSUM stability test.
- Newy-West HAC is applied for obtaining heteroskedsticity and autocorrelation consistent standard errors.
- Insignificant Variables including the intercept are dropped from the model.

The results given in table. 6.1 for the closed form specification of the Phillips-curve model show that there might be some missing variables in the model. Hence, for this purpose the closed economy model is transformed into an open economy model where an additional variable q^g_t is also included in the model. The purpose here is to find out that whether q^g_t play any role in the determination of $\pi^g{}_t$ or not. The results are given in table. 6.2. The results show that y^g_t is still positively significant and with the inclusion of the q^g_t in the model its influence on $\pi^g{}_t$ increased as compared to table. 3.1 i.e. 0.207597 > 0.197717. Similarly, m^g_t is also significant both at m^g_{t-1} and m^g_{t-2} and its overall impact on $\pi^g{}_t$ is positive. However, as compared to table. 3.1 its overall impact on $\pi^g{}_t$ increased i.e. 0.088606 > 0.069505. The real exchange rate (q^g_t) turned significant with the expected sign in the model but only at lag-2 i.e. q^g_{t-2}. However, q^g_{t-1} is also included in the model for avoiding the model misspecification problem. The results show that a rise of q^g_t also brings increase in $\pi^g{}_t$ via imports channel. The dummy variable (D_{Inf2}) for the second high inflation period i.e. 1974 is also still significant with the expected sign, however, like table. 3.1 D_{Inf1} is still insignficant. The value of the adjusted R^2 value shows that the model is improved with the inclusion of q^g_t in the model as compared to table.3.1 i.e. 0.53 > 0.45. Similarly, the DW statistic value is 1.76. The reliability of the results is confirmed by the post diagnostic tests i.e. Q-statistic, LM test and CUSUM stability tests which are given in Appendix.

Table. 6.3:Estimation Results for the Open Economy Backward Looking Phillips-curve model [with Regime Shifts [OLS Estimation, 1973-2008]

Adjusted Sample: 1975-2008		
Parameters	Estimates	Standard Error
y^g_t	0.337629**	(0.100329)
y^g_{t-1}	-0.326660**	(0.109354)
m^g_{t-1}	0.291045***	(0.066516)
m^g_{t-2}	-0.280448**	(0.105832)
q^g_{t-1}	0.146702**	(0.069324)
q^g_{t-2}	0.192017***	(0.057707)
π^g_{t-1}	0.330177**	(0.132275)
D_{Inf2}	6.385769***	(1.381957)
$D_{Regm\ 1}$	1.994410**	(0.615235)
R^2	0.73	
$AdjR^2$	0.63	
DW	1.84	

- The asterisks "*" , "**" , "***" stand for 90%, 95%, and 99% confidence level.
- The regressions results given in the table are the best obtained results on the basis of post diagnostic tests i.e. Q-statistic, LM test and CUSUM stability test.
- Newy-West HAC is applied for obtaining heteroskedsticity and autocorrelation consistent standard errors.
- Insignificant variables including the intercept are dropped from the model.

Similarly, for examining the impact of two regimes shifts on inflation two dummy variables i.e. $D_{Regm\ 1}$ and $D_{Regm\ 2}$ are also included in the open economy model. The results are shown by table. 6.3. The results show that y^g_t is significant not only contemporaneously but also at first lag i.e. y^g_{t-1}. However, its overall impact on π^g_t is still positive i.e. 0.291045 and -0.280448. This result is consistent with the Coe and McDermott (1996) who obtained the same results for Japan and Philippines. m^g_t also remained significant at both lags i.e. m^g_{t-1} and m^g_{t-2}. Also its overall impact on π^g_t is still positive i.e. 0.291045 and - 0.280448. However, with the inclusion of the dummy variable for the regime shifts q^g_t become significant both at q^g_{t-1} and q^g_{t-2} with the expected signs. π^g_t is also positively significant but only at first lag i.e. π^g_{t-1}. Similarly, $D_{Inf\,2}$ is still expectedly significant whereas $D_{Inf\,1}$ remained insignificant like table. 3.1 and 3.2. The dummy variables i.e. $D_{Regm\ 1}$ and $D_{Regm\ 2}$ are also included in the model. However, $D_{Regm\ 1}$ turned significant and $D_{Regm\ 2}$ remained insignificant and dropped from the model. The results show that a shift from fixed to managed float exchange rate system also influence inflation. The adjusted R^2 value is also comparatively greater i.e. 0.63 > 0.53 > 0.45 which showed that the results are improved. The DW statistic value is 1.84. The reliability of the results is confirmed by using the Q-statistic, LM statistic and CUSUM stability tests which are given in appendix.

Conclusion

High and persistent inflation remained one of the major characteristic of Pakistan economy. The economy has a very unique experience of high inflationary episodes during the study period. Previous studies constrained their focus to the conventional and micro founded modeling of inflation in Pakistan. This paper extended to model inflation in a calibrated open economy model derived from the Ball (1997, 1998) open economy Phillips curve models. The econometric estimations show that real exchange depreciations raised inflation in Pakistan. Moreover, it is found that domestic output and money supply gaps also showed positive relationship with the inflation. Furthermore, inflation is also found to be dependent on its past performance. Finally, the interaction between the exchange rate regime switches of the State Bank of Pakistan and inflation is also found to be positive.

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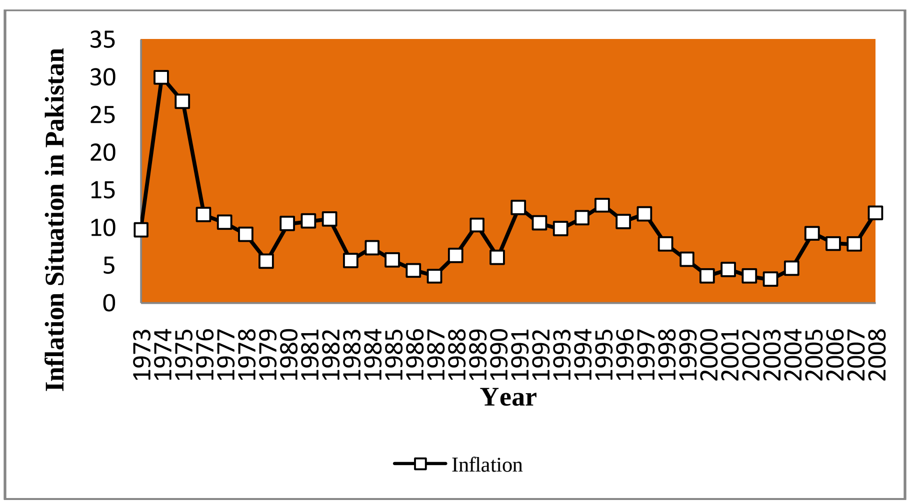
Appendix

Fig. 1: Inflation Situation in Pakistan during 1973-2008



- Source: Economic Survey of Pakistan various Issues

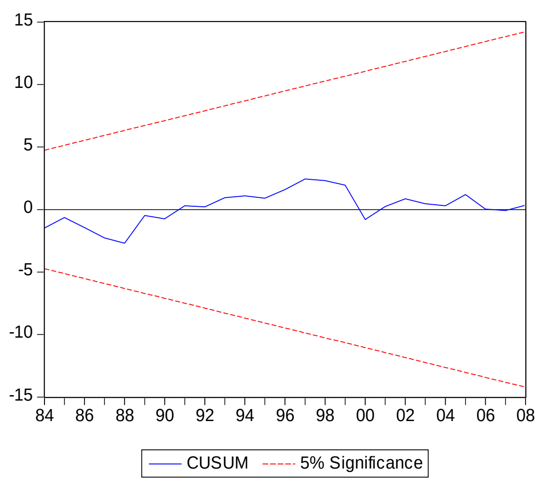
Q-Statistics Results for Table.6.2

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*. |	. |*. |	1	0.117	0.117	0.5093	0.475
. |*. |	. |*. |	2	0.088	0.075	0.8067	0.668
.*| . |	.*| . |	3	-0.099	-0.120	1.1958	0.754
**| . |	**| . |	4	-0.311	-0.303	5.1423	0.273
. | . |	. |*. |	5	-0.001	0.089	5.1424	0.399
. |*. |	. |** |	6	0.140	0.214	6.0033	0.423
. |*. |	. |*. |	7	0.209	0.132	7.9921	0.333
. |*. |	. | . |	8	0.151	-0.022	9.0667	0.337
. | . |	.*| . |	9	-0.045	-0.080	9.1639	0.422
**| . |	**| . |	10	-0.313	-0.249	14.155	0.166
.*| . |	. |*. |	11	-0.101	0.075	14.693	0.197
.*| . |	. | . |	12	-0.111	-0.003	15.384	0.221
. | . |	.*| . |	13	-0.004	-0.117	15.385	0.284
. |*. |	. | . |	14	0.191	0.004	17.627	0.224
.*| . |	**| . |	15	-0.157	-0.222	19.211	0.204
.*| . |	. | . |	16	-0.069	-0.036	19.532	0.242

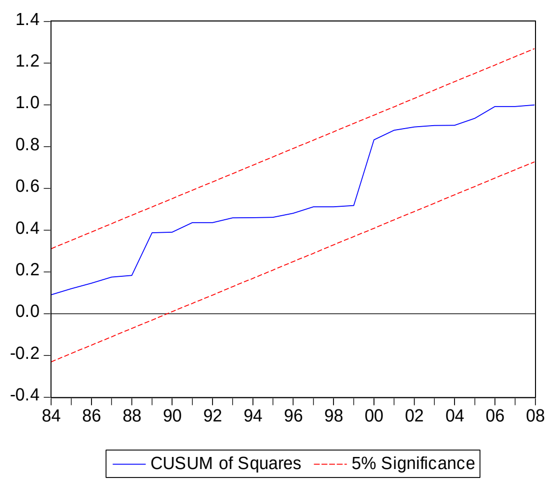
Breusch-Godfrey Serial Correlation LM Test Results for Table.6.2

LM Test	Estimated Values	P-Values
F-statistic	0.447720	0.6450
Obs*R-squared	1.390471	0.4990

CUSUM Stability Test for Table.6.2



CUSUM Squares Stability Test for Table.6.2



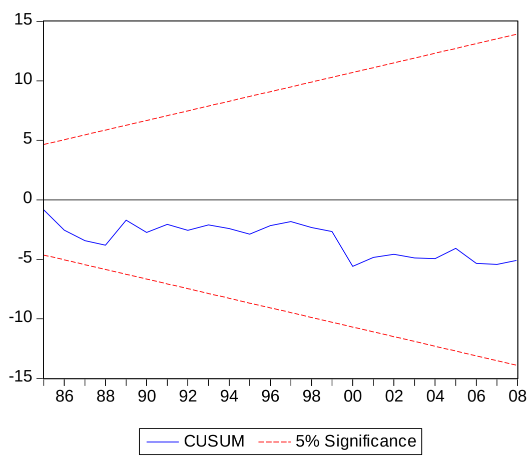
Q-Statistics Results for Table.6.3

<table>
<tr><th>Autocorrelation</th><th>Partial Correlation</th><th></th><th>AC</th><th>PAC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>. | . |</td><td>. | . |</td><td>1</td><td>0.073</td><td>0.073</td><td>0.1999</td><td>0.655</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>2</td><td>-0.012</td><td>-0.017</td><td>0.2054</td><td>0.902</td></tr>
<tr><td>**| . |</td><td>**| . |</td><td>3</td><td>-0.261</td><td>-0.261</td><td>2.8998</td><td>0.407</td></tr>
<tr><td>**| . |</td><td>**| . |</td><td>4</td><td>-0.348</td><td>-0.335</td><td>7.8450</td><td>0.097</td></tr>
<tr><td>.*| . |</td><td>.*| . |</td><td>5</td><td>-0.105</td><td>-0.107</td><td>8.3059</td><td>0.140</td></tr>
<tr><td>. |*. |</td><td>. |*. |</td><td>6</td><td>0.140</td><td>0.084</td><td>9.1570</td><td>0.165</td></tr>
<tr><td>.|**. |</td><td>. |*. |</td><td>7</td><td>0.227</td><td>0.079</td><td>11.497</td><td>0.118</td></tr>
<tr><td>.|** |</td><td>. |*. |</td><td>8</td><td>0.232</td><td>0.098</td><td>14.024</td><td>0.081</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>9</td><td>0.002</td><td>-0.005</td><td>14.024</td><td>0.121</td></tr>
<tr><td>**| . |</td><td>.*| . |</td><td>10</td><td>-0.207</td><td>-0.105</td><td>16.218</td><td>0.094</td></tr>
<tr><td>.*| . |</td><td>. | . |</td><td>11</td><td>-0.201</td><td>-0.045</td><td>18.364</td><td>0.074</td></tr>
<tr><td>. | . |</td><td>. |*. |</td><td>12</td><td>-0.025</td><td>0.101</td><td>18.400</td><td>0.104</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>13</td><td>0.084</td><td>0.046</td><td>18.809</td><td>0.129</td></tr>
<tr><td>.|** |</td><td>. |*. |</td><td>14</td><td>0.257</td><td>0.111</td><td>22.865</td><td>0.062</td></tr>
<tr><td>. | . |</td><td>.*| . |</td><td>15</td><td>0.022</td><td>-0.107</td><td>22.897</td><td>0.086</td></tr>
<tr><td>. |*. |</td><td>. |*. |</td><td>16</td><td>0.144</td><td>0.200</td><td>24.310</td><td>0.083</td></tr>
</table>

Breusch-Godfrey Serial Correlation LM Test Results for Table.6.3

LM Test	Estimated Values	P-Values
F-statistic	0.095252	0.9095
Obs*R-squared	0.291889	0.8642

CUSUM Stability Test for Table.6.3



CUSUM Squares Stability Test for Table.6.3