The Pakistan Development Review
49 : 1 (Spring 2010) pp. 19–35

Exchange Rate Pass-through to Consumer Prices in Pakistan: Does Misalignment Matter?

ATIF ALI JAFFRI

This study investigates the impact of exchange rate changes on consumer prices (commonly known as exchange rate pass-through (ERPT)) in Pakistan for the period 1995M1 to 2009M3. The study estimates short-run and long-run ERPT in Pakistan while taking into account the existing real exchange rate misalignment (RERM). The results suggest that the ERPT to consumer price inflation in Pakistan is very low (close to zero). The impact of the previous periods' misalignment on inflation is found significant in managed exchange rate regime. However, the overall sample misalignment does not affect inflation. The impact of foreign inflation on domestic inflation is positive and statistically significant.

JEL classification: F31, F41, E31
Keywords: Pass-through, Misalignment, Inflation

1. INTRODUCTION

The hypothesis "exchange rate changes affect consumer prices" is important for both policy-makers and academia due to its relevance to effectiveness of monetary and exchange rate policies and adoption of a more flexible exchange rate regime. In the traditional literature, Exchange Rate Pass-through (ERPT) is defined in terms of import prices in local currency. According to Goldberg and Knetter (1997), "exchange rate pass-through is the percentage change in import prices in local currency resulting from a one percent change in the exchange rate between the exporting and importing countries". The increase in import prices, however, also translates into increase in the producer and consumer prices in an economy if producers raise their prices in the wake of increase in import prices. Therefore, ERPT is broadly defined as the percentage change in domestic prices resulting from one percent change in exchange rate.

Specifically, changes in exchange rate can affect domestic prices through direct and indirect channels. Under the direct channel, a fall in exchange rate may trigger increase in the prices of imported finished goods and imported inputs in local currency. However, pass-through into local currency import prices is only complete if (a) mark-up of prices over costs is constant and (b) marginal cost of foreign exporter is constant [see Goldberg and Knetter (1997)].

Under the indirect channel, depreciation of the exchange rate makes domestic products relatively cheaper for foreign buyers, and as a consequence exports and

Atif Ali Jaffri <atif_jaffri@yahoo.com> is Head of Economics Department at the University of Gujrat, Hafiz Hayat Campus, Gujrat.

Author's Note: This paper is based on author's PhD thesis submitted at PIDE, Islamabad. The author is thankful to his supervisor, Dr Rehana Siddiqui for her guidance in writing this paper.

aggregate demand rise and induce an increase in the domestic price level. Since nominal wage contracts are fixed in the short run, real wages decline. However, when real wages approach to their original level over time, the production cost increases and the overall price level moves up.

Recent literature tends to emphasise the importance of ERPT in conducting effective monetary and exchange rate policies. According to Choudhri and Khan (2002), "if the devaluation-inflation link exists, then devaluation comes with an important cost that necessarily must be factored into the exchange rate policy. Furthermore, it implies that the authorities can only affect the real exchange rate temporarily, because as domestic prices rise, the initial effects of a nominal depreciation on the real exchange rate would be reversed." According to Choudhri and Hakura (2001), "a low exchange rate pass-through is thought to provide greater freedom for pursuing an independent monetary policy and to make it easier to implement inflation targeting". Edwards (2006) argues that, "if the inflationary effects of exchange rate changes are large, the authorities will have to implement monetary and fiscal policies that offset the inflationary consequences of exchange rate changes."

There are very few studies on ERPT for Pakistan (see Appendix Table 1). The existing studies provide mixed results regarding the relation between exchange rate and prices; however, the dominant view is that there is no evidence of any significant effect of devaluation on domestic price inflation [e.g., Siddiqui and Akhtar (1999) and Choudhri and Khan (2002)]. Recent literature on ERPT provides several explanations of low or decline in pass-through. By using a recursive VAR model, McCarthy (1999) examines the impact of exchange rates and import prices on domestic Producer Price Index (PPI) and Consumer Price Index (CPI) in nine selected industrialised economies for the period from 1976:1 to 1998:4.[1] The study concludes that pass-through is somewhat stronger in countries with a larger import share. Choudhri and Hakura (2001) test Taylor's hypothesis that a low inflationary environment leads to low ERPT. They find strong evidence that the relation between pass-through and average inflation rate is positive and significant across regimes. Goldfajn and Werlang (2000) show that real exchange rate misalignment (RERM) is the most robust determinant of exchange rate pass-through for emerging markets.[2] They find that initial RER overvaluation negatively affects inflation and the ERPT coefficient. Goldfajn and Valdes (1999) illustrate that, "depreciations that are not based on required adjustments in relative prices would either induce inflation or reverse itself through a future nominal appreciation."

The purpose of this study is to investigate whether misalignment is a significant determinant in pass-through relationship for Pakistan. The study contributes to the existing literature for Pakistan by, (a) developing a model to estimate ERPT while taking

[1]Recently a number of studies used the McCarthy (1999) methodology for analysing ERPT in various countries. Among these are Bhundia (2002) for South Africa; Leigh and Rossi (2002) for Turkey; Rowland (2003) for Colombia; Gueorguiev (2003) for Romania; Belaisch (2003) for Brazil, and Hyder and Shah (2003) for Pakistan.

[2]RERM refers to a sustained departure of the real exchange rate (RER) from its long-run equilibrium real exchange rate (ERER). Empirically, an exchange rate is labeled overvalued (undervalued) when it is more appreciated (depreciated) than the equilibrium real exchange rate. ERER is defined as a rate consistent with macroeconomic fundamentals.

into account the existing level of RERM; (b) estimating the short-run and long-run ERPT for Pakistan; (c) providing implications for appropriate monetary and exchange rate policies. In the remaining part of this paper, Section 2 discusses the theoretical framework and the model estimated in this study, Section 3 elucidates empirical results; finally, conclusion and policy implications are discussed in Section 4.

2. THEORETICAL MODEL

In this study, the typical ERPT model specification approach is employed as a starting point. It is then extended to make it suitable to estimate ERPT at the aggregate level for CPI index and to incorporate the impact of RERM on inflation. The typical modeling approach in the pass-through literature is based on the pricing behaviour of a foreign exporting firm that exports its products to the domestic country [see, e.g., Dornbusch (1987); Knetter (1989); Marston(1990); Menon (1995); Goldberg and Knetter (1997) and Bailliu and Fujii (2004)]. The foreign firm solves the following profit-maximisation problem:

$$\underset{p}{Max}\ \pi = ER^{-1}pq - C(q) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

In Equation (1), π is profit in foreign currency, ER is the exchange rate defined in terms of the domestic currency per unit of the foreign currency, p is the price of the good in home currency, $C(.)$ is the cost function in foreign currency, and q is the quantity demand of good. Following Bailliu and Fujii (2004), Equation (2) represents the first-order condition (added by mark-up of price over marginal cost)[3] drawn from Equation (1):

$$P = ER\ C_q\ \mu \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Here, C_q is the marginal cost of the foreign firm, and μ is the mark-up. Equation (2) shows that it is essential to take into account variations in these control variables to properly isolate the effects of exchange rate changes on import prices. Previous studies on ERPT into import prices have employed import price equations derived within the mark-up framework [see, Menon (1995) and Goldberg and Knetter (1997)]. This framework allows for interaction between domestic and foreign firms by restricting the effect of changes in exchange rate on competitiveness by changing the mark-up. Menon (1996) has hypothesised mark-up to depend on competitive pressure in the domestic market and the exchange rate:

$$\mu = [P_D / (C_q\ ER)]^{\alpha} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

Where, mark-up depends on exchange rate and the gap between the price of goods produced in importing country (P_D) and the exporter's production cost.

Substituting (3) into (2) and using lower-case letters to denote logarithms, a simple log-linear reduced-form equation is obtained as follows:[4]

[3]Mark-up may also be defined as $\mu = \lambda/1-\lambda$, where λ is price elasticity of demand for the good. In a perfectly competitive industry, λ is infinite so μ is always 1. However, in monopolistically competitive environment, the exporting firm may have some leverage to raise the price above marginal cost.

[4]In the empirical estimation, we do not impose the cross-coefficient restrictions implied by our theoretical model.

$$p_m = \alpha\, p_d + (1-\alpha)\, c_q + (1-\alpha)\, er$$
$$p_m = \alpha\, p_d + \beta\ c_q + \gamma\, er \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

The coefficient γ measures ERPT into import prices, and, α and β are measures of the importing country's demand conditions and exporter's marginal cost, respectively. Variants of Equation (4) are widely used in the literature of ERPT into import prices [see, Goldberg and Knetter (1997)].

A few changes are made in this specification for estimating ERPT to consumer prices.

First, let us define consumer prices in log form as

$$p = \theta p_m + (1\text{-}\theta) p_d \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

where θ represents weight of imported goods.

Second, substituting for p_m from (4) in (5), we get (6)

$$p = \theta(\alpha\, p_d + \beta\, c_q + \gamma\, er\ ) + (1\text{-}\theta) p_d$$
$$p = \theta\alpha\, p_d + \theta\, \beta\, c_q + \theta\, \gamma\, er + (1\text{-}\theta) p_d$$
$$p = (\theta\alpha\ + (1\text{-}\theta)) p_d + \theta\, \beta\, c_q + \theta\, \gamma\, er \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

Third, the Equation (6) is transferred into difference form as CPI and exchange rate are generally observed to follow non-stationary paths.[5]

$$\Delta p_t = (\theta\alpha\ + (1\text{-}\theta))\Delta\, p_{dt} + \theta\, \beta\, \Delta\, c_{qt} + \theta\, \gamma\, \Delta er_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

Fourth, since ERPT model is estimated at high frequency data, and, for p_{dt} no appropriate price index (e.g., GDP deflator) at high frequency is available for Pakistan. Therefore, following Montiel (2002), and Kamin (1997), Δp_{dt} is related with real exchange rate misalignment.[6,7]

$$\Delta\, p_{dt} = \lambda\, (rer - rer^*)_{t-1} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (8)$$

Where *rer* is log of real exchange rate and *rer** is the log of equilibrium real exchange rate. Substituting (8) into (7) we obtain Equation (9):

$$\Delta p_t = (\theta\alpha\ + (1\text{-}\theta))\lambda\, (rer - rer^*)_{t-1} + \theta\, \beta\, \Delta\, c_{qt} + \theta\, \gamma\, \Delta er_t$$
$$\Delta p_t = \theta_0\, (rer - rer^*)_{t-1} + \theta_1\, \Delta\, c_{qt} + \theta_2\, \Delta er_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (9)$$

Fifth, the literature on inflation dynamics has emphasised the need to account for the observed inertial behaviour of inflation. This is accomplished by including lags of inflation as explanatory variables in Equation (9).

$$\Delta p_t = \theta_0\, RERM_{t-1} + \theta_1\, \Delta\, c_{qt} + \theta_2\, \Delta er_t + \theta_3\, \Delta p_{t-i} + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad (10)$$

In this equation, θ_2 measures the impact of exchange rate change on inflation. The magnitudes of the coefficient of the overvaluation are relevant. The exchange rate

[5]In case of Pakistan, monthly CPI index and exchange rate are nonstationary of order I(1) .

[6]This kind of relation has been used in the literature in many studies, e.g., Adams and Gross (1986), Kamin (2001), and Klau (1998).

[7]The reason for substituting $\Delta\, p_{dt}$ with misalignment (only) is to take into account domestic demand conditions. Pass-through models include the cost of foreign exporting firms and domestic demand conditions as control variables.

devaluation that does not overshoot its required adjustment would not have severe consequences in terms of inflation.

To estimate Equation (10), Foreign Consumer Price Index (FCPI) is used as a proxy for foreign exporter's cost and Nominal Effective Exchange Rate (NEER) as a proxy for exchange rate.[8] The variable RERM is taken from Jaffri (2009). Jaffri (2009), estimates equilibrium real exchange rate through Behavioural Equilibrium Exchange Rate (BEER) approach. The BEER approach uses cointegration technique to establish a long run relationship between REER and its fundamental determinants.[9]
Rewriting Equation (10), by including lags of explanatory variables except RERM:

$$\Delta p_t = \theta_0 \, RERM_{t-1} + \theta_{1i} \, \Delta \, fcpi_{t-i} + \theta_2 i \, \Delta neer_{t-i} + \theta_{3i} \, \Delta p_{t-1-i} + \varepsilon_t \quad \ldots \quad \ldots \quad (11)$$

Following Edwards (2006), Otani, *et al.* (2003), and Campa and Goldberg (2002) the short-run exchange rate pass-through (SRERPT) and long-run exchange rate pass-through (LRERPT) are calculated from the above mentioned model as follows:

$$\text{SRERPT} = \theta_0$$
$$\text{LRERPT} = \sum \theta_2 i \, / \, (1 - \sum \theta_{3i})$$

The SRERPT is a measure of contemporaneous impact of increase in NEER appreciation on consumer price inflation. The expected sign of this coefficient is negative. On the other hand, LRERPT takes into account the previous periods' exchange rate changes and inflation, thus, estimating aggregated pass-through. Let us suppose SRERPT= –0.05 and LRERPT = –0.40, then it means that 1 percent increase in the rate of appreciation of the trade weighted nominal exchange rate leads to 0.05 percent decline in CPI inflation in the same period, and 0.40 percent in the long-run.

The ERPT model (Equation 11) is estimated by Ordinary Least Square (OLS) method, as it provides an unbiased estimate of parameters in the presence of stationary variables in the model [see, Enders (2004)]. The OLS methodology could be inappropriate if causality runs both ways; however, using alternative methodologies, such as two- stage least squares, could also have problems like unavailability of sufficient data and proper instrument for ΔNEER. In recent literature, Edwards (2006), Campa and Goldberg (2002), and Gagnon and Ihring (2004) have used the OLS method to estimate models similar to this study. Edwards (2006) has discussed this issue in detail.

Data Description

The purpose of estimating model for two sub-samples was to check whether pass-through has declined after shifting toward a flexible exchange rate regime. For nearly thirty-five years, Pakistan maintained a fixed peg exchange rate regime. On January 8, 1982, the SBP adopted managed floating exchange rate regime, which continued until July 20, 1998 when the SBP decided to start the transition from managed floating to a free

[8]This study follows Choudhri and Hakura (2001) in extracting FCPI from REER and using NEER as proxy for exchange rate. Choudhri and Khan (2002) have also applied same definition of foreign prices and exchange rate.

[9]The variables used as proxies of fundamentals include: log of industrial production index (LPROD) as a proxy for productivity in tradable; log of exports (LOPEN) as a proxy of trade openness; log of foreign direct investment inflow (LFDI) as a proxy of capital inflows, and log of workers' remittances (LREMIT).

floating exchange rate regime. Pakistan experienced a dual exchange rate system between July 22, 1998 and May 18, 1999. From July 22, 1998 to July 20, 2000 the exchange rate regime was completely transformed from managed floating to free floating.

In this study, the model is estimated for three specifications: (a) Regression 1: (for the overall sample period from 1995M1 to 2009M3); (b) Regression 2: (for the sub-sample from 1995M8-2000M7); and (c) Regression 3: (for the sub-sample 2000M8-2009-M3). The data sources are IFS CD-ROM and State Bank of Pakistan. [10] All indices are adjusted for 2000 base year. The variables used in the model are described as follows:

Consumer Price Inflation (INF)

This study uses natural log differentials of overall CPI proxy for inflation. To examine the trends of CPI prices and inflation, the price index and its log differential are subsequently plotted in Figures 1a, 1b. From the figure 1a it is observed that LCPI is of increasing trend, which implies non-stationarity of CPI. However, the Figure 1b shows that the inflation series is converging on its mean, implying stationarity of the series.[11]

Exchange Rate Appreciation (GNEER)

The proxy for nominal exchange rate used in this study is Nominal Effective Exchange Rate (NEER) index.[12] The NEER index represents the ratio (expressed on the base 2000=100) of an index of Rupee's period average exchange rate to US Dollar and a weighted geometric average of exchange rates for the currencies of selected countries.

The index is based on a methodology that takes account of each country's trade in both manufactured goods and primary products with its partner, or competitor, countries.[13] An increase in NEER represents appreciation of Rupee against currencies of trading partners and vice versa.

The plots of log of NEER (LNEER) and its change (GNEER) are shown in Figures 1c and 1d. Figure 1c shows that NEER has a decreasing trend which means that NEER is depreciating throughout the sample period. Further, it reflects that the series is non-stationary. However, the difference of the series converges towards its mean implying stationarity of the series.

Foreign Inflation (FINF)

In this study, foreign weighted consumer price index (FCPI) is used as a proxy for foreign exporter's cost. Foreign inflation (FINF) is defined as difference of natural log of FCPI.[14] The plots of natural log of FCPI (LFCPI) and foreign inflation (FINF) are shown in Figures 1e and 1f. The Figure 1e represents an increasing trend in foreign prices and

[10]Author has benefitted from E.Views programme for econometric estimation.

[11]Formal tests of stationarity are presented in Table 1.

[12]This study uses IFS data on REER and NEER, however, SBP also publishes these indices based on 22 trading partner countries and 16 currencies but the data is available only for the period from January, 2001.

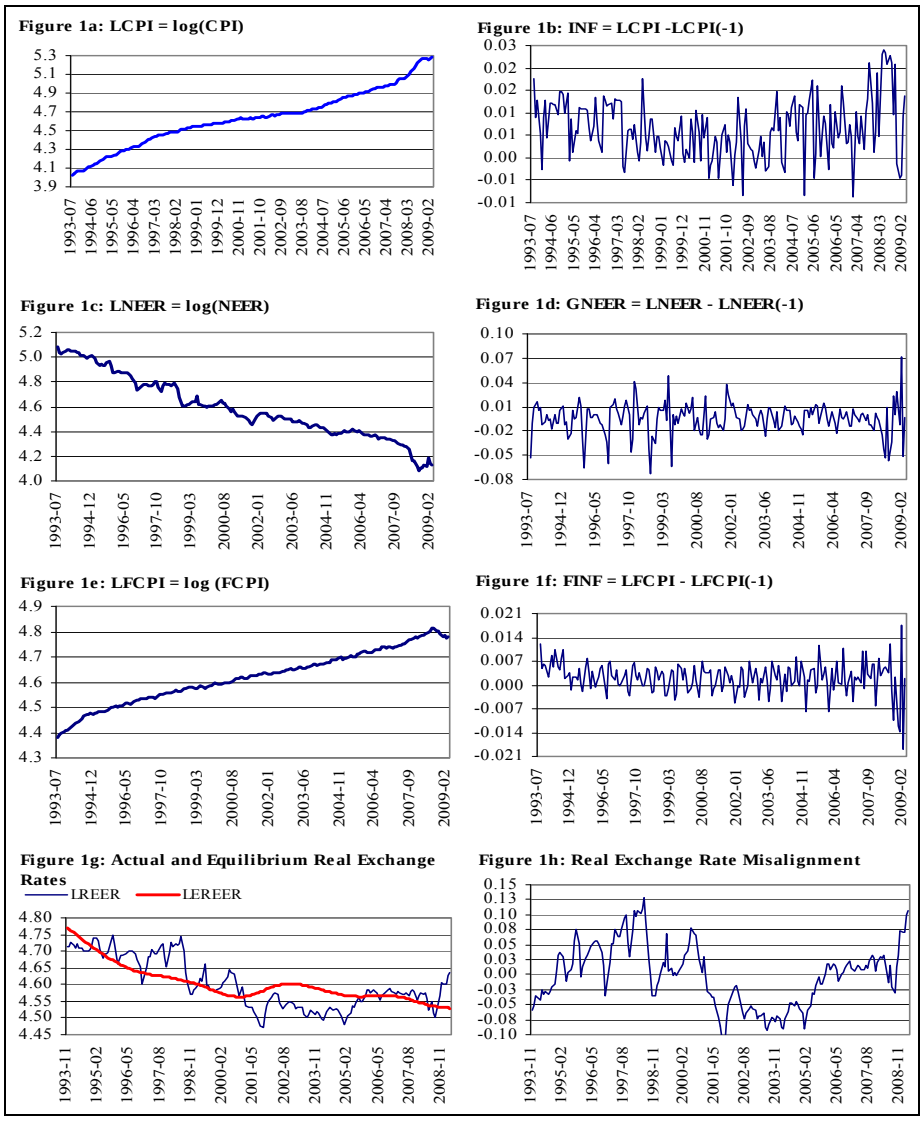
[13]An IMF's working paper entitled "A Primer on the IMF's Information Notice System" (WP/97/71), provides background on the concept and methodology underlying the effective exchange rates.

[14]Following Choudhri and Hakura (2001), FCPI is extracted from Real Effective Exchange Rate (REER). Choudhri and Khan (2002) have also followed this method of extracting FCPI from REER provided by INS.

shows the series is non-stationary. However, the difference of the series shows convergence toward means i.e., stationarity of the series.

Misalignment (MIS)

Misalignment (MIS) is the difference between the log of the actual and equilibrium real effective exchange rates. REER index represents a nominal effective exchange rate index adjusted for relative movements in home CPI index and of selected countries. An increase in REER represents appreciation of home currency and vice versa. In the Figure 1g, actual and equilibrium exchange rate (derived from BEER approach) in log form are shown. The RERM, which is the difference between actual and equilibrium REER is shown in Figure 1h.



3. ESTIMATION RESULTS

Before estimating the ERPT model (Equation 11), the stationarity property of variables has been checked by applying unit root test. Table 1 shows that all variables in ERPT model (ΔLCPI, Δ LNEER, Δ LFCPI, RERM) are stationary at level.

Table 1

Unit Root Test

Series in ERPT Model	With Intercept	With Intercept and Trend
Δ LCPI	–4.86(2)***	–4.89(2)***
Δ LNEER	–2.12(0)***	–12.08(0)***
Δ LFCPI	–.41(14)***	–.33(14)**
RERM	–.97(1)**	–.99(1)*

* ; ** and *** denote significance of test statistic at 10 percent, 5 percent and 1 percent level of significance against the null hypothesis of unit root. The critical values are taken from MacKinnon (1996). Figures in the parenthesis represent lags selected on the basis of Akaike Information Criterion (AIC). White noise of residuals in ADF tests have been checked.

The model has been estimated for two sub-samples along with the overall sample. Initially, the maximum number of lags permitted by data were considered for estimation of Regression 1. However, following the General to Specific method, most of the insignificant lags were dropped [for General to Specific Methodology, see, Hendry (2003); Nell (2003) and Pentecost and Moore (2006)].

The estimated model passes all the diagnostic tests such as normality, auto-correlation, hetroskedasticity, and RESET test for specification error. The adjusted R^2 of all regressions shows that they are reasonably good fits. All three specifications are stable as indicated by CUSUM and CUSUM Q stability tests (see Figure 2). The results of the estimation of ERPT model are reported in Tables 2 and 3. In the following, important outcomes of the estimation of these regressions are discussed.

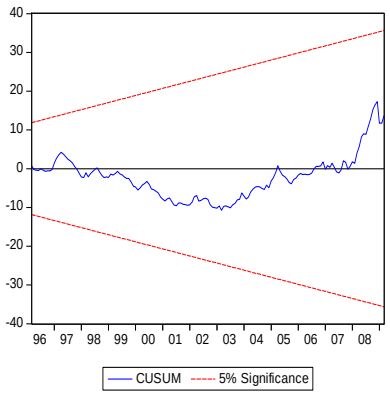
In the first regression, RERM (–1) variable is insignificant and has a weak magnitude. The SERPT is –0.05 percent whereas long-run ERPT is equal to –0.15. It shows that 1 percent increase in the rate of appreciation of the trade weighted nominal exchange rate leads to 0.05 percent decline in CPI inflation in the same period, and 0.15 percent in the long-run. The effect of foreign inflation on inflation with a positive sign is significant. The lagged domestic inflation exerted 0.20 percent increase in domestic inflation after 3 months.

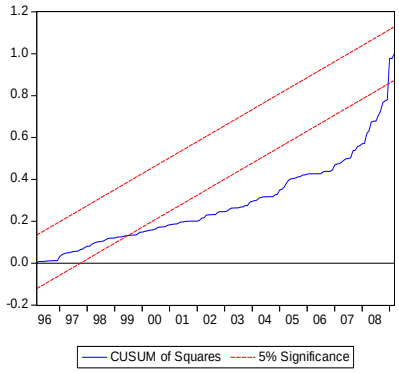
In the second regression, the coefficient of RERM (–1) is negative and significant indicating that 1 percent overvaluation in the previous period exerted almost 0.03 percent reduction in domestic inflation. Moreover, the impact of foreign inflation is positive and significant.

In the third regression, the pass-through coefficients are close to zero. Most of the coefficients of lagged foreign inflation affect inflation positively and significantly. The sign of the coefficient of lagged inflation is positive and maximum effect (0.17 percent) is realised after 3 months.

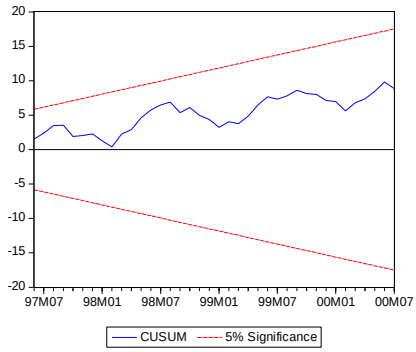
Fig. 2. Test for Stability of Parameters

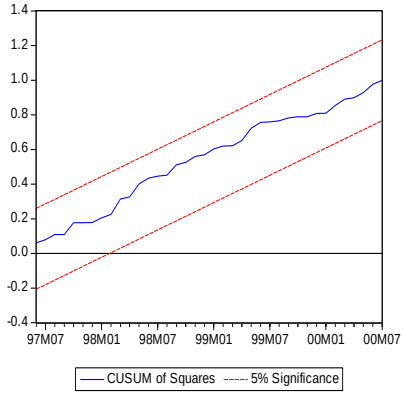
Regression 1



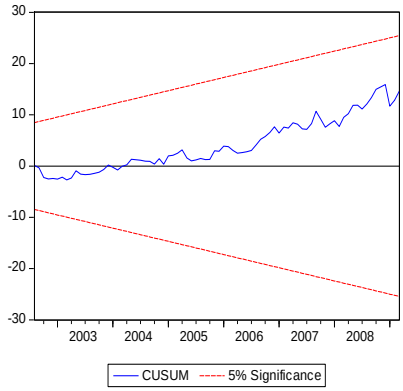


Regression 2





Regression 3



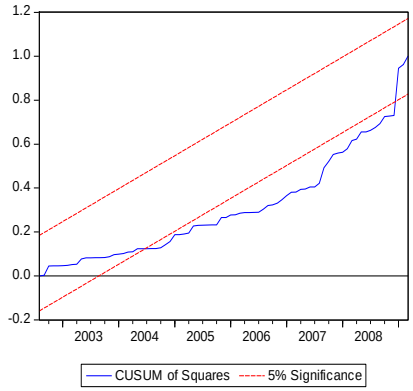
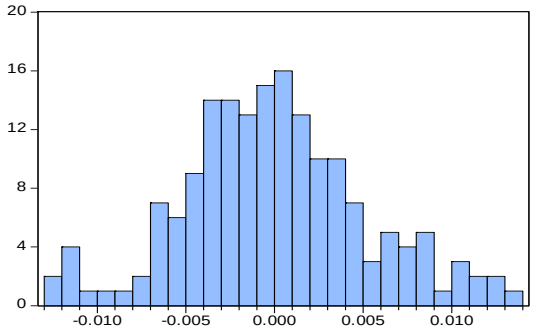


Fig. 3. Histogram-Normality Test

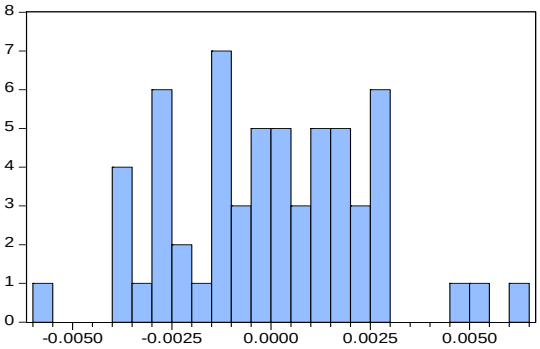
Regression 1



Series: Residuals
Sample 1995M01 2009M03
Observations 171

Mean	1.06e-18
Median	-0.000180
Maximum	0.013846
Minimum	-0.012698
Std. Dev.	0.005220
Skewness	0.170541
Kurtosis	3.218664
Jarque-Bera	1.169580
Probability	0.557223

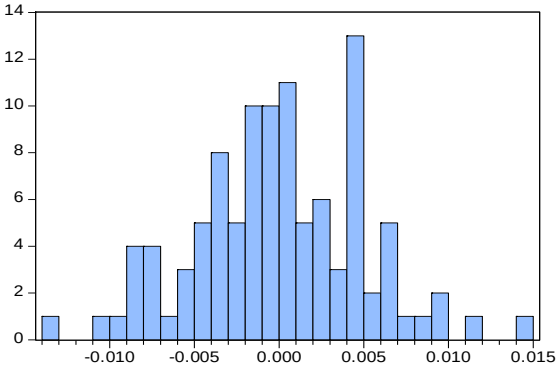
Regression 2



Series: Residuals
Sample 1995M08 2000M07
Observations 60

Mean	-1.49e-18
Median	-6.01e-05
Maximum	0.006168
Minimum	-0.005645
Std. Dev.	0.002407
Skewness	0.180396
Kurtosis	2.814195
Jarque-Bera	0.411735
Probability	0.813941

Regression 3



Series: Residuals
Sample 2000M08 2009M03
Observations 104

Mean	-9.09e-19
Median	-5.13e-05
Maximum	0.014985
Minimum	-0.013222
Std. Dev.	0.004938
Skewness	0.084850
Kurtosis	3.205057
Jarque-Bera	0.307003
Probability	0.857699

Table 2

Estimates of Pass-through Relation
Sample (Adjusted): 1995M01 2009M03

Variables	Coefficients	t-values
C	–0.000560	–0.60
MIS(–1)	–0.002634	–0.31
GNEER	–0.048745	–2.07**
GNEER(–7)	–0.021658	–0.85
GNEER(–10)	–0.027181	–1.07
GNEER(–17)	–0.067570	–2.78***
FINF	0.210417	2.79***
FINF(–1)	0.295562	3.53***
FINF(–2)	0.431233	4.24***
FINF(–3)	0.119985	0.87
FINF(–4)	0.326070	2.66***
FINF(–11)	0.322694	2.67***
FINF(–12)	0.572744	4.41***
INF(–3)	0.197551	2.44***
Adj. R^2 0.32		
SE of Regression 0.0054		

Diagnostic Tests

Jarque-Bera Normality Test	$Chi^2(2) = 1.17$ (0.56)
Breusch-Godfrey LM Test	$Chi^2(1) = 4.20$ (0.12)
Engle's ARCH LM Test	$Chi^2(1) = 2.95$ (0.11)
Ramsey's RESET Test	$= Chi^2(1) = 1.67$ (0.20)

Source: Estimation of this study.

***, **, * Reflect significance at 1 percent, 5 percent and 10 percent respectively. Figures in brackets are probabilities.

Table 3

Estimates of Pass-through Relation

Regression 2: (Adjusted Sample 1995M08 2000M07)			Regression: 3(Adjusted Sample: 2000M08 2009M03)		
Variables	Coefficients	t-values	Variables	Coefficients	t-values
C	–0.0018	–1.31	C	–0.007183	–2.97***
MIS(–1)	–0.025	–1.71*	MIS(–1)	–0.021878	–1.43
GNEER	0.0120	0.56	GNEER	–0.091164	–2.06**
GNEER(–2)	0.0681	2.89***	GNEER(–1)	0.097738	2.02**
GNEER(–3)	–0.0476	–2.02**	GNEER(–2)	–0.006367	–0.14
GNEER(–4)	–0.0417	–2.06**	GNEER(–6)	0.085589	1.83*
GNEER(–13)	0.0597	2.65**	GNEER(–7)	–0.166026	–3.30***
GNEER(–14)	–0.0015	–0.06	GNEER(–8)	0.151043	2.95***
GNEER(–15)	0.0743	2.61**	GNEER(–17)	–0.102580	–2.53**
GNEER(–16)	–0.0094	–0.35	FINF	0.371725	3.77***
GNEER(–17)	0.043	1.46	FINF(–1)	0.298793	2.43**
FINF	1.2880	4.02***	FINF(–2)	0.578176	3.34***
FINF(–1)	0.6234	2.70**	FINF(–3)	0.405591	1.80*
FINF(–2)	0.8414	2.99***	FINF(–4)	0.194521	0.91
FINF(–3)	0.6116	1.95*	FINF(–5)	0.538994	2.61**
FINF(–4)	0.4889	1.87*	FINF(–6)	0.043006	0.22
FINF(–5)	0.6130	2.46**	FINF(–7)	0.639146	3.07***
FINF(–6)	0.2751	1.29	FINF(–8)	0.333625	1.71*
FINF(–11)	0.4213	2.11**	FINF(–9)	0.263726	1.23
FINF(–12)	0.1619	0.52	FINF(–10)	0.580103	2.54**
INF(–3)	0.2083	1.78*	FINF(–11)	0.343753	1.65*
INF(–24)	–0.1597	–1.46	FINF(–12)	1.039366	4.85***
			INF(–1)	0.100420	1.03
			INF(–3)	0.166116	1.71*
Adj. R^2	0.632		Adj. R^2	0.44	
SE of Regression	0.0030		SE of Regression	0.0056	
Diagnostic Tests					
Jarque-Bera Normality Test	$Chi^2(2) = 0.41$ (0.81)		Jarque-Bera Normality Test	$Chi^2(2) = 0.31$ (0.86)	
Breusch-Godfrey LM Test	$Chi^2(1) = 3.16$ (0.08)		Breusch-Godfrey LM Test	$Chi^2(1) = 4.01$ (0.13)	
Engle's ARCH LM Test	$Chi^2(1) = 0.08$ (0.78)		Engle's ARCH LM Test	$Chi^2(1) = 5.88$ (0.18)	
Ramsey's RESET Test	$Chi^2(1) = 1.48$ (0.22)		Ramsey's RESET Test	$Chi^2(1) = 0.15$ (0.70)	

Source: Estimation of this study.

***, **, *Reflect significance at 1 percent, 5 percent and 10 percent respectively. Figures in brackets are probabilities.

5. CONCLUSION AND POLICY IMPLICATIONS

This study investigates the impact of exchange rate changes on domestic consumer prices (ERPT) in Pakistan for the period 1995M1 to 2009M3. In case of Pakistan, the literature provides mixed results regarding the significance of pass-through relationship; however, the dominant view is that there is no evidence of any significant effect of devaluation on domestic inflation [e.g., Siddiqui and Akhtar (1999) and Choudhri and Khan (2002)]. The current literature on ERPT provides several explanations of low pass-through [e.g., Taylor (2000); Goldfajn and Werlang (2000) and Choudhri and Hakura (2001)]. According to Goldfajn and Werlang (2000) initial real exchange rate overvaluation and initial inflation are the most robust determinants of ERPT. In case of Pakistan, no previous study has incorporated misalignment in the pass-through model. This study develops an ERPT model which incorporates previous period's real exchange

rate misalignment as an independent variable. In the following, concluding remarks based on empirical findings of the study are presented.

First, short-run and long-run exchange rate pass-through, from NEER appreciation to consumer price inflation in Pakistan, is very low (close to zero).[15] Second, overvaluation in the previous period significantly reduced inflation in managed exchange rate regime, although, coefficient of RERM (–1) is low. However, the coefficient of RERM(–1) is found insignificant in the overall sample (*Regression 1*) due to the dominance of second sub-sample which includes the transition period of the exchange rate regime. Third, the impact of foreign inflation on domestic inflation is positive. In all three regressions, foreign inflation significantly affects domestic inflation.

Policy Implications

(1) Low pass-through into consumer prices has important policy implication for the adoption of inflation targeting by SBP.[16] A floating exchange rate system is the requirement for a well functioning inflation targeting regime because in a world of capital mobility, independent monetary policy cannot coexist with a pegged exchange rate regime. The conjunction of inflation targeting and flexible exchange rates has raised question of exchange rate volatility and resulting fear of exchange rate pass-through into consumer price inflation. However, evidence of low pass-through supports the adoption of an inflation targeting regime in Pakistan.

(2) To realign real exchange rate towards equilibrium, policy-makers must know both the level of existing RERM and pass-through relationship. For this purpose, misalignment may be estimated regularly like other macroeconomic variables.

[15]This finding is consistent with existing empirical evidence on ERPT for Pakistan [see, e.g., Choudhri and Khan (2002), and Choudhri and Hakura (2001)].

[16]According to Choudhri and Hakura (2001) "a low exchange rate pass-through is thought to provide greater freedom for pursuing an independent monetary policy and to make it easier to implement inflation targeting".

APPENDIX

Appendix Table 1a

Recent Empirical Literature on ERPT in Pakistan

Authors	Hypothesis	Empirical Approach	Data	Findings Related to ERPT
1. Ahmad and Ram (1991)	Whether import prices affect inflation?	Monetarist model of price inflation by applying OLS	Annual data of Pakistan from 1960-61 to 1987-88	1. The growth in import prices, monetary expansion and inflation in the past are the major causes of inflation. 2. The growth in output helps in controlling inflation but not very forcefully.
2. Khan and Qasim (1996)	Determinants of general food and non-food inflation in Pakistan	Single Equation Models/ OLS, Cointegration, Error Correction Model	Annual data of Pakistan from 1971-72 to 1994-95	1. Borrowing from banks to finance budget deficit is main cause of inflation in Pakistan. 2. Frequent currency devaluation/depreciation has also caused inflation in Pakistan.
3. Ahmad and Ali (1999)	Relationship between ER and Prices	Simultaneous Equation Model/ Two Stage Least Square Method	Quarterly data from 1982:2 to 1996:4	Relationship between price level and exchange rate is not unidirectional, though the short run effect of devaluation on inflation is estimated to be smaller than the effect of inflation on devaluation.
4. Siddiqui and Akhtar (1999)	Impact of changes in foreign prices and changes in monetary and real variables on domestic prices	Monetarist type model, Cointegration, ECM, Granger Causality Test	Annual data of Pakistan from 1972 to 1998	1. No significant uni-directional or bi-directional causal relationship between changes in exchange rate and domestic prices. 2. Money supply and level of domestic activity affect domestic prices.
5. Choudhri and Khan (2002)	Whether inflation systematically related to exchange rate changes?	Difference Model, VAR Model, Impulse Response Function, Variance Decomposition	Quarterly data of Pakistan from 1982:1 to 2001:2	There is no evidence of a significant pass-through of Rupee depreciation to consumer prices in SR. Response of inflation to ER shocks is close to zero even after 2 years.
6. Hyder and Shah (2002)	Effect of ER movements on domestic WPI and CPI inflation in Pakistan	Recursive VAR suggested by McCarthy (1999), Impulse Response Function, Variance Decomposition Method	Monthly Data from January 1988 to December 2002	1. ER movement have moderate effect on domestic price inflation. 2. ER pass-through is stronger in WPI as compared to CPI. 3. The impact of pass-through on domestic prices spread over 18 months, however, the most effect is felt in first four months. 4. Response is weak in food group and strong in Fuel and Lightening.

REFERENCES

Adams, Charles, and Daniel Gros (1986) The Consequences of Real Exchange Rate Rules for Inflation: Some Illustrative Examples. *IMF Staff Papers* 33, 439–6.

Ahmad, Eatzaz and Hari Ram (1991) Foreign Price Shocks and Inflation in Pakistan: A Monetarist Approach. *Pakistan Economic and Social Review* 29:1, 1–20.

Ahmad, Eatzaz and Saima Ahmad Ali (1999) Exchange Rate and Inflation Dynamics. *The Pakistan Development Review* 38:3, 235–251.

Bailliu, J. and E. Fujii (2004) Exchange Rate Pass-through and the Inflation Environment in Industrialised Countries: An Empirical Investigation. Bank of Canada. (Working Paper 2004-21).

Belaisch, A. (2003) Exchange Rate Pass-through in Brazil. International Monetary Fund, Washington. (IMF Working Paper 03/141.)

Bhundia, A. (2002) An Empirical Investigation of Exchange Rate Pass-through in South Africa. International Monetary Fund, Washington. (IMF Working Paper 02/165.)

Campa, Jose Manuel and Linda S. Goldberg (2002) Exchange Rate Pass-through into Import Prices: A Macro or Micro Phenomenon? NBER. (NBER Working Papers Series 8934).

Choudhri, Ehsan U and Dalia S. Hakura (2001) Exchange Rate Pass-through to Domestic Prices: Does the Inflationary Environment Matter? Washington, DC, International Monetary Fund. (IMF Working Paper No. 01/194).

Choudhri, Ehsan U. and Mohsin S. Khan (2002) The Exchange Rate and Consumer Prices in Pakistan: Is Rupee Devaluation Inflationary? *The Pakistan Development Review* 41:2, 107–120.

Choudhri, Ehsan U., Hamid Faruqee, and Dalia S. Hakura (2005) Explaining the Exchange Rate Pass-through in Different Prices. *Journal of International Economics* 65, 349–374.

Dornbusch, R. (1987) Exchange Rate and Prices. *American Economic Review* 77, 93–106.

Edwards, S. (2006) The Relationship between Exchange Rates and Inflation Targeting Revisited. (NBER Working Paper No. 12163).

Enders, Walter (2004) *Applied Econometric Time Series*. (Second Edition). Wiley Series in Probability and Statistics.

Gagnon, Joseph E. and Jane Ihrig (2004) Monetary Policy and Exchange Rate Pass-through. *International Journal of Finance and Economics* 9 (October), 315–38.

Goldberg, Pinelopi K. and Michael M. Knetter (1997) Goods Prices and Exchange Rates: What Have We Learned? *Journal of Economic Literature* 35:3, 1243–1272.

Goldfajn, I. and R. Valdes (1999) The Aftermath of Appreciations. *Quarterly Journal of Economics* 114:1.

Goldfajn, IIan, and Sergio Werlang (2000) The Pass-through from Depreciation to Inflation: A Panel Study. (Departamento De Economia Puc-Rio Texto Para Discussao No. 424).

Gueorguiev, N. (2003) Exchange Rate Pass-through in Romania. International Monetary Fund, Washington. (IMF Working Paper 03/130.)

Hendry, D. F. (2003) *Econometrics: Alchemy or Science?* Essays on Econometric Methodology.

Hyder, Zulifqar and Sardar Shah (2003) Exchange Rate Pass Through to Domestic Prices in Pakistan. State Bank of Pakistan. (Working Paper No. 5).

Jaffri, A. A. (2009) Recent Surge in FDI and Real Exchange Rate Misalignment in Pakistan. A study submitted for publication in *Pakistan Economic and Social Review*

Kamin, Steven B. (1997) A Multi-country Comparison of the Linkages between Inflation and Exchange Rate Competitiveness. Bank for International Settlements, Monetary and Economic Department (BASLE, Working Paper No. 45).

Kamin, Steven B. (2001) Real Exchange Rates and Inflation in Exchange–rate Based Stabilisations: An Empirical Examination. *Journal of Development Economics* 64, 237–253.

Khan, Ashfaque H. and Mohammad A. Qasim (1996) Inflation in Pakistan Revisited. *The Pakistan Development Review* 35: 4, 747–759.

Klau, Marc (1998) Exchange Rate Regimes and Inflation and Output in Sub-Saharan Countries. Bank for International Settlements, Monetary and Economic Department. (BASLE, Working Paper No. 53).

Knetter, M. (1989) Price Discrimination by U.S. and German Exporters. *American Economic Review* 79, 198–209.

Leigh, D. and M. Rossi (2002) Exchange Rate Pass-through in turkey, International Monetary Fund, Washington. (IMF Working Paper 02/2004.)

Mackinnon, James G. (1996) Numerical Distribution Functions for Unit Root and Cointegration Tests. *Journal of applied Economics* 11, 601–618.

Marston, R. C. (1990) Pricing to Market in Japanese Manufacturing. *Journal of International Economics* 29, 217–36.

McCarthy, Jonathan (2000) Pass-through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialised Economies. Federal Reserve Bank of New York. (Staff Reports 11).

Menon, Jayant (1995) Exchange Rate Pass-through. *Journal of Economic Surveys* 9:2, 197–231.

Menon, Jayant (1996) The Degree and Determinants of Exchange Rate Pass-through: Market Structure, Non-tariff Barriers and Multinational Corporations. *The Economic Journal* 106: (March), 434–444.

Montiel, Peter J. (2002) The Long-Run Equilibrium Real Exchange Rate: Theory and Measurement. In Mohsin S. Khan, Saleh M. Nsouli, and Chorng-Huey Wong (ed.) *Macroeconomic Management Programmes and Policies.* International Monetary Fund 307–344.

Nell, K. S. (2003) The Stability of M3 Money Demand and Monetary Growth Targets: The Case Study of South Africa. *Journal of Development Studies* 39: 3, 51–180.

Otani, Akira, S. Shiratsuka, and T. Shirota (2003) The Decline in the Exchange Rate Pass-through: Evidence from Japanese Import Prices. Bank of Japan. (IMES Discussion Paper No. 2003.)

Pentecost, E. J. and T. Moore (2006) Financial Liberalisation in India and a New Test of the Complementarity Hypothesis. *Economic Development and Cultural Change* 487–502

Rowland, Peter (2003) Exchange Rate Pass-through to Domestic Prices: The Case of Colombia, Banco de la Republica, <prowland@banrep.gov.co>

Siddiqui, Rehana and Naeem Akhtar (1999) The Impact of Changes in Exchange Rate on Prices: A Case Study of Pakistan. *The Pakistan Development Review* 38:4, 1059–66.

Taylor, John (2000) Low Inflation, Pass-through and Purchasing Power of Firms. *European Economic Review* 44, 1389–1408.