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Exchange Rate Pass-Through to Domestic Prices in Pakistan

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Abstract

This paper assesses the extent to which the movements in exchange rate affect domestic wholesale and consumer prices in Pakistan by analyzing data from January 1988 to September 2003. The empirical model is a recursive VAR, suggested by McCarthy (2000), incorporating a distribution chain of pricing. Impulse response function and variance decomposition are used to measure the exchange rate pass-through to domestic prices. The major findings of this paper are: (1) the exchange rate movements have only a moderate effect on domestic prices, i.e., exchange rate pass-through is low; (2) the exchange rate pass-through is more stronger in wholesale price index (WPI) relative to consumers price index (CPI); (3) the impact of pass-through on domestic prices spreads over 12 months, however, the effect is mostly felt in the first four months; (4) the exchange rate pass-through to consumer prices have further weakened after the free float of Rupee/Dollar parity in July 2000; (5) within the WPI commodity groups, the exchange rate pass-through is stronger in 'Fuel & Lighting' and 'Manufactures' groups while in the case of CPI, pass-through is more pronounced in 'Transport & Communication' and 'Fuel & Lighting' group. Furthermore, the exchange rate pass-through to domestic prices is much stronger in higher inflationary environment during Jan-88 to Dec-97 relative to lower inflationary environment down the road.

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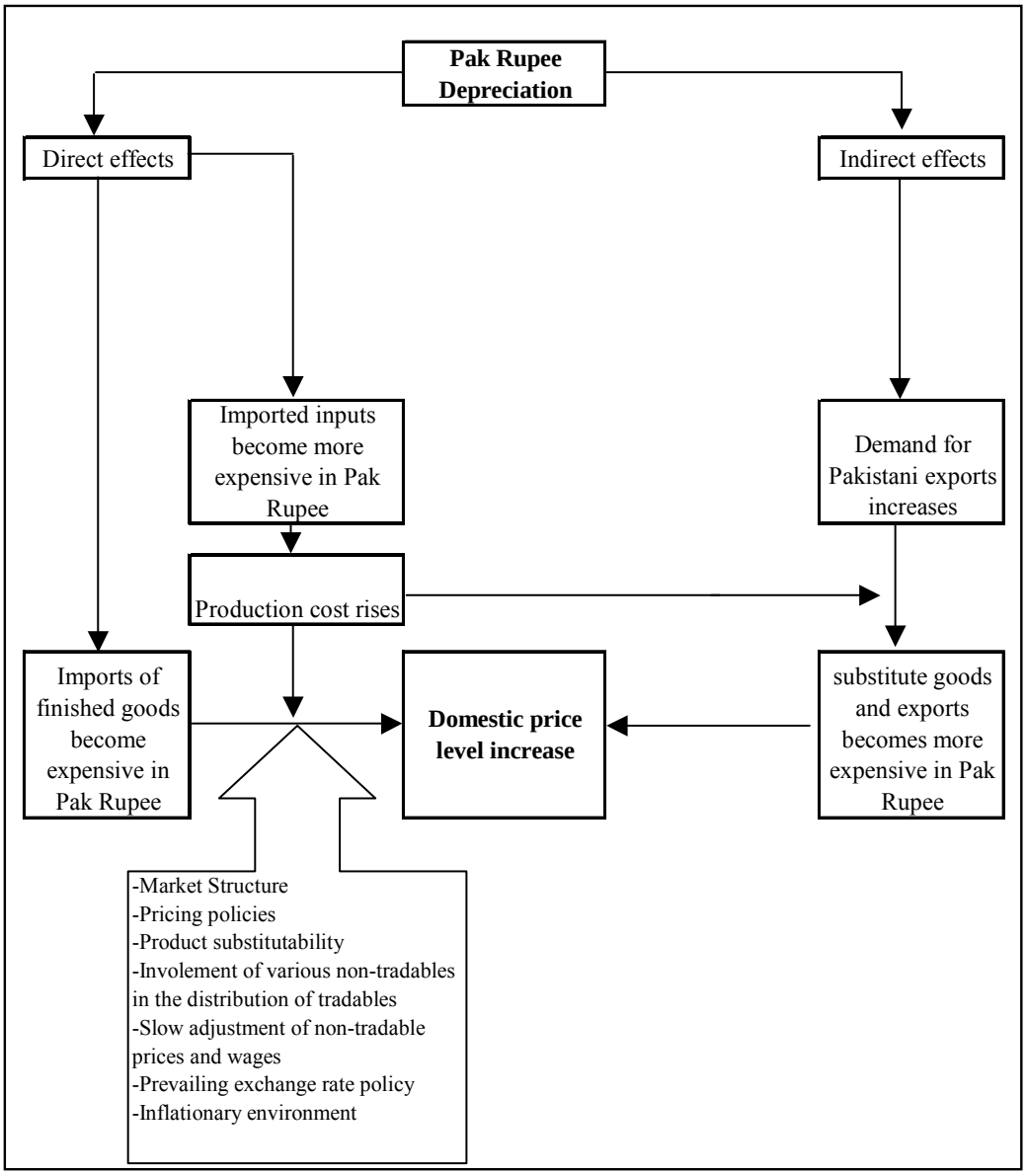
1. Introduction

The monetary policy in Pakistan aims at stabilizing the domestic and external value of the currency and to foster economic growth. Therefore, the exchange rate pass-through to domestic wholesale and consumer prices is an important link in the process of monetary policy transmission. Since Pakistan's economy has a considerable degree of openness to foreign trade, the domestic price level cannot remain immune to external price shocks i.e. exchange rate depreciation/appreciation and changes in import prices. Any appreciation or depreciation of the exchange rate will not only result in significant changes in the prices of imported finished goods but also imported inputs that affect the cost of the finished goods and services.

Specifically, exchange rate movements can influence domestic prices through direct and indirect channels (see **Chart 1**). In case of direct channel, exchange rate movements can affect domestic prices through changes in the price of imported finished goods and imported inputs. In general, when a currency depreciates it will result in higher import prices while lower import prices result from appreciation in price taker countries like Pakistan. The potentially higher costs of imported raw material and capital goods associated with an exchange rate depreciation increase marginal costs and lead to higher prices of domestically produced goods. In case of indirect effect, the exchange rate depreciation affects the net exports which in turn influence the domestic prices through the change in aggregate demand, putting upward pressure on domestic prices. In addition, import-competing firms might increase prices in response to foreign competitor price increases in order to maintain profit margins. However, the extent and the speed of exchange rate pass-through depends on several factors such as market structure, pricing policies, general inflationary environment, involvement of non-tradables in the distribution of tradables, relative share of imports in WPI and CPI basket, etc.

This paper assesses the extent to which exchange rate changes affect domestic prices in Pakistan. Specifically, we have focused on both WPI and CPI inflation by analyzing data from January 1988 to September 2003. The paper employs McCarthy (2000) recursive VAR methodology that provides a model to track pass-through from exchange rate movements to each stage of distribution in a simple integrated framework. After estimating the VAR model, we generate impulse-response functions in order to quantify the effect of an exchange rate shock on domestic prices. Variance decomposition is then used to rank the relative share of exchange rate movements for the explanation of domestic price changes.

Chart 1: Exchange Rate Pass-through to Domestic prices



The impulse response functions and variance decompositions indicate that: (i) the exchange rate movements have a moderate effect on domestic price inflation or in other words, exchange rate pass-through is low; (ii) it is found that the exchange rate pass-through is more pronounced in WPI relative to CPI; (iii) although the impact of the pass-through on domestic prices continues over 12 months, it is mostly felt in the first four months; (iv) the exchange rate pass-through to consumer prices have further weakened after the free float of Rupee/Dollar parity in July 2000; (v) a disaggregated analysis of the WPI indicates that the pass-through of exchange rate movements is stronger in 'Fuel & Lighting' and

'Manufactures' groups while in the case of CPI, pass-through is more pronounced in the 'Transport & Communication' and 'Fuel & Lighting' groups; (vi) the response of exchange rate movements is weak in the case of the 'Food' group in both WPI and CPI. Furthermore, the exchange rate pass-through to domestic prices is much stronger in higher inflationary environment during Jan-88 to Dec-97.

The paper is organized as follows. The next section presents a review of literature on exchange rate pass-through to domestic prices. Section 3 describes the methodology adopted for the analysis. The data coverage, its sources and preliminarily statistical properties are presented in section 4. The results from the impulse responses and variance decompositions are presented in section 5, and Section 6 concludes.

2. Review of Literature

There is a substantial theoretical and empirical literature on the exchange rate pass-through to domestic producer and consumer prices, some of which has been surveyed in Goldberg and Knetter (1997). However, much of the literature has dealt with advanced economies. The studies on exchange rate pass-through can be broadly divided into three categories: (1) the first category comprises studies that focus on examining exchange rate pass-through into import prices for specific industries (for example, Feinberg, 1989, and Goldberg, 1995); (2) the second category includes studies that examine pass-through into aggregate import prices (for example, Hooper & Mann, 1989, and Campa & Goldberg, 2002); and (3) the third category of studies examines exchange rate pass-through into WPI and CPI (for example, McCarthy, 2000; Papell, 1994; Heng, 1999; and Kim, 1998).

Recently, McCarthy (2000) recursive VAR framework[1], which incorporates a distribution chain of prices, has been widely adopted by a number of authors for analyzing the exchange rate pass-through for various countries e.g. Ashok (2002) for South Africa; Leigh and Rossi (2002) for Turkey; and Rabanal and Schwartz (2001) for Brazil.

Ashok (2002) finds that the average pass-through is low and inflationary impact of exchange rate depreciation is absorbed at the intermediate stage of production in South Africa. However, shocks to producer prices tend to have a considerable impact on consumer prices. He also found that pass-through is much higher for nominal rather than for real shocks. The findings of Leigh and Rossi (2002) are (i) the pass-through from the exchange rate to

[1] McCarthy has analyzed the impact of exchange rate changes & import price fluctuations on producer and consumer prices in six industrialized OECD countries from 1976:1 to 1998:4. The impulse response function and

domestic prices continues for a year but is more intense in the first four months (ii) the pass-through to WPI is more pronounced than CPI (iii) forecast of inflation based on estimates of the pass-through coefficient provides only partial information about the underlying price pressures. Rabanal and Schwartz (2001) show that after 18 months about two-thirds of the initial exchange rate shock is passed through to WPI and two-ninths to CPI in the case of Brazil, indicating that the pass-through to WPI is more pronounced as compared to the pass-through to CPI.

Choudhri, Faruqee, and Hakura (2002) examine the performance of different new open economy macroeconomic models in explaining the exchange rate pass-through in a wide range of prices. The results show that the best-fitting model incorporates a number of features highlighted by different strands of the literature: sticky prices, sticky wages, distribution costs, and a combination of local and producer currency pricing.

Literature Related to Pakistan

Rehana and Naeem (1999) examine the impact of imported inflation and changes in monetary and real variables on domestic prices during 1972-98. Cointegration test is applied to determine the long-term relationship and the causality between the domestic price level and exchange rates. This study does not find any significant uni-directional or bi-directional causal relationship between changes in exchange rate and domestic prices.

Eatzaz and Saima (1999) explore the relationship between nominal exchange rate and domestic price level and also their relationship with other economic variables for Pakistan by using quarterly data form 1982-II to 1996-IV. This paper traces the pattern and speed of adjustment in the two variables in response to different types of shocks. Cointegration method is used for the model estimation, the findings of the study suggest that one percent increase in price level of import, whether due to exchange rate devaluation or rising world prices, results in 0.15 percent increase in CPI.

Anjum Nasim (1997) uses annual data from 1974 to 1994 and explores the main determinants of inflation in Pakistan. The price equation used for estimation is the general form of the price equation by expressing the overall price level as weighted average of the price of tradables and price of non-tradables. The paper identifies monetary growth and growth rate of foreign prices as the key determinants of inflation in Pakistan. It is found that a 1 percent

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variance decomposition show that the exchange rate has a modest effect on domestic price over the post-Bretton Woods era. He also found that pass-through is somewhat stronger in countries with a larger import share.

permanent increase in foreign prices results in a 0.14 percent increase in CPI in the first year and 0.35 percent in the second year. While the long run impact is 0.32 percent.

Hasan, Khan, Pasha and Rasheed (1995) investigate the main determinants of WPI inflation in Pakistan. Disaggregated price equations are estimated for food, raw materials and manufactures. The estimated price indices for these three categories are combined with two other sub indices taken to be exogenous to arrive at a prediction of WPI. The study concludes that an increase in the procurement price of wheat, administered prices and external prices are the prime factors for inflation in Pakistan.

3. Methodology

To examine the pass-through of exchange rate to domestic prices, this paper utilizes a recursive Vector Autoregressive (VAR) approach proposed by McCarthy (2000). The model is based on six variables in the following order: oil price inflation, $\prod^{oil}$ (denominated in the local currency) is used as a proxy for international supply shock; demand shock, Δy is proxied by the Quantum Index of Manufacturing (QIM); the growth in money supply, $\Delta M2$; the change in nominal exchange rate, Δe; wholesale price inflation, $\prod^{WPI}$; and consumer price inflation $\prod^{CPI}$.

$$\Pi_t^{oil} = E_{t-1}\left[\Pi_t^{oil}\right] + \varepsilon_t^{oil}$$
$$\Delta y_t = E_{t-1}\left[\Delta y_t\right] + \alpha_1 \varepsilon_t^{oil} + \varepsilon_t^{\Delta y}$$
$$\Delta M2_t = E_{t-1}\left[\Delta M2_t\right] + \beta_1 \varepsilon_t^{oil} + \beta_2 \varepsilon_t^{\Delta y} + \varepsilon_t^{\Delta M2}$$
$$\Delta e_t = E_{t-1}\left[\Delta e_t\right] + \lambda_1 \varepsilon_t^{oil} + \lambda_2 \varepsilon_t^{\Delta y} + \lambda_3 \varepsilon_t^{\Delta M2} + \varepsilon_T^{\Delta e}$$
$$\Pi_t^{WPI} = E_{t-1}\left[\Pi_t^{WPI}\right] + \delta_1 \varepsilon_t^{oil} + \delta_2 \varepsilon_t^{\Delta y} + \delta_3 \varepsilon_t^{\Delta M2} + \delta_4 \varepsilon_t^{\Delta e} + \varepsilon_t^{WPI}$$
$$\Pi_t^{CPI} = E_{t-1}\left[\Pi_t^{CPI}\right] + \gamma_1 \varepsilon_t^{oil} + \gamma_2 \varepsilon_t^{\Delta y} + \gamma_3 \varepsilon_t^{\Delta M2} + \gamma_4 \varepsilon_t^{\Delta e} + \gamma_5 \varepsilon_t^{WPI} + \varepsilon_t^{CPI}$$

This model considers pricing along the distribution chain; inflation at a particular distribution stage –wholesale or consumer – in period *t* is assumed to be comprised of several different components. The first component is the expected inflation at that stage based on the available information at the end of period *t* – 1. The second and third components are the effects of supply and demand shocks on inflation. The fourth component is the growth in money supply, which is used to incorporate monetary policy in the model[2]. The reasoning behind including monetary policy reaction function is: (1) in line with the findings of Parsley and Popper (1998) and McCarthy (2000); they found that taking monetary policy in the analysis

[2] As monetary aggregate M2 is used as "intermediate target" by SBP, therefore we also used growth in monetary aggregate to incorporate the central bank reaction function in our model.

significantly improves the estimation results of exchange rate pass-through; (2) Central bank targets domestic inflation in order to insulate prices from exchange rate movements, therefore neglecting central bank behavior would distort the true consequences of exchange rate variation; and (3) recently monetary policy is effectively used in order to the quell speculations of exchange rate depreciation in the interbank market. The fifth component is the effect of exchange rate shocks on inflation at a particular stage followed by the effects of inflation shocks at previous stage of the distribution chain. Finally, the model also includes the inflation shock at that particular stage.[3]

In order to recover the structural shocks from the VAR residual, a Cholesky decomposition of the residual variance-covariance matrix is used (Hamilton, 1994). This decomposition stems from a recursive assumption where zero-restrictions are imposed on the simultaneous correlation among residuals. As a result, the ordering of the variables is crucial. The intuition of this decomposition is that a shock on the last ordered variable in the system does not contemporaneously affect the previous variables. More specifically, if the covariance between various respective innovations associated with each variable in the model i.e. ε^{i} is zero then innovation in any variable has an immediate effect on this variable and therefore impacts all future variables in the VAR model. However, usually, the covariance between innovations is not zero and they have some common component, which is generally attributed to first variables in the VAR model.[4]

After imposing the Cholesky decomposition, two sets of statistics are used to assess the pass-through from exchange rate fluctuations to domestic inflation. First, impulse response of WPI and CPI inflation to a one standard deviation shock of exchange rate are estimated, which are subsequently used in the calculation of cumulative pass-through coefficients.[5] Second, variance decomposition of WPI and CPI is used to assess how much of the (forecast) variance in domestic price indices over this period can be attributed to exchange rate fluctuations.[6]

[3] The inflation shock at any stage is simply that portion of inflation that cannot be explained by using information from period t–1 plus information about supply and demand variables, money supply growth, exchange rate, and period t inflation at previous stages of the distribution chain.
[4] More technically, the errors are orthogonalised i.e. Cholesky Decomposition uses the inverse of the Cholesky factor of the residual covariance matrix to orthogonalize the impulses. This decomposition imposes an ordering of the variables in the VAR and attributes all of the effect of any common component to the variable that comes first in the VAR system. The responses can change dramatically if we change the ordering of the variables.
[5] An impulse response function traces the effect of a one standard deviation shock to one of the innovations on current and future values of the endogenous variables.
[6] Variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR.

In order to determine the respective impulse-response functions, the variables need to be given a plausible ordering. The following ordering for the impulse-response analysis is used:

$$\Pi^{oil} \longrightarrow \Delta y \longrightarrow \Delta M2 \longrightarrow \Delta e \longrightarrow \Pi^{WPI} \longrightarrow \Pi^{CPI}$$

It may be noted that McCarthy (2000) ranked the central bank reaction function last, as he assumed a reactive behavior of the central bank. However, we argue that the position of M2 is prior to the wholesale prices. Given the long and variable lags of monetary policy, central banks usually react to expected inflation rather than realized inflation (forward-looking behavior). In this respect it would make sense to consider M2 prior to the wholesale price index and thus let prices react to central bank policy, i.e. central banks set the target of M2 after observing leading indicators for inflation like oil prices, output changes etc. Additionally, SBP also uses the monetary policy to appease the exchange rate fluctuations. However, we do not find significant changes due to a different ordering of the M2.[7]

4. Data and preliminarily statistical properties

Data used in this study is monthly from January 1988 to September 2003, thus giving us a total of 189 observations. The source of the data for all variables except QIM and international oil prices is the SBP Statistical Bulletin, while QIM and international oil prices are taken from the International Financial Statistics (IFS).[8]

Before we proceed to estimate recursive VAR, it is important to establish the order of integration of the series involved and then select the optimal lag length of the VAR model, which should be high enough to ensure that the errors are approximately white noise, but small enough to allow estimation. The Augmented Dickey Fuller (ADF) unit root test is used to determine the stationarity of the variables in the system, which suggests that all variables in logarithm have I (1) order of integration. The results of the ADF are presented in **Table A1** of the Appendix. The VAR is estimated in first difference with 3 lags as optimal lag length based on likelihood ratio test.

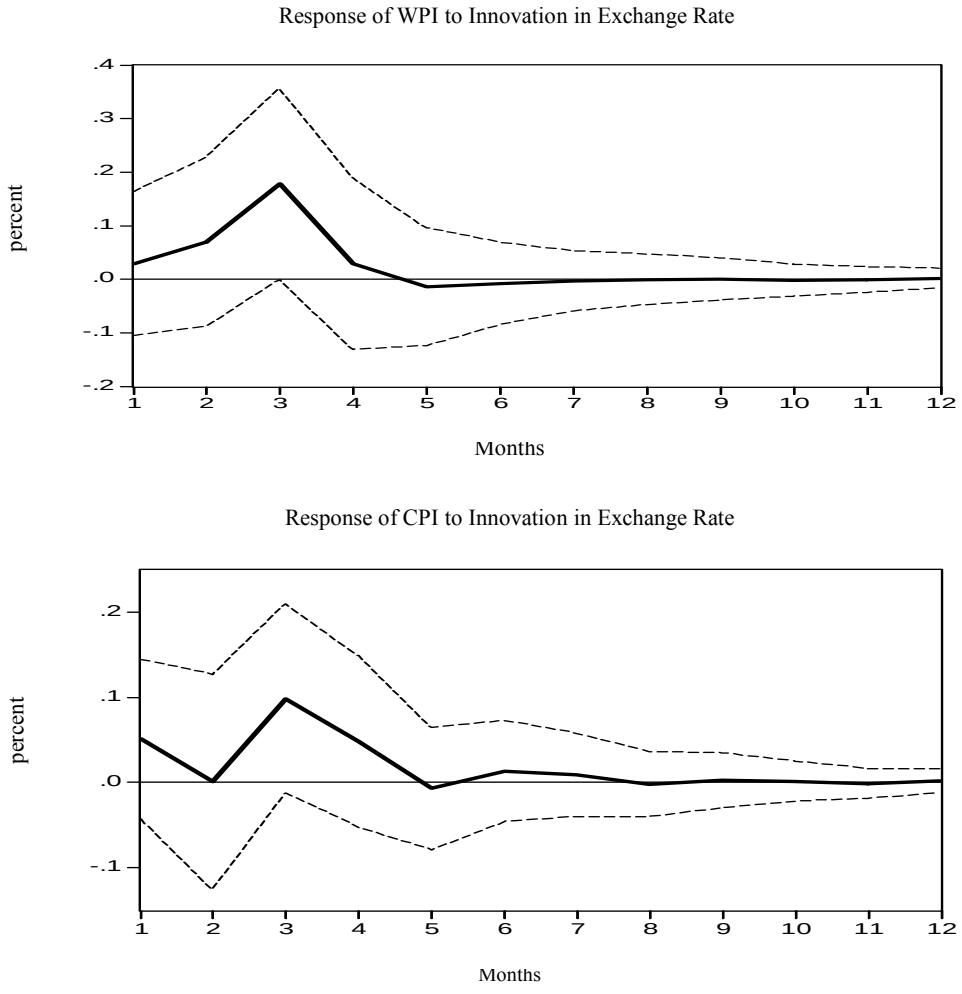
5: Empirical Results

The result of impulse response functions are described in Figure 1, from which it may be seen that the exchange rate pass-through to domestic prices is quite low which is consistent with estimates reported in other studies of the pass-through in Pakistan [see Choudhri and Hakura (2001); and Eatzaz and Saima (1999)]. The domestic prices both WPI and CPI respond

[7] We also computed pass-through coefficient and variance decomposition by ranking the growth in money supply last, however, the results did not show any significant change.

immediately rising for the first four months after a depreciation shock to exchange rate and dwindle away gradually thereafter as measured by impulse response functions and cumulative pass-through coefficients (see Figure 1 & Figure 2). [9]

Figure 1: Impulse Responses of Domestic Prices to One Standard Deviation Innovation in Exchange Rate ± 2 S.E.[10]



[8] The missing values of IFS's QIM are taken from SBP's Statistical Bulletin and the base of these indexes is adjusted accordingly.

[9] The pass-through coefficient is defined as: $PT_{t, t+j}=P_{t, t+j} / E_{t, t+j}$ where $PT_{t, t+j}$ and $E_{t, t+j}$ are cumulative change in the price level and exchange rate respectively between t and t+j months.

[10] The dashed lines are 2 standard error bands and estimated using Monte Carlo method employed by Eviews 4.1 with 100 repetitions.

Figure 2: Estimated Cumulative Pass-Through Coefficients

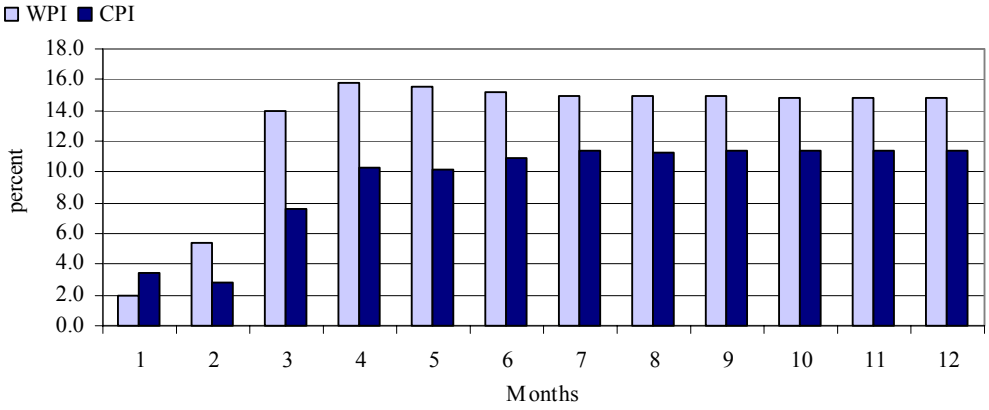


Figure 1 & Figure 2 also exhibit that the effect of an exchange rate shock is more pronounced in the case of WPI relative to CPI, with as much as 14.86 percent and 11.43 percent of the exchange rate change being eventually reflected in WPI and CPI prices. The pass through coefficients indicate that after four months, 15.85 percent and 10.27 percent of the exchange rate change have already been reflected into wholesale and consumer prices respectively (see Table 1). This seems to be a manifestation of: (1) the larger share of tradable commodities in WPI as compared to CPI; (2) CPI also includes services that are generally not-traded and less affected by exchange rate changes directly;[11] and (3) it also implies that exchange rate movements have an effect on domestic prices through changes in the cost of production, which emanate from price changes in imported intermediate goods.

Table 1: Estimated Cumulative Pass-Through Coefficient of Domestic Prices

WPI Inflation					
Periods	**Jan-88 to Sep-03**	**Jan-88 to Jun-00**	**Jul-00 to Sep-03**	**Jan-88 to Dec-97**	**Jan-98 to Sep-03**
1	1.98	1.85	2.87	6.87	2.95
2	5.41	3.27	3.79	3.68	3.58
3	13.91	11.97	6.03	12.62	7.08
4	**15.85**	**11.99**	11.73	19.21	**10.18**
5	15.56	10.55	**12.76**	**19.85**	9.60
6	15.15	10.79	9.07	18.74	7.49
9	14.95	9.95	11.19	18.38	8.52
12	14.86	9.95	10.85	18.13	8.25
CPI Inflation					
1	3.44	3.57	-1.21	6.68	3.90
2	2.81	2.96	-7.79	3.30	0.71
3	7.53	5.36	2.00	4.92	4.69
4	**10.27**	7.71	**5.57**	8.78	8.31
5	10.18	7.49	5.17	**9.30**	**8.45**
6	10.89	8.23	3.21	8.40	6.76
7	11.36	**8.67**	3.59	9.09	6.22
9	11.35	8.07	4.84	8.65	7.05
12	11.43	8.25	4.73	8.65	6.89

[11] Tradable goods are defined as those goods and services that are imported/exported by a country as well as those goods and services that are close substitutes for the exportable and importable goods. The domestic prices of tradable goods are determined by the international market subject to the transportation cost, tariff rate etc. On the other hand domestic supply and demand forces exclusively determine the domestic price of non-tradables.

The cumulative pass-through coefficient are also computed for sub-samples prior to and after July 2000 to estimate the impact of free floating of Rupee/Dollar parity on exchange rate pass-through to domestic prices. The estimated coefficients of cumulative pass-through of these sub-samples indicate that the exchange rate pass-through to consumer prices have dropped from 8.25 percent to 4.73 percent after the free floating of exchange rate (see Table 1). The sharp appreciation of rupee/dollar parity during latter part of the sub-sample and resultant structural changes in the economy reversed the expectations of the economic agents about future exchange rates and thus impact their price setting behavior. Surprisingly, the pass-through to wholesale pries merely increased from 9.95 percent to 10.85 percent.

Furthermore, we also test the hypothesis suggested by Taylor (2000) that the magnitude of exchange rate pass-through to domestic prices depends on the general inflationary environment prevailing in the economy. As the exchange rate pass-through reflects the expected effect of exchange rate shock on the current and future cost, a higher inflationary environment would tend to increase the pass-through by strengthening the expected future effect of the exchange rate shock. In case of Pakistan, the estimated cumulative pass-through coefficients confirm this hypothesis during the relatively higher inflationary period from Jan-88 to Dec-97 relative to lower inflationary environment down the road (see Table 1) amid the tightening of monetary policy and the appreciation of rupee and the ample availability of food products.

Results of Variance decomposition, which show the contribution of innovation in the exchange rate to the variability of both WPI and CPI, are presented in Table 2, while the contributions of other explanatory variables are reported in Table A2 in appendix.

Table 2: Variance Decomposition of Domestic Prices

Percentage of forecast error variance attributed to Exchange Rate shock:

Forecast Horizon	Jan-88 to Sep-03	Jan-88 to Jun-00	Jul-00 to Sep-03	Jan-88 to Dec-97	Jan-98 to Sep-03
WPI Inflation					
1	0.09	0.08	0.18	0.73	0.34
2	0.59	0.20	0.19	0.72	0.35
3	3.64	2.85	0.60	3.21	1.11
6	3.64	2.87	2.67	4.07	1.75
9	3.63	2.86	2.86	4.06	1.80
12	3.63	2.86	2.86	4.07	1.80
CPI Inflation					
1	0.24	0.61	0.17	1.22	2.45
2	0.30	0.59	6.96	1.28	3.57
3	2.15	0.96	15.87	1.38	6.18
6	2.41	1.10	17.33	1.93	8.30
9	2.41	1.12	17.44	1.97	8.36
12	2.41	1.12	17.44	1.97	8.36

As shown by Table 2, the exchange rate shock only explains 3.63 percent and 2.41 percent of the forecast error variance of WPI and CPI respectively, while the remainder of the variance of WPI and CPI inflation is explained by innovations in other variables (see Table 2 in Appendix). Specifically, 86.98 percent of the variance is explained by its own innovation followed by industrial output growth which explains 4.49 percent of variance. In case of CPI, apart from 56.02 percent of variance explained by its own impact, 30.71 percent of variation is explained by wholesale prices followed by money supply growth.

The variance decomposition of sub-samples shows that the explanation of forecast error variance due to exchange rate remains unchanged in case of WPI before and after the free float, while the share of exchange rate in explanation of forecast error variance declined in low inflationary environment (see Table 2). On the other hand, the share of exchange rate in explaining forecast error variance of CPI increased in both sub-samples.

In order to investigate which commodity group in WPI and CPI is more sensitive to exchange rate fluctuations, a disaggregated analysis is also carried out. Three commodity groups of WPI; 'Food', 'Manufactures' and 'Fuel & Lighting' groups are investigated and results show that 'Fuel & Lighting' group is more sensitive to exchange rate changes compared with 'Food' and 'Manufactures' groups (see Table A3 and Figure A2 in Appendix). The results are also verified from cumulative exchange rate pass-through coefficients, which exhibit 33 percent and 14 percent of the exchange rate change being eventually reflected in 'Fuel & Lighting' and 'Manufactures' groups respectively and the pass-through effect is mostly felt in first four months (see Figure A2). In case of 'Food' group, the government policy of announcing procurement price for wheat has a greater impact on food prices than exchange rate movements.[12] On the other hand, 'Fuel & Lighting' group prices are more sensitive to exchange rate changes as government promptly shifts the increase in domestic prices. Recently, the government has delegated the function of determining oil prices to the Oil Companies Advisory Committee (OCAC), which reviews the oil prices on fortnightly basis.

As far as group wise analysis of CPI is concerned, three groups; 'Food & Beverages', 'Fuel & Lighting' and 'Transport & Communication' are investigated. The variance decomposition analysis shows that 'Transport & Communication' group is more susceptible to exchange rate changes followed by 'Fuel & Lighting' group, while the 'Food' group is less sensitive to

[12] In order to provide support to farmers, the government announces the procurement prices for wheat, sugarcane and cotton and buys these crops at that price, which may be different from the market price.

exchange rate movements (see Table A4, Figure A1 & A2 in Appendix). The estimated cumulative pass-through coefficients show that 58 percent and 27 percent of the exchange rate change is eventually reflected in 'Transport & Communication' and 'Fuel & Lighting' groups respectively and the pass-through effect is mostly felt in first four months (see Figure A2).

6. Conclusion

In this paper, we use a recursive VAR model suggested by McCarthy (2000) on monthly data from January 1988 to September 2003. The findings of the paper suggest that: (1) the exchange rate movements have a moderate effect on domestic price inflation mainly due to higher share of wheat, sugarcane, cotton and energy in WPI and CPI baskets which are subject to procurement and administrated prices of government; (2) the exchange rate pass-through is more pronounced in WPI as compared to CPI due to the higher share of tradables in WPI basket relative to CPI basket; (3) the impact of pass-through on domestic prices spreads over 12 months, however, the effect is more pronounced in the first four months as indicated by pass-through coefficients of WPI and CPI; (4) the exchange rate pass-through to consumer prices have further weakened after the free float of Rupee/Dollar parity in July 2000 and resultant structural changes in the economy; (5) within the WPI commodity groups, the pass-through of exchange rate movements is stronger in 'Fuel & Lighting' and 'Manufactures' groups while in the case of CPI, pass-through is more pronounced in 'Transport & Communication' and 'Fuel & Lighting' group; (6) not surprisingly, the response of exchange rate movements in the 'Food' group is weak both in the case of WPI and CPI.

This result, which shows a low exchange rate pass-through to domestic prices, has an important implication for the monetary policy implementation. Low exchange rate pass-through provides greater freedom for pursuing independent monetary policy especially through inflation targeting regime.

References

Anjum Nasim (1997), "Determinants of inflation in Pakistan", State Bank of Pakistan.

Bhundia, Ashok J (2002) "An Empirical Investigation of Exchange Rate Pass-Through in South Africa", Working Paper No. 02/165, IMF.

Campa, José Manuel and Linda S. Goldberg. 2002. "Exchange Rate Pass-Through into Import Prices: A Macro or Micro Phenomenon?" Working Paper No. 8934, National Bureau of Economic Research, USA.

Choudhri, Ehsan U ; Faruqee, Hamid ; Hakura, Dalia S (2002) "Explaining the Exchange Rate Pass-Through in Different Prices", Working Paper No. 02/224, IMF.

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

Eatzaz Ahmad and Saima Ahmed Ali (1999), "Exchange Rate and Inflation Dynamics", Pakistan Development Review, Vol: 38, No: 3.

Feinberg, Robert M (1989) "The Effects of Foreign Exchange Movements on U.S. Domestic Prices", Review of Economics and Statistics, Vol. 71, No. 3, pp. 505-11.

Hooper, Peter and Catherine L. Mann. 1989. "Exchange Rate Pass-Through in the 1980s: the Case of U.S. Imports of Manufactures", Brookings Papers on Economic Activity, 1.

Goldberg, P.K. (1995). "Product Differentiation and Oligopoly in International Markets: The Case of the U.S. Automobile Industry", Econometrica, Vol. 63(4), pp. 891-951

Goldberg, P. K. and Knetter M. M. (1997): "Goods Prices and Exchange Rates: What Have We Learned?", Journal of Economic Literature, Vol. 35, No. 3, pp. 1243-72.

Hamilton, James D. (1994), "Time Series Analysis", Princeton University Press.

Hasan, M.Aynul, Ashfaque H. Khan, Hafiz A. Pasha and Aijaz Rasheed (1995), "What Explains the Current High Rate of Inflation in Pakistan?", Pakistan Development Review, Vol: 35, No: 4.

McCarthy, Jonathan (2000) "Pass-Through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialized Economies", Staff reports No.11, Federal Reserve Bank of New York.

Kim, Ki-Ho (1998): "US Inflation and the Dollar Exchange Rate: A Vector Error Correction Model", Applied Economics, Vol. 30, pp. 613-19.

Leigh, Daniel, Rossi, Marco (2002) "Exchange Rate Pass-Through in Turkey", Working Paper No. 02/204, IMF.

Parsley, D.C. and H.A. Popper (1998), "Exchange rates, domestic prices, and central bank actions: recent U.S. experience", Southern Economic Journal, 64 (4), pp.957-972.

Rabanal , P., and G. Schwartz (2001), "Exchange Rate Changes and Consumer Price Inflation: 20 months after the floating of the Real in Brazil: Selected Issues and Statistical Appendix", IMF Country Report N0. 01/10, IMF.

Siddiqui, Rehana and Akhtar, Naeem (1999), "The Impact of Changes in Exchange Rate on Prices: A Case Study of Pakistan", Pakistan Development Review, Vol: 38, No: 4.

Taylor, John (2000), "Low Inflation, Pass-through, and the Pricing Power of Firms", European Economic Review, Vol: 44, pp.1389-1408.

Appendix I:

Table A1: Augmented Dickey Fuller Test (Unit Root)

	Level	First Difference	Order of Integration
LOILP	-1.35 (3)	-7.11 (2)*	I(1)
LINDY	-1.15 (2)	-11.51 (2)*	I(1)
LER	-1.31 (1)	-8.28 (1)*	I(1)
LWPI	-2.02 (1)	-10.60 (0)*	I(1)
LCPI	0.97 (1)	-12.40 (0)*	I(1)
LM2	-1.17(1)	-11.64 (1)*	I(1)

(*) Significant at 1 percent

Table A 2: Variance Decomposition of Domestic Inflation

Percentage of forecast error variance attributed to:

Forecast Horizon	Oil prices	Industrial output growth	Money supply	Exchange rate	WPI	CPI
WPI Inflation						
1	0.48	3.60	0.03	0.09	95.79	0.00
2	0.62	3.40	1.29	0.59	93.93	0.17
3	0.92	4.22	1.25	3.64	89.70	0.27
6	1.81	4.39	1.46	3.64	87.24	1.45
9	1.82	4.49	1.54	3.63	87.00	1.51
12	1.82	4.49	1.55	3.63	86.98	1.52
CPI Inflation						
1	2.11	1.07	0.09	0.59	31.71	64.44
2	2.10	1.08	0.43	0.56	34.75	61.08
3	2.70	1.53	1.36	2.53	33.13	58.77
6	3.52	1.66	4.87	2.72	30.96	56.28
9	3.52	1.73	5.26	2.71	30.72	56.05
12	3.53	1.73	5.26	2.70	30.71	56.02

Table A3: Variance Decomposition of WPI Inflation: By Commodity Group

Percentage of forecast error variance attributed to Exchange Rate:

Forecast Horizon	Food	Manufactures	Fuel, Lighting & Lubricants
1	0.04	0.00	1.40
2	0.06	0.14	3.52
3	1.10	2.51	4.45
4	1.33	2.33	4.63
5	1.33	2.30	4.71
6	1.32	2.30	4.73
9	1.33	2.30	4.71
12	1.33	2.30	4.71

Table A4: Variance Decomposition of CPI Inflation: By Commodity Group
Percentage of forecast error variance attributed to Exchange Rate:

Forecast Horizon	Food & Beverages	Fuel & Lighting	Transport & Communication
1	0.48	2.60	0.82
2	0.52	3.38	1.14
3	1.98	3.67	5.75
4	1.92	5.98	6.01
5	1.92	6.07	6.30
6	1.93	6.05	6.31
9	1.93	6.07	6.32
12	1.93	6.07	6.32

Figure A1: Estimated Cumulative Pass-Through Coefficients: Group-Wise

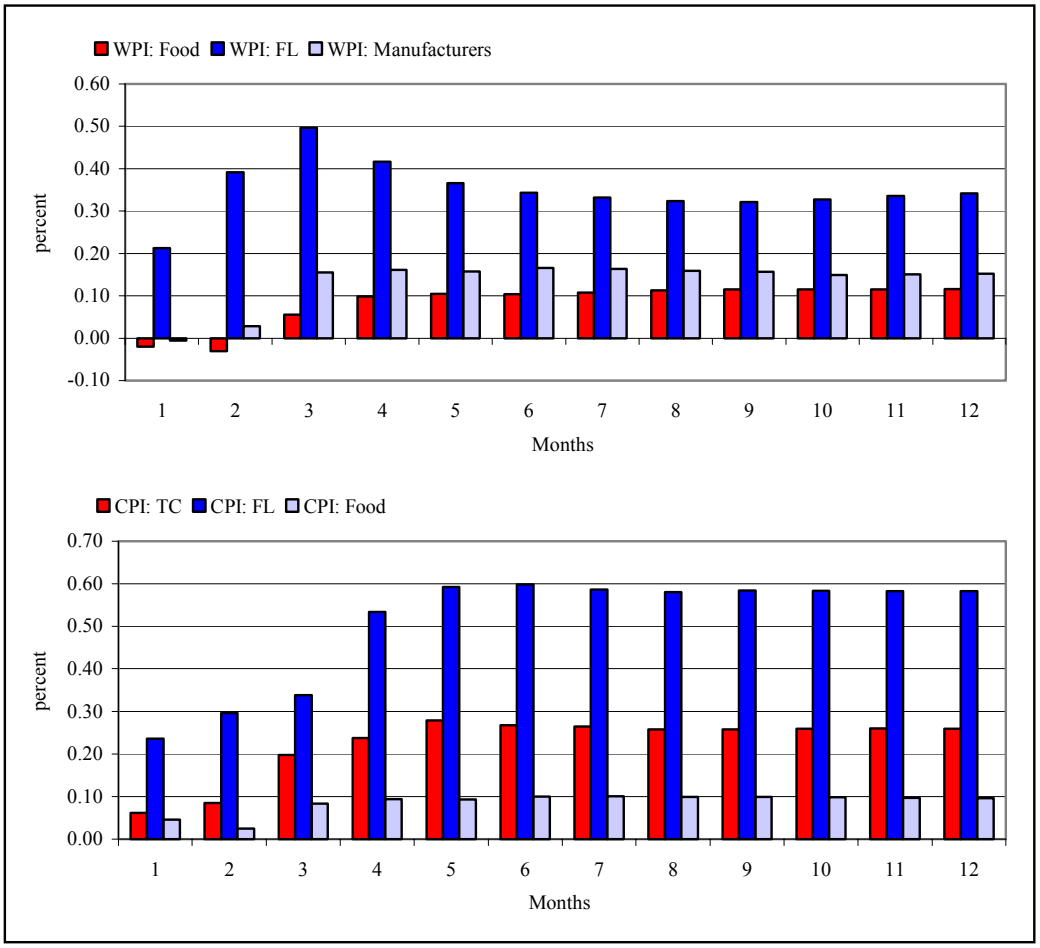


Figure A2: Impulse Response Functions of WPI & CPI Inflation: Group-Wise