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Exchange Rate Pass-Through to Domestic Prices in Iran (1990-2006)

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Abstract

This article investigates the pass-through of exchange rate shocks into import, wholesale and consumer price indexes in Iran by using a monthly data set for the period 1990-2006. The baseline analysis is carried out with identified an unrestricted vector autoregressive model. Impulse response functions show that pass-through is incomplete. Moreover, the price effect of an exchange rate shock is more pronounced in the case of import price relative to wholesale and consumer prices. Variance decomposition method indicates exchange rate shocks are important in explaining the variance of the prices. Also the variance of exchange rate has the biggest share in explaining the CPI inflation. These results are remarkably robust to a number of alternative specifications of the model.

Key words: Exchange Rate, Pass-through, Price indexes, VAR

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1- Introduction

Exchange rate pass-through into prices plays a key role in the monetary policy transmission. In an open economy like Iran's economy, the domestic price level cannot remain immune to external price shocks such as exchange rate movements and changes in import prices. Any depreciation or appreciation of the exchange rate not only results in significant changes in the prices of imported final goods, but also affects imported inputs and therefore, the cost of the final goods and services.

Specifically, exchange rate movements can influence domestic prices through direct and indirect channels. In case of direct channel, exchange rate movements can affect domestic prices through changes in the price of imported final goods and imported inputs. In general, when a currency depreciates, it will increase import prices while appreciation in a price taker country like Iran will cause import prices to lower. The potentially higher costs of imported raw material and capital goods associated with an exchange rate depreciation push up marginal costs and lead to higher prices of domestic 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 which puts 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-tradable goods in the distribution of tradable goods, relative share of imports in WPI and CPI basket, etc.[1]

"The textbook definition of exchange rate pass-through is the percentage change in local currency import prices resulting from a one percent change in the exchange rate between the exporting and importing countries." (Goldberg and Knetter, 1997, p. 1248)

1- See Zulfiqar Hyder, 2004

Since, Changing in import prices passed on to wholesale and consumer prices, in the present research we use a broader definition of exchange rate pass-through, which is seen as the change in import and then domestic prices.

Thi research examines how the exchange rate changes affect price indexes in Iran. Sspecifically, we have focused on the changes in import, wholesale and consumer price indexes by analyzing monthly data for the period 1990:3 to 2006:6 and the baseline empirical model is a Vector Auto Regressive (VAR) model. In order to quantify the effect of an exchange rate shock on prices, Impulse-Response Functions are used. Then, we apply the Variance Decomposition methods to rank the relative share of exchange rate movements for the explanation of changes in price indexes.

This study contains 7 sections. In the next section, we have a review of the relevant literature. Adopted empirical approach is introduced in section 3. The data set and preliminarily statistical and the econometric model are also presented in this section. Section 4 continues by the analysis and empirical results of the study, including the results of estimation, applying the impulse-response functions and Variance Decomposition methods. In section 5, we explain the sensitivity analysis. Summery and conclusion are presented on section 6. Finally, references are mentioned in sections 7.

2- Review of Literature

There are various theoretical researches about pass-through exchange rate. Some of them try to explain exchange rate pass-through by microeconomic models and the others discuss it in the context of macroeconomics. For instance**,** Goldberg and Knetter (1996) provides a microeconomic theoretical explanation for the incompleteness of pass-through from an industrial-organization perspective. This research indicates that common currency relative prices for similar goods exported to different markets are highly correlated with exchange rates between those markets. It concludes that incomplete pass-through is a consequence of imperfect competition i.e. third-degree price discrimination.

Krugman (1987) introduces the concept of pricing-to-market, which stands for exchange rate induced price discrimination across countries. In other words, it describes a situation where exporting firms adjust their

(destination-specific) markups to compensate for exchange rate changes. Pricing-to-market may thus be considered as a microeconomic explanation for incomplete exchange rate pass-through into import prices.

By contrast, traditional open macroeconomic models postulate perfect competition, fully flexible prices and purchasing power parity. In these models, the pass-through is necessarily complete. For example, Obstfeld and Rogoff (1995) introduces nominal rigidities and market imperfections into a microfounded dynamic general equilibrium model. However, purchasing power parity is still maintained at all times, and the pass-through is complete. In Obstfeld and Rogoff's model, nominal prices are set in producers' currencies (producer currency pricing) and consequently, nominal exchange rate fluctuations cause one-to-one reactions in prices of imported goods that means in the short-run exchange rate pass-through is complete.

But studies on exchange rate pass-through have almost unanimously rejected the assumption of purchasing power parity and, thus, a one-to-one relationship between exchange rate changes and changes in the prices, particularly in the short run. If significant lags exist in the transmission of exchange rate changes to domestic prices, exchange-rate depreciation would only have limited impact on the rate of domestic inflation.

Menon (1995a) which is one of the most comprehensive surveys of the literature on exchange rate pass-through presents an overview of 43 empirical studies on industrialized economies, of which the most often studied is the United States. The majority of studies conclude that exchange rate pass-through is incomplete, indeed although the degree of pass-through does vary significantly across different countries. The size and the openness of the individual economies are the main factors that influence the degree of pass-through across countries. It furthermore, reports that pass-through relationships have remained almost stable over the time.1 Different results for a country stem primarily from the use of different model specifications and variable selections and different methodologies for estimating the models, rather than from different time periods studied. Some studies have

1- See also Parsley (1993). Some studies have, nevertheless, challenged this result. See, for example, Taylor (2000), and Gagnon and Ihrig (2001)

also found pass-through to be asymmetric, which implies that the rate of pass-through is different during exchange rate depreciations and appreciations.[1]

All except one of the studies reviewed by *Menon (1995a)* use the OLS estimation technique and they did not consider time-series properties of the data, particularly the non-stationarity. By that time, Kim (1991) had been the only study on exchange rate pass-through which applied a vector autoregressive (VAR) framework. It addresses the problem by employing method developed by Johansen (1988). In a system of five-equation vector error correction model, this paper finds that the US inflation, exchange rate, money supply, income, and interest rate are cointegrated. The cointegration analysis of the data shows that the dollar exchange rate has a significant negative impact on the inflation measured by the producer price index. It is further established that the exchange rate Granger causes the inflation.

After Kim (1991), many studies use VAR frameworks to investigate exchange rate pass-through such as Kenny and McGettigan (1998), Rowland (2003), Hyder (2004) and Choudhri, E. U., Faruqee, H. and D. S. Hakura. (2005).

A more recent stream of literature examines the pass-through exchange rate in context of cross-country analysis. These researches like McCarthy (2000) and Mihailov (2005) study the pass-through into different prices for different countries. In general, they find that the pass-through into consumer prices, which is the major concern for monetary policy, is small and often even insignificant.

In summaries, McCarthy (2000) examines the impact of exchange rates and import prices on the domestic PPI and CPI in selected industrialized economies. The empirical model is a VAR incorporating a distribution chain of pricing. Estimating the model over the post-Bretton Woods era, impulse responses indicate that exchange rates have a modest effect on domestic price while import prices have a stronger effect. It finds that pass- through is

1- Some of these studies are Mann (1986), Kreinin, Martin and Sheehey (1987), and Marston (1990). However, some others have found no evidence for such an asymmetry, like Athukorala (1991)

larger in countries with a larger import share. It is also larger in the countries with more persistent exchange rates and import prices.

Mihailov (2005) compares exchange rate pass-though on aggregate prices in the US, Germany and Japan across a number of dimensions. By using the recent empirical approach, the contribution of this study is to perform a pass-though sensitivity analysis of alternative pass-through estimates. Mihailov (2005) finds that the econometric methods, data and frequency and variable proxy employed matter for precision of details, yet they often agree on some general trends. Thus this research indicates that pass-through on import prices has declined in the 1990s relative to 1980s, pass-though on export prices remains country-specific and pass-through on consumer prices is nowadays negligible in all three considered countries.

Feinberg (2000) and Hüfner and Schröder (2002) are some other researches which apply the cross-country analysis. In order to determine the linkage between exchange rate movements and domestic producer prices, Feinberg (2000) examines Colombia, Korea, and Morocco as three developing countries and Hüfner and Schröder (2002) studies the pass-through of exchange rate changes to consumer prices for the euro area by estimating vector error correction models for Germany, France, Italy, the Netherlands and Spain. In these researches, generally, incomplete pass-through into domestic prices is found and Feinberg (2000) finds this impact is greater for developed economies.

In addition, *Campa and S. Goldberg (2005)* provides cross-country and time series evidence on the extent of exchange rate pass-through into the import prices of 23 OECD countries. It finds compelling evidence of partial pass-through in the short run, especially within manufacturing industries. It also shows that over the long run, producer-currency pricing is more prevalent for many types of imported goods. This research concludes that countries with higher rates of exchange rate volatility have higher pass-through elasticities and macroeconomic variables have played a minor role in the evolution of pass-through elasticities over time.

3- Empirical Approach

In order to examine the exchange rate pass-through into the prices in each stage of distribution, this research utilizes an unrestricted Vector Autoregressive (VAR) model which account for endogeneity of the variables. The major benefit from using unrestricted VAR model is that it remains usable when theoretical prescriptions are insufficient. That is why we use this model and prevent to do Johansen procedure or even structural VAR models.

After estimating the VAR model, impulse-response functions will be used. At the end, in order to quantify the effect of an exchange rate shock on prices we will apply Variance Decomposition methods to rank the relative share of exchange rate movements for explanation of changes in the price indexes. Chosen Variables are motivated by many recent researches especially by McCarthy (2000) and Faruqee, et al (2005).[1]

3-1- Data and Preliminarily Statistical Properties

In this study, data is collected from statistical resources published by central bank of Iran (CBI). Whole sample includes 196 monthly observations for the period 1990:3 to 2006:6

Our model is based on the following series: Nominal Exchange Rate (EXR), Import Price Index (MPI), Wholesale Price Index (WPI), Consumer Price Index (CPI), Output Gap (GAP) and broad Money (M2). The first four variables are the center variables in our analysis. Output Gap which is defined as the difference between potential and actual output, added to the model for considering real fluctuations in the economy. In order to consider the effect of monetary policy, we also add Money variable to our model.

All series, except the output gap are used in logarithm form[2]. A detailed description of the data is provided in Appendix A.

1- Faruqee, Hakura & Choudhri (2005) examines the performance of different new open economy macroeconomic models in explaining the exchange rate pass-through in a wide range of prices. In this research predicted responses are compared with the evidence based on VAR models to see how well different models fit the data.

2- Since output gap is negative for some years, it can not be used in logarithm form.

Before we proceed to estimate the model, it is important to find the order of integration of each variable and then select the optimal lag length for the VAR model. The results of Augmented Dickey Fuller (ADF) and Philips Peron (PP) unit root tests[1], used to determine the stationarity of the variables, are presented in tables (B-1) and (B-2). They show that all variables are I (1) i.e. integrated of degree one except GAP which is stationary.

The optimal lags for estimating the VAR model are chosen based on what indicated by the majority of available criteria. (Optimal lags are 8)

3-2- Econometric Model

Our VAR model is estimated with six endogenous variables. The reduced form representation of the model can be written as

$$Z(L)y_t = c + \varepsilon_t \qquad (1)$$

Where $E(\varepsilon_t \varepsilon_t') = \Sigma \qquad \Sigma = \sigma_{ij}, i, j = 1,2,...,T$

Where

$y_t = [\ DLEXR_t, DLMPI_t, DLWPI_t, GAP_t, DLM2_t, DCPI_t]'$ is the vector of m=6 endogenous variables, c is a vector of constants and ε_t is a vector of residuals. DL in the beginning of the name of each variable denotes difference of that variable in natural logarithm form. $Z(L\ ) = I + Z_1 L + Z_2 L^2 + ... + Z_p L^p$ is a matrix polynomial in lag operator and in our model p is equal 2.

The corresponding Vector Moving Average of this model is:[2]

$$y_t = B(L)u_t \qquad E(u_t u_t') = I$$

1- See Dickey and Fuller (1979) and Phillips P. C. B (1987). You can also see Hamilton (1994), pp. 504- 530

2- See for example Lutkepohl (2005, chapter 2) and Hamilton (1994, chapter 11 and 12)

Where $B(L) = \sum_{k=0}^{\infty} B_k L^k = B_0 u_t + B_1 u_{t-1} + B_2 u_{t-2} + ...$

To identify the structural shock, we need some restrictions. This identification can be achieved by setting B_0 equals to the Cholesky decomposition that means $\Sigma = B_0 B_0'$.

In this study, the following ordering of the variables has been chosen for the Cholesky decomposition:

DLEXR ⇨ DLMPI ⇨ DLWPI ⇨ GAP ⇨ DLM2 ⇨ DLCPI

Choosing of this ordering is based on both theoretical and empirical reasons. The theoretical reasons were explained expansively in section 1. In addition, since changing in wholesale prices affect GDP through the cost of production, it is considered before GAP. DLM2 is put after GAP and almost at the end of raking because we assume a reactive function for the central bank, as it is noted by McCarthy (2000).

In the empirical researches, the decision on the ordering of the variables is often based on the pairwise granger causality tests. The results of doing these tests for our variables are reported in Table (B-3) and (B-4). They confirm chosen causality between all variables in the above ordering.

4- Results

In the current section we explain Impulse-Response Functions (IRF) and Variance Decomposition results.

4-1- Impulse-Response Functions

After estimating the explained VAR model, the Impulse-Response Functions (IRF) have been used to quantify the degree of exchange rate pass-through. By this method, we can estimate the effect of an imposed innovation to the equation of exchange rate into the other variables of the system like as import, wholesale and consumer prices. Since the imposed shocks (impulses) in the log-differenced exchange rate variable are normalized to one, we can interpret the estimated responses as the pass-through elasticity.

IRF results for the period of study are reported in figures (A-2-1), (A-2-2), (A-2-3),(A-2-4) and tables (B-5) , (B-6). Also, the exchange rate pass-through into different prices is patterned at appendix B.1. These results indicate that all prices response quickly to an exchange rate shock. The accumulative exchange rate pass-through amounts to 27 percent to import prices and 17 percent for both wholesale and consumer prices after 7 months. It increases such that after 12 months, it comes to 40.6, 27.5 and 21 percent for MPI, WPI and CPI respectively and almost after 24 months (two years) it is going to be constant at 61.8, 43 and 33.5 percent for these indexes. These amounts are significantly different from zero but less than one. Therefore, the exchange rate pass-through is incomplete.

Figure (B-6) compares the exchange rate pass-through for the different prices. It exhibits that the exchange rate shock is more pronounced in the case of MPI relative to WPI and CPI. Consumer Price Index (CPI) is affected less than other price indexes.[1] This evidence is obvious because the share of tradable commodities in MPI is bigger that in WPI and CPI. Moreover, CPI includes services that are generally not traded and so less affected by exchange rate changes directly.

4-2- Variance Decomposition

Although the impulse responses indicate the extent of pass-through to the prices, they do not indicate how important these shocks have been in price fluctuations. If the exchange rate shocks in a country are small, then pass-through could be large but exchange rate would have little influence on domestic inflation. In order to investigate the importance of exchange rate volatility on inflation, we examine the variance decompositions of the price variables.

Results of Variance decomposition, which show the contribution of innovation in the exchange rate to the variability of MPI, WPI and CPI, are presented in tables (B-7), (B-8) and (B-9). As we can see, the exchange rate shocks are important in explaining the variance of the prices. For instance, at

1- This result is in line with many other exchange rate pass- pass through researches. See for example McCarthy (2000), Choudhri, Faruquee and Hakura (2005) and Mihailov (2005)

a six month forecast horizon, their share is about 20.5,19 and 25 percent for MPI, WPI and CPI respectively. Therefore, although the pass-through exchange rate into CPI is less than other price indexes, the variance of exchange rate has the biggest share in explaining the CPI inflation.

The percentage of variance explained by the exchange rate comes into the highest amount after four months for CPI (26.29 percent), eight months for WPI (19 percent) and nine months for MPI (22 percent). Then it declines as the forecast horizon increases.

5- Sensitivity Analysis

One way for testing the robustness of the baseline results is examining the sensitivity of the estimated model with respect to the different identifications. In our baseline model all of variables are nominal except GAP. The alternative model is the same as the explained model in section 3.2 but the difference is in endogenous vector y_t. In the alternative model, we consider y_t as follows:

$y_t = [\ DLEXR_t, DLMPI_t\ DLWPI_t, DLM2_t, DCPI_t\ ]'$. That is we estimate the model without real variable and omit the GAP variable. Tables (B-10) and (B-11) and figure (A-2-5) compare the results of alternative estimated model with the results of the baseline model. To preventing the confusion, variables of the model without GAP are noted with*. As it is shown, except for CPI, whose results changed slightly, there is not significant difference between the results of two models.

We also estimated the baseline model with different Cholesky ordering of the variables proposed by the Granger Causality test. In all of these cases the results are not noticeable different. For abbreviation, we do not report them.

Since the baseline VAR model is not sensitive to the different specifications, the results of variance decomposition, Impulse Response Functions (IRF) and the estimated pass- through elasticities are reliable.

6- Summary and Conclusion

This study investigated the pass-through of exchange rate shocks into import, wholesale and consumer price indexes in Iran by using a monthly

data set for the period 1990-2006. First, we reviewed the relevant literature. Then, empirical approach was explained.

The baseline analysis was carried out with identified a Vector Auto-regressive (VAR) model and pass-through effects were quantified by means of impulse response functions. Evidence showed that pass-through elasticities are significantly different from zero but less than one. Therefore, they are incomplete. Moreover, exchange rate shock is more pronounced in the case of import price relative to wholesale and consumer prices such that after two years , the accumulative pass- through comes to 61.8,43 and 33.5 percent for MPI, WPI and CPI respectively.

To investigate the importance of exchange rate volatility on inflation, we examined the variance decompositions of the price variables. This method indicated that exchange rate shocks are important in explaining the variance of the prices and although the pass-through exchange rate into CPI is less than other price indexes, the variance of exchange rate shocks has the biggest share in explaining the CPI inflation.

These results were remarkably robust to a number of alternative specifications of the model. For instance, we estimated the baseline model without GAP variable as the representative of real fluctuations and the results were not significantly different.

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Appendix

A- Data Appendix

A.1- Definitions

EXR: Nominal (Market) Exchange Rate in terms of Dollar/Rial, Monthly, Economic Trends, Published by Central Bank of Iran (CBI)

MPI: Import Price Index, Quarterly, (1997=100), Published at Economic Trends, Central Bank of Iran (CBI)

WPI: Import Price Index, Quarterly, (1997=100), Published at Economic Trends, Central Bank of Iran (CBI)

CPI: Consumer Price Index, Quarterly, (1997=100), Published at Economic Trends, Central Bank of Iran (CBI)

GAP: Defined as the difference between potential and actual Gross Domestic Production

Actual GDP: Gross Domestic Production, at constant prices 1997, after seasonal adjustment in terms of billion Rials, Quarterly, Published at Economic Trends, Central Bank of Iran (CBI)

Potential GDP: Calculated by using Hodrick-Prescott Filter (lambda=1600) for actual GDP

M2: Liquidity in terms of Billion Rials, Quarterly, Published at Economic Trends, Central Bank of Iran (CBI)

Note: Date of the beginning of the year in Iran is 21 March.

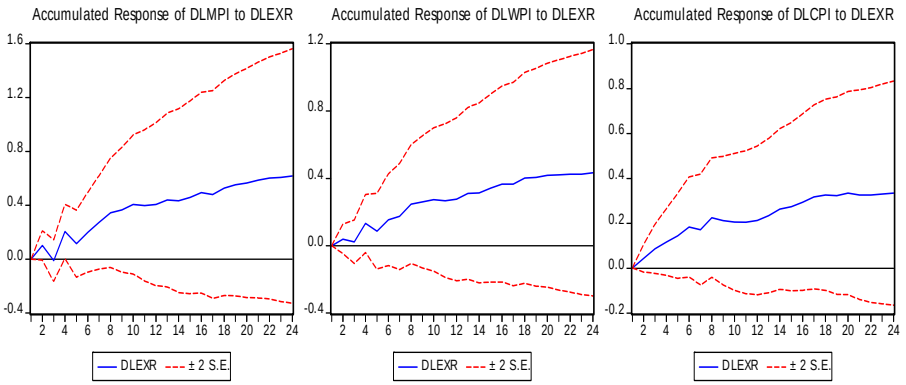
A- Results Appendix

A.2- Figures

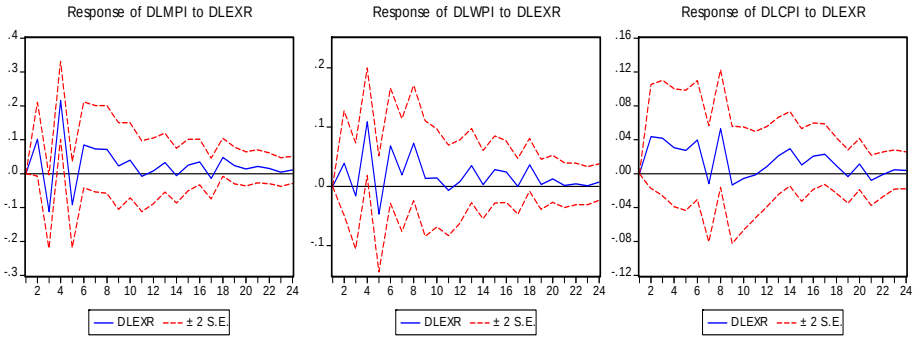
Exchange Rate Pass-Through into

Import Price Index (MPI) ,Wholesale Price Index (WPI), Consumer Price Index (CPI)

Figure(A-2-2):Accumulated Response to one Unit DLEXR



Figure(A-2-1):Response to one Unit DLEXR Innovations



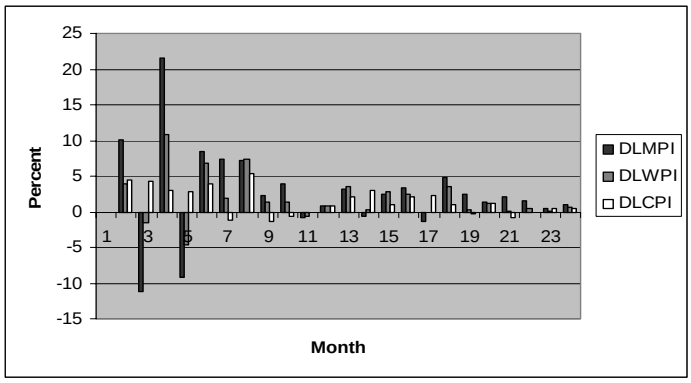


Figure (A-2-3): Exchange Rate Pass-Through into Price Indexes

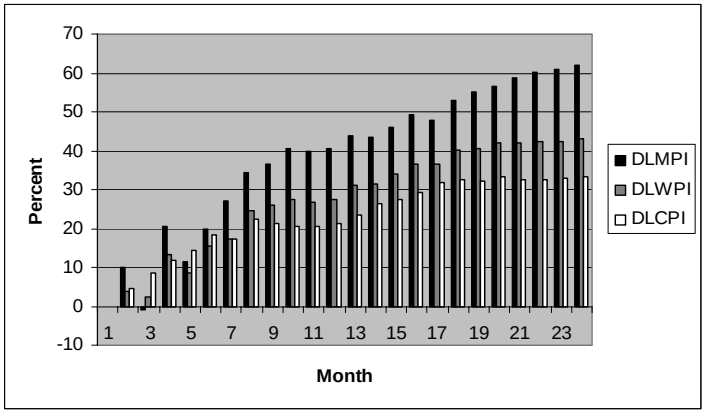


Figure (A-2-4): Accumulated Exchange Rate Pass-Through into Price Indexes

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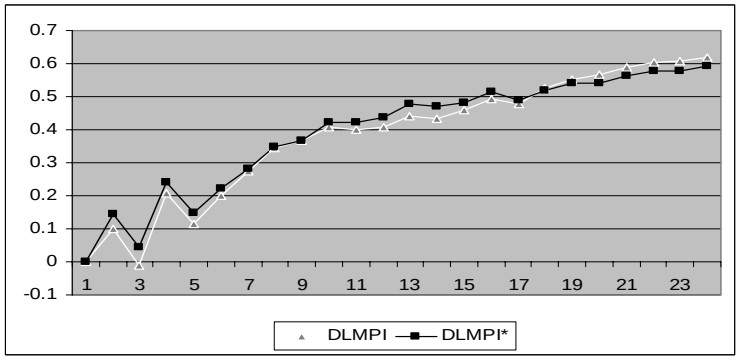
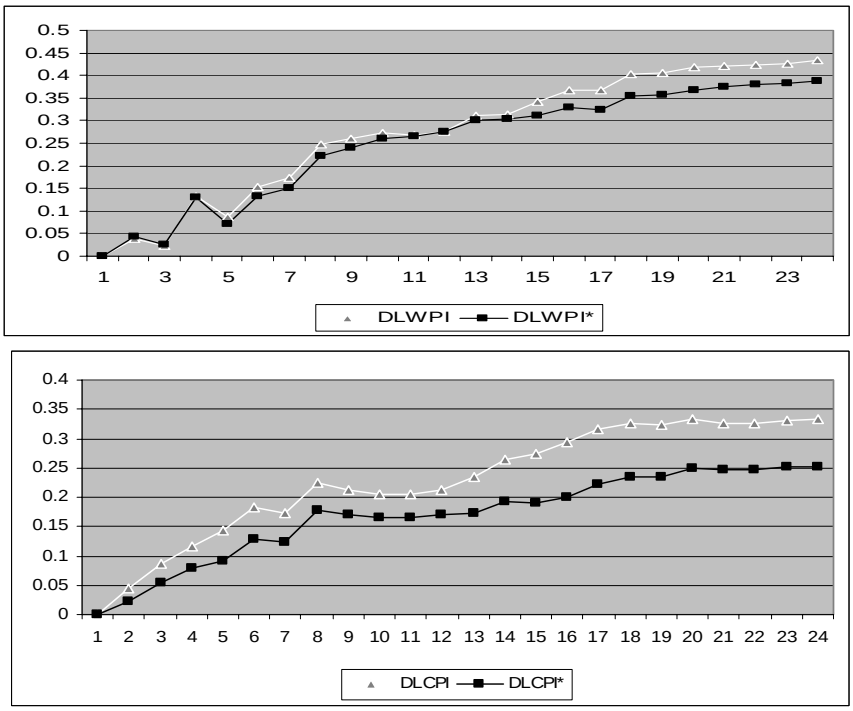


Figure (A-2-5): Accumulated Exchange Rate Pass-Through into Price Indexes in the Models with and without GAP



B- Tables

Table (B-1)

Augmented Dickey Fuller Unit Root Test (ADF)				
Variable	**With Intercept**		**With Intercept and Trend**	
	Level	**First Difference**	**Level**	**First Difference**
LEXR	ADF(0)=-1.41	ADF(0)=-11.24	ADF(1)=-0.92	ADF(0)=-11.30
LMPI	ADF(2)=-2.99	ADF(1)=-8.02	ADF(0)=-1.10	ADF(1)=-8.75
LWPI	ADF(0)=-4.36	-	ADF(0)=-0.25	ADF(0)=-12.68
GAP	ADF(2)=-6.63	-	ADF(2)=-6.61	-
LM2	ADF(12)=-0.02	ADF(11)=-2.67	ADF(12)=-2.41	ADF(11)=-2.66
LCPI	ADF(1)=-2.16	ADF(0)=-8.62	ADF(1)=-0.57	ADF(0)=-8.94

Note: The value in parentheses is the order of the lag used, which is decided by using the Schwartz information criteria. The null hypothesis in each case is that the variable is integrated of order one and therefore it is non-stationary. In the first case (With Intercept) the 5% rejection region for the Dickey-Fuller statistic is ADF < -2.89, and the 1% rejection region is ADF < -3.46. In the first case (With Intercept and Trend) the 5% rejection region for the Dickey-Fuller statistic is ADF < -3.48 and the 1% rejection region is ADF < -4.11.

Table (B-2)

Philips- Peron Unit Root Test (PP)				
Variable	**With Intercept**		**With Intercept and Trend**	
	Level	**First Difference**	**Level**	**First Difference**
LEXR	PP(2)=-1.60	PP(6)=-11.13	PP(2)=-0.75	PP(7)=-11.17
LMPI	PP(6)=-4.06	-	PP(6)=-1.15	PP(7)=-14.60
LWPI	PP(7)=-3.41	PP(8)=-12.75	PP(7)=-0.49	PP(7)=-13.11
GAP	PP(4)=-14.93	-	PP(4)=-14.89	-
LM2	PP(11)=0.39	PP(10)=-21.18	PP(3)=-2.41	PP(10)=-21.19
LCPI	PP(5)=-2.08	PP(1)=-8.59	PP(5)=-0.26	PP(3)=-8.91

Note: the value in parentheses is the number of bandwidth (according to the Newey-West using Bartlett kernel). The null hypothesis in each case is that the variable is integrated of order one and therefore it is non-stationary. In the first case (With Intercept) the 5% rejection region for the Philips-Peron statistic is PP < -2.89, and the 1% rejection region is PP < -3.46. In the first case (With Intercept and Trend) the 5% rejection region for the Philips-Peron statistic is PP < -3.48 and the 1% rejection region is PP < -4.11.

Table (B-3): Results of Pairwise Granger Causality Tests

Variable	DLEXR	DLMPI	DLWPI	GAP	DLM2	DLCPI
DLEXR	-	→	-	→	-	-
DLMPI	→	-	→	→	-	-
DLWPI	-	-	-	→	-	-
GAP	→	-	-	-	→	-
DLM2	-	-	-	-	-	→
DLCPI	-	→	→	→	-	-

Note:→ indicates the direction of Granger Causality and – means variable in row does not cause variable in column.

Table (B-4): Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Probability
DLEXR does not Granger Cause DLCPI	193	2.32293	0.12914
DLCPI does not Granger Cause DLEXR		1.66346	0.1987
DLM2 does not Granger Cause DLCPI	189	19.0767	0.000021
DLCPI does not Granger Cause DLM2		0.20025	0.65504
DLMPI does not Granger Cause DLCPI	192	0.05406	0.8164
DLCPI does not Granger Cause DLMPI		8.2621	0.00451
DLWPI does not Granger Cause DLCPI	190	0.67354	0.41287
DLCPI does not Granger Cause DLWPI		23.9811	2.10E-06
GAP does not Granger Cause DLCPI	190	0.19226	0.66155
DLCPI does not Granger Cause GAP		6.51371	0.0115
DLM2 does not Granger Cause DLEXR	189	0.00272	0.95849
DLEXR does not Granger Cause DLM2		1.35024	0.24673
DLMPI does not Granger Cause DLEXR	192	6.30207	0.0129
DLEXR does not Granger Cause DLMPI		2.94484	0.08779
DLWPI does not Granger Cause DLEXR	190	2.20597	0.13916
DLEXR does not Granger Cause DLWPI		1.47589	0.22595
GAP does not Granger Cause DLEXR	190	3.29219	0.07121
DLEXR does not Granger Cause GAP		6.00328	0.0152
DLMPI does not Granger Cause DLM2	189	1.30824	0.25418
DLM2 does not Granger Cause DLMPI		0.00141	0.97013
DLWPI does not Granger Cause DLM2	186	1.32103	0.25191
DLM2 does not Granger Cause DLWPI		0.17241	0.67846
GAP does not Granger Cause DLM2	189	1.85565	0.09111
DLM2 does not Granger Cause GAP		0.00444	0.94692
DLMPI does not Granger Cause DLWPI	189	3.40117	0.06674
DLWPI does not Granger Cause DLMPI		0.88065	0.34924
GAP does not Granger Cause DLMPI	190	0.00422	0.94829
DLMPI does not Granger Cause GAP		3.94287	0.04853
GAP does not Granger Cause DLWPI	187	1.35505	0.2459
DLWPI does not Granger Cause GAP		4.15167	0.04303

Table (B-5): Response of DLMPI, DLWPI and DLCPI to One Unite Exchange Rate Innovation

Period	DLMPI	DLWPI	DLCPI
1	0	0	0
2	0.101801	0.039207	0.043915
3	-0.111968	-0.016026	0.041841
4	0.216231	0.108984	0.030625
5	-0.091688	-0.046578	0.027369
6	0.084804	0.068675	0.039806
7	0.073326	0.019319	-0.011796
8	0.07136	0.073007	0.05324
9	0.022469	0.013188	-0.013327
10	0.039959	0.014181	-0.00575
11	-0.00755	-0.006847	-0.001391
12	0.008221	0.008439	0.008368

Table (B-6): Accumulative Response of DLMPI, DLWPI and DLCPI to One Unite Exchange Rate Innovation

Period	DLMPI	DLWPI	DLCPI
1	0	0	0
2	0.101801	0.039207	0.043915
3	-0.010166	0.02318	0.085756
4	0.206064	0.132164	0.116381
5	0.114376	0.085586	0.14375
6	0.19918	0.154262	0.183556
7	0.272506	0.17358	0.17176
8	0.343866	0.246588	0.225
9	0.366335	0.259775	0.211673
10	0.406294	0.273956	0.205923
11	0.398744	0.267109	0.204533
12	0.406965	0.275548	0.212901

Note: In Varianec Decomposition considered Cholesky Ordering is:DLEXR DLMPI DLWPI GAP DLM2 DLCPI

Table(B-7): Variance Decomposition of DLMPI

Period	S.E.	DLEXR	DLMPI	DLWPI	GAP	DLM2	DLCPI
1	0.039411	1.411488	98.58851	0	0	0	0
2	0.042896	6.241878	90.34138	0.018207	0.180593	0.370125	2.847817
3	0.043864	5.747863	79.93712	3.679207	5.897794	0.32472	4.413296
4	0.045056	19.02088	65.19181	6.983399	4.752362	0.439171	3.612369
5	0.046461	18.61308	63.33435	7.65996	5.72121	0.68662	3.98478
6	0.046935	20.53672	60.26241	7.44939	6.773917	0.967052	4.010512
7	0.048893	20.73184	60.89016	7.18013	6.388966	0.930247	3.87865
8	0.050009	21.75463	59.05743	8.128539	6.323851	0.973914	3.761628
9	0.050657	22.0093	58.37026	8.373107	6.334179	0.998345	3.914816
10	0.051084	21.98734	58.07588	8.520424	6.353545	1.149998	3.912815
11	0.051217	21.7128	57.67231	9.24538	6.386171	1.131588	3.851749
12	0.051412	21.59515	57.74937	9.291069	6.38505	1.125286	3.854069

Table(B-8): Variance Decomposition of DLWPI

Period	S.E.	DLEXR	DLMPI	DLWPI	GAP	DLM2	DLCPI
1	0.039411	8.827083	54.39364	36.77927	0	0	0
2	0.042896	10.83227	48.14214	32.5576	2.719977	0.199876	5.548137
3	0.043864	10.82964	45.71846	32.94385	2.945565	0.249811	7.312669
4	0.045056	18.43488	39.12717	33.18988	2.544651	0.214937	6.488487
5	0.046461	17.98034	38.2002	33.43312	3.697591	0.363132	6.325614
6	0.046935	19.05534	37.64445	32.99403	3.718282	0.381145	6.206755
7	0.048893	17.71676	38.44102	33.65541	3.815276	0.536423	5.835109
8	0.050009	19.06129	36.76259	33.59542	3.794547	0.54036	6.245781
9	0.050657	19.06742	36.67948	33.32607	3.8403	0.670814	6.415916
10	0.051084	18.99011	36.58641	33.19192	3.981608	0.669611	6.580337
11	0.051217	18.77007	36.66864	33.26183	4.088686	0.658686	6.552091
12	0.051412	18.75847	36.65226	33.09599	4.306945	0.66341	6.522932

Table(B-9):Variance Decomposition of DLCPI

Period	S.E.	DLEXR	DLMPI	DLWPI	GAP	DLM2	DLCPI
1	0.039411	20.15795	10.21475	30.68839	2.336408	0.729973	35.87253
2	0.042896	24.12479	7.87616	26.41778	2.18222	8.799682	30.59937
3	0.043864	25.39229	7.447357	25.79456	3.807864	8.30894	29.24899
4	0.045056	26.29074	7.05256	27.6233	3.586059	7.807115	27.64023
5	0.046461	26.00546	6.918504	27.15171	3.518738	9.0995	27.30609
6	0.046935	25.16878	6.693648	28.49883	3.402582	8.93286	27.3033
7	0.048893	23.68767	9.641682	28.94678	3.577969	8.714315	25.43158
8	0.050009	24.8298	10.04708	28.07325	3.623181	8.612776	24.81392
9	0.050657	24.20761	10.98833	28.13861	3.545288	8.899737	24.22043
10	0.051084	24.16759	11.00736	28.11502	3.619752	8.91073	24.17955
11	0.051217	24.04183	11.35582	27.94751	3.582307	8.81951	24.25302
12	0.051412	24.04027	11.2193	28.17231	3.935211	8.691411	23.9415

Exchange Rate Pass-Through to into Price Indexes in the Model without GAP

Table (B-10):Response of DLMPI*, DLWPI* and DLCPI* to one unit DLEXR Innovation

Period	DLMPI*	DLWPI*	DLCPI*
1	0	0	0
2	0.101801	0.039207	0.043915
3	-0.111968	-0.016026	0.041841
4	0.216231	0.108984	0.030625
5	-0.091688	-0.046578	0.027369
6	0.084804	0.068675	0.039806
7	0.073326	0.019319	-0.011796
8	0.07136	0.073007	0.05324
9	0.022469	0.013188	-0.013327
10	0.039959	0.014181	-0.00575
11	-0.00755	-0.006847	-0.001391
12	0.008221	0.008439	0.008368
13	0.032695	0.035013	0.020978
14	-0.005737	0.002881	0.029414
15	0.025322	0.028308	0.010251
16	0.034511	0.024499	0.02062
17	-0.014294	-7.25E-06	0.022945
18	0.048162	0.036361	0.009404
19	0.024148	0.003368	-0.003553
20	0.013979	0.012527	0.011341
21	0.021602	0.001705	-0.007685
22	0.015407	0.004157	-0.000887
23	0.004586	0.001048	0.004691
24	0.010865	0.007154	0.004001

**Table (B-11):Accumulated Response of DLMPI*, DLWPI*, DLCPI*
To on unit DLEXR Innovation**

Period	DLMPI*	DLWPI*	DLCPI*
1	0	0	0
2	0.101801	0.039207	0.043915
3	-0.010166	0.02318	0.085756
4	0.206064	0.132164	0.116381
5	0.114376	0.085586	0.14375
6	0.19918	0.154262	0.183556
7	0.272506	0.17358	0.17176
8	0.343866	0.246587	0.225
9	0.366335	0.259775	0.211673
10	0.406294	0.273956	0.205923
11	0.398744	0.267109	0.204533
12	0.406965	0.275548	0.212901
13	0.43966	0.310561	0.233879
14	0.433924	0.313442	0.263293
15	0.459245	0.34175	0.273543
16	0.493756	0.36625	0.294164
17	0.479463	0.366242	0.317109
18	0.527625	0.402604	0.326513
19	0.551772	0.405971	0.32296
20	0.565752	0.418498	0.334301
21	0.587354	0.420203	0.326616
22	0.602761	0.42436	0.325728
23	0.607347	0.425407	0.330419
24	0.618212	0.432561	0.33442