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Have Economic Reforms Affected Exchange Rate Pass-Through to Prices in India?

JEEVAN KUMAR KHUNDRAKPAM

This paper examines the behaviour of exchange rate pass-through to domestic prices in India after the reforms initiated in the early 1990s. Unlike observed in several countries, it finds a rise in exchange rate pass-through to domestic prices until recent years. Besides economic factors typically associated with economic liberalisation, the persistence of higher inflation is an important factor for the rise in pass-through.

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A macroeconomic puzzle of the 1990s is the phenomenon of low inflation despite episodes of large currency depreciation in several countries. In the cross-country context, this is shown to be the results of the low global inflationary environment itself [Taylor 2000; Choudhri and Hakura 2001; Gagnon and Ihrig 2004]. Several other factors such as exchange rate volatility, import penetration, openness, import composition, trade distortions, transport costs and income have also been identified as important determinants of pass-through [Goldfajn and Werlang 2000; Campa and Goldberg 2004 and Frankel et al 2005]. With economic reforms, these macroeconomic variables determining exchange rate pass-through undergo substantial transformation during the transition.

In India, since the early 1990s economic reforms were initiated on several fronts and have led to a market determined exchange rate, full convertibility in the current account, a substantial reduction in peak and weighted average tariff rates, abolition of import licensing and quantitative restrictions, encouragement of foreign investment through liberalisation and simplifying procedures, abolition of industrial licensing, allowing private sectors in areas earlier reserved for the public sector, decontrol of interest rates, reduction in pre-emption of banking resources and enforcing capital adequacy and prudential norms, government borrowing at market rates and discontinuation of automatic monetisation of deficit, and gradual liberalisation of administrative price control mechanism on a number commodities.

Have the economic reforms affected the exchange rate pass-through to domestic prices in India? Do we observe the same declining phenomenon as in several countries? Currently, there is not much literature on India. The cross-country studies which have included India do not indicate temporal behaviour. This paper, using monthly data further investigates the behaviour of exchange rate pass-through to domestic prices during the post-economic reforms period.

The rest of the paper has six sections. Section 1 provides a review of the literature to identify factors determining pass-through. In Section 2, the data issues and the stylised facts are briefly discussed. The empirical framework is laid out in Section 3 and the results are presented in Section 4. Section 5 provides a conjectural explanation for the observed trend in pass-through. The final section summarises.

1 What Determines Pass-Through?

In the traditional open-economy macroeconomic models, under purchasing power parity (PPP) assumption, exchange rate pass-through to domestic prices is always immediate and

complete. Thus, research on it was microeconomic in nature and the explanation for the evidence of incomplete pass-through was based on imperfect competition and pricing to market theory [Dornbusch 1987 and Krugman 1987]. Firms, in order to maintain market share, adjust their mark-up instead of fully passing the exchange rate movement to prices [for a survey, see Goldberg and Knetter 1996].

Table 1: Annualised Average Inflation, Exchange Rate and Their Volatility (in %)

Period	Average Inflation	Inflation Volatility	Average Exchange Change	Exchange Volatility
1990:4 to 1995:3	10.24	6.70	11.19 (7.46)	34.81 (19.59)
1995:4 to 2000:3	5.00	6.46	2.91	20.22
2000:4 to 2005:3	4.53	5.27	0.08	21.61
Overall	6.25	6.67	4.73 (3.46)	26.65 (20.6)

Figure in parentheses are excluding the devaluation in July 1991.
Volatility is measured by the standard deviation.

Analysing pass-through from a macroeconomic perspective is related to developments in open-economy macroeconomics literature beginning with Obstfeld and Rogoff (1995), and its further extension by Betts and Devereux (1996, 2000) and others. In this new open macroeconomic model, pass-through depends upon the pricing strategy of firms. Under producer currency pricing (PCP), the home currency price of foreign goods will move one-for-one with changes in the nominal exchange rate, i e, pass-through is complete. With local currency pricing (LCP), there is no change in the short-run prices faced by the consumer, and thus, no pass-through. The aggregate pass-through, therefore, depends upon the combination of firms practising PCP and LCP [Betts and Devereux 1996 and Engle 2002].

Another influential view, based on staggered price setting and monopolistic competition behaviour of firms, is that a credible low inflation regime leads to a lower pass-through [Taylor 2000].

1.1 Cross-country Evidence

Before providing evidence from the literature, it may be appropriate to point out that there are different stages of exchange rate pass-through to domestic prices. First, the change in exchange rate impacts the import prices (called the first stage of pass-through) and the resulting change in the import prices in turn affects the other domestic prices (second stage of pass-through).

Goldfajn and Werlang (2000), using a sample of 71 countries find that the main determinants of pass-through are the cyclical component of output, the initial overvaluation of the real exchange rate (RER), the initial rate of inflation and the degree of openness. Among them, the RER misalignment is the most important determinant for emerging markets while it is the initial inflation for developed countries.

For pass-through to import prices, Campa and Goldberg (2004) for 25 Organisation for Economic Cooperation and Development (OECD) countries find the composition of imports to be more important in explaining the behaviour of pass-through than inflation and exchange rate volatility.[1]

On domestic prices, Choudhri and Hakura (2001) in a study of 71 countries, consisting of both developed and developing countries, find a strong positive association between pass-through and the average inflation rate across countries. The inflation rate was found to dominate other macroeconomic variables in explaining the cross-country differences in the pass-through. Similarly, in 122 countries, Devereux and Yetman (2003) find a positive non-linear relationship between pass-through and mean inflation and exchange rate.

Gagnon and Ihrig (2004) further test whether the change in pass-through in 20 industrialised countries is explained by the change in inflation regime. Relating the estimated pass-through for pre- and post-inflation regime change for each country with the corresponding inflation regimes, they find that the decline in pass-through is explained by the fall in inflation variability. Bailliu and Fujii (2004) for 11 industrialised countries also find that pass-through declined with a shift to low-inflation environment brought about by change in monetary policy.

Frankel et al (2005) on eight select goods of 76 countries during 1990-2001 also find decline in pass-through, which was much more rapid for developing countries than high-income countries. They find that per capita income, bilateral distance, tariffs, country size, wages, long-term exchange rate variability and long-term inflation are important determinants of pass-through.

Figure 1: Five Years Rolling Average Inflation and Volatility

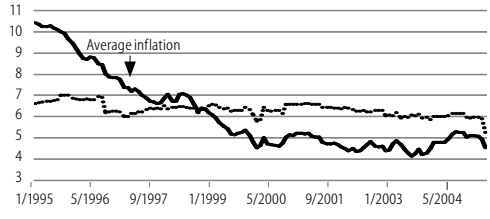


Figure 2: Five Years Rolling Average Exchange Rate Change and Volatility

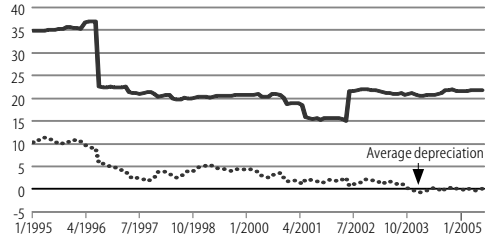
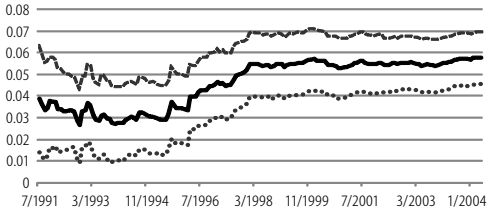


Figure 3: Recursive Estimates of Coefficient



1.2 VAR Approach

Pass-through is also analysed under a recursive VAR framework by assessing the impulse responses and variance decomposition of various prices along the distribution chain obtained from shocks to exchange rate and import prices. For six industrialised countries, the pass-through is found to decline along the distribution chain, with only a modest effect on consumer prices. Further, the pass-through is found to be stronger for a more open economy [McCarthy 1999].

Several studies adopting this approach in individual countries have found lower pass-through along the distribution chain, and decline in the pass-through with lower inflation [Bhundia 2002 for South Africa; Leigh and Rossi 2002 for Turkey; and Belaisch 2003 for Brazil]. Kang and Wang (2003), however, find that in Thailand and Korea the pass-through increased after the Asian crisis due to higher exchange rate volatility resulting from adoption

of free-floating exchange rate regime and increase in trade to GDP ratio.

1.3 Asymmetry and Non-linearity

Pass-through can differ between depreciation and appreciation (asymmetry), and between large and small change (non-linearity). When firms face capacity constraints and/or there are trade restrictions, pass-through is higher for depreciation than appreciation [Knetter 1994; Pollard and Coughlin 2004].

Table 2: Model Estimates and Robustness Tests-1990:2 to 2005:3

Model	Constant	Δe_t	ΔP^*_t	ΔY_t	ΔP_{t-1}	$Fshock_t$	ΔM_{t-1}	R^2	LM
Model a	0.0037	0.069	0.373	0.052				0.46	1.67
	(10.4)	(5.0)	(5.4)	(2.3)					
Model b	0.0023	0.068	0.46	0.044	0.254			0.52	2.27
	(4.9)	(5.2)	(6.7)	(2.1)	(4.5)				
Model c	0.0022	0.057	0.39	0.042	0.30	0.14		0.62	0.09
	(5.3)	(4.9)	(6.3)	(2.2)	(5.9)	(6.8)			
Model d	0.001	0.056	0.40	0.037	0.31	0.13	0.088	0.62	0.02
	(1.4)	(4.8)	(6.5)	(1.9)	(6.1)	(6.1)	(1.9)		

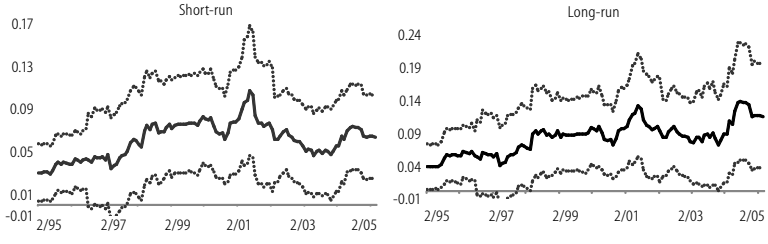
The figures in the parentheses are t-statistics; The reported statistics on LM test for serial correlation is f-statistics.

When firms are building up market share, appreciation allows firms to lower import prices even while maintaining their mark up, while depreciation leads to reduction in mark-up to keep price unchanged to maintain market share [Knetter 1994].

The non-linearity in pass-through arises in the presence of the menu cost and depends on the type of price invoicing. Under PCP, a small changes in the exchange rate are passed-though, but a large changes are absorbed by altering the invoice price, while the opposite happens with LCP [Pollard and Coughlin 2004].

Many empirical studies support asymmetry in pass-through, but the directions have varied. For the US, Mann (1986) found higher pass-through during appreciation than depreciation. For seven Asian countries, Webber (2000) finds the opposite to hold. With regard to non-linear response, Ohno (1989) finds Japanese export prices to respond more to large exchange rate changes than small changes. For 30 US import industries, Pollard and Coughlin (2004) also find most firms responding positively to the size of exchange rate change.

Figure 4: Rolling Regressions Coefficients



1.4 Factors Explaining Pass-Through

Thus, several factors affecting exchange rate pass-through can be identified: first, higher inflation and its volatility would lead to higher pass-through and vice versa; second, the impact of exchange rate volatility is not unambiguous, though some of the studies find that the higher the misalignment of RER higher is the pass-through; third, a higher import penetration ratio and higher imports and exports to GDP ratio lead to higher pass-through; fourth, the composition of imports with varying degrees of pass-through affects aggregate pass-through even when they remain unchanged for individual components. Fifth, trade distortions resulting from tariffs and quantitative restrictions by acting as a barrier to arbitrage of goods between countries would lead to lower pass-through. Sixth, in the presence of asymmetry and non-linearity, the pass-through would depend upon the period of appreciation and depreciation and the size of exchange rate change during various sub-periods.

2 Data Issues and Stylised Facts

This section discusses the data issues and stylised facts.

2.1 Source of Data

We use the monthly data during the period 1990:1 to 2005:3 from the *Handbook of Statistics on Indian Economy* (Reserve Bank of India). The variables are: wholesale price index (P)[2], nominal effective exchange rate (e) defined as domestic currency per unit of foreign currency, index of industrial production (Y), broad money (M), and trade weighted foreign prices (P*). Trade weighted foreign prices is derived using the definition of real effective exchange rate adopted by RBI. As the real effective exchange rate (rer) is defined as weighted average of nominal effective exchange rate (e) $\times$ [wholesale price inflation (P) $\div$ foreign inflation (P*)], we can derive $P^* = (e \times P) \div rer$.[3] All the series are seasonally adjusted.

2.2 Some Stylised Facts

The annualised month-to-month average inflation rate, exchange rate change and their volatility for sub-sample period of five years in Table 1 (p 72) shows decline in average inflation and its volatility, particularly the former. The average depreciation rate also declined considerably due to increasing two way movements in the more recent times. On the other hand, the decline in volatility was far less prominent, particularly with the exclusion of depreciation in July 1991.

The rolling five years average in Figure 1 (p 72) show that the annualised average month-to-month inflation declined from over 10 per cent to around 4 to 5 per cent. Volatility also declined but to much lesser extent.

Similarly, the average rate of depreciation steadily declined due to increasing two way movements, resulting in appreciation in the more recent period (Figure 2, p 72). The volatility, excluding the major devaluations in July 1991, on the other hand, appears to have not changed much.

3 Empirical Framework

We discuss here the model used in the exercise.

3.1 Model Estimated

Drawing on the literature [Bailliu and Fujii 2004], a reduced form specification is derived from the profit maximising behaviour of an exporting foreign firm of the following type,

$$\underset{P}{\text{Max}}\,\pi = e^{-1}PQ - C(Q) \qquad \ldots(1)$$

where 'π' is profit in exporting firm's currency, 'e' is the exchange rate of domestic currency per exporting firms currency, 'P' is price in domestic currency, C(Q) is the cost function in exporting

firm's currency and 'Q' is the quantity demanded. The first order condition for maximisation of (1) is derived as,

$$P = eC_q\mu \quad ...(2)$$

where 'C_q' is the marginal cost and 'μ' is the mark-up over marginal cost which depends on the price elasticity of demand of the good. Thus, the price in domestic currency 'P' can change as a result of exchange rate, change in marginal cost of the firm and mark-up. The marginal cost will change because of local input cost, while the mark-up can change due to change in demand factors in the domestic country. Thus, in reduced form, the price equation is written as,

$$P_t = \alpha_o + \alpha_1 e_t + \alpha_2 P^*_t + \alpha_3 Y_t + \varepsilon_t \quad ...(3)$$

where 'P^*' is exporting firm's marginal cost and 'Y' is domestic demand conditions, with α_1 as the measure of pass-through. In the literature, variants of (3) are used to estimate pass-through [Golberg and Knetter 1996].

To estimate pass-through at the aggregate price level, the following issues needs to be taken into account, and accordingly adapt (3). As macroeconomic variables such as price, output and exchange rate are generally assumed to follow a non-stationary process I(1), the specifications are commonly used in first difference, i e, in the form of an inflation equation [Bailliu and Fujii 2004 among others]. In our case, as the unit root properties discussed in the Appendix (p 78) show that all the variables are stationary in first difference, and are in any case not cointegrated in level form, we also consider the specification in first difference in order avoid spurious relationship. Second, the lagged effects of the explanatory variables need to be taken into account, leading to an inflation equation of the type.

Table 3: Trend Fits on Rolling Regression Coefficients

Pass-Through	α_1	$\alpha_1+\alpha_3$	R-bar Square	Wald Test $\alpha_1=0$	Wald Test $\alpha_1+\alpha_3=0$
Short-run	0.00023		0.23	37.0	
	(6.1)			[0.00]	
Short-run	0.0008	-0.00013	0.76	386	1.60
	(19.6)	(-1.3)		[0.00]	[0.21]
Long-run	0.0005		0.62	201.0	
	(14.2)			[0.00]	
Long-run*	0.0008	0.0013	0.75	236.0	50.0
	(15.4)	(7.1)		[0.00]	[0.00]

The figures in round brackets are t-statistics and those in square brackets are p-values; * Each of the slope coefficients in the two sample periods are greater than the average for the full period, which is accounted by decline in intercept dummy not reported.

$$\Delta P_t = \alpha_o + \alpha_1 \sum_{i=o}^{n} \Delta e_{t-i} + \alpha_2 \sum_{i=o}^{n} \Delta P^*_{t-i} + \alpha_3 \sum_{i=o}^{n} \Delta Y_{t-i} + \varepsilon_t \quad ...(4)$$

Third, (4) being an inflation equation, we account for inflation persistence by following an adaptive expectations approach and include lags of inflation. This also allows us to distinguish between short- and long-run pass-through.

$$\Delta P_t = \alpha_o + \alpha_1 \sum_{i=1}^{n} \Delta P_{t-i} + \alpha_2 \sum_{i=o}^{n} \Delta e_{t-i} + \alpha_3 \sum_{i=o}^{n} \Delta P^*_{t-i} + \alpha_4 \sum_{i=o}^{n} \Delta Y_{t-i} \quad ...(5)$$

Fourth, in India shock in primary commodities, particularly food prices, due to adverse supply conditions often affects the general price level. Following Mohanty and Klau (2001) food price shock 'fshock' is defined as the excess of current food price inflation over the general price inflation of the previous year, leading to the following specification.

$$\Delta P_t = \alpha_o + \alpha_1 \sum_{i=1}^{n} \Delta P_{t-i} + \alpha_2 \sum_{i=o}^{n} \Delta e_{t-i} + \alpha_3 \sum_{i=o}^{n} \Delta P^*_{t-i} + \alpha_4 \sum_{i=o}^{n} \Delta Y_{t-i} + \alpha_5 \sum_{i=o}^{n} \text{fshock}_{t-i} + \varepsilon_t \quad ...(6)$$

Finally, as much of the monitoring of inflationary situation in India is done through the monitoring of growth of money supply, it is also included as an additional variable. Thus, the final augmented equation is of the following type.[4]

$$\Delta P_t = \alpha_o + \alpha_1 \sum_{i=1}^{n} \Delta P_{t-i} + \alpha_2 \sum_{i=o}^{n} \Delta e_{t-i} + \alpha_3 \sum_{i=o}^{n} \Delta P^*_{t-i} + \alpha_4 \sum_{i=o}^{n} \Delta Y_{t-i} + \alpha_5 \sum_{i=o}^{n} \text{fshock}_{t-i} + \alpha_6 \sum_{i=o}^{n} \Delta M_{t-i} + \varepsilon_t \quad ...(7)$$

where 'M' stands for money supply. The lagged inflation term gives the speed of pass-through to inflation. The short-run pass-through coefficient is given by α_2 and the long-run coefficient by $\alpha_2/(1-\alpha_1)$.

3.2 Asymmetry and Non-linearity

The asymmetry and non-linearity is estimated by interaction of the exchange rate variable with appropriate dummies in the following manner.

Asymmetry: Two dummies for appreciation and depreciation respectively are:

$D_A = 1$ for $\Delta e < 0$, 0 otherwise and $D_D = 1$ for $\Delta e > 0$, 0 otherwise

Interaction of the above dummies with exchange rate change yields the equation

$$\Delta P_t = \alpha_o + \alpha_1 \sum_{i=1}^{n} \Delta P_{t-i} + \alpha_{2A} \sum_{i=o}^{n} D_A \Delta e_{t-i} + \alpha_{2D} \sum_{i=o}^{n} D_D \Delta e_{t-i} + \alpha_3 \sum_{i=o}^{n} \Delta P^*_{t-i} + \alpha_4 \sum_{i=o}^{n} \Delta Y_{t-i} + \alpha_5 \sum_{i=o}^{n} \text{fshock}_{t-i} + \alpha_6 \sum_{i=o}^{n} \Delta M_{t-i} + \varepsilon_t \quad ...(8)$$

with α_{2A} and α_{2D} as the pass-through coefficients for appreciation and depreciation, respectively.

Non-linearity: The two dummies for absolute large and small change respectively, are:

$D_L = 1$ for $\Delta e >$ threshold, 0 otherwise and $D_S = 1$ for $\Delta e <$ threshold, 0 otherwise

Interaction of the above dummies with exchange rate change yields the equation,

$$\Delta P_t = \alpha_o + \alpha_1 \sum_{i=1}^{n} \Delta P_{t-i} + \alpha_{2L} \sum_{i=o}^{n} D_L \Delta e_{t-i} + \alpha_{2S} \sum_{i=o}^{n} D_S \Delta e_{t-i} + \alpha_3 \sum_{i=o}^{n} \Delta P^*_{t-i} + \alpha_4 \sum_{i=o}^{n} \Delta Y_{t-i} + \alpha_5 \sum_{i=o}^{n} \text{fshock}_{t-i} + \alpha_6 \sum_{i=o}^{n} \Delta M_{t-i} + \varepsilon_t \quad ...(9)$$

with α_{2L} and α_{2S} as the pass-through coefficients for large and small changes, respectively.

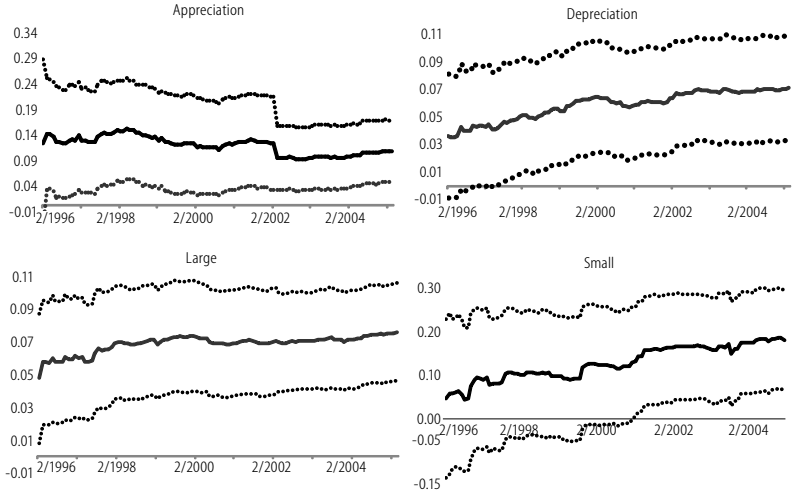
4 Empirical Results

The following are the empirical results.

4.1 Robustness Tests: Table 2 (p 73) presents the results obtained from the estimation of alternative specifications defined by (4) to (7) representing model A to model D, respectively.[5, 6] The model A is well estimated with all the variables statistically significant, has reasonable explanatory power, and does not suffer from serial correlation. There is substantial difference between the coefficient of foreign price (input cost) and the exchange rate. The exchange rate pass-through (0.07 per cent) is much lower than input cost pass-through (0.37 per cent), with Wald test [19.51(0.00)] decisively rejecting the equality between

the two. This can arise as foreign firms consider change in input cost to be more permanent that than exchange rate changes that more of the former is passed-through.

Figure 5: Rolling Regression – Asymmetry and Non-linerity



The inclusion of the autoregressive term (model B) does not alter the pass-through coefficient, though it can differentiate the short-run and long-run pass-through while the explanatory power improves. The alterations in the impact of foreign prices and the domestic demand shocks cannot be considered as fundamentally different. Further inclusion of food price shock (model C) leads to a slight decline in the pass-through coefficients (both the short and long-run), but is not substantial and fundamentally different. The explanatory power improves markedly. Augmenting with change in money supply (model C) hardly makes any difference in terms of the coefficients and the explanatory power compared to model C. Thus, the estimated pass-through coefficients are robust to alternative specifications incorporating important determinants of inflation in India. In the remaining, we analyse pass-through using model C, as we essentially estimate an augmented supply curve and therefore, as mentioned above, including money supply may not be appropriate.

4.2 Comparison of Coefficients with Earlier Estimates: Estimated pass-through coefficients of 0.06 in the short-run and 0.08 to 0.09 in the long-run imply 10 per cent change in exchange rate, and lead to increase in final prices by 0.6 to 0.9 per cent. Such magnitudes of pass-through to final prices are typically estimated and are similar to the estimates of Choudhri and Hakura (2001) of 0.06 and 0.10, respectively for India. The short-run pass-through is larger than the average pass-through of low inflation countries and several industrialised countries, while the long-run pass-through is somewhat lower than the average reported by them on quarterly data for 1979 to 2000. Devereux and Yetman (2003) using annual data during 1970 to 2001, however, estimate a much higher pass-through of 0.36 for India, as inflation gets accumulated over a year while exchange rate change may not be large due to both way movements.

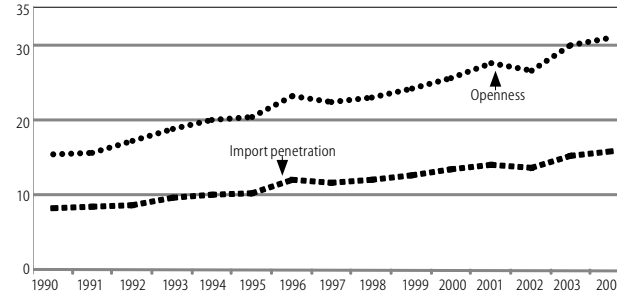
4.3 Stability of Coefficients: The stability of the coefficients using the parameter stability test of Hansen (1991) finds the coefficients to be stable.[7] Andrews and Ploberger (1994) test also reveals no structural break in the individual coefficients and jointly.[8] The recursive estimates of the coefficients, however, show an overall rise in the coefficient of the exchange rate (Figure 3, p 72). Thus, the pass-through coefficient could have undergone a gradual change, which is not captured by the above tests. Thus, we carry out rolling regressions.

4.4 Pass-Through Coefficients from Rolling Regressions[9]: Figure 4 (p 73) shows the short-run and long-run pass-through coefficients obtained from rolling regressions, along with the 90 per cent confidence intervals.[10] It can be seen that the short-run pass-through coefficients rose from about 0.03 to about 0.11 up to mid-2001 and then falls to about 0.07. The rise in the long-run pass-through, on the other hand, is much more consistent and steady, increasing from about 0.04 to more than 0.13.

Two trends were fitted to observe the increase: (1) PT = β_0 + β_1Trend, where PT is the series of pass-through coefficients obtained from the rolling regressions. For $\beta_1 > 0$ pass-though has increased, $\beta_1 < 0$ the pass-through has declined and $\beta_1 = 0$ there is no change. (2) PT = β_0 + (β_2 + β_0) Dummy + β_1 Trend + (β_1 + β_3)Dummy*Trend. Dummy takes the value of 1 from the point of significant trend break and thereafter, and 0 otherwise.[11] The selection criterion is the highest R-bar square. β_1 is the trend before the identified point and thereafter, it is (β_1 + β_3).

Table 3 (p 74) shows that both the short-run and long-run pass-through increased.[12] While the short-run coefficient increased by a monthly average of 0.00023, the long-run coefficient increased by a higher monthly average of 0.0005. The Wald tests indicate that the increases are significantly different from zero. For the short-run coefficient, after increasing by a monthly average of 0.0008, it has levelled off (the Wald test rejects the decline by -0.00013). On other hand, the increase in long-run coefficients accelerates from a monthly average increase of 0.0008 to a monthly average of 0.0013 (the Wald test shows statistical significance).

Figure 6: Openness and Import Penetration Ratio



The positive slope in the trend of rolling regression coefficients, however, does not ensure that the coefficients are statistically different from each other. Therefore, we perform Wald-test between the coefficients of six pairs of windows, viz: the first and the 5th window (with lowest short-run and long-run coefficient) against each of the windows with highest short-run coefficient

(76th), highest long-run coefficient (115th) and the last window (121st). The results are presented in Table 4.

The increases up to the 76th window are significant at 5 per cent to 7 per cent critical values for both the short and the long-run. The short-run pass-through coefficients declines thereafter, and by the 115th window, the increases from the initial windows are statistically insignificant. The long-run pass-through, however, records the highest coefficient by this window and the increase remains significant at the 9 per cent critical value. By the last window, the increase in both the short-run and long-run pass-through coefficients turns statistically insignificant. Thus, during the major part of period under consideration, the exchange rate pass-through to domestic prices, particularly the long-run pass-through, increased.

Table 4: Change in Pass-Through Coefficients and Wald Test

	76th minus 1st	6th minus 5th	115th minus 1st	115th minus 5th	121st minus 1st	121st minus 5th
Short-run	0.077	0.078	0.043	0.044	0.034	0.035
	(0.056)	(0.046)	(0.15)	(0.13)	(0.256)	(0.23)
Long-run	0.094	0.094	0.10	0.10	0.077	0.077
	(0.074)	(0.068)	(0.09)	(0.086)	(0.16)	(0.15)

The reported statistics in brackets are p-values of the F-test of the null that the increase is equal to zero.

4.5 Asymmetry and Non-linearity

Asymmetry: The pass-through is higher for appreciation than depreciation. The respective coefficients shown in Table 5 are 0.07 and 0.10.[13] Following discussion in Section 2 this is expected since most goods were domestically produced irrespective of quality under the erstwhile strategy of industrialisation.

Table 5: Asymmetry and Non-linearity in Pass-Through Coefficients

Asymmetry/	Depreciation		Appreciation		Large		Small	
Non-linearity	Short	Long	Short	Long	Short	Long	Short	Long
Asymmetry	0.05	0.071	0.073	0.105				
	(3.2)	(3.1)	(2.9)	(2.8)				
Non-Linearity								
1) > Sample average					0.053	0.076	0.124	0.178
					(4.4)	(4.2)	(2.6)	(2.5)
2) > Median					0.06	0.079	0.113	0.16
					(4.6)	(4.4)	(1.8)	(1.8)
3) > 0.02					0.047	0.067	0.11	0.156
					(3.7)	(3.6)	(3.8)	(3.7)

Figure in brackets are t-statistics.

Thus, foreign exporters would have faced some degree of competition from the locally produced substitutes, and therefore, expanding or holding of market share would be an important objective. Rolling regression, however, shows that the pass-through from appreciation dips markedly around the beginning of 2002 while that of depreciation rises steadily (Figure 5, p 75).[14]

Non-linearity: With no set criteria to select threshold levels distinguishing large and small absolute exchange rate changes, we considered three levels viz, median (0.91 per cent), sample average (1.33 per cent) and 2 per cent (a value higher than the sample average).[15] As seen from Table 5, the estimated pass-through coefficients are found to be much higher for small than large changes, and do not vary much between the three alternative threshold levels. Pass-through from small changes ranges from 0.156 to 0.178, as against 0.067 to 0.79 for large changes. With most imports in India priced in exporter's currency (PCP) or invoiced in US $ [RBI 2001], the higher pass-through from small exchange rate change is as expected.[16] The rolling regressions, however, show that pass-through from both large and small exchange rate changes increased but flattened out in the later period, particularly that of large exchange rate changes.[17] For small changes, however, the coefficients are statistically significant only in the later periods and continue to show a small rising trend (Figure 5).

5 Explaining Increase in Pass-Through: Conjectural Evidence[18]

We discuss here the various explanations for the increase in pass-through.

5.1 Can Asymmetry and Non-linearity Explain?

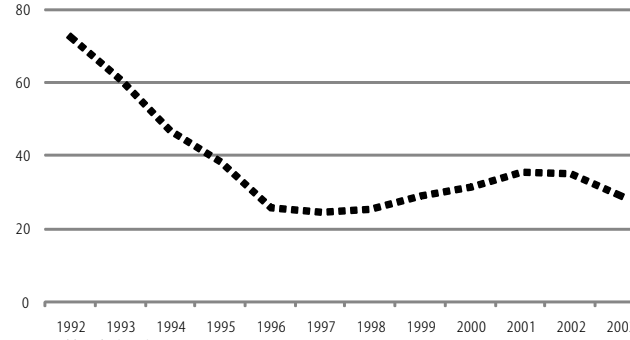
When the pass-through is higher for appreciation, increase in the frequency of appreciations would lead to rise in pass-through. From the data series, it is observed that appreciation accounted for 44 per cent of the total observations, but in the second half and last one-third of the sample period, it accounted for 48 per cent and 52 per cent, respectively. However, the pass-through from appreciation dips markedly around the beginning of 2002.

The frequency of small changes with higher pass-through increased to 67 per cent in the last one-third of the sample period, as against 63 per cent during the total sample period. The pass-through from it also rises but is statistically significant only in the latter period. Thus, it is apparent that rather than the magnitude of asymmetry and non-linearity and their frequencies per se, it is their trends which also explain the overall trend.

5.2 Explaining with Macroeconomic Variables

Exchange Rate Volatility: Devereux and Engel (2001) and Bacchetta and vanWincoop (2001) argue that lower nominal volatility is associated with lower pass-through as currencies of countries with lower exchange rate variability imply a stable monetary policy and is chosen as the currency of invoice. The counter argument is that greater exchange rate volatility implies common and transitory fluctuation and makes firms wary of changing prices for fear of losing market share and adjust profit margins more [McCarthy 1999; Frankel et al 2005]. The empirical evidences are also inconclusive. As against the evidence provided by McCarthy (1999) and Frankel et al (2005) of a negative impact of exchange rate volatility on pass-through, Choudhri and Hakura (2001), Devereux and Yetman (2003) and Kang and Wang (2003) find a positive impact.

Figure 7: Weighted Average Import Duty Rate

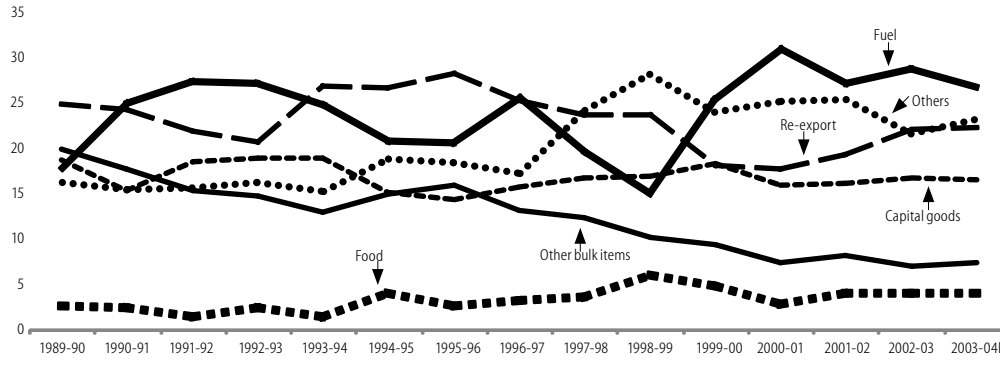


Source: Ahluwalia (2002).

In India, the exchange rate volatility during the period under consideration did not change much due to intervention of RBI to remove extreme volatility (see Table 1 and Figure 2). Therefore, irrespective of the disagreement in the literature, exchange rate volatility might not have played an important role in explaining the observed trend in pass-through.

Openness and Import Penetration: Goldfajn and Werlang (2000) show, and empirically verify, a higher degree of pass-through for more open economy [see also Kang and Wang 2003]. Also, rise in import penetration ratio will lead to rise in pass-through [McCarthy 1999]. In India, with import liberalisation, many local inferior goods produced under the erstwhile import-substitution strategy of industrialisation would likely be substituted by superior imports. Figure 6 (p 75) shows that both import penetration ratio and openness have increased substantially since the beginning of 1990s, indicating a strong possibility for increase in exchange rate pass-through to domestic price.

Figure 8: Import Consumption

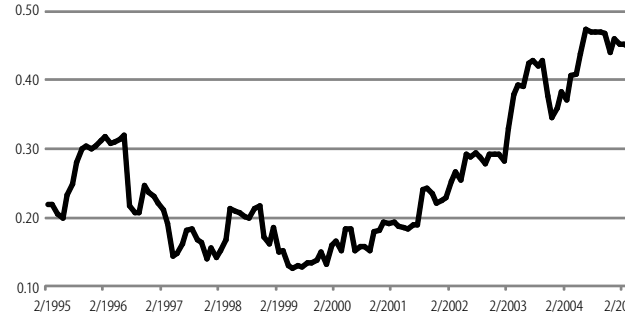


Reduction in Import Tariffs and Removal of Trade Restrictions: Frankel et al (2005) argue that any theory of incomplete pass-through must posit some barrier to arbitrage of a good between country of origin and the country of purchase, and therefore, act against law of one price. Tariff is one such barrier and will have negative effects on the pass-through. They find that the negative pass-through impact of tariff is particularly significant to the CPI of developing countries. A negative relationship between tariff and exchange rate pass-through can also be argued on the following ground. Under PCP as in India, as tariff is levied on the exchange rate change also, a given exchange rate change would impact domestic prices more with higher tariff than with a lower tariff. For instance, other things remaining same, 10 per cent depreciation with 50 per cent tariff rate would increase domestic price by 5 per cent, while it would be 1 per cent at 10 per cent tariff rate. Given a targeted price level in the domestic market to maintain its market share, a firm will absorb a much higher percentage of the depreciation at higher tariff than at a lower tariff, i e, pass-through will be lower with higher tariff than lower tariff. Figure 7 (p 76) shows a marked decline in the level of weighted average import duty from 72.5 per cent in 1992 to 25 per cent in 1997, though the trend reversed somewhat in the next four years. Thus, the fall in the average level of tariff would have led to increase in pass-through, while the reversal in the trend would have reduced pass-through, as observed. Removal of other quantitative trade barriers such as quota should also lead to increase in exchange rate pass-through.

Import Composition: The overall pass-through of exchange rate movements would also depend upon the composition of imports. Items such as fuel, food and raw materials have higher pass-through, while that of manufacturing is lower [see for examples Campa and Goldberg 2004; Otani et al 2003]. Figure 8 shows six components of commodity imports in India since the beginning of the 1990s. Among these six components, the share of energy, food and "others" have increased. Increase in the share of energy and food would lead to increase in overall pass-through, while that of "others" is not certain as they mostly comprise of miscellaneous product not clearly defined.

The remaining three components showed a declining trend, particularly the "other bulk imports". The bulk imports consist of items which are manufactured but in the nature of raw materials such as iron and steel, other metals, paper and paper boards, etc. Share of capital goods, which are manufactured but used as industrial inputs, increased initially and then declined with deceleration in growth of GDP in the second half of the 1990s. As these two components are mostly manufactured intermediate goods, their impact on pass-through is uncertain. Thus, the trend in the share of manufacturing and raw materials including industrial inputs is not clear. However, the rise in the shares of fuel and food could have led to increase in the overall pass-through.

Figure 9: Lagged Coefficient (Inflation Persistence)

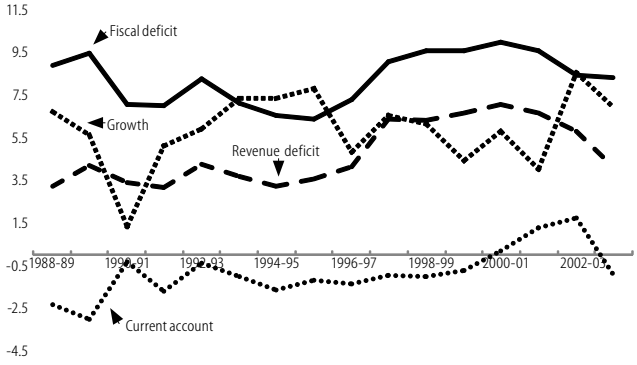


Inflation Persistence: We had observed in Figure 1 that both the average inflation rate and its volatility declined barring periodic spurts due to supply shocks. Literature suggest that they should have led to decline in pass-through, but the change in the other macro variables could have more than neutralised the impact. While the short-run pass-through stabilised, the long-run pass-through continued to increase due to rise in the coefficient of the autoregressive term in the model estimated above (Figure 9).

Non-decline of inflation persistence when the actual inflation has fallen substantially is consistent with a number of empirical findings for several industrialised and Latin American countries [Cecchetti and Debelle 2004; O'Reilly and Whelan 2004].

Interestingly, in the Indian case so far, for the following reasons, inflation persistence could rise without actual inflation

Figure 10: Growth, Government Deficit and Current Account Balance



rising. First, the oil price control has been steadily liberalised by reducing the deficit in oil pool account that absorbed a large part of the external oil price shocks on domestic prices, while the demand for fuel is on the rise.[19] The administrative control on the prices of a number of commodities, for example iron and steel and coal, has also been liberalised. Second, fiscal deficit of the government sector remains a matter of major concern with the deficit which declined from about 9 per cent during the first half of 1990s to 6 per cent rose since the later part of the 1990s and stood over 8 per cent. More worryingly, the revenue deficit (dissavings) worsened, crossing 7.0 per cent in some of the years primarily due to salary revision of the public sector employees following the recommendation of the Fifth Pay Commission (Figure 10). Third, wage revision in the public sector would affect the wage structure of other organised sectors leading to an upward revision of inflation expectation in the economy. Fourth, when the fiscal situation worsens, it is harder to suppress inflation expectations when the central bank is not fully independent and credibility on inflation control not fully established.

On the other hand, the actual inflation remained low due to several factors. First, the ability of monetary authority to control inflation improved from the limited autonomy it gained. Second, the benign world inflationary situation during major part of the 1990s translated into lower domestic inflation in several countries including India. Third, demand pressure eased due to lower than trend growth in output during the second half of the 1990s. As against the average real GDP (factor cost) growth of 6.2 per cent during 1992-93 to 2004-05, the average growth during 1997-98 to 2002-03 was 5.3 per cent. The same was reflected in rising current account surpluses since 2001-02, i e, savings exceeding investment when the former was lower due to higher public sector dis-savings (Figure 10).[20] Fourth, the supply management was facilitated by the large food stocks, which could be released into the open market and through the public distribution system to keep prices under check. Fifth, allowing free import of commodities such as sugar, edible oils and cotton since the mid-1990s improved the supply position. Sixth, exchange rate appreciations were more frequent than depreciations in the latter period, which lowered domestic price.

6 Conclusions

This paper investigated the exchange rate pass-through to domestic prices in India during the post-economic reform period and found fairly robust evidence of a rise in pass-through until recent years. This is in contrast to a decline in pass-through observed in several countries since the 1990s. When a large domestic economy liberalises, and gets increasingly integrated with the global economy, the influence of the external sector, including the exchange rate movement, could become substantial during the transition. Dismantling various types of controls within the economy itself could also affect the way the external sector influences the inflationary process in the economy. In consonance with the literature, the plausible factors are reduction in tariff and removal of quantitative restrictions on trade; rise in the proportion of imports and exports in the income and consumption basket; changing composition of imports; increased inflation persistence due to dismantling of price controls and lack of control on government deficit under limited monetary independence.

A few monetary policy implications follow: First, in assessing the inflationary situation, there is the greater need now to monitor the impact of exchange rate movement than before, as assuming an unchanged or lower pass-through could mean underestimating the future inflation. Second, removing large exchange rate volatility as an important monetary policy objective of RBI is vindicated, as otherwise the pass-though impact on domestic inflation could be much higher both due to higher exchange rate movement itself and a higher pass-through that could result from greater volatility. Third, increased inflation persistence needs to be controlled as it has led to higher total pass-through when short-run pass-through appears to have stabilised. While some reasons for rise in inflation persistence would relate to dismantling of price control regime, the other important reason was related to lack of control on fiscal imbalance until the enactment of Fiscal Responsibility and Budget Management (FRBM) Act, which under limited autonomy of monetary authority may reduce the credibility of monetary

Appendix

Unit Root Properties

Three residual base tests were conducted, viz, ADF, PP and Zivot-Andrews (1992) allowing for structural break. Table A1 shows that the unit root properties of only 'P*' is not convincingly determined, while the remaining series are I(1), except 'e'.

Table A1: Unit Root Tests (1990:1 to 2005:3)

Variables	Level		First Difference		Z-A	Order
	ADF	PP	ADF	PP		
Y	-1.98(t)	-2.84(t)	-19.4*	-20.21*	NB	I(1)
M	-1.76	-1.69	-16.4*	-16.4*	NB	I(1)
e	-3.49*(t)	-3.78*(t)	12.47*(t)	-12.47*(t)	NB	I(0)
P*	-3.1(t)	-2.78(t)	-10.7*(t)	-19.23*(t)	B	NC
P	-2.58(t)	-2.70(t)	-10.68*(t)	-10.59*(t)	NB	I(1)

(1) t in parentheses denoted a trend component; (2) lag lengths are selected based on SBC and PP-test is with Newey-West using Bartlett Kernel; (3)* denote significance at 1 per cent; (4) NB stands for no break and B for break.

Cointegration Tests

Two residual based cointegration tests, viz, Engle-Granger (1987) and Gregory-Hansen (1996) allowing for structural breaks were conducted. None of the models indicate cointegration among the variables.

Table A2: Cointegration Tests

Variables	Engle-Granger	Gregory-Hansen		
		Level Break	Full Structural Break	Trend with Level Break
P, e, P*, Y, M	-2.34(-4.50)	-4.69(-5.56)	-5.57(-5.83)	-5.57(-6.41)
P, e, P*, Y	-2.50(-4.16)	-4.70(-5.28)	-5.47(-6.00)	-4.57(-5.57)

Figure in parentheses are critical values at 5 per cent.

policy on inflation control. This underscores the need to control fiscal imbalances of government. In any case, a greater monetary autonomy, and therefore, credible monetary policy is achieved with a prudent fiscal policy, and not with fiscal profligacy.

NOTES

1 On the contrary, Otani et al (2003) in the case of Japan finds that the decline in the exchange rate pass-through to import prices came mainly from declines in each product, rather than a shift in composition of imports. Marazzi et al (2005) find that shift in the composition of core imports provides only a partial explanation for decline in the aggregate pass-through to US import prices.

2 WPI is considered as it is the headline measure of inflation computed on all-India basis with larger coverage of commodities, released at higher frequency with lesser lag that coincides with the release of monetary data and is more easily understood by the public.

3 Effective exchange rates based on 36-countries bilateral trade weights is considered as it more comprehensive in terms of coverage.

4 As the final specification is of a back-ward-looking augmented Phillips curve type, including money supply variable may not be appropriate. However, it has been retained to test for robustness of the estimated pass-through coefficient among the alternative models.

5 Dummy variables were used to control for few instances of month-to-month rate of domestic and foreign inflation, which on an annualised basis were over 18 per cent. Month-to-month inflation series is generally volatile due to measurement error or temporary factors unrelated to underlying inflation trends, which is controlled by the included dummies.

6 The lag lengths were selected based on their statistical significance. Starting from the maximum of 11 lags, as they are monthly data, statistically insignificant lags were progressively dropped.

7 The test statistics for Δe, ΔP_{t-1} and joint statistics are 0.19, 0.22 and 1.2, which is less than 5 per cent critical values of 0.47, 0.47 and 1.2, respectively.

8 The Andrews-Ploberger LM test statistics for Δe, ΔP_{t-1} and all coefficients were 0.28, 0.99 and 4.73 with p-value of 0.67, 0.20 and 0.52, respectively.

9 The reported results are for model C for five years window size. Similar results are obtained for window sizes of six and seven years and for other models with different window sizes. They are not reported due to space constraints but are available from the author.

10 The standard error of the long-term coefficients to derive the confidence interval is estimated as,

$$se=\sqrt{\left(\frac{1}{(1-\alpha_1)}\right)^2 \text{Variance}[\alpha_2] + \left(\frac{\alpha_2}{(1-\alpha_2)^2}\right)^2 \text{Variance}[\alpha 1] + 2\left(\frac{1}{(1-\alpha_1)}\right)\left(\frac{\alpha_2}{(1-\alpha_2)^2}\right) \text{Covariance}(\alpha_1, \alpha_2)}.$$

11 Since this point is not known a priori, we search it within a range of 15 per cent to 85 per cent of the sample period, which is the standard practice in the literature to locate structural breaks at an unknown point of time.

12 The increase is indicated in all the window sizes and for the alternative specifications, which are not reported due to space constraints, but are available from the author.

13 Wald test [0.51(0.48)], however, does not reject the equality between the coefficients, and therefore, the evidence of presence of asymmetry is rather weak.

14 As rolling at both ends gave highly volatile coefficients, we fixed the starting date at 1996:2 and kept adding a new observation up to the full sample period, i e, roll at one end only.

15 These are non-annualised month-to-month absolute changes.

16 The Wald test [3.88 (0.05)] rejects the equality of the coefficients at 5 per cent level with threshold of 2 per cent. Therefore, the evidence on non-linearity is much stronger than that of asymmetry.

17 The reported rolling regressions are with sample average as the threshold level.

18 It is called conjectural as direct tests were not possible due to non-availability of monthly data on most macroeconomic variables. Thus, using annual data and supported by theoretical and empirical evidences in literature, the inferences were drawn.

19 India with 3.1 per cent of global oil consumption was the sixth largest consumer of petroleum products in 2003, up from 2.2 per cent and 14th place in 1993 [Pattnaik and Samantaraya 2005].

20 The current account balance, however, has reversed its trend in the most recent period.

REFERENCES

Ahluwalia, Montek S (2002): 'Economic Reforms in India since 1991: Has Gradualism Worked?', *Journal of Economic Perspectives*, Vol 16, pp 67-88.

Andrews, Donald W K and Werner Ploberger (1994): 'Optimal Tests When a Nuisance Parameter Is Present Only under the Alternative', *Econometrica*, Vol 62, No 6, pp 1383-1414.

Bacchetta, Philippe and Eric vanWincoop (2001): 'A Theory of the Currency Denomination of International Trade', DNB Staff Reports No 75.

Bailliu, Jeannine and Eiji Fujii (2004): 'Exchange Rate Pass-Through and the Inflation Environment in Industrialised Countries: An Empirical Investigation', Bank of Canada Working Paper No 2004-21, Bank of Canada, Ottawa.

Belaisch, Agnes (2003): 'Exchange Rate Pass-Through in Brazil', IMF Working Paper No 03/141, International Monetary Fund, Washington.

Betts, C and M Devereux (1996): 'The Exchange Rate in a Model of Pricing-to-Market', *European Economic Review*, 40, pp 1007-21.

– (2000): 'Exchange Rate Dynamics in a Model of Pricing-to-Market', *Journal of International Economics*, 50(1), pp 215-44.

Bhundia, Ashok (2002): 'An Empirical Investigation of Exchange Rate Pass-Through in South Africa', IMF Working Paper No 02/165, International Monetary Fund, Washington.

Campa, Jose Manuel and Linda S Goldberg (2004): 'Exchange Rate Pass-Through into Import Prices', CEPR Discussion Paper Series No 4391, Centre for Economic Policy Research, London.

Cecchetti, Stephen and Guy Debelle (2004): 'Has the Inflation Process Changed?', paper prepared for the Third BIS Annual Conference 'Understanding Low Inflation and Deflation' Brunnen, Switzerland, June 18-19.

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

Devereux, M B and J Yetman (2003): 'Price-setting and Exchange Rate Pass-Through: Theory and Evidence' in *Price Adjustment and Monetary Policy*, proceedings of a conference held by the Bank of Canada, Ottawa, November 2002, pp 347-71.

Dornbusch, R (1987): 'Exchange Rates and Prices', *American Economic Review*, Vol 77, pp 93-106.

Engel, C (2002): 'The Responsiveness of Consumer Prices to Exchange Rates: A Synthesis of Some New Open Economy Macro Models', The Manchester School, 70, pp 1-15.

Engle, R and C Granger (1987): 'Cointegration and Error Correction: Representation, Estimation and Testing', *Econometrica*, 55, pp 251-76.

Frankel, Jeffrey, David Parsley and Shang-Jin Wei (2005): 'Slow Pass-Through around the World: A New Import for Developing Countries', NBER Working Paper 11199.

Gagnon, J E and Jane Ihrig (2004): 'Monetary Policy and Exchange Rate Pass-Through', Board of Governors of the Federal Reserve System, International Finance Discussion Paper No 704.

Goldberg, K Pinelopi and Michael M Knetter (1996): 'Goods Prices and Exchange Rates: What Have We Learned?', NBER Working Paper 5862.

Goldfajn, Ilan and Sergio Riberio da Costa Werlang (2000): 'The Pass-Through from Depreciation to Inflation: A Panel Study', Banco Central do Brasil Working Paper Series No 5, Brasilia.

Gregory, Allan W and Hansen Bruce E (1996): 'Residual Based Tests for Cointegration in Models with Regime Shifts', *Journal of Econometrics*, 70(1), pp 99-126.

Hansen (1991): 'Parameter Instability in Linear Models', *Journal of Policy Modelling*, 14 (4), pp 517-33.

Kang, Sammo and Yunjong Wang (2003): 'Fear of Inflation: Exchange Rate Pass-Through in East Asia', KIEP Working Paper 03-06, Korea Institute for International Economic Policy, Seoul.

Knetter, Michael M (1994): 'Is Export Price Adjustment Asymmetric? Evaluating the Market Share and Marketing Bottlenecks Hypotheses', *Journal of International Money and Finance*, 13 (1), pp 55-70.

Krugman, P (1987): 'Pricing to Market When the Exchange Rate Changes' in S Arndt and J Richardson (eds), *Real-Financial Linkages among Open Economies*, MIT Press, Cambridge, Massachusetts.

Leigh, Daniel and Marco Rossi (2002): 'Exchange Rate Pass-Through in Turkey', IMF Working Paper No 02/204, International Monetary Fund, Washington.

Mann, Catherine L (1986): 'Prices, Profit Margins, and Exchange Rates', *Federal Reserve Bulletin*, 72(6), pp 366-79.

Marazzi, M, Nathan Sheets, Robert Vigfusson and Others (2005): 'Exchange Rate Pass-Through to US Import Prices: Some New Evidence', Board of Governors of the Federal Reserve System, International Finance Discussion Paper No 833.

McCarthy, Jonathan (1999): 'Pass-Through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialised Economies', BIS Working Paper No 79, Bank for International Settlements, Basel.

Mohanty, M S and Marc Klau (2001): 'What Determines Inflation in Emerging Market Economies', BIS Papers No 8, Bank for International Settlements, Basel.

Ohno, Kenichi (1989): 'Export Pricing Behaviour of Manufacturing: A US-Japan Comparison', IMF Staff Papers, 36(3), pp 550-79.

O'Reilly, Gerard and Karl Whelan (2004): 'Has Euro-Area Inflation Persistence Changed Over Time?', European Central Bank Working Paper Series 335.

Otani, Akira, Shigenori Shiratsuka and Toyoichiro Shirota (2003): 'The Decline in the Exchange Rate Pass-Through: Evidence from Japanese Import Prices', *Monetary and Economic Studies*, October, Institute for Monetary and Economic Studies, Bank of Japan, pp 53-81.

Pattnaik, R K and Amaresh Samantaraya (2005): 'The Evolving Inflation Process: Review of Indian Experience', paper presented in Autumn Economists' Conference during October 27-28, 2005 at Bank for International Settlements, Basel.

Phillips, P C B and P Perron (1988): 'Testing for a Unit Root in Time Series Regression', *Biometrika*, 75, pp 335-46.

Pollard, Patricia S and Cletus C Coughlin (2004): 'Size Matters: Asymmetric Exchange Rate Pass-Through at the Industry Level', FRB Working Paper Series 2003-029C, The Federal Reserve Bank of St Louis.

Reserve Bank of India (2001): 'Currency-Wise Pattern of Invoicing of India's Imports and Exports: 1990-91 to 1999-2000', *Reserve Bank of India Bulletin*, April.

Taylor, B John (2000): 'Low Inflation, Pass-Through and the Pricing Power of Firms', *European Economic Review*, 44 (7), pp 1389-1408.

Webber, Anthony (2000): 'Newton's Gravity Law and Import Prices in the Asia Pacific', *Japan and the World Economy*, 12(1), pp 71-87.