

## EXCHANGE RATE PASS-THROUGH IN INDIA'S EXPORT PRICES

*Anu Satyal*<sup>1</sup>

*This paper discusses the concept of exchange rate pass-through (ERPT) in export prices. Exchange rate variations affect international price-competitiveness of exports and their profitability in domestic currency terms. ERPT for exports refers to the degree to which exchange rate changes affect prices of traded goods measured in importer's currency, i.e., whether changes in exchange rates are passed on to foreign consumers or absorbed by exporters, to retain market shares, by maintaining stable prices in international markets. The choice depends on the assumptions regarding the international market structure and product differentiation. Magnitude and speed of pass-through helps understand the relation between exchange rate changes and its impact on trade balance. In this paper, we estimate the ERPT for Indian aggregate non-oil exports and find low pass-through over the long period between 1960-2007. The magnitude increases slightly in the post-1991 period in the wake of competitive currency adjustments by many developing countries. It can thus be argued that currency adjustments alone cannot bring about an adjustment in current balance. There is a need to pay attention to commodity mix and aspects of non-price competitiveness to improve shares in world exports.*

**Keywords:** Exchange Rate Pass-Through, India, Pricing to Market

*JEL classification:* F41, F140

### 1. Introduction

The relationship between exchange rates and prices has been explored in the context of the law of one price and the exchange rate pass-through (ERPT). The former tests the purchasing power parity hypothesis and the latter examines the ability of currency devaluation in correcting trade imbalances. Effect of currency devaluation on price competitiveness of exports highlights the relationship between exchange rate movements and prices of traded goods. This relationship is called ERPT. Text-book models assume perfect competition, constant mark-ups and thus complete pass-through. This is refuted empirically because markets are imperfect whereby mark-ups adjust and pass-through is incomplete.

---

<sup>1</sup>Assistant Professor, College of Vocational Studies, University of Delhi.

Exchange rate variations affect international price-competitiveness of exports and their profitability in domestic currency terms. The former is achieved if currency depreciation is passed on to importers in terms of lower prices and the latter when most changes in exchange rates are absorbed in mark-ups. Thus ERPT for exports refers to the degree to which exchange rate changes affect prices of traded goods measured in importer's currency, i.e., whether changes in exchange rates are passed on to foreign consumers or absorbed by exporters, to retain market shares, by maintaining stable prices in international markets. The choice depends on the assumptions regarding the international market structure and product differentiation.

The narrow definition of pass-through is the partial derivative of the export price with respect to nominal exchange rate in a partial equilibrium model that relates export price to exchange rate, i.e., percentage change in the selling price of exports to percentage change in the exchange rate. Magnitude and speed of pass-through helps to understand the relation between exchange rate changes and its impact on trade balance<sup>2</sup>.

A related line of research looks at stability of prices across different destinations. Krugman (1987) defines it as 'pricing to market' (PTM). Recent analyses note that imperfect competition and product differentiation do not imply market segmentation in terms of price discrimination. The latter is a result of market power. Therefore, PTM is perfectly compatible with integrated markets. PTM is more product-specific than destination-specific. If it is destination-specific because of market power and not because of distribution and transportation costs, then true market segmentation exists.

Hooper and Mann (1989) discuss pass-through in relation to US imports. Athukorala (1991) estimates the pass-through coefficient for Korean aggregate manufactured exports and finds a low pass-through estimate implying that Korea is a price-follower in international markets. Menon (1992) estimates pass-through coefficients for Australia for four categories of manufactured exports: textiles; basic metal products; chemicals, petroleum and coal products; and transport equipment. His estimates are close to zero for the first two categories and large for the last two product groups. He also notes the varied effect of exchange rate changes on export prices across industries, in terms of magnitude and timing.

---

<sup>2</sup>Goldstein and Khan (1985): Evidence in support of 'J-curve' makes it imperative to know about the extent of pass-through. J-curve reflects the tendency of import prices to respond faster to currency depreciation than export prices such that trade balance in foreign currency terms deteriorates as a short-run response to depreciation. Even if import and export demand price elasticities are large, if supply elasticities with respect to prices are small then the trade balance effect is less than the desired effect which would have been if the supply elasticities were large.

Factors increasing pass-through are the extent of foreign control and ownership, share of output exported and industry's share of exports in country's total exports. Athukorala and Menon (1994) find a low pass-through coefficient for Japan using a different definition of pass-through - 'total pass-through' (TPT). Accordingly, PTM is essentially a 'temporary phenomenon designed to buy time' until the firm is able to make appropriate supply-side adjustments. As the exporter's currency appreciates contemporaneously, the exporter, prices to market, by keeping the importer's price stable and varying his own margins. After a time lag lower input costs due to currency appreciation allow him to maintain the 'strategic' foreign currency price with less pressure on his profit-margin.

Yang and Hwang (1994) study the price behaviour in Korean manufacturing estimating the pass-through coefficient for six Korean manufactured exports and confirm Athukorala's findings. Marston (1990) finds low pass-through coefficients for Japan and complete pass-through for US<sup>3</sup>. Knetter (1993) look sat four source countries (US, UK, Japan and Germany), for individual industries in each source country and for specific destinations to which these four export. He finds industry-level evidence in support of a destination-specific mark-up adjustment by Japanese, German and British exporters but not in the American case. There is also marked industry variation in PTM for different industries in all source countries and the effects are similar for a particular industry across source countries. Finally, he finds 'local currency price stability' (LCPS) across destination-markets and that coefficients are not very different for different destinations from the results obtained for pooled destinations<sup>4</sup>. For Italy, Mejan (2004) notes that microeconomic pricing strategies create differences in the pass-through estimates. ERPT at the disaggregated level depends on structural factors highlighting behavioural heterogeneity at individual industry level.

In India, currency depreciation has been a major part of economic policy to achieve export competitiveness. Proponents of devaluation in India face opposition by the critics<sup>5</sup>. In this paper, we estimate the ERPT for Indian aggregate non-oil exports for the period 1960-2007. The long run estimate of pass-through is estimated using the vector auto regressive (VAR) methodology. Cointegration among the variables is established which is suited for non-stationary time-series. The results confirm the hypothesis of incomplete pass-through in

---

<sup>3</sup> Ohno (1989) provides estimates for Japan.

<sup>4</sup> LCPS is exporters' attempt to keep prices in importer's currency stable and hence vary their mark-ups in response to currency adjustments as opposed to a policy of constant mark-ups. (Knetter, 1993).

<sup>5</sup> Main advocates have been Joshi and Little (1993,1994), Wadhva (1988), Rajaraman (1991, 1993). The critics are Sarkar (1992, 1994a, 1994b), Sarkar and Bagchi (1993), Ghosh (1990), Nayyar (1988), Sen (1986), Pradhan (1993), Sen and Mukhopadhyay (1994), Sen (1994). In the short-run competitive devaluation reduces pass-through magnitude.

case of India. In the post-liberalisation period the pass-through coefficient rises confirming the pressures of competitive devaluation which further confirms Kaldor's (1978) view point that there is no direct link between exchange rate depreciation and an increase in a country's shares in world exports.

The analytical framework is followed by the results and the last section gives conclusions. Appendix A gives the cointegration tests for determination of the number of cointegrating vectors and unit root test of variables.

## 2. Analytical Framework

The optimal response of a firm's export price to currency depreciation depends on factors operating through the effect of exchange rates on marginal costs (MC) and on mark-ups. The adjustment of mark-ups in response to exchange rate changes is PTM. Exporters reduce mark-ups to buyers whose currencies have depreciated against the seller thus stabilising prices in buyer's currency relative to a constant mark-up policy. In this case, PTM depends on the elasticity of demand and supply and the number of competitors in the market.

Market structure is important in determining the extent of pass-through because pass-through cannot occur in a competitive model of trade. In integrated competitive markets, mark-ups are zero. In integrated but imperfect markets mark-ups are not equal to zero. Imperfect markets imply differentiated products but no price-discrimination. It is likely that the presence of a large number of firms will make these firms 'price-takers' in the sense of being close followers of world prices<sup>6</sup>. Goldberg and Knetter (1997) argue that PTM signifies imperfect markets but not market segmentation. The latter reflects market power which results in price-discrimination (such that elasticities are different and no resale is possible) and destination-specific mark-ups. Hence incomplete pass-through does not imply market power. Incomplete pass-through occurs if mark-ups adjust or if the importer can influence world price due to its 'largeness'. They also note that if most of the exports are invoiced in buyer's currency then there is little evidence of PTM. Moreover, if exchange rate changes are temporary then also mark-ups adjust and pass-through is less but if the change is perceived as permanent then prices may adjust indicating presence of pass-through. Local consumer prices in destination markets could be different from export prices because of distribution costs. Chaudhuri, Faruquee and Hakura (2005) and Corsetti and Dedola (2005) argue that exporters could pass-through a small percentage of change in the exchange rate

---

<sup>6</sup>Monopolistic competition allows firms to overcome the trade-off between scale economies and variety which the firm faces due to the domestic market-size constraint.

and maintain LCPS, yet local prices could vary between markets because of internal costs and distribution services. This destination-specific price difference is not a reflection of exporters' market power. Even if import prices across countries were not very different, their respective distribution costs, trade barriers and trade policies may lead to differences in final consumer prices across countries such that law of one price does not hold.

If producers' costs increase there is almost complete pass-through into export prices but if the exchange rate changes it may not necessarily lead to a change in export price. In partial equilibrium models, exogeneity of exchange rate changes to changes in MC is often a maintained assumption. LCPS is possible when mark-ups adjust or local components become cheaper due to devaluation. Currency appreciation and a change in global production arrangements, with outsourcing of production of components, cause a downward shift of the MC. With its appreciation, overall demand for country's exports falls, leading to further decline in the MC whereby pressure on mark-ups is reduced overtime.

The mark-up model shows how margins adjust when currency valuation changes. When the exchange rate changes marginal cost curve shifts due to changes in imported inputs' prices. Moreover strategic pricing behaviour on part of the exporting firm implies that it prices to market and holds the local price of the importer stable. These changes result in incomplete pass-through. Currency appreciation leading to a fall in costs can still allow the exporter to price strategically and maintain stable prices without pressures on margins. The mark-up model allows for strategic interaction between domestic and foreign firms operating through variations in mark-up.

Our model of estimation of pass-through for aggregate exports, takes exporters as one of the many suppliers of imperfect but close substitutes in international markets. This assumption of imperfect competition implies that pass-through is a result of conscious price-setting behaviour of the exporting firm. Yet prices may differ across destinations even if exporters do not have control over their price in export markets<sup>7</sup>.

Price determination model used to analyse the extent of pass-through of currency devaluation is the mark-up model which is applicable for differentiated goods. It allows for possible strategic interaction between domestic and foreign firms in the form of limiting the effect of exchange rate changes on competitiveness through varying the mark-up. The implicit assumption in using the mark-up model is that demand and supply price elasticities

---

<sup>7</sup> Knetter (1993) notes that incomplete information, transportation costs, trade barriers and health and safety regulations can create subtle product differentiation and could be possible reasons why prices may not equalise across buyers in different markets.

are not infinite whereby pass-through effects are less than complete (Dornbusch, 1987; Hooper and Mann, 1989). The premise underlining PTM is that in order to maintain market-shares, exporters do not adjust prices in importers' currency, i.e., aim at LCPS. Instead they adjust margins and keep export prices stable in foreign currency terms. LCPS also depends on the number of competitors. The larger the number of foreign competitors faced by the firm the greater is the LCPS (Dunn, 1970; Froot and Klemperer, 1989).

We assume that a typical exporting firm sets its export price in rupee terms ( $P_x$ ) as a mark-up ( $\Pi$ ) on the domestic cost of production ( $CP$ ).

$$P_x = \Pi.CP \dots\dots\dots (1)$$

$P_x$  in dollar terms can be written as

$$P_x^* = P_x/ER \dots\dots\dots (2)$$

where,  $ER$  is exchange rate defined as the domestic currency price of a unit of foreign currency.  $ER$  is the nominal 'effective' exchange rate weighted by the export shares of India's trading partners. The choice of weights and the number of trading countries chosen to construct the index affects the results (Hooper and Mann, 1989). Substituting (1) in (2), we get,

$$P_x^* = \Pi.CP/ER \dots\dots\dots (3)$$

Here  $\Pi$  is the mark-up and is assumed to be variable as it responds to competitive pressures in foreign markets and demand pressures in both domestic and foreign markets combined.

Competitive pressures in foreign markets are determined by competing prices in these markets proxied by producer prices, ( $WPI^*$ ), taken in domestic currency terms,  $[(WPI^*).ER]$ . Demand pressures are given by capacity utilisation ( $CU$ ) in India.

Hence, the mark-up is

$$\Pi = [(WPI^*.ER)/CP]^\alpha . [CU]^\beta \dots\dots\dots (4)$$

Substituting (4) in (1), we get

$$P_x = \{[(WPI^*.ER)/CP]^\alpha . [CU]^\beta\} . CP \dots\dots\dots (5)$$

Taking natural logs on both sides expressed in lower case letters, (5) can be written as:

$$px = \alpha(wpi^* + er - cp) + \beta cu + cp$$

or

$$px = \alpha wpi^* + \beta er + (1 - \alpha)cp + \beta cu \dots\dots\dots (6)$$

If the coefficient of  $er$  given by  $\alpha = 1$ , pass-through in importers prices  $P_x^*$  is equal to zero and all the benefits of rupee depreciation show up in a rise in the price of exports in domestic currency terms. In this case, holding  $CP$  constant, exporters set their dollar prices equal to world prices and domestic costs and exchange rates have no effect on dollar prices, i.e. mark-ups absorb the shock to exchange rate and domestic costs. If pass-through is almost zero, then one can contend that Indian exporters follow world prices. The latter is proxied by the export-weighted producer prices in importing countries. This should then show a significant relation between  $WPI^*$  and  $P_x^*$ , i.e., the two prices are close in common currency terms. Changes in exchange rate will then be absorbed in profit-margins. It is the mark-up that adjusts when exchange rate changes. Profit-margin rises when  $ER$  depreciates and contracts when  $ER$  appreciates.

On the other hand, if the coefficient of  $er$  given by  $\alpha = 0$ , pass-through in  $P_x^*$  is said to be complete. In this case, all benefits of devaluation are passed on to foreign consumers in terms of lower dollar prices. Mark-ups remain unchanged and changes in exchange rate and domestic costs pass-through completely. The intermediate cases,  $0 < \alpha < 1$  implies in complete pass-through which is obtained in most empirical exercises.

In the mark-up model, effects of ERPT are examined in a partial equilibrium framework because variables like exchange rate, costs of production and demand pressures are treated as exogenous (Ohno, 1989). Even if markets are imperfect but integrated, the mark-up is not equal to zero and is common to all destinations which implies product differentiation and not price-discrimination. Hence, PTM cannot comment on market power.

The sign of  $\beta$  can be positive or negative. As overall demand-pressures rise, capacity utilisation rises which raises export prices in the short-run because supply constraints surface. If, in contrast, the economy has underutilised capacity, increased foreign or domestic demand will raise output, lower unit costs and help reap scale economies and render exports more competitive such that  $\beta$  would be negatively signed.

A more general model of ERPT would limit the extent of pass-through effects if one takes into account the economy's internal market structure and imperfections, product differentiation, price discrimination; inflation in the home country relative to inflation in competitor's country; institutional setting and macro-economic structure and uncertainty. The pass-through effects of currency appreciation or depreciation on import prices in turn have domestic price feed-back effects. These are reflected in the changes in domestic costs

of production and the general price level. Pass-through may not be possible because of the cost-constraint imposed by stickiness of real wages and indexation of wages.

Magnitude of pass-through depends on the size of demand and supply price elasticities of exports. Demand elasticities depend on the degree of specialisation in the export basket and the exporting country's share in world exports. If the exporting country has a low degree of specialisation and is one of the many suppliers in export markets, demand elasticity of exports is high and export prices follow world prices.

Elasticity of supply depends on the nature of exports, proportion of output exported and capacity utilisation. If the export structure comprises largely of industrial goods, the percentage of output exported is small and the degree of capacity utilisation is low, then the supply elasticity of exports is high and pass-through is greater. A less than infinite price elasticity of supply implies that export prices in domestic currency will move to offset some or all change in the exchange rate on the foreign currency price of exports, i.e., less than complete pass-through. Given a less than infinite price elasticity of supply of exports the trade balance effect of an exchange rate change depends on the size of the price elasticity of demand for exports. If the demand price elasticity is high, a lower supply elasticity reduces the effect of an exchange rate change on the value of the trade balance. When demand is inelastic, a higher supply price elasticity enlarges the effect of an exchange rate change (Branson, 1972; Spittaller, 1980; Goldstein and Khan, 1985). A combination of low supply and high demand elasticity will result in low pass-through and the trade-balance effect will be small. On the other hand, when demand is inelastic and supply elasticity is low, the effect of currency depreciation is nullified as the low supply elasticity does not allow foreign-currency prices to fall which would otherwise do because of low demand elasticity<sup>8</sup>. This is summarised in Table 1.

**Table 1: Magnitude of Pass-Through and the Size of Demand and Supply Elasticity**

	Infinitely Elastic	Perfectly Inelastic
Supply elasticity	full pass-through	zero pass-through
Demand elasticity	zero pass-through	full pass-through

The effect of currency depreciation on *MC* operates through the change in import prices and a relative decline in domestic input prices. Import prices respond more quickly to

<sup>8</sup>Ohno (1989) notes that besides being a function of demand elasticities, pass-through could also be a function of the number of foreign firms in the importer's domestic market and of the stochastic properties of macroeconomy.

depreciation, the lags of pass-through are shorter and in the short-run trade balance deteriorates. This rise in import prices in domestic currency terms has further domestic price feed-back effects. Even if pass-through of changes in exchange rate to import prices is fast, domestic price feed-back of import prices can be slow (Goldstein and Khan, 1985). If production is import-intensive, greater is the elasticity of domestic costs and producer prices to import prices<sup>9</sup>. If the elasticity of factor prices, particularly money wages, to domestic prices is high then the feed-back effects are strong. In response to increased factor prices domestic costs and prices rise further and feed-back effects are reinforced. This rise in material costs and overall price level increases labour costs due to wage-indexation. Downward rigidity in real wages fuels cost of production and raises producer prices and the general price level. In this situation exporters may perceive changes in production costs as permanent and raise prices rather than lower profits. If domestic currency depreciates and these links are kept in mind, it will be difficult for exporters to pass-on the benefits of depreciation to importers in lower dollar prices. Therefore, the cost or the supply-side constraints do not allow producers to pass full benefits of exchange rate depreciation to foreign consumers. Producers would resist a cut in their profit-margins under these circumstances such that trade balance effect of depreciation is small<sup>10</sup>. In the short-run, rupee import prices rise more than export prices and trade balance deteriorates resulting in a J-curve effect. Domestic price feed-back effects sharply reduce the expenditure-switching effects of exchange rate changes.

The import-price pass-through and domestic price feed-back effects vary across countries. The extent of pass-through is neither uniform nor identical in magnitude and its speed across industries. It is observed that disaggregating the data reduces the total pass-through and the lag length (Hooper and Mann, 1989). Pass-through estimates for individual industries would be more useful as the coefficient varies with industry. However, Ohno (1989) points out that the disaggregate results depend to a great extent on the industries chosen. The results thus obtained are unreliable because other important industry-specific

---

<sup>9</sup> Evidence regarding import-intensity of production and exports is presented in EXIM Bank (1991), Mani (1991), Sathe (1995, 1997) and Burange (2001-02). The main point is that import-intensity has generally increased since the 1960s. The decline in the late 1980s or early 1990s is more due to import compression in the wake of economic crisis of 1991. C. P. Chandrashekhara (2001) notes that India's import bill surged between 1991-96. This period coincided with industrial growth. Once industrial growth decelerated, import bill declined. Hence, he concludes that Indian industry is dependent on imports. Ratio of non-oil imports to GDP increased from 5.9% in 1991/92 to 9.1% in 1995/96 and decelerated to 8.9% in 1997/98. Hence, import-intensity of domestic production increased with import liberalisation especially in the capital goods sector.

<sup>10</sup> Dornbusch (1987), Feinberg (1986), Menon (1992), Mann (1986), Hooper and Mann (1989), Athukorala (1991), Goldstein and Khan (1985), Golberg and Knetter (1997), Corsetti and Dedola (2005).

variables are improperly captured. This way aggregate data cancels out 'idiosyncracies of individual industries'. Hence even aggregate studies provide useful insight into the magnitude of pass-through. Knetter (1993) shows that pass-through coefficient varies more across industries than destinations within each industry.

Baldwin (1988) and Hooper and Mann (1989) point out the need to capture the dynamic response of  $Px$  to changes in exchange rate. This is primarily to allow for temporal instability of the ERPT coefficient. Apart from a lagged response of  $Px$  to exchange rate changes, it is likely that exporters will respond differently to short-term fluctuations on the one hand and medium and long term fluctuations on the other. In particular, exporters may squeeze their profits initially in response to currency appreciation but they may not do so indefinitely, i.e., if the pass-through effect in  $Px^*$  is near zero, a rupee appreciation leaves dollar prices unchanged and profit-margins decline. Gradually, a rise in exchange rate would lead to a pass-through in dollar prices such that profit-margins are restored to their initial levels<sup>11</sup>. Thus, mark-ups respond immediately to shocks in exchange rates but later return to their original levels.

In reality, exchange rate is more volatile than costs and firms are more willing to absorb currency changes in their profit-margins, with the expectation that these changes would reverse in future, than absorb changes in costs which are more likely to be permanent. The perception of exchange rate change as permanent or transitory and the size of change in the exchange rate (small or large) also affects the extent of pass-through. If exchange rate changes are taken to be transitory, exporters adjust their margins<sup>12</sup>. The size of pass-through also depends on how the size of the industry is affected when exchange rate changes. Baldwin (1988) and Baldwin and Krugman (1989) analyse how large exchange rate shocks alter the market structure by affecting the number of firms operating in the market. This change in the structure is permanent even though the exchange rate returns to its earlier level. 'Hysteresis' in this instance occurs because of sunk costs of establishing a plant by the new firm. The number of active firms in the domestic market remains unchanged when the exchange rate fluctuates within a range. Once it moves out of this range (even temporarily), entry (if exchange rate depreciates) or exit (if exchange rate appreciates) of firms occurs and the industry supply curve is permanently affected. This affects the size of industry and volume of exports and hence the pass-through.

---

<sup>11</sup>Also because exchange rate changes feed into domestic prices which affect production costs.

<sup>12</sup>Orcutt (1950), Wilson and Takacs(1979) Froot and Kempler (1989).

If the long-run pass-through is small it implies that export prices follow world prices in dollars or industry structure is altered or both. If the coefficient of domestic cost is insignificant then the exporter is taken to be one of the many suppliers in international markets. On the other hand, if pass-through is complete or close to one then export prices are cost-determined and exporters have a significant market share. For differentiated products, pass-through is greater if the elasticity of other countries' devaluation in response to the focus country's currency depreciation is low (Spitaller, 1980).

### 3. Methodology

In this paper the empirical model for pass-through for aggregate exports is given by:

$$PXI_t = \text{constant} + \alpha NEER_t + \gamma DOMWPI_t + \delta GEOWPI_t^* + \beta FIXCAP_t + \phi TOTEXP_t + \text{error}_t$$

where  $\alpha, \gamma, \beta, \delta$  and  $\phi$  are estimated values of the original coefficients.  $PXI$  is the rupee price of Indian exports proxied by the unit value index ( $UVI$ ) of exports,  $NEER$  is the nominal effective exchange rate of India given by the reciprocal of  $NER$  taken as the rupees per unit of foreign currency,  $DOMWPI$  is the wholesale price of India for non-oil commodities for aggregate exports which is a proxy used for costs of production<sup>13</sup>.  $GEOWPI^*$  is the competitors' price taken as the geometric average of the wholesale prices or producer prices of the same 11 developed countries used to construct  $NEER$ .  $FIXCAP$  and  $TOTEXP$  together give the level of capacity utilisation in India.  $FIXCAP$  gives the net fixed capital stock of India and  $TOTEXP$  gives the total final consumption expenditure. A rise in the net fixed capital stock implies a rise in the capacity which helps ease supply side constraints and thus the pressure on prices. A rise in domestic demand given by consumption expenditure is expected to exert a negative effect on export prices. All variables are in natural logs. Thus regarding the a priori signs of the coefficients we expect  $\alpha > 0$ ,  $\gamma > 0$ ,  $\delta > 0$ ,  $\beta < 0$  and  $\phi > 0$  respectively.

All variables are first difference stationary. It is imperative to establish cointegration between the variables and estimate the long run elasticity of pass-through (Refer to Appendix A). Cointegration is a long term property of time series data which allows the series to move together in the long term even if they digress from this 'equilibrium' in the short run and are individually not mean-reverting. There are forces in the system which ensure that the the series move together such that they are cointegrated. The two-step method

<sup>13</sup> Hooper and Mann (1989) discuss the limitations of using WPI or CPI as a proxy for domestic costs and note that the results are significantly affected by using WPI than an alternate measure incorporating labour, material and energy costs.

given by Granger and Engle (1987) has limitations if more than two variables are used. Hence, the systems method given by Johansen (1988) is used which gives ML estimates. The error correction mechanism gives the amount of error corrected in one time period. It, thus, gives the amount of disequilibrium that is corrected per unit of time. The impulse response functions exhibit the path of movement towards equilibrium for a system-wide shock. A structural break is tested for 1991 using a dummy variable taking the value zero for period upto 1990 and one from 1991 to control for a change in economic policy after 1991. This period saw the intensification of the forces of globalisation in almost all developing countries. An interactive dummy with NEER and world prices is also used in the error correction model.

#### 4. Results

Appendix A gives all the tests conducted prior to estimating the long run cointegrating relation. The unit root test shows all variables to be  $I(1)$ . The lag length for the VAR given by  $p$  is 1 which is acceptable given that we are using annual data. The number of cointegrating relations appears to be two but going by economic theory we expect one cointegrating relation between the given variables. Of the two vectors only one vector has correctly signed coefficients. Hence, we can impose the condition that there is one cointegrating relation between the variables or  $r=1$ . The difference between the coefficients for the vector when  $r=1$  and  $r=2$  is extremely small and hence can be considered negligible. Table 2 presents the pass-through estimates for the preferred model for aggregate exports. All variables taken in the equation to estimate the pass-through coefficient are correctly signed and significant. *TOTEXP* is found to be insignificant and hence dropped from the specifications. The coefficient of *NEER* is less than one and the size of the pass-through is 0.148. The coefficient of *NEER* falls after 1991 to 0.709 and hence the pass-through coefficient rises to 0.291<sup>14</sup>. Domestic prices in importers' country (*GEOWPI\**) also influence export prices from India. The role of domestic costs (*DOMWPI*) in determining export prices is also significant and the coefficient is larger than world prices. This may also suggest the role of a rise in costs

---

<sup>14</sup>Swamy(1994) notes that international currency alignments and recession in the domestic market in the 1970s allowed exporters to price their products more competitively in international markets. It also coincided with improved profitability of aggregate exports. Indian exports are import-intensive and rupee depreciation leads to a rise in production costs. In this context it is not possible for exporters to pass-through a large proportion of currency depreciation. Fiscal incentives partially cover these costs and allow competitive pricing. In the 1990s, these subsidies actually declined drastically in view of a sharp devaluation in 1991 highlighting the policy stance of treating fiscal incentives and currency adjustments as alternatives. In most specifications for aggregate exports, subsidies do not induce exporters to raise the pass-through coefficient due probably to a proportionately larger rise in costs when rupee price of imported inputs increase. This is intuitively what Athukorala and Menon (1994) describe PTM measured above as part of TPT.

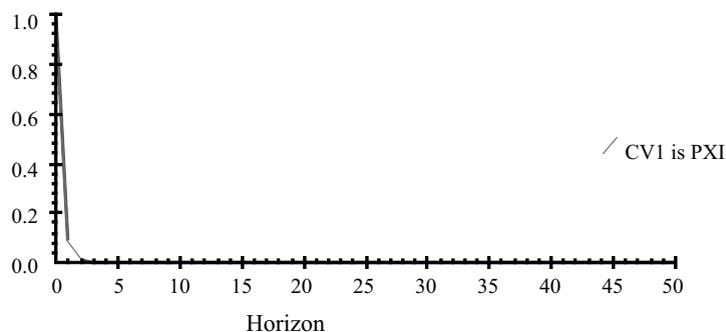
especially that of imported inputs after currency depreciation such that export prices in rupee terms have to rise to compensate the exporters for cost increases. This limits the possibility of a large pass through in importers' prices. The increase in capacity given by net fixed capital stock (*FIXCAP*) helps ease supply side constraints and pressure on prices. The error correction term is correctly signed and a small part of the disequilibrium is corrected in each period.

**Table 2: Pass-Through Estimates for Aggregate Exports, 1960-2007**

Variables	Cointegrating Relation
PXI	-1.00
NEER	<b>0.852(6.218)</b>
GEOWPI*	<b>0.458(2.423)</b>
DOMWPI	<b>1.174(2.815)</b>
FIXCAP	<b>-1.7(-2.474)</b>
ECM1(-1)	-0.124(-1.43)
DUM91	<b>-2.822(-1.856)</b>
D91NER	<b>-0.143(-2.222)</b>
D91GEOWPI*	<b>0.75(2.038)</b>
LR-c <sup>2</sup> (1)	0.396

Note: Figures in the brackets are *t* ratios.

**Figure 1: Persistence Profile of the Effect of a System-Wide Shock to PXI**



In Figure1, persistence profile of a system-wide shock traces the departure from equilibrium and the time taken to come back to it. To test for stability of coefficients, 1991

marks a point of discretionary change in the exchange rate. For 1991, the level dummy is significant and shows that the pass-through coefficient rises in the 1990s in line with major currency devaluation in 1991 and competitive devaluations during the decade<sup>15</sup>. The LR test of block Granger non-causality is  $\chi^2(4)=16.912$  which suggests that the null hypothesis of insignificant lagged values of *NEER*, *GEOWPI\**, *LNWPIALL* and *FIXCAP* can easily be rejected. It thus confirms a long run relationship between the given variables and *PXI*.

## 5. Conclusion

Pass-through coefficient for India's aggregate non-oil exports is not equal to one. The results confirm an incomplete ERPT for aggregate exports of India which is in line with most empirical studies on the subject. The real exchange rate shows a long term depreciation, the decline being sharper in the late 1980s and early 1990s. Part benefits of exchange rate changes are absorbed in the exporters' prices and profit-margins. India is one of the many suppliers in international markets facing high price elasticities of demand but not infinite elasticity. Hence, international market structure is characterised by monopolistic competition with large number of sellers selling a large variety of differentiated goods.

Rupee depreciation increases import prices and given the high import-intensity of Indian exports, exporters find it difficult to squeeze their margins indefinitely. Rather, if there is evidence of incomplete pass-through then devaluation results in a rise in margins as margins adjust when rupee price of exports increase. If the benefits of devaluation cannot be passed on and exporters maintain local currency price stability, then margins increase. A squeeze in profit-margins occurs when currency appreciates. In the post 1991 period, there have been periods of both depreciation and mild real appreciation. In the post liberalisation period a squeeze in the margins due to increased foreign and domestic competition is partially offset by a rise in margins due to devaluation of the currency.

The pass-through relationship changes over 1960-2007. A structural break is recorded in 1991. Prior to the 1990s, mark-ups adjust more with currency adjustments. In the 1990s, with large cumulative nominal depreciation, Indian exporters pass-through a relatively larger proportion of currency depreciation in terms of lower importers' prices due primarily to competitive devaluations confirming the fallacy of composition argument for currency adjustments to promote exports and concentrate on price-competitiveness alone. Indian

---

<sup>15</sup>China's presence in international markets as a source of cheap and competitively priced goods also affected developing countries terms of trade (UNCTAD 2002). This implies that margins for Indian exporters flattened out from the mid 1980s and through the 1990s.

exporters follow world prices though domestic costs are also significant.

Low estimates of pass-through for India indicate that devaluation, as a policy tool, cannot improve competitiveness and world export shares on its own. A correctly determined exchange rate is necessary but insufficient to make exports competitive. Pass-through effects depend crucially on import price changes and consequent domestic feed-back effects of exchange rate changes. Higher import price changes and domestic price feed-back effects reduce the extent of ERPT even if demand elasticity is low. Timing of these feedback effects is also crucial as they appear before the resource-allocation effects. The efficacy of devaluation in improving trade imbalances depends on these associated changes. A combination of low short-run supply response to prices due to fixed capacity in the short-run with a more rapid increase in rupee import prices than export prices produces a deterioration in trade balance of the devaluing country. The effect of devaluation also depends on commodity composition of trade, degree of openness, capacity utilisation, stickiness of real wages and the mix of monetary and fiscal policies. Incomplete pass-through implies that exporters' profitability is affected by changes in exchange rates. Increased profitability of exports affects export earnings and thus affects real exports positively. Devaluation shifts domestic terms of trade in favour of tradeables. Macro policy needs to be complemented with firm and industry-specific policy to alter export-structure and address aspects of non-price competitiveness. Further, research must look at pass-through for individual commodities and to different destinations. Study at the disaggregated level will help understanding that blanket policy prescriptions involving currency adjustments alone will not achieve a dynamic commodity mix. Rather, policy must ensure provision of adequate infrastructure, build effective institutions and enhance firm-level capabilities. It must address industry and firm-specific issues at the micro-level to improve competitiveness.

## APPENDIX A

### UNIT ROOT TESTS (WITH INTERCEPTS AND A TREND)

Variable	Adf (1)	Critical Values
PXI	-2.468	-3.513
NEER	-1.735	-3.511
GEOWPI*	-0.978	-3.511
DOMWPI	-1.935	-3.511
FIXCAP	-0.132	-3.516

### VAR LENGTH

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model  
 \*\*\*\*\*  
 Based on 45 observations from 1964 to 2008. Order of VAR = 4  
 List of variables included in the unrestricted VAR:  
 PXI                      NEER                      GEOWPI\*DOMWPIFIXCAP  
 List of deterministic and/or exogenous variables:  
 CONST                      T                      DUM91                      D91NEER                      D91GEOWPI\*  
 \*\*\*\*\*  

Order	LL	AIC	SBC	LR test	Adjusted LR test
4	575.2540	450.2540	337.3376	-----	-----
3	541.3546	441.3546	351.0215	CHSQ( 25)= 67.7988[.000]	30.1328[.219]
2	502.9642	427.9642	360.2143	CHSQ( 50)= 144.5796[.000]	64.2576[.085]
1	458.9507	408.9507	363.7842	CHSQ( 75)= 232.6065[.000]	103.3807[.017]
0	361.3287	336.3287	313.7455	CHSQ(100)= 427.8505[.000]	190.1558[.000]

 \*\*\*\*\*  
 AIC=Akaike Information Criterion                      SBC=Schwarz Bayesian Criterion

### NUMBER OF COINTEGRATING VECTORS

Cointegration with unrestricted intercepts and restricted trends in the VAR  
 Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix  
 \*\*\*\*\*  
 48 observations from 1961 to 2008. Order of VAR = 1.  
 List of variables included in the cointegrating vector:  
 PXI                      NEER                      GEOWPI\*                      DOMWPIFIXCAP  
 Trend  
 List of I(0) variables included in the VAR:  
 DUM91                      D91NEER                      D91GEOWPI\*  
 List of eigenvalues in descending order:  
 .81099                      .64886                      .39781                      .24645                      .068619                      .0000  
 \*\*\*\*\*  

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r = 1	79.9667	37.8600	35.0400
r<= 1	r = 2	50.2352	31.7900	29.1300

 \*\*\*\*\*  
 Use the above table to determine r (the number of cointegrating vectors).

Cointegration LR Test Based on Trace of the Stochastic Matrix  
 \*\*\*\*\*  
 48 observations from 1961 to 2008. Order of VAR = 1.

*Exchange Rate Pass-Through in India's Export Prices*

```

List of variables included in the cointegrating vector:
PXI          NEER          GEOWPI*DOMWPIFIXCAP
Trend
List of I(0) variables included in the VAR:
DUM91        D91NEER        D91GEOWPI*
List of eigenvalues in descending order:
.81099      .64886      .39781      .24645      .068619      .0000
*****
Null      Alternative      Statistic      95% Critical Value      90% Critical Value
r = 0      r >= 1      171.5411      87.1700      82.8800
r <= 1      r >= 2      91.5744      63.0000      59.1600
*****
Use the above table to determine r (the number of cointegrating vectors).
Choice of the Number of Cointegrating Relations Using Model Selection Criteria
*****
48 observations from 1961 to 2008. Order of VAR = 1.
List of variables included in the cointegrating vector:
PXI          NEER          GEOWPI          DOMWPIFIXCAP
Trend
List of I(0) variables included in the VAR:
DUM91        D91NEER        D91GEOWPI*
List of eigenvalues in descending order:
.81099      .64886      .39781      .24645      .068619      .0000
*****
Rank      Maximized LL      AIC      SBC      HQC
r = 0      409.0447      389.0447      370.3327      381.9734
r = 1      449.0280      419.0280      390.9600      408.4211
r = 2      474.1456      436.1456      400.5928      422.7102
*****
AIC = Akaike Information Criterion      SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

```

**LR Test of Block Granger Non-Causality in the VAR**

```

*****
Based on 48 observations from 1961 to 2008. Order of VAR = 1
List of variables included in the unrestricted VAR:
PXI          NEER          GEOWPI*DOMWPIFIXCAP
List of deterministic and/or exogenous variables:
DUM91        D91NEER        D91GEOWPI*
Maximized value of log-likelihood = 460.1309
*****
List of variable(s) assumed to be "non-causal" under the null hypothesis:
NEER          GEOWPI*DOMWPIFIXCAP
Maximized value of log-likelihood = 451.6749
*****
LR test of block non-causality, CHSQ( 4) = 16.9120[.002]
*****
The above statistic is for testing the null hypothesis that the coefficients
of the lagged values of:
NEER          GEOWPI*DOMWPIFIXCAP

```

in the block of equations explaining the variable(s):  
PXI  
are zero. The maximum order of the lag(s) is 1.  
\*\*\*\*\*

**Data Sources**

- PXI Unit value index of India's non-oil exports, RBI Handbook of Statistics on Indian Economy
- NEER Nominal effective exchange rate (trade weighted), IMF International Financial Statistics and own calculations
- DOMWPI India's wholesale price index, RBI Monthly Bulletin
- GEOWPI\* Wholesale price indices of trading partners, geometrically weighted, IMF, International Financial Statistics
- FIXCAP Netfixed capital stock, CSO, National Accounts Statistics
- TOTEXP Total final consumption expenditure, CSO, National Accounts Statistics

**References**

Athukorala, P. (1991), "Exchange Rate Pass-Through, The Case of Korean Exports of Manufactures", *Economic Letters*, No. 35, pp. 79-84.

Athukorala, P. and J.Menon (1994), "Pricing to Market Behaviour and Exchange Rate Pass-through in Japanese Exports", *Economic Journal*, Vol. 104, March, pp. 271-281.

Baldwin, R.E. (1988), "Hysteresis in Import Prices: The Beachhead Effect", *American Economic Review*, Vol. 78, pp. 773-785.

Branson, W. H. (1972), "The Trade Effects of the 1971 Currency Realignment", *Brookings Papers on Economic Activity*, No. 1, pp. 15-70.

Choudhri, E.U., H.Faruqee and D.S.Hakura (2005), "Explaining the Exchange Rate Pass-through in Different Prices", *Journal of International Prices*, Vol. 65, No. 2, March, pp. 349-374.

Corsetti, G. and L.Dedola (2005), "A Macroeconomic Model of International Price Discrimination", *Journal of International Economics*, Vol. 67, No.1, September, pp. 129-155.

Dornbusch, R. (1987), "Exchange Rate and Prices", *American Economic Review*, Vol. 77, No. 1, pp. 93-106.

Dunn, R.M. (1970), "Flexible Exchange Rates and Oligopoly Pricing: A Study of Canadian Markets", *Journal of Political Economy*, Vol. 78, pp. 140-151.

EXIM Bank (1991), "How Import-Intensive are Indian Exports?", *Export-Import Bank of India Occasional Paper*, No. 16, December.

Feinberg, R.M. (1986), "The Inter-Action of Foreign Exchange and Market Power Effects on German Domestic Prices", *Journal of Industrial Economics*, Vol. 35, pp. 61-70.

Froot, K.A. and P.Klemperer (1989), "Exchange Rate Pass-Through when Market Share Matters",

*American Economic Review*, Vol. 79, pp. 637-654.

Ghosh, J. (1990), "Exchange Rate and Trade Balance: Some Aspects of Recent Indian Experience", *Economic and Political Weekly*, March 3, pp. 441-445.

Goldar, B. and A.Kato (2006), "Import-Penetration and Price-Cost Margins in Indian Manufacturing Industries", *Institute of Economic Growth Working Paper*, No. E/271/2006.

Goldar, B. and S.C.Aggarwal (2004), "Trade Liberalisation and Price-Cost Margin in Indian Industries", *ICRIER Working Paper*, No. 130.

Goldberg, P.K. and M.M.Knetter (1997), "Goods Prices and Exchange Rates: What have We Learned?", *Journal of Economic Literature*, Vol. 35, No. 3, September, pp. 1243-1272.

Goldstein, M. and M.S.Khan (1985), "Income and Price Effects in Foreign Trade", in R.W.Jones and P.B.Kenen (eds.), *Handbook of International Economics*, Vol. 2, North-Holland, Amsterdam.

Granger, C.W.J. and R.F.Engle (1987), "Cointegration and Error Correction: Representation, Estimation and Testing", *Econometrica*, Vol. 55, No. 2, March, pp. 251-276.

Hooper, P. and C.L.Mann, (1989), "Exchange Rate Pass-Through in the 1980s: The Case of US Imports of Manufactures", *Brookings Papers on Economic Activity*, No. 1, pp. 297-337.

Johansen, S. (1988), "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control*, Vol. 12, pp. 231-254.

Joshi, V. and I.M.D.Little (1994), *Macroeconomics and Political Economy, 1964-1991*, Oxford University Press.

Joshi, V. and I.M.D.Little (1993), "Future Trade and Exchange Rate Policy for India", *Economic and Political Weekly*, July 31, pp. 1599-1605.

Kaldor, N. (1978), "The Effect of Devaluation on Trade in Manufactures", in N.Kaldor, *Further Essays on Applied Economics*, Duckworth, London.

Knetter, M.M. (1993), "International Comparisons of Pricing-to-Market Behaviour", *American Economic Review*, Vol. 83, No.3, pp. 473-486.

Krugman, P.R. (1987), "Pricing to Market when the Exchange Rate Changes", in S.W.Arndt and J.D.Richardson (eds.), *Real Financial Linkages in Among Open Economics*, MIT Press, Cambridge.

Mann, C.L. (1986), "Prices, Profit Margins and Exchange Rates", *Federal Reserve Bulletin*, No. 72, June, pp. 366-379.

Marston, R.C. (1990), "Pricing to Market in Japanese Manufacturing", *Journal of International Economics*, Vol. 29, pp. 217-236.

Mejean, I. (2004), "Exchange Rate Movements and Export Prices: An Empirical Analysis", August,

*CREST and EUREQua*, University of Paris.

Menon, J. (1992), "Exchange Rates and Prices of Australian Manufactured Exports", *Weltwirtschaftliches Archiv*, Vol. 128, No. 4, pp. 695-710.

Nayyar, D. (1988), "India's Export Performance, 1970-85: Underlying Factors and Constraints", in R.E.B.Lucas and G.F.Papanek (eds.), *The Indian Economy*, Oxford University Press, Delhi.

Ohno, K. (1989), "Export Pricing Behaviour of Manufacturing: A US-Japan Comparison", *International Monetary Fund Staff Papers*, Vol. 36, September.

Orcutt, G. (1950), "Measurement of Price Elasticities in International Trade", *Review of Economics and Statistics*, No. 32, pp. 117-132.

Pradhan, H.K. (1993), "Exchange Rate Policy of India 1970-92", *Export Import Bank of India Occasional Paper*, No. 22, May.

Rajaraman, I. (1991), "Impact of Real Exchange Rate Movements on Selected Industrial Exports", *Economic and Political Weekly*, Annual Number, March, pp. 669-678.

Rajaraman, I. (1993), "Real Exchange Rate Movements of the Indian Rupee: Impact on Selected Commodity Exports", *UNCTAD Review*, No. 4, pp. 117-135.

Rangan, S., R.Z.Lawrence. and R.N.Cooper (1993), "The Responses of US Firms to Exchange Rate Fluctuations: Piercing the Corporate Veil", *Brookings Papers on Economic Activity*, Vol. 1993, No. 2, pp. 341-379.

Sathe, D. (1997), "Import-Intensity of India's Exports-Some Fresh Evidence", *Economic and Political Weekly*, Vol. 32, No. 8, pp. M31-M44.

Sathe, D. (1995), "Impact of Diversification of Composition of Exports: An Analysis of the Linkages of Indian Exports", *Indian Economic Journal*, Vol. 42, No.3, pp. 114-130.

Sarkar, P. (1992), "Rupee Depreciation and India's External Trade and Payments since 1971", *Economic and Political Weekly*, June 13-20, pp. 1259-1266.

Sarkar, P. (1994a), "India's Balance of Payments and Exchange Rate Behaviour since 1971: A New Approach", *Economic and Political Weekly*, January 19, pp. 43-48.

Sarkar, P. (1994b), "Exchange Rate and Balance of Trade", *Economic and Political Weekly*, Vol. 29, No. 35, August 27, pp. 2310

Sen, P. (1986), "The 1966 Devaluation in India: A Reappraisal", *Economic and Political Weekly*, Vol. 21, No. 30, July 26, pp. 1322-1329.

Sen, S. and H.Mukhopadhyay (1994), *Devaluation, Liberalisation and the Structural Linkages between India's Foreign Trade and National Income*, Mimeo, June.

- Sen, S. (1994), "Dimensions of India's External Economic Crisis", *Economic and Political Weekly*, April 2, pp. 805-812.
- Spitaller, E. (1980), "Short-Run Effects of Exchange Rate Changes on Terms of Trade and Trade Balance", *International Monetary Fund Staff Papers*, Vol. 27, June, pp. 320-348.
- Swamy, D.S. (1994), *The Political Economy of Industrialisation: From Self-reliance to Globalisation*, Sage Publications, New Delhi.
- UNCTAD (2002), *Trade and Development Report*, United Nations, New York and Geneva.
- Wadhva, C.D. (1988), "Some Aspects of India's Export Policy and Performance", in R.E.B. Lucas and G. Papanek (eds.), *The Indian Economy, Recent Developments and Future Prospects*, Oxford University Press, Delhi.
- Wilson, J.F. and W.E. Takacs (1979), "Differential Responses to Price and Exchange Rate Influences in the Foreign Trade of Selected Industrial Countries", *Review of Economics and Statistics*, Vol. 69, No. 2, May, pp. 267-279.
- Yang, Y.Y. and M. Hwang (1994), "Price Behaviour in Korean Manufacturing", *Review of Economics and Statistics*, Vol. 76, No. 3, August, pp. 461-70.