

Exchange Rate Pass-Through and India's Export Prices

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This paper estimates exchange rate pass-through to India's export prices during 1960-2000. In the literature, exchange rate pass-through is mostly found to be incomplete. In this study we develop a simultaneous equation demand-supply model of export determination along the lines of an imperfect substitute model to estimate pass-through both at aggregate and disaggregate manufactured exports. This is done using the best possible econometric technique and a time comparable dataset. The study shows high, but incomplete, exchange rate pass-through into India's aggregate export prices. The degree of exchange rate pass-through is found to vary across product groups.

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1. Introduction

With quantum growth in India's exports in recent period, it is intriguing to understand the factors that bring about such performance. Traditionally, relative prices are found have played a key role in determining exports¹. Recent studies, e.g. Brahmabhatt et al. (1996), Joshi and Little (1994), Krishnamurthy and Pandit (1995), Sinha Roy (2009), Srinivasan (1998), Srinivasan and Wallack (2004), and Virmani (1991), show significant price responsiveness of India's exports. It is also evident that the degree of price responsiveness varies across sectors [see Krishnamurthy and Pandit (1995), Lucas (1988), and Rajaraman (1991)] with elasticities above unity only for certain product groups.² Analytically, these elasticity estimates depend on the degree of exchange rate pass-through to export prices.³ This paper investigates into the degree to which exchange rate changes pass-through to India's exports prices during 1960-61 to 1999-2000. An examination across sectors will provide evidence on the differences, if any, in the degree of pass-through. A study on exchange rate pass-through in India remains important with swings in nominal exchange rates and persistence of current account deficit for a large part of the period. The findings on exchange rate pass-through have implications for exchange rate being used as a policy instrument for promoting exports during reforms.

Exchange rate pass-through (ERPT, hereafter) is the percentage change in price of tradeables on account of a unit change in the exchange rate between two trading nations. Full ERPT – showing proportional response of prices of tradeables to exchange rate changes – underlies the Marshall-Lerner condition⁴. ERPT is complete when both mark-up over cost and marginal cost remain unchanged with exchange rate changes (see Goldberg and Knetter, 1997). However, evidence on the persistence of trade imbalance across countries including India even after changes in exchange rate indicates the possibility of incomplete pass-through⁵. The existing literature provides overwhelming evidence of incomplete pass-through across developed as well as developing economies⁶, which depends on the variations in mark-ups and marginal costs, and

¹ Bhagwati and Srinivasan (1975) was one of the early studies to raise this issue for India. Marjit and Ray Chaudhuri (1997) and Sinha Roy (2009) provide a recent review of the existing literature.

² This is in addition to Marjit and Raychaudhuri (1997) and Sinha Roy (2009) arguing for the role of non-price factors in India's export determination.

³ The price elasticity estimates are indicative of the extent of pass-through, *a la* Goldstein and Khan (1985).

⁴ Goldstein and Khan (1985) provide ample evidence on the Marshall-Lerner condition holding good across countries.

⁵ The observed trade imbalance may be on account of either export supplies not being perfectly elastic as assumed under Marshall-Lerner condition or adjustments in mark-ups and marginal costs with changes in exchange rate.

⁶ See Menon (1995), Goldberg and Knetter (1997) and Engel (2002) for evidence on incomplete pass-through across countries.

hence on market imperfections. The exchange rate pass-through to export prices is also a test of the pricing behavior of exporters. For an emerging market economy like India, movements in exchange rate often followed shifts in policies and hence, the degree of pass-through would depend to a large extent on the direction of change in nominal exchange rates. It is also widely perceived that other demand and supply factors determine pass-through⁷.

On the exchange rate front, with the Indian rupee value being fixed to the pound sterling in the early 1960s, the nominal exchange rate remained constant. With real exchange rate appreciation during that period and India's exports turning uncompetitive, the rupee was devalued by about 36 per cent, with an effective devaluation of around 17.8 per cent after adjusting for incentives, in mid-1966.⁸ The exchange rate was kept constant thereafter till 1971. Following the shifts in the world payments system towards a flexible exchange rate regime, the realignment of major currencies thereafter and countries opting for exchange rate regime of their choice,⁹ India's exchange rate system changed (Panchamukhi, 1984). The rupee was changed from a single currency peg to a basket peg in order to reduce volatility of the nominal exchange rate in a regime of generalized float. The basket peg value was adjusted periodically leading to depreciation in the nominal exchange rate till 1975 (Economic Survey, 1975-76). To further contain the fluctuations in currencies, the band of the exchange rate was widened in 1979, which helped in fixing a more appropriate exchange rate of the rupee. The rupee value during the 1980s largely depended on the dollar value in the international market and also on the RBI policy effecting small but frequent discretionary devaluations of the rupee – often termed as the crawling peg arrangements. Thus, with the exchange rate of the rupee being made a crawling peg since 1983-84, real exchange targeting was practiced during the period thereafter (Joshi and Little, 1994).

⁷ The importance of other demand and supply factors in determining pass-through is evident in the literature. See Mann (1986) and Marston (1990) for instance. Goldberg and Knetter (1997), in their survey paper, also highlight the importance of other control variables.

⁸ Bhagwati and Srinivasan (1975).

⁹ Even though par values changed during in the late 1960s, the world payments system changed with a floating of pound sterling in 1972. The other major countries followed suit. The SDR was also delinked from gold and was redefined in terms of a basket. The adoption of the Second Amendment of the Articles of the IMF allowed nations to opt for exchange rate regimes of their choice.

With exchange rate reforms¹⁰, the rupee was continuously adjusted downwards especially after the mid-1980s. However, the rupee under the crawling peg till the early 1990s failed to reflect market developments. The exchange rate became market-determined rate during the 1990s with a nominal devaluation of about 18-19 per cent in 1991 followed by the introduction of a dual exchange rate system in 1992,¹¹ and finally current account convertibility in 1993. Post-1993, following current account convertibility, a managed float regime replaced the then pegged rate system. During this period, the Reserve Bank of India intervened in the foreign exchange market to ensure a stable exchange rate for export promotion.

With shifts in exchange rate regime, the nominal exchange rate depreciated during most of the years after 1983, except for some years after the mid-1990s when either depreciation was marginal or it even appreciated.¹² Prior to 1983, phases of marginal depreciation were interspersed with years of appreciation in nominal exchange rate. However, as Patnaik (2003) finds, the post-1993 fluctuations in the Indian currency are to a significant extent explained by the movement in the US dollar. Despite reforms, India's currency regime is often classified as a *de facto* peg to the US dollar since 1979¹³. On the whole, exchange rate policy has become more flexible over the period; and all these changes in the currency value are expected to impact, among other macroeconomic variables, on export prices.

Along with movements in nominal exchange rate, India's merchandise export prices are found to have moved in the same direction over the period 1960-61 to 1999-2000, except for some years after the mid-1990s (see Figure 1). Prima facie, as Figure 1 shows, there is a possibility of a stable long run relationship between the nominal exchange rate and merchandise export price in India. Often such long run relationship is tested using co-integration method. Recent studies, using cointegration technique or otherwise, have shown a stable long-run relationship across

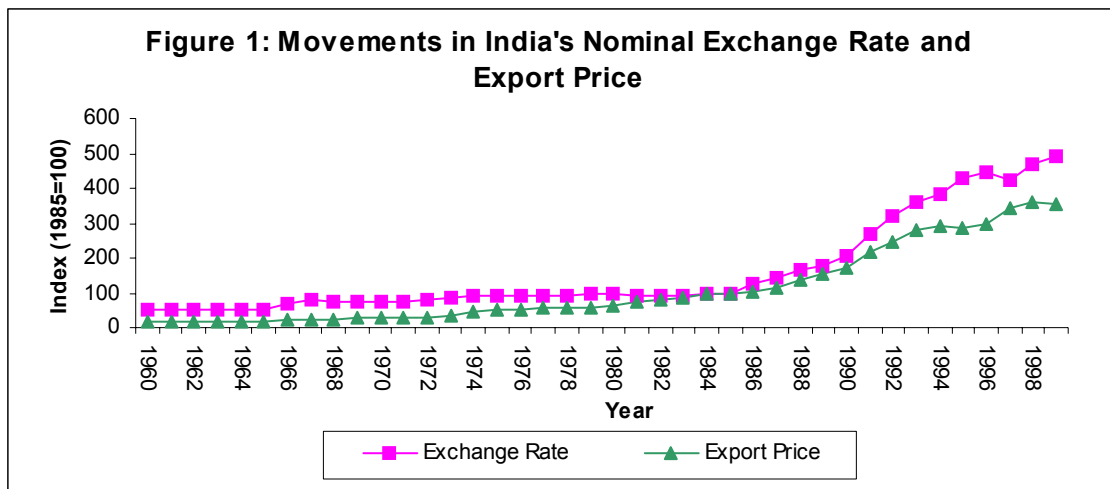
¹⁰ Exchange rate reforms in India, like in many other developing countries, forms an integral part of trade policy reforms, even though it being an instrument of general macroeconomic policy differs from trade policy. Helleiner (1994) opines that exchange rate policy is used for achieving internal and external balance, while trade policy relates to incentives for production and trade. Like most developing countries, India pursued trade policy reforms through devaluing her currency to promote exports. Acharyya (*forthcoming*) provides an account of the direction of exchange rate policy reforms in India since 1991.

¹¹ The dual exchange rate system with 60 per cent of the current receipts being converted at a market-determined rate replaced Exim Scrips in 1992. This partial convertibility of the rupee is often viewed as surrogate devaluation (Pradhan, 1993).

¹² There were intermittent real currency appreciations during the 1990s. Sen (2003) is of the opinion that these appreciation episodes followed large capital inflows.

¹³ Reinhart and Rogoff (2002) do this classification based on certain criterion.

countries.¹⁴ Despite stable pass-through relationship over the long-run, as may be evident from Figure 1, there might be short run deviations. Hence, it would be interesting to investigate into and offer explanations to the nature of short-run adjustment in sectoral export prices following changes in exchange rates¹⁵. Even though the literature, both theoretical and empirical, on exchange rate pass-through has been growing by exploring various dimensions of the pass-through phenomenon, the literature on emerging economies like India continues to be insignificant. This study becomes all the more important in the context of limited evidence on exchange rate pass-through in small emerging economies like India.



While the macroeconomics of the study draws in a large way from Dornbusch (1987), the econometric modelling is carried out on the lines of Goldstein and Khan (1985). The study is structured as follows. Section 2 provides a broad review of the empirical literature on the various dimensions related to exchange rate pass-through to export prices in general and incomplete pass-through in specific. The following section provides in some details the method and data used in investigating the phenomenon of pass-through. Section 4 provides in brief the results

¹⁴ See, for instance, Martson (1990), Gagnon and Knetter (1995), Feenstra, Gagnon and Knetter (1996), Athukorala and Menon (1994, 1995), Gross and Schmitt (2000), Banik and Biswas (2007). Evidence from these studies show incomplete pass-through against the widely held view of a full ERPT relationship over a long run.

¹⁵ Gagnon and Knetter (1995) show that in the presence of adjustment costs, export prices might show short run adjustments essentially in terms of error correction mechanism. A large number of studies including Athukorala (1991), Athukorala and Menon (1995), Banik and Biswas (2007), Feenstra, Gagnon and Knetter (1996), Gagnon and Knetter (1995), Gross and Schmidt (1996, 2000) and Yang (1998) have estimated both long run and short run pass-through coefficients. Some other studies including Gil-Pareja (2001), Knetter (1994), Mann (1986), Marston (1990), and Yang (1997) have estimated the short run pass-through coefficient only.

arrived at and their interpretation. The final section concludes with a summary of the main findings and implications.

2. Review of Literature

In this section, we provide a broad review of the existing literature on incomplete exchange rate pass-through. Dornbusch (1987) explains the adjustment of relative prices to exchange rate movements in terms of the degree of market concentration, the extent of product homogeneity and substitutability, and the relative market shares of domestic and foreign firms and market structure. All the sub-models in this analysis predict that appreciation should lead to a decline in the price of imports. For homogenous goods, domestic firms fully match the decline in price. If products are differentiated, relative price of the imported brands declines in response to an appreciation. The degree of fall depends on the extent of competition and on the ratio of number of home to foreign firms. For differentiated products, export and domestic prices will stay closer in line than import and domestic prices.

Krugman (1987) explains evidence on incomplete pass-through and pricing-to-market in case of German exports, machinery and transport equipment in particular, in terms of supply dynamics resulting from the costs of rapidly adjusting the marketing and distribution infrastructure, and the demand dynamics resulting from the need of firms to invest in reputation. Feenstra, Gagnon and Knetter (1996), using a Bertrand differentiated product model, show high pass-through in the presence of high market share of a country's exports. For countries with small and intermediate market shares, the relationship is nonlinear. When market share is very high, the firms face less competition that has not experienced a similar change in costs, and thus will more fully pass-through an exchange rate change for a given market demand schedule. In case of incomplete pass-through, with exchange rate changes, exporters change the price in their currency to stabilize their export prices in the importers' currency. This phenomenon is possible in imperfect competition and associated mark-up pricing¹⁶. Theoretically, the phenomenon of incomplete pass-through is explained through a mark-up model (Knetter, 1989; Gagnon and Knetter, 1995). Engel (2002) draws a simple link between the literature on currency of price setting and the literature in which firms can choose their price with knowledge of all shocks. The result of this paper is that firms prefer to invoice in the importer's currency when their optimal price (if they

¹⁶ The definition of imperfect competition relies on the existence of mark-ups in the presence of product differentiation. The differentiation present mostly in the manufacturing sector gives each firm a degree of monopoly power that allows the firm to use mark-up pricing.

could observe all factors affecting the pricing decision when they set the price) is stable in the importer's currency.

Mann (1986), in her empirical study, shows that dollar prices of US exports and profit margins are insensitive to exchange rate changes indicating pass-through to foreign currency prices. Evidence on foreign currency denominated profit margins of US non-agricultural export prices show near complete pass-through. The result also seems to hold good for profit margins of most disaggregated exports except machinery. Athukorala (1991) find incomplete exchange rate pass-through to Korean export prices with the exporters, on an average, absorbing 72 per cent of a change in exchange rate in their margin on export sales. The Korean exporters are found to adjust their profit margin to keep their export prices in line with that of competitors, while cost of production and demand pressure do not impact on price setting. In sharp contrast, Wang and Wu (1999) show that Taiwanese petrochemical export firms absorb only a small portion of a given weighted exchange rate change in their export prices indicating a weak PTM pattern.

Gagnon and Knetter (1995) find significant and persistent markup adjustment in Japanese automobile exports driven by exchange rate movements designed to stabilize the price measured in the buyer's currency as against either weak evidence of such behaviour in case German exports or no evidence of such adjustments in case of US exporters. Banik and Biswas (2007) also find price interdependence among rival firms for both small and medium sized automobiles. However, there is no price competition between Canadian exporters of medium size automobiles and the Japanese and Korean ones. There is evidence of low degree of pass-through for the Japanese and Korean exporting firms, which can offset the effect of exchange rate changes on buyer's prices in order to avoid losing their market share in the U.S. market. Marston (1990), in an earlier study, corroborate to the above evidence by finding that PTM elasticities being significantly greater than zero in most Japanese industries. It is also evident that PTM elasticities are higher in some industries in periods of currency appreciation. The variations in the estimated PTM elasticities across product groups show variations in this margin planned by Japanese firms to keep their products competitive in foreign markets. However, Athukorala and Menon (1994) reject the widely held view that Japanese export firms have relied more heavily on PTM strategies during the period of yen appreciation in order to maintain market shares. This is despite the pervasive evidence of incomplete pass-through. The evidence also suggests that estimates may over-emphasize the degree of pass-through to the extent that production costs are sensitive to exchange rate changes. Banik and Biswas (2007) also show that Canadian small-size automobile exports show a high degree of ERPT, implying that they were less concerned about protecting their market share in the US.

Estimates of pass-through coefficients by Menon (1992) show varying coefficients across Australian manufacturing industries, in terms of both magnitude and timing. The extent of foreign ownership and control, the share of output exported and the industry's share of exports in total exports appeared to be positively related to the degree of exchange rate pass-through across industries. Feenstra, Gagnon and Knetter (1996), through panel data estimates for automobile exports from four countries, show that the relationship between pass-through and market share is significantly nonlinear: pass-through is lowest when the source country's market share is around 40 percent and highest when market share approaches 100 percent. Wang and Wu (1999) pay attention to Herfindahl index and price elasticities of demand in addition to production cost and capacity utilization in order to emphasize the importance of market structure and industry characteristics in the studies of the exchange rate pass-through. Yang (1997), in a modified Dixit–Stiglitz framework, shows pass-through in US manufacturing industries is incomplete and it varies across industries. The degree of pass-through depends positively on product differentiation and inversely elasticity of marginal cost with respect to output. Yang (1998) also found that US exporters pass-through most of the changes in exchange rate to foreign currency prices. The pricing behaviour varies across US exports depending to some extent on industry characteristics such as market share, product differentiation and factor intensity.

The literature studying exchange rate pass-through to India's export prices is however limited, some of which are even dated. Ranjan (1995) shows incomplete but high degree of exchange rate pass-through to export prices in foreign currency. The pass-through coefficient varies across industries: from low in case of gems and jewellery and textile fabrics and manufactures to high in case of leather and leather manufactures and chemical and related products. Dholakia and Saradhi (2000), using quarterly data for the period 1980-96, show that export prices exhibit near complete exchange rate pass-through only after 1991, which was considerably incomplete prior to economic reforms in India. Recent studies by Mallick and Marques (2006, 2008) find evidence of incomplete pass-through in export prices with Indian exporters mostly absorbing exchange rate changes by adjusting their profit margins. It is also found that a larger number of industries show incomplete pass-through behaviour since 1991 after having controlled for industry-specific factors, reflecting higher degree of pricing power in these industries in the reforms period.

With regards to ERPT, certain observations are in order. First, the response of tradeable prices depends on the nature of competition in the market and the product characteristics. Second, given market imperfections, as Mann (1986), Yang (1998), Dholakia and Saradhi (2000) and Mallick and Marques (2006) show, the response of price of tradeables to exchange rate changes is different for exporters and importers. Third, prices of tradeables respond differently to events of

appreciation and depreciation. For instance, with home currency appreciation, exporters often do not pass-through the change entirely to their selling price in foreign currency to retain their market share resulting in incomplete pass-through. On the other hand, exporters pass through depreciation in home currency to foreign currency price.¹⁷ A study of exchange rate pass-through to India's export prices is justified on account of the different empirical modelling exercise that will be undertaken for the purpose. Further, the estimation exercise will show the effectiveness of trade policy reforms in determining the degree of pass-through. However, a study of the differential impact of appreciation and depreciation remains outside the scope of the present paper.

3. Empirical Model, Estimation Method and Data

3.1. Empirical Model

Empirically exchange rate pass-through is generally defined as the elasticity of export prices to exchange rate changes. There are several methods by which pass-through are estimated. Several authors (Mann, 1986; Dornbusch, 1987; Feenstra, 1989; Froot and Klemperer, 1989; Hooper and Mann, 1989; Yang, 1995; Goldberg and Knetter, 1997) measured pass-through directly using equation where the price in the trading country's currency was the dependent variable. The estimated coefficient of exchange rate measures the degree of pass-through. On the other hand, a model based on the definition of the price of exports in domestic currency as the product of marginal cost and a mark-up coefficient estimates pass-through only indirectly (Krugman, 1987; Giovannini, 1998; Knetter, 1989, 1993, 1995; Marston, 1990; Gagnon and Knetter, 1995; Goldberg, 1995). On similar lines, though more broad-based, are the models estimated by Athukorala and Menon (1994) and Wang and Wu (1999).

In contrast to the above models, we use a simultaneous demand-supply model of export determination along the lines of an imperfect substitutes model where export volume and prices are determined simultaneously.¹⁸ In this model, real exchange rate and world demand are demand-side explanatory variables, while relative price and capability are the supply side determinants. Export demand is specified as:

¹⁷ Mann (1986), Martson (1990), Knetter (1994), Goldberg (1995) Gil-Pareja (2000), Pollard and Coughlin (2004) find evidence of asymmetric response to appreciations and depreciations, but the direction of asymmetry varies. This, however, contrasts the findings of Athukorala (1991), and Athukorala and Menon (1994), who do not find any statistically significant evidence of such a conjecture.

¹⁸ Dholakia and Saradhi (2000) also estimate the degree of exchange rate pass-through using structural simultaneous equation models.

$$X_t^d = f(REER_t, W_t) \quad (1)$$

with $X_r' < 0$ and $X_w' > 0$

where X^d is real exports demanded, $REER = \left(\frac{P^x}{eP^w} \right)$ is real effective exchange rate expressed

in terms of P^x as price of exports, eP^w as exchange rate multiplied by world prices, W is world demand, and X_r' and X_w' are first order derivatives of X_t^d with respect to $REER_t$ and W_t respectively. Equation 1 can be re-written in the log-linear form as:

$$\ln X_t^d = \alpha_0 + \alpha_1 \ln P_t^x + \alpha_2 \ln e_t + \alpha_3 \ln P_t^w + \alpha_4 \ln W_t + u_t \quad (2)$$

with $\alpha_1 < 0$; $\alpha_2, \alpha_3, \alpha_4 > 0$.

The supply of exports (X^s) is specified as a function of the relative price of exports ($RP =$ relative price of exports expressed as $\left(\frac{P^x}{P^d} \right)$) and supply capability measured in terms of GDP (denoted Y). This specification as distinct from Goldstein and Khan (1985) includes a supply scale variable. The export supply function is expressed as:

$$X_t^s = f(RP_t, Y_t) \quad (3)$$

The supply equation 3 in log-linear can be re-written as:

$$\ln X_t^s = \beta_0 + \beta_1 \ln P_t^x + \beta_2 \ln P_t^d + \beta_3 \ln Y_t + v_t \quad (4)$$

with $\beta_1, \beta_3 > 0$; $\beta_2 < 0$

$$\text{In equilibrium, } X_t^d = X_t^s = X_t \text{ (say)} \quad (5)$$

Simultaneous equation estimates vary depending on the normalisation procedure used. Conventionally, following Goldstein and Khan (1978), export demand is normalised by quantity as the dependent variable and export supply by price. While Muscatelli et al. (1992) follow this

normalisation procedure, studies such as by Riedel (1988) and Athukorala and Riedel (1991, 1994, and 1996) deviate from the convention instead. The evidence in Indian trade literature is at best mixed. Given the objectives of the study, the above demand and supply side equations (2) and (4) are normalised as follows:

$$\text{Export Demand: } \ln P_t^x = \gamma_0 + \gamma_1 \ln X_t^d + \gamma_2 \ln e_t + \gamma_3 \ln P_t^w + \gamma_4 \ln W_t + u_t \quad (6)$$

$$\text{Export Supply: } \ln X_t^s = \beta_0 + \beta_1 \ln P_t^x + \beta_2 \ln P_t^d + \beta_3 \ln Y_t + z_t \quad (7)$$

where $X_t^d = X_t^s = X_t$

$$\text{and } \gamma_0 = -\left(\frac{\alpha_0}{\alpha_1}\right); \gamma_1 = \left(\frac{1}{\alpha_1}\right); \gamma_2 = -\left(\frac{\alpha_2}{\alpha_1}\right); \gamma_3 = -\left(\frac{\alpha_3}{\alpha_1}\right); \gamma_4 = -\left(\frac{\alpha_4}{\alpha_1}\right)$$

with $\gamma_1 < 0$; $\gamma_2, \gamma_3, \gamma_4 > 0$.

3.2. Estimation Method

The empirical estimation of exchange rate pass-through has been mostly carried out in a panel data framework (Knetter, 1994; Gagnon and Knetter, 1995; Feenstra et al., 1996; Madsen, 1998; Goldberg and Knetter, 1999). Even though a panel structure has advantages in terms of time and cross-sectional effects, export price determination is carried out in this study by using time series methods following Athukorala (1991), Menon (1992) and Athukorala and Menon (1994).

Usually long time series are found to have a structural break in the trend, as for aggregate and manufacturing exports in 1985-86.¹⁹ Apart from structural break, the time series variables used in the above simultaneous equation system may also have unit roots. The existence of structural break, often multiple, in different variables led to the use of modified Augmented Dickey-Fuller (ADF) test while verifying (non) stationarity.²⁰ In the estimation of unit roots, only level dummy is taken into account. For 'X', while testing for unit roots, 1985 is taken as the only breakpoint even if there are multiple breaks. For other variables as well, the estimation of the Perron equation has taken into account a single break keeping in view of the degrees of freedom. After incorporating structural break, as Table 1 presents, exports and all other variables are I (1). The use of an error-correction specification is thus justified in this case where all variables are

¹⁹ These time series can have multiple structural breaks Sinha Roy (2004).

²⁰ See Perron (1989).

integrated of order one. The error-correction estimation shows the short run dynamics correcting for deviations from long run equilibrium.

Table 1: Unit Root Tests for Exchange Rate and Other Variables

Variable	Levels / 1 st difference	Structural Break at	t-statistic	Significance level	Inference
NEER	1 st difference	1966	-3.87	1%	I(1)
P ^d	1 st difference	1978	-4.45	1%	I(1)
P ^w	1 st difference	No break	-2.09	5%	I(1)
P ^x	1 st difference	No break	-4.83	1%	I(1)
W ^d	1 st difference	1983	-5.12	1%	I(1)
Y	1 st difference	1979	-6.73	1%	I(1)
X	1 st difference	1985	-5.73	1%	I(1)
Chemicals Exports*	1 st Difference	1983	-5.66	1%	I(1)
Engineering Exports*	1 st Difference	1982	-5.02	1%	I(1)
Manufacturing Exports*	1 st Difference	1985	-4.03	1%	I(1)

Note: The level of significance is based on Mackinnon's critical values in Mackinnon (1991).

* The estimated equations for unit root test include the intercept term.

The Engle-Granger two-step method is used to arrive at the error-correction specification of the simultaneous equation model outlined above.²¹ The lagged structural error terms u_{t-1}^d and u_{t-1}^s , as in Equations (8) and (9), are used in the demand and the supply equations respectively to arrive at the ECM specifications.²² The error-correction equations are:

²¹ For a detailed exposition on the two-step Engle-Granger method, refer Enders (1995).

²² The structural error terms, u_t^d and u_t^s are estimated respectively from the demand and the supply equations by applying 2SLS method.

$$\Delta \ln P_t^x = \lambda_0 + \sum_{i=1}^N (\lambda_{1i} \Delta \ln P_{t-i}^x) + \lambda_2 \Delta \ln X_t + \lambda_3 \Delta \ln e_t + \lambda_4 \Delta \ln P_t^w + \lambda_5 \Delta \ln W_t + \lambda_6 u_{t-1}^d + \mu_t \quad (8)$$

$$\Delta \ln X_t = \theta_0 + \sum_{i=1}^N (\theta_{1i} \Delta \ln X_{t-i}) + \theta_2 \Delta \ln P_t^x + \theta_3 \Delta \ln P_t^d + \theta_4 \Delta \ln Y_t + \theta_5 u_{t-1}^s + \nu_t \quad (9)$$

Equation (8) with normalization on $\Delta \ln P_t^x$ states the export demand relationship, while Equation (9) with $\Delta \ln X_t$ shows the supply relationship. The significance of λ_6 and θ_5 in the above equations shows the validity of the error correction mechanism. Pass-through to export prices in home currency in the short run will therefore be equal to λ_3 . When the small country assumption holds true, exporters are price taker in the world market, then both world price and exchange rate should be fully absorbed into domestic export prices ($\lambda_3 = \lambda_4 = 1$) and hence, pass-through into foreign price will be zero. Conversely when exporters hold some degree of market power, they can set domestic currency prices independently.

For the purpose of error-correction estimation, as against 2SLS estimation method, Full Information Maximum Likelihood (FIML) method is used. Even though single equation estimates are consistent, they are not asymptotically efficient (Kmenta, 1971). On the other hand, the FIML method uses the available information about each equation in the system in terms of correlation between the disturbances of different structural equations thus ensuring asymptotic efficiency even in small samples.²³

3.3. Data: Export Prices and Exchange Rate

In India, export prices at the sectoral level are not available. As it is well known, unit value index of exports is an imperfect proxy for the true export price of goods and are subject to aggregation bias (Sinha Roy, 2001). However, in the absence of micro data, unit value indices available across commodities on an annual basis can be regarded as a first best approximation to allow the analysis of an important issue. The direction of India's trade is critical in terms of the choice of exchange rate. Instead of using rupee-to-UD \$ exchange rate, which is the main currency of invoice for India's most export transactions, export-weight based nominal effective exchange rate (NEER) is used for the purpose.

²³ The disadvantage of the FIML approach is that it introduces non-zero restrictions in the structural equations, and thus estimation becomes more complicated. The estimation is done using the statistical software PC-GIVE.

The unit value indices of exports across a number of sectors and the nominal effective exchange rate are compiled from the Handbook of Statistics on the Indian Economy, Reserve Bank of India. Data on exports, including re-exports, are free-on-board (f.o.b.) values are obtained from the Monthly Statistics of Foreign Trade in India published Director General of Commercial Intelligence and Statistics, Kolkata. The broad product groups considered for empirical estimation are aggregate exports, manufactured exports, chemical and related products, engineering goods.

4. Empirical Results

As against single equation estimates of pass-through, simultaneous demand-supply equations are used to estimate exchange rate pass-through to export prices. The estimated coefficients are thus robust in the sense that they do not have simultaneity bias, in contrast to the ones that can be arrived at from single equation estimates. Further, the estimation procedure takes into account time series properties of the variables in the model. The ECM estimates are obtained by using the system method – the Full Information Maximum Likelihood (FIML) method. The results (Tables 3a to 3d) show that the coefficients of the lagged error term in the demand equation is negative and significant at 1 per cent level.²⁴ Thus, for exports, aggregate and disaggregate, error correction representation is found to exist both for the demand as well as the supply equations. The model fits the data well and thus explains the behaviour of aggregate and total manufacturing export prices appropriately. The modelling of disaggregated pass-through behaviour as an error-correction process was successful in that significant error correction was found to exist across product groups, chemicals and engineering goods. The results are thus an improvement over the existing ones on disaggregated exports.

Table 3a: Estimation of Exchange Rate Pass-Through for Aggregate Exports

Variable	Coefficient	Std. Error	t-Statistic	Prob
D(IPw)	1.03	0.144	7.12	0.000
D(le)	0.57	0.092	6.31	0.000
D(IWd)	0.29	0.074	3.94	0.000
D(IX)	-0.02	0.180	-0.12	0.907
U(-1)	-0.62	0.112	-5.62	0.000

²⁴ The significance of the lagged error term is also found in the supply equation. However, due to paucity of space, the supply results are not reported here.

Table 3b: Estimation of Exchange Rate Pass-Through for Manufactured Exports

Variable	Coefficient	Std. Error	t-Statistic	Prob
D(IP ^w)	0.89	0.166	5.37	0.000
D(le)	0.71	0.118	6.01	0.000
D(IW ^d)	0.43	0.132	3.30	0.002
D(IX)	-0.15	0.183	-0.83	0.410
U(-1)	-0.46	0.122	-3.75	0.001

Table 3c: Estimation of Exchange Rate Pass-Through for Chemicals Exports

Variable	Coefficient	Std. Error	t-Statistic	Prob
D(IP ^w)	2.28	0.510	4.47	0.000
D(le)	0.95	0.250	3.80	0.001
D(IW ^d)	1.04	0.392	2.64	0.012
D(IX)	-1.12	0.286	-3.92	0.000
U(-1)	-1.03	0.277	-3.71	0.001

Table 3d: Estimation of Exchange Rate Pass-Through for Engineering Goods Exports

Variable	Coefficient	Std. Error	t-Statistic	Prob
D(IP ^w)	0.95	0.399	2.39	0.022
D(le)	0.38	0.190	1.98	0.056
D(IW ^d)	0.67	0.205	3.26	0.003
D(IX)	-0.37	0.197	-1.89	0.067
U(-1)	-0.61	0.113	-5.37	0.000

On the face of it, India is often held as a small open economy, and is therefore regarded as a 'price taker' in the international market. Under these circumstances, with movements in nominal exchange rate, pass-through coefficient in foreign currency can be posited to be unity. The dependent variable is the export price in the home currency and, assuming marginal costs are independent from the importing markets, it also represents the exporter's mark-up. As long as these mark-ups vary with exchange rate changes, pass-through in foreigner's currency will be incomplete.

For aggregate exports, the coefficient of exchange rate has the expected sign and is significant. However, the value of the coefficient being less than unity is indicative of adjustments in export prices with exchange rate changes. Incomplete pass-through for the entire period is indeed indicative of imperfect export market structure. For manufactured exports as well, the results show significant but less than unity coefficient of exchange rate. A less-than-unity coefficient may be on account of shifts in the marginal cost curve emanating from changes in imported input costs that follow from the exchange rate change. As long as the export price in home currency represents a mark-up, any change in exchange rate leads to adjustments in mark-up in the presence of market imperfections. However, the existing analysis does not take into account the market structure for exports, which is identified in literature as an important factor that determines the extent of pass-through to export price. In the existing literature, incomplete pass-through is evident mostly in situations of currency appreciation, when exporters pass-through the entire depreciation in home country currency. However, in case of India's exports, there is evidence of incomplete pass-through.

The short run exchange rate elasticities thus arrived at, though high, are less than unity indicating incomplete pass-through both at the aggregate and at the disaggregate levels. However, the degree of pass-through is found to vary across product groups. While the exchange rate coefficient for chemicals exports is 0.95, for engineering goods exports, the degree of pass-through to export prices in home currency is lower at 38 percent. While the degree of absorption of exchange rate adjustments in export prices in home currency is near complete for chemicals, the estimated changes in foreign currency export price of chemicals is small. The corresponding extent of pass-through to foreign currency price of engineering goods exports is larger. The results, following Goldberg and Knetter (1997), show adjustments in exporters' mark-ups to vary by products and hence in the degree of pass-through across export product groups. In addition, the significance of the coefficients of world price shows that India's export price across product groups move in tandem with world price. India's exporters, thus, do not deviate from the world price in a large way in order to remain competitive in the world market. This result, which is evident across product groups, indeed supports the finding of incomplete pass-through where exporters adjust their mark-up in domestic currency in order to remain competitive in destination markets.

The model explains well for the entire period, the estimation results do not show any significant break either in 1985 or 1991.²⁵ The pass-through coefficients thus do not show significant

²⁵ The study period ends at 1999-2000. It seems that the incorporation of a longer time period might change the results on post-reforms exchange rate pass-through. The robustness of the present econometric model however may

difference during post trade and exchange rate reforms. This result is counter-intuitive as the pass-through coefficient is expected to improve with competition post reforms. This finding indeed contrasts the existing results, which find that pass-through to export prices is complete during the post-reforms period.

Even though the study period is up to 1999-2000²⁶, the results are contextual and relevant as there are no major changes either in exchange rate policies or in export pricing policies after 2000. The results also wide open the debate on export incentive policies and also on the degree of market imperfections.

The results, on the whole, confirm incomplete exchange rate pass-through to prices of disaggregated exports with large variations in the degree of pass-through across products. The evidence of incomplete pass-through may reflect strategic pricing behaviour on the part of exporting firms which aim to protect its market share during currency appreciation or to augment profit margins during currency depreciation.

5. Summary and Conclusions

The study shows high, but incomplete, exchange rate pass-through into India's exports prices both at the aggregate as well as at the disaggregate levels. However, the extent of pass-through varies across product groups with near complete pass-through for export prices of chemicals and incomplete and low pass-through for prices of engineering goods exports. The observed differences in sector-wise results only highlight the importance of having sector-specific policies. Above all, incomplete pass-through itself is indicative of imperfect export markets. Similar exercise has to be carried out for other product groups such as leather and leather manufactures, iron and steel, and textiles and garments before arriving at firm conclusions at the product specific levels.

The above results also call for investigating into pass-through to export prices for a large cross-section of exports at the disaggregated level, may be product specific, especially for the reforms period. For the purpose, structure of the international market at the product specific level can provide additional explanations to the pass-through phenomenon. The evidence of incomplete export price pass-through depends on the levels of mark-ups in export prices and product

not change the results very significantly.

²⁶ This is largely on account of non-availability of consistent data afterwards.

differentiation, which are in turn dependent on the degree of market imperfection. This can be the agenda for future research.

References

1. Acharyya, R. (forthcoming). India's Trade and Exchange Rate Policies: Understanding the BOP Crises and the Reforms Thereafter. In C. Ghate (Ed.) *Oxford Handbook on Indian Economy*. UK/USA: Oxford University Press.
2. Athukorala, P. (1991). Exchange Rate Pass-through: The Case of Korean Exports of Manufactures. *Economics Letters*, Vol. 35(1), 79–84.
3. Athukorala, P. and J. Menon (1994). Pricing-to-market Behavior and Exchange Rate Pass-Through in Japanese Exports. *Economic Journal*, Vol. 104 (423), 271–81.
4. Athukorala, P. and J. Menon (1995). Exchange Rates and Strategic Pricing in Swedish Machinery Exports. *Oxford Bulletin of Economics and Statistics*, Vol. 57(4), 529-42.
5. Athukorala, P. and J. Riedel (1991). The Small Country Assumption: A Reassessment with Evidence from Korea. *Review of World Economics (Weltwirtschaftliches Archiv)*, Vol. 127(1), 138-51.
6. Athukorala, P. and J. Riedel (1994). Demand and Supply Factors in the Determination of NIE Export: A Simultaneous Error Correction model for Hong Kong: A Comment. *Economics Journal*, Vol. 104 (427), 1411-1413.
7. Athukorala, P. and J. Riedel (1996). Modeling NIE Exports: Aggregation, Quantitative Restrictions and Choice of Econometric Methodology, *Journal of Development Studies*, Vol. 33(1), 81-98.
8. Banik, N. and B. Biswas (2007). Exchange Rate Pass-through in the US Automobile Market: A Cointegration Approach. *International Review of Economics and Finance*, Vol. 16(2), 223-236.
9. Bhagwati, J. and T. N. Srinivasan (1975). *Foreign Trade Regimes and Economic Development: India*. New York: Columbia University Press (for the NBER).
10. Brahmabhatt, M., T. G. Srinivasan and K. Murrell (1996). India in the Global Economy. *Policy Research Working Paper No. 1681*, World Bank, Washington DC.
11. Dholakia, R.H. and V. R. Saradhi (2000). Exchange Rate Pass-Through and Volatility: Impact on Indian Trade. *Economic and Political Weekly*, Vol. 35(43-53), 4109-4116.
12. Dornbusch, R. (1987). Exchange Rates and Prices. *American Economic Review*, Vol. 77(1), 93–106.

13. Enders, W. (1995). *Applied Econometric Time Series*. Wiley, New York.
14. Engel, C. (2002). The Responsiveness of Consumer Prices to Exchange Rates and the Implications for Exchange-Rate Policy: A Survey of a Few Recent New Open-Economy Macro Models. *NBER Working Paper* No. 8725. Cambridge, MA: National Bureau of Economic Research. (<http://www.nber.org/papers/w8725>).
15. Feenstra, R. C. (1989). Symmetric Pass-through of tariffs and Exchange Rates under Imperfect Competition: An Empirical Test. *Journal of International Economics*, Vol. 27(1-2), 25-45
16. Feenstra, R., J. Gagnon and M. Knetter (1996). Market Share and Exchange Rate Pass-through in World Automobile Trade. *Journal of International Economics*, Vol. 40(21), 187–207.
17. Froot, K. and P. Klemperer (1989). Exchange Rate Pass-through When Market Share Matters. *American Economic Review*, Vol. 79(4), 637–54.
18. Gagnon, J. and M. M. Knetter (1995). Markup Adjustment and Exchange Rate Fluctuations: Evidence from Panel Data on Automobile Exports. *Journal of International Money and Finance*, Vol. 14(2), 289–310.
19. Gil-Pareja, S. (2000). Exchange Rates and European Countries' Export Prices: An Empirical Test for Asymmetries in Pricing to Market Behaviour. *Review of World Economics (Weltwirtschaftliches Archiv)*, Vol. 136(1), 1-23.
20. Gil-Pareja, S. (2001). Pricing to market in European automobile exports to OECD countries: A panel data approach. *Applied Economics*, Vol. 33(14), 1845–1856.
21. Giovannini, A. (1988). Exchange Rates and Traded Goods Prices. *Journal of International Economics*, Vol. 24(1-2), 45–68.
22. Goldberg, P. K. (1995). Product Differentiation and Oligopoly in International Markets: the Case of the US Automobile Industry. *Econometrica*, Vol. 63(4), 891–951.
23. Goldberg, P. K. and M. M. Knetter (1997). Goods Prices and Exchange Rates: What have we Learned? *Journal of Economic Literature*, Vol. 35(3), 1243–72.
24. Goldberg, P. K. and M. M. Knetter (1999). Measuring the intensity of Competition in Export Markets. *Journal of International Economics*, Vol. 47(1), 27-60.
25. Goldstein, M. and M. Khan (1978). The Supply and Demand for Exports: A Simultaneous Approach. *Review of Economics and Statistics*, Vol. 60(2), 275-86.

26. Goldstein, M. and M. Khan (1985). Income and Price Effects in Foreign Trade. In R. W. Jones and P. B. Kenen (Eds.). *Handbook of International Economics*, Vol. 2, 1041-1105. North Holland, Amsterdam.
27. Gross, D. M. and N. Schmitt (1996). Exchange Rate Pass-through and Rivalry in the Swiss Automobile Market. *Review of World Economics (Weltwirtschaftliches Archiv)*, Vol. 123(2), 278–303.
28. Gross, D. M. and N. Schmitt (2000). Exchange Rate Pass-through and Dynamic Oligopoly: An Empirical Investigation. *Journal of International Economics*. Vol. 52 (1), 89-112.
29. Helleiner, G. K. (1994). Introduction. In G. K. Helleiner (Ed.) *Trade Policy and Industrialisation in Turbulent Times*. Routledge, London.
30. 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*, Vol. 20(1), 297–337.
31. India, Department of Economic Affairs (1976). *Economic Survey 1975-76*, Ministry of Finance, Government of India, New Delhi.
32. Joshi, V. and I. M. D. Little (1994). *India: Macroeconomics and Political Economy, 1964-1991*. Oxford University Press, Delhi.
33. Kmenta, J. (1971). *Elements of Econometrics*. Macmillan, New York.
34. Knetter, M. (1989). Price Discrimination by US and German Exporters. *American Economic Review*, Vol. 79 (1), 198–210.
35. Knetter, M. (1993). International Comparisons of Pricing-to-market Behaviour. *American Economic Review*, Vol. 83(3), 473–86.
36. Knetter, M. (1994). Is Export Price Adjustment Asymmetric? Evaluating the Market Share and Marketing Bottlenecks Hypotheses. *Journal of International Money and Finance*, Vol. 13(1), 55–70.
37. Knetter, M. (1995). Pricing to Market in Response to Unobservable and Observable Shocks. *International Economic Journal*, Vol. 9(2), 1–25.
38. Krishnamurthy, K. and V. Pandit (1995). India's Trade Flows: Alternative Policy Scenarios: 1995-2000. *Working Paper No. 32*, Centre for Development Economics, Delhi School of Economics, Delhi.
39. Krugman, P. (1987). Pricing to Market when the Exchange Rate Changes. In S.W. Arndt and D. Richardson (Eds.) *Real-Financial Linkages among Open Economies*, MIT Press, Cambridge, MA, 49–70.

40. Lucas, R. E. B. (1988). Demand for India's Manufactured Exports. *Journal of Development Economics*, Vol. 29 (1), 63-75.
41. Mackinnon, J. (1991). Critical Values for Cointegration Tests. In R. F. Engle and C. W. J. Granger (Eds.) *Long-Run Economic Relationships: Readings in Cointegration*. The University Press, Oxford, 267-76.
42. Madsen, J. (1998). Errors-in-variables, Supply side Effects, and Price Elasticities in Foreign Trade. *Review of World Economics (Weltwirtschaftliches Archiv)*. Vol. 134(4), 612-37.
43. Mallik, S. and H. Marques (2006). Sectoral Exchange Rate Pass-through: Testing the Impact of Policy Reforms in India. *Scottish Journal of Political Economy*, Vol. 53(2), 280-330.
44. Mallik, S. and H. Marques (2008). Exchange Rate Transmission to Industry-level Export Prices: A Tale of Two Policy Regimes in India. *IMF Staff Papers*, Vol. 55(1), 93-108.
45. Mann, C. (1986). Prices, Profit Margins, and Exchange Rates. *Federal Reserve Bulletin*. Vol. 72 (June), 366-79.
46. Marjit, S. and A. Raychaudhuri (1997). *India's Exports: An Analytical Study*. Oxford University Press, Delhi.
47. Marston, R. (1990). Pricing to Market in Japanese Manufacturing. *Journal of International Economics*, Vol. 29(3-4), 217-36.
48. Menon, J. (1992). Exchange Rate and Prices of Australian Manufactured Exports. *Review of World Economics (Weltwirtschaftliches Archiv)*, Vol. 128(4), 695-710.
49. Menon, J. (1995). Exchange Rate Pass-Through. *Journal of Economic Surveys*, Vol. 9(2), 197-231.
50. Muscatelli, V. A., T. G. Srinivasan and D. Vines (1992). Demand and Supply Factors in the Determination of NIE Export: A Simultaneous Error Correction model for Hong Kong. *Economics Journal*, Vol. 102 (415), 1467-1477.
51. Panchamukhi, V. R. (1984). Exchange Rate Regimes in Developing Countries: Experience of India. *Foreign Trade Review*, Vol. 19(1), 1-48.
52. Patnaik, I. (2003). India's Policy Stance on Reserves and the Currency. *ICRIER Working Paper No 108*, Indian Council for Research on International Economic Research, New Delhi.
53. Perron, P. (1989). The Great Crash: The Oil Price Shock, and the Unit Root Hypothesis. *Econometrica*, Vol. 57(6), 1361-1401.
54. Pollard, P. S. and C. Coughlin (2004). Size Matters: Asymmetric Exchange Rate Pass-through at the Industry Level. *Federal Reserve Bank of St. Louis Working Paper 2003-029C*,

Research Division, Federal Reserve Bank of St. Louis, St. Louis.
(<http://research.stlouisfed.org/wp/2003/2003-029.pdf>)

55. Pradhan, H. K. (1993). Exchange Rate Policy of India: 1970- 92. *EXIM-Bank Occasional Paper*, No 22, May. EXIM Bank of India, Mumbai.
56. Rajaraman, I. (1991). Impact of Real Exchange Rate Movements on Selected Indian Industrial Exports. *Economic and Political Weekly*, Vol. 26(11/12), 669-678.
57. Ranjan, R. (1995). Competitiveness of India's Exports: Some Aspects. *Reserve Bank of India Occasional Papers*, 16(4), 257-300.
58. Reinhart, C. M. and K. S. Rogoff (2002). The Modern History of Exchange Rate Arrangements: A Reinterpretation. *NBER Working Paper* No. 8963, National Bureau of Economic Research, Cambridge MA
59. Riedel, J. (1988). The Demand for LDC Exports of Manufactures: Estimates from Hong Kong. *Economic Journal*, Vol. 98 (389), 138-48
60. Sen, P. (2003). Exchange Rate Policy in India. In R. Jha (Eds.) *Indian Economic Reforms*, Palgrave Macmillan, Hampshire, U.K.
61. Sinha Roy, S. (2001). India's Trade Database: Contours, Inconsistencies, and Ways Ahead. *Economic and Political Weekly*, Vol. 36 (1), 51-58.
62. Sinha Roy, S. (2004). *Factors in the Determination of India's Exports*. Unpublished Ph.D. Thesis submitted to Jawaharlal Nehru University, New Delhi, Centre for Development Studies, Thiruvananthapuram.
63. Sinha Roy, S. (2005). Post-reforms Export Growth in India: An Explanatory Analysis. In N. Banerjee and S Marjit (Eds.) *Development, Displacement and Disparity: India in the Last Quarter of the Twentieth Century*. Orient Longman Limited, Hyderabad.
64. Sinha Roy, S. (2009). The Determinants of India's Exports. *Working Paper* No. 03-09, *International Trade Research Series*, Department of Economics, Jadavpur University. Kolkata.
65. Srinivasan, T. N. (1998). India's Export Performance: A Comparative Analysis. In I. J. Ahluwalia and I. M. D. Little (Eds.) *India's Economic Reforms and Development: Essays for Manmohan Singh*, Oxford University Press, Delhi.
66. Srinivasan, T. N. and J. S. Wallack (2004). Export Performance and Real Effective Exchange Rate. In A. O. Krueger and S. Z. Chinoy (Eds.) *Reforming India's External, Financial and Fiscal Policies*, Oxford University Press, New Delhi.

67. Virmani, A. (1991). Demand and Supply Factors in India's Trade. *Economic and Political Weekly*, Vol. 26(6), 309-314.
68. Wang, K. L. and C. S. Wu (1999). Exchange rate Pass-through and Industry Characteristics: The Case of Taiwan's Exports of Midstream Petrochemical Products. In T. Ito and A. O. Krueger (Eds.) *Changes in Exchange Rates in Rapidly Developing Countries: Theory, Practice, and Policy Issues*, The University of Chicago Press, Chicago, 211-230
69. Yang, J. (1995). Exchange Rate Pass-through in the U.S. Market: A Cross-country and Cross-product Investigation. *International Review of Economics and Finance*, Vol. 4(4), 353-371.
70. Yang, J. (1998). Pricing-to-Market in US Imports and Exports: A Time Series and Cross-Sectional Study. *Quarterly Review of Economics and Finance*, Vol. 38(4), 843-61.
71. Yang, J. (1997). Exchange Rate Pass-through in US Manufacturing Industries. *Review of Economics and Statistics*. Vol. 79(1), 95-104.