Chapter 2

Evidence on Exchange Rate Pass-Through:

Review, Issues and Insights

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Brief Content

2.1. Introduction

The concerns with how domestic prices are impacted by exchange rate variations have been a part of the larger macroeconomic debates on the implications of external shocks on domestic economic conditions due to the gradual opening of economies to trade in goods, services and assets. Movements in the exchange rate are expected to induce both quantity and price impacts which may be intertwined with each other, thus complicating the assessment of the true extent to which exchange rate affects an economy. In the International Finance literature, both the quantity and price effects of exchange rate have been investigated rigorously. The analysis of exchange rate regimes and the economic cost-benefit analysis of the different models of exchange rate systems led to a large body of literature on the quantity effects of exchange rate variations. This strand of literature emerged due to the shifts in the kind of exchange rate systems that various countries began adopting with the advent of trade liberalization in the advanced economies, and thereafter in the emerging economies. The nature of balance of payments adjustment mechanism under the fixed, floating and the hybrid exchange rate systems has been one of the thorniest issues in the regard. The shift from fixed to more flexible systems brought costs as well as gains that required a comprehensive understanding of how the domestic economies would react in real terms to such a change. Both disaggregate and aggregate analyses were undertaken to accommodate these concerns into a proper economic framework and thus provide usable inputs to policymakers who were grappled with the need to replace the more rigid exchange rate regime by more flexible and tolerant regimes. In general, these issues were subsumed under the ambit of monetary economics and the different schools of thoughts such as the Classicals, Keysnesians, New Classicals, New Keynesians, and others enriched the stock of knowledge on this matter gradually with time. The broad consensus that emerged from the various debates in this regard was that allowing exchange rate to vary as freely as possible will generally provide a larger room for monetary policy to achieve the domestic economic goals. However, this consensus in the literature has been conditional upon the extent of volatility in exchange rates. The inherently volatile nature of exchange rate was realized soon after the Bretton Woods agreement and countries – both industrially advanced and the developing ones, oscillated between a continuum of rigid and floating exchange rate systems. Pure fixed regime was found to strip away the capability of monetary policy to contribute meaningfully in domestic monetary management, while pure

flexible regimes were juxtaposed against the fixed regimes as sources of uncertainty and shocks to the domestic economy.

The increasing realization of the inherently volatile nature of exchange rates and the need to study its impact much beyond the quantity impacts was ignited by several seminal works. Among them, the work that is generally agreed to be the ignition point of the pass-through literature is that of Dornbusch (1976). While there are debates on the genesis of the ERPT literature, the role of the overshooting model as framed by Dornbusch is undeniable, though he himself recognized other authors who shared similar concerns before him and largely credited his ideas to the works of Mundell and Fleming. The fears of floating were brought to the centre table of discussion again by Dornbusch and the nations that had or were contemplating increasing the market-orientation of their exchange rate policies were faced with the same concerns that existed in the pre-Bretton Woods era. Inherently volatile nature of exchange rate would transmit higher uncertainties and shocks into the domestic macroeconomic system, thereby making exchange rates as possible impediments in the achievement of domestic macroeconomic goals. Such matters made it necessary to give increasing recognition not only the quantity impact of exchange rates, but also to their price impact[1]. Attention to the price impact of exchange rate variations provided a stronger explanation of the fact that the Law of One Price (LOOP) and Purchasing Power Parity (PPP) will not always hold and that this can be persistent rather than temporary. Works of Baldwin (1988), Dixit (1989), and perhaps the co-authored work of Baldwin and Krugman, could be considered as some of the first movers in the ERPT literature. Thereafter, the literature on the price impact of exchange rates has evolved into a wide and deep area of study in macroeconomics whose summarization into a few pages is not possible. However, at the cost of selection bias, the next section summarizes the important works in the ERPT literature while recognizing the invaluable contributions of many other studies which have contributed equally into the evolution of the pass-through literature.

2.2. Review of Evidence at the International level

The early concerns with the possible impact of exchange rate and its volatility on domestic economy can be traced to the seminal work of Dornbusch (1976, and 1987). Dornbusch (1976) proposed the exchange rate overshooting model wherein price stickiness in goods markets, accompanied by rapid adjustments in asset markets, causes the exchange rate to increase beyond

its long run level when a monetary expansion occurs. The author infers that as goods market adjusts via changing prices following a monetary policy shock, the exchange rate would return to its long run levels. Price and real output rigidities are used as key assumptions to analyze the adjustment process in exchange rates due to monetary policy shocks. The ERPT relation is derived via the adjustment process theorized for the goods market under perfect competition, perfect capital mobility and a small-country framework.

Dornbusch (1987) examined how exchange rate changes impact domestic relative prices in the U.S. within the industrial organization framework. His focus was on the way price setting works for importers and the market structure under which economic agents function. Analysis was undertaken within a partial equilibrium model by imposing exogeneity on the nominal exchange rate. However, rather than focusing on how exchange-rate-relative-price nexus works for individual firms, the author drew attention to the industry-wide adjustment process of relative prices to exchange rate movements. The fundamental assumptions of the author's analysis were exogenous nominal exchange rate and sticky wages, quite similar to the framework in Taylor (2000). The primary focus of the author was on the large appreciation experienced by the U.S. Dollar between 1980 and 1985. The author highlights that the effects of this episode on relative prices across U.S. import and export commodity groups could be explained by two different economic models. The first was the 'law of one price' and the second a Keynesian sticky-wage model that relaxes the assumptions of perfect competition and perfect arbitrage. The author suggests that the assumption of constant mark-up underlying the classical model produces a proportionate relation between relative prices and exchange rate movements. This assumption is relaxed in the analysis. Exchange rate changes affect relative prices at the industry-level through the supply side, namely via cost shocks. Three models are elaborated in this regards. The first is the Cournot model that assumes imperfections in the market. Specifically, the author includes "assumes perfect substitution between alternative suppliers and places more emphasis on the extent of oligopoly". The Cournot model yields a less-than-proportionate relation between exchange rate and relative prices. The second model analyzed by the author was the Dixit-Stiglitz model that assumed "imperfect substitution between alternative suppliers". This model yields a more-than-proportional change in the import prices due to appreciation of the currency while export prices remain fairly constant due to unchanged domestic labour costs. Finally, the so-called Salop model is analyzed "where consumers' tastes are uniformly spread over the unit circle". This

model yields a non-linear outcome wherein exchange rate changes affect export prices differently depending on the number of firms in the industry. This model produces considerable variations in the price response of importers as well as exporters to exchange rate changes based on the degree of competition, including interdependency, among the firms. The author has analyzed the short term economic adjustments following real appreciation of currency under a constant wage-rate model. Long run analysis has been kept out of the purview. The models analyzed by the author provide useful framework and reference point to study how domestic inflation would evolve following an exchange rate shock in the short term.

A contrasting view is presented by Baldwin (1988) who analyzes the pass-through relationship between real exchange rate and real import prices. The author studied the persistence, "hysteresis" as they called it, of import prices to below-equilibrium level even after complete adjustment in the exchange rate to its equilibrium level as predicted by the Dornbusch (1976) overshooting model. The author surveys the different models that can explain the persistence of domestic prices even after real exchange rate adjustment following a shock has occurred. Analysis is undertaken via an inverse demand function to examine the ERPT relationship. The author assumes perfect foresight of economic agents in terms of predicting the future real exchange rate. Number of firms, variety of products, current and expected price of products, is used among others to analyze the effects of exchange rate shocks. The price implications of currency shocks on import price inflation are evaluated in terms of the quantum of the currency shock itself. Large shocks are defined as those that either is much higher than the equilibrium exchange rate value or which is persistent for a longer period of time. The author finds differential impact of large versus small exchange rate shocks, thereby giving credence to the idea of nonlinearity in ERPT. The 'threshold level' argument in ERPT analysis is substantiated by the author. The transmission of 'large' exchange rate shocks to import prices occurs via the market-structure effects of exchange rate movements. Substantial shifts in exchange rates cause changes in the number of firms in the market, the degree of competition among them and the product composition of the domestic goods market, thereby causing effects on the import prices. Small shocks do not cause much effect on the structure of the domestic goods market and thus do not induce any variations in import prices and via it on the domestic general price level. The analysis in this paper is confined to the first stage ERPT. In the theoretical formulation by the author, import prices are determined by the real exchange rate, price elasticity of demand of the products under consideration and the number of

varieties of the products sold by the home and foreign firms within the domestic market. This is undertaken within the inverse demand function for import products. The author shows that in case of a large exchange rate shock, the market structure undergoes substantial changes and thus the import prices after the exchange rate shock are permanently lower than those before the shocks, thereby signifying hysteresis. Lastly, the author concludes with empirical evidence on a structural break in the ERPT relationship after the exchange rate shock of early 1980s.

De Grauwe (1988) examined the relation between exchange rate volatility and international trade. Even though this issue is not directly pertaining to ERPT, the issue of exchange rate volatility is crucial for ERPT analysis. Hence it has been briefly presented here. The author examined how the introduction of flexible exchange rate regime in the industrial countries increased volatility of the real exchange rate and subsequently lowered the quantum of international trade. The author found substantial empirical evidence for this belief. Increased volatility in exchange rate was found to be causing a reduction in the international trade flows for the selected industrialized countries. Implicitly, the ERPT relationship too should have become more unstable and possibly weaker. However, this is a mere speculation and the study did not delve into it.

Dixit (1989) examined the issue of ERPT with special reference to the entry-exit costs in domestic markets for home and foreign firms. The author focused on the issue of hysteresis in the import prices in domestic current. The primary issue was to link the persistence of the impact of exchange rate swings even after the swings passed away and the real exchange rate returned to its equilibrium value. The study argued that the sunk costs on entry prevent foreign firms from immediately reacting to exchange rate adjustments and reverse their initial reactions. With large sunk costs, it would be costly for foreign firm to reverse their reactions immediately to an initial exchange rate shock. A fundamental concern of the author was their dissatisfaction with the simplifying assumptions of perfect foresight as in Baldwin (1988) and, that of independent and identical distribution of exchange rate levels as made in the co-authored works by Baldwin and Krugman. The author theorized the exchange rate behaviour as a random walk process thereby allowing higher volatility in exchange rate into the ERPT analysis. Doing so allowed the author to impose higher costs of entry and exit on firms in the domestic market. This was one possible source of hysteresis in domestic prices as firms would find it difficult to quickly react to any reversal in an initial exchange rate shock. The author found empirical evidence on the existence of hysteresis

in import prices through an inverse demand function for imported goods. The extent of ERPT under alternative scenarios is also analyzed. It is found that the extent of ERPT is determined by the number of firms competing in the domestic market- both home and foreign. The author concluded that when the number of firms remained constant, ERPT remained at zero. When entry and exit are permitted into the model, the size of the ERPT coefficient was seen to be higher, and in some cases even close to one.

Webber (1999) investigated the first-stage ERPT for nine Asia-Pacific countries namely Korea, Pakistan, Thailand, Philippines, Malaysiaa, Australia, Japan, Singapore, and New Zealand for the time period 1978:Q1 to 1994:Q4. The author theorized ERPT within a competitive market framework and derived the exchange rate elasticity of import prices in domestic currency as a function of foreign demand elasticity, domestic demand elasticity and foreign supply elasticity of the imported commodities. The analysis was undertaken at the aggregate level. Both the long-run and short-run ERPT coefficients were estimated within a time-series econometric framework. The Johansen cointegration and the rank-restricted vector error-correction methodologies were employed to derive the import-price pass through of exchange rate shocks. Both the long-run and short-run ERPT coefficients were estimated via an import price function that accounted for a vector of macroeconomic variables such as seasonal dummies, exchange rate dummies, lagged bilateral exchange rate, lagged foreign price index, and lagged domestic price. The authors thus analyzed the pass-through issue within a dynamic partial equilibrium framework. It was found that the long-run cointegrating relationship existed for seven out of the nine countries. For majority of the remaining economies only one long-run cointegrating relationship was evident. Partial import price pass-through was obtained for most of the economies, i.e. the ERPT coefficient value was between zero and one. The key determinants of the observed ERPT to import prices are located in the composition of import bundle of the country (particularly the proportion of low-value added goods), the absolute aggregate size of the economy (measured as the ratio of total import expenditure to world import expenditure), and the duration of the exchange rate shock (defined in terms of the frequency and volatility of the bilateral exchange rate). Conclusive results on the main factor from among these three could not be located by the authors, perhaps due to the aggregative nature of their study which they themselves concede to. The estimates for the short-run ERPT showed low degree of pass-through for all the countries in the sample. Thus, the exporters were

found to be slowly adjusting their import price quotations with time rather than responding immediately to any exchange rate shock.

Peltzman (2000) analyzed the relation between output and inputs prices using disaggregated commodity-level data for 77 consumer goods and 165 producer goods. The author was primarily interested in the differential impacts of positive and negative cost shocks on output prices. Hence, the asymmetry in response of output prices to increases and decreases in inputs prices was examined in the study. Vector Auto Regressive (VAR) model was used to analyze this issue. While this paper did not directly investigate the issue of ERPT, it did provide important insights on the nature of cost-output relation which is at the heart of the ERPT phenomenon. One source of asymmetry in ERPT relation may be the differences in the response of domestic prices to cost shocks that are themselves induced by exchange rate shocks. Hence, when exchange rate shocks cause changes in the price of imports which may form a part of the production cost of domestic producers, the asymmetric response of domestic prices to exchange rate shock may be due to different response to increase versus decrease in import prices.

Goldfajn and Werlang (2000) examined the transmission of exchange rate depreciation to domestic inflation for 71 economies using panel data for the period 1980-1998. Both the advanced and emerging economies were examined and the differences in ERPT dynamics for them were investigated by the authors. The primary aim of the paper was to study the ERPT mechanism for large depreciations in exchange rates. The authors defined the ERPT coefficient in a lagged framework thereby allowing past exchange rate depreciations to be linked with current inflationary movements. Exchange rate was defined as the effective nominal trade-weighted exchange rate index while inflation was defined as seasonally adjusted CPI index. Among other important findings, the authors inferred that the ERPT coefficient itself was shifting upwards over time. However, the pass-through remained incomplete with the highest value reaching 0.732 in a horizon of 12 months. The study also examined the pass-through coefficients for five regions by dividing the sample of countries amongst the groupings. For the emerging economies, the pass-through was consistently higher across all time horizons as compared to the advanced economies. Thereafter, the determinants of observed extent of ERPT were examined in terms of the initial overvaluation, GDP deviation, initial inflation and the degree of openness of the economies. The specification of the model for studying the determinants was undertaken using a functional form that included both

the individual terms and the interaction terms for the chosen variables. The authors justified this approach due to volatile exchange rate swings for several of the chosen countries and outliers such as for those economies that had the fixed exchange rate regime. Real exchange rate overvaluation and initial inflation (persistence) were found to be the most impactful determinants. The impact of the chosen determinant variables differed considerably across different time horizons, ranging from 1 month post-depreciation shock to 12 months after the same.

While not directly focusing on the issue or ERPT, Obstfeld and Rogoff (2000) examined the various empirical puzzles in international finance literature that have some form of direct or indirect association with the pass-through issue being examined here. The authors found that the inclusion of transactions costs into the models that study or include exchange rate-related issues can considerably improve the explanatory power of the models and can also bring the analysts closer to resolving the same.

Webber (2000) examined the issue of asymmetry in ERPT on account of depreciation versus appreciation in the home currency for Korea, Singapore, Malaysia, Australia, Thailand, Japan, Pakistan and the Philippines for the period 1980:Q2 to 1997:Q3. The fundamental econometric model employed by the author was the co-integrated VAR along with a host of standard time series econometric techniques to ensure compatibility of the variables for the VAR modelling. The author first elaborated the three major sources of asymmetry in ERPT in terms of the marketing constraint hypothesis, the production technology switching hypothesis and the market share objective. The marketing constraint hypothesis states that the positive quantity response in imports to an exchange rate appreciation is dependent on the marketing elasticity of sales. Thus, if this elasticity is low, then the import supplying foreign firms will have to incur a large marketing expense to induce a small positive quantity response which may not be feasible. Hence, an appreciation in exchange rate may not induce any change in local currency import prices (due to low marketing elasticity output) while a depreciation may cause the suppliers to increase the prices either fully or partially, which implies different quantitative reaction of import prices to exchange rate appreciation versus depreciation. The production switching hypothesis suggests that import suppliers might be using both domestic and imported inputs and this could cause switching between both as the exchange rate changes. Depreciation changes both the marginal revenue and cost by equal proportions and thus leaves the import price constant, implying a zero pass-through.

However, an appreciation leads to change in marginal revenue but not in the marginal cost and thus at least a partial pass-through would occur in the form of a fall in the import price. Finally, the market share hypothesis suggests that in order to maintain the market share, the import suppliers will not pass-through the depreciation while in order to expand the share, they can fully pass-through the appreciation to import prices in home market currency. The author also examined the four major approaches to pass-through estimation, namely the static partial equilibrium approach, intertemporal models, hysteresis models and the macroeconomic models. The author conducted the analysis using the co-integrated VAR model and found strong evidence of asymmetry in the ERPT mechanism. This implied that appreciation would not lead to desired reduction in import prices while depreciation of currency would be quickly passed over to increases in import prices. However, it was found that the asymmetric pass-through itself was partial, which was consistent with findings in the previous works.

Clarida et al. (2001) was a theoretical attempt to derive the economic conditions for the optimal design of monetary policy within an open-economy framework. The authors developed the theoretical framework as elaborated in their previous papers and accounted for small-open economy features into their empirical strategy. They took into account the ERPT mechanism and concluded that under complete pass-over to native prices, an optimal monetary policy should allow a floating currency even if it increases the variability in the domestic CPI. They also concluded that the central bank must give importance to the international macro forces, particularly exchange rate, only to the extent that it affects the domestic prices or the real equilibrium interest rate.

Baqueiro et al. (2003) studied the relationship between the inflation environment and the degree of ERPT for Mexico. The author initially highlighted a critical issue in the ERPT literature: the fear of floating exchange rate regimes. It was noted that the fears of a pure float emerged from the so-called 'original sin' hypothesis, which states that under a purely floating regime, a depreciation shock will force the domestic borrowers to borrow from abroad due to increased interest rates at home. The second source of the fear of floating the exchange rate was due to the possibility of high ERPT for small open economies which could worsen the domestic inflation rate and perhaps its variability. These two issues pointed out the fact that the independence of monetary policy and exchange rate policy broke down when fears of floating forced central banks to begin 'managing' the exchange rate. 16 countries were examined in a panel framework. The fundamental

issue of analysis was the nature of ERPT under different inflationary environments. Countries with different inflationary environments and degree of openness were analysed. Thereafter, the empirical estimates of pass-through for each country were analyzed for the high versus the low inflation periods to test the hypothesis that inflation environment affects the extent of ERPT. Two-stage OLS estimation was used for the analysis. The first stage allowed the estimation of the ERPT while in the second stage, the determinants of ERPT were analyzed. The author found evidence across most of the economies of direct relation between the prevailing inflation environment, as proxied by the level of inflation, and the estimated currency pass-through. It was also found that the variance of exchange rate was low in the 'low inflation' periods and thus the consequent ERPT was also lower in these periods as compared to the 'high' inflation periods. The determinants of ERPT were also examined using the two-stage least squares technique. The average inflation rate, nominal exchange rate volatility (coefficient of variation), the trade balance (net exports) as a percentage of GDP and the average spread between consumer (CPI) and producer (PPI) prices indices were found to be the major determinants of observed ERPT.

Devereux et al. (2003) analyzed the theoretical relationship between ERPT, exchange rate volatility and money supply variability. The primary aim of the paper was to examine the economic conditions required to establish macroeconomic equilibrium when pass-through is low versus when it is high. The authors theorized ERPT as endogenous to exchange rate behaviour. They firstly highlight the currency pricing problem in the literature and state that the degree of price impact from current variations is extremely sensitive to the very currency in which trade contracts are priced. Both the Producer Currency Pricing (PCP) and Local Currency Pricing (LCP) were examined. The following key results were derived by the authors: 1. Higher variability in exchange rate provided higher incentive to price contracts in producer's currency, thus implying higher ERPT to importing country's prices; 2. Exchange rate volatility and ERPT were found to be simultaneously determined; 3. Higher volatility in exchange rate was associated with lower ERPT to importer's currency prices; 4. Stable monetary policy actions in terms of smoother growth in the aggregate money stock was found to be associated with lower degree of pass-over, mainly because it incentivized exporters and importers to seek pricing their contracts in the currency whose value remained stable over time.

Monacelli (2003) studied the nature of relationship between ERPT and an optimal monetary policy design in an open economy. The fundamental concern of the paper was with the implications of incomplete ERPT for the efficacy of monetary policy and the subsequent trade-off between inflation stabilization and output gap. The authors concluded several important theoretical generalizations while analyzing the problem of a fully forward-looking monetary policy when ERPT to import prices was incomplete. Most importantly, the authors found that incomplete ERPT results in a serious trade-off between inflation stabilization and output gap stabilization in an open-economy framework with forward-seeking monetary policy agents. This was concluded in case of a small-open economy. The authors thereafter found that irrespective of the target inflation variable, this trade-off persisted. With reference to the credibility problem in designing monetary policy, the authors found that commitment-based policy designs yielded much lower variability in the real and nominal exchange rates relative to the discretionary monetary policy stance.

Gagnon and Ihrig (2004) investigated the issue of declining pass-through in industrialized countries as a direct result of inflation stabilization policies, which were meant to reduce the variability in inflation rate, adopted in the early 1980s. They studied 20 industrialized countries across 1971 to 2003. The basic hypothesis in this study was that credible and aggressive commitment to inflation stabilization by central banks prevented foreign sellers from passing over exchange rate depreciations to import prices of the inflation-targeting importing country. The empirical analysis of the link between inflation variability and extent of ERPT was undertaken separately for each country while the issue of relation between the level of ERPT and its change across two sub-sample periods constructed for each country, was analyzed in a panel regression framework. The macro model that was estimated in the study consisted of six equations representing different parameters of the optimal monetary policy decision rule using a Taylor-style specification. Monte-Carlo simulations were used to build estimates of long-run ERPT across the sample countries. 1000 trials were undertaken to produce the estimated ERPT level and change across the two sub-periods as specified for each of the country. The parameters of the macroeconomic model were estimated using the simulation approach. On the first account, the authors found that lower variability in inflation caused lower level of exchange rate pass-over. On the second account, it was found that credible commitments to stable inflation rate were associated with lower change in the ERPT while there was no statistically significant relation between the level of ERPT and the monetary policy stance.

Kang and Wang (2004) estimated the extent of pass-through to import prices (stage I) and domestic prices (stage II) for selected East Asian countries with a special emphasis on the post-Asian financial crisis of 1997. Japan, South Korea, Singapore and Thailand were examined by the authors. The authors noted that the issue of ERPT was at the heart of the choice of exchange rate regime that a country would adopt. They stressed on the well-known 'fears of floating' and the subsequent adoptions of soft and hard pegs-based regimes that distorted the ERPT mechanism in several countries. Money stock, NEER (Nominal Effective Exchange Rate), import prices, consumer prices and industrial production were the key variables whose interactions were hypothesized as the components of the ERPT process. Monthly data from January 1991 to December 2001 were used for the analysis. The empirical approach was VAR-based impulse response functions to analyze the impact of exchange rate shocks on the system of variables chosen for the analysis. The sample period was divided into two sub-periods, with the year 1997 being the break point due to the Asian financial crisis. The study found that stage-I ERPT was consistently higher than stage-II ERPT for all the four economies. For Korea and Thailand, it was found that the Asian crisis increased the extent of stage-I and stage-II ERPT.

Frankel et al. (2005) estimated the ERPT to CPI using data on 76 cities with one city from each of the selected countries across eight branded commodities for the period of 1990 to 2002. An error correction model was estimated to link import prices to a host of macroeconomic factors that included the relative income levels of importing and exporting countries, tariffs in importing country, distance between bilateral trading partners, relative economic size, real wage in importing country, inflation rate, and exchange rate volatility. The authors found that the extent of ERPT to CPI had fallen down across the sample period and that it was low to begin with. Not only the extent but also the pass-through adjustment process had slowed down significantly for the selected countries. It was also found that the ERPT reduced as the authors moved from the dock prices of imports to their retail prices. All the variables included above were found to be significantly causing the ERPT to change fundamentally. All these factors were found to have contributed to the low and falling ERPT.

Ito et al. (2005) studied the ERPT phenomenon to domestic prices, i.e. both import prices and consumer prices, for selected East Asian countries. These countries included Malaysia, Thailand, Singapore, Indonesia, Korea, Japan, and Hong Kong for the period 1996:M1 to

2004:M9, i.e. by using monthly data for the period 1996 to 2004. The analysis was set in the post-Asian crisis era to investigate not only the impact of ERPT for economic adjustments and macroeconomic equilibrium but also for economic recovery post-crisis. Traditional OLS-based exporter profit function was used to estimate the short-run and long-run ERPT elasticities. The profit function of a monopolistically competitive exporter's pricing problem was utilized to specify the ERPT function. It was found that Hong Kong, Japan, Korea, Thailand and Indonesia experienced producer currency pricing in the short-run with regards to import prices, i.e. very high ERPT to domestic prices. The long-run ERPT coefficient was found to be larger than the short-run estimates, thereby implying that ERPT increases with time as sufficient room for economic adjustments after an exchange rate shock is available to foreign exporters. In terms of consumer prices, the results were broadly similar as those for the import-price pass-through, but the extent of ERPT was much smaller and was higher for those countries that had higher import content in their domestic CPI basket. A Vector Auto Regressive structure was employed with Choleski decomposition to examine the pass-over mechanism and the degree to which currency shocks propagate to various domestic prices. Variations in crude oil inflation, stock of money, NEER, local inflation and output gap were utilized. The Vector Auto Regressive results showed significant divergence in the nature of shock propagation through the system with particular differences on the time-lag required for the observed ERPT to be realized. The study also found that the degree of ERPT was different across domestic price measures. It was found that import prices were the most responsive followed by PPI and then CPI.

Barhoumi (2006) examined the issue of long-run ERPT to import prices in 24 developing countries across the period 1980 to 2003. The author specified the pass-through relationship through the new open economy macroeconomic literature by theorizing the pricing behaviour of an exporting firm with some positive degree of market power in the importing nation. The author utilized demand pressure – measured by real GDP, import unit value index, marginal cost, NEER and REER in the ERPT function's estimation. The author first tested for non-stationarity using the so-called Hadri test and the t-bar test. Thereafter, panel cointegration test was conducted on the chosen variables. The Pooled Mean Group Estimator method was used to deal with cross-sectional heterogeneity in the panel data. Specifically, the FMOLS and DOLS techniques were used to estimate the long-run ERPT coefficient. The overall results across all chosen countries revealed that the ERPT coefficient was higher in the long-run but remained incomplete. The long-run ERPT

was found to be substantially different across the countries. Thus, the factors causing these differences were investigated. Three macroeconomic factors were used in this regards – namely, exchange rate volatility, country openness and inflation environment. The author found strong evidence of the variables being $I(1)$ and also for possible existence of cointegration among the chosen variables. The countries were grouped as per their existing exchange rate regime into eight groupings. It was found that fixed exchange rate countries had higher long-run ERPT as also the countries with on-an-average high inflation rate and low barriers to international trade. Alternative econometric models were used and similar conclusions were drawn.

Bussiere (2007) examined the dual issues of asymmetry and non-linearity in the behaviour of stage-I ERPT for G7 economies for both the import and export prices. The author used quarterly data for the period 1980 to 2006 and specified the ERPT function by incorporating both linear and polynomial terms so as to ensure the extent and nature of non-linearities in the response of trade prices to exchange rate movements. The results revealed that the import-price ERPT was generally higher than the export-price ERPT for the G7 economies. It was also found that the extent of ERPT was higher in the long-run than in the short-run for both the export and import prices. The issue of asymmetry was analyzed via dummy variables. Strong evidence was found for the existence of non-linearities in ERPT. Evidence suggested that depreciation induced a larger response in trade prices as compared to appreciation and that large changes had a lower impact on trade prices as compared to lower changes. Considerable heterogeneity in results was observed across the countries but the overall findings were fairly similar and consistent. The author also found that non-linearities were limited on the import side as compared to the export side.

Ca' Zorzi et al. (2007) analyzed the issue of ERPT to domestic prices for 12 emerging markets in Asia, Latin America, and Central and Eastern Europe by using a VAR framework. The countries included China, South Korea, Singapore, Taiwan, and Hong Kong, Czech Republic, Hungary, Poland, Turkey, Argentina, Chile and Mexico. Structural shocks were identified using Cholesky decomposition to the variance covariance matrix of the residuals in the reduced form. Various VAR models were estimated with the baseline model consisting of oil price index, aggregate output variable, exchange rate, import price index, consumer price index, and short-term interest rate and ordered in the same manner. Quarterly data were employed. NEER was used as a measure of exchange rate for all the countries. Various information criteria and specification tests

were used to finalize the optimal lag length of four quarters. ERPT to import and consumer prices were estimated for fur and eight quarter lengths. It was found that pass-through declined across the pricing change which has been a standard conclusion in a large number of studies. For Asian countries particularly, ERPT was the lowest. The authors also found supporting evidence for the so-called Taylor-hypothesis that suggests a strong positive correlation between ERPT and domestic inflation except in case of Argentina and Turkey. Furthermore, alternative specifications of the VAR ordering of variables did not change the broad nature of the results.

Corsetti et al. (2007) studied the issue of import price stability in local currency from a theoretical perspective. The trade-offs between domestic macroeconomic goals introduced by local price stability due to price rigidities versus pricing-to-market were examined in this paper and specifically focused upon the strategic interactions between upstream and downstream firms engaged in international trading. The authors specifically focused upon the effects of staggered pricing model by downstream firms on the optimal pricing decisions of the upstream firms. Furthermore, the relationship between pricing dynamics between upstream and downstream firms, i.e. firms that are vertically linked in the international distribution chain, and the optimal cooperative monetary policy with credible commitment was also analyzed. First important result was that nominal rigidities locally created incentives for monetary authorities to deviate from the aim of stabilizing final consumer prices and rather focus upon import prices. Second result was that technological shocks at the downstream firms prevented perfect stabilization of consumer prices and forces monetary authorities to tolerate some amount of volatility and uncertainty in the behaviour of domestic inflation. The third result was that increased volatility of inflation rate locally reduced the elasticity of producer demand curve and thus allowed authorities to increase their emphasis on final price stabilization. Interestingly, the authors also derived the result that increased focus on optimal monetary policy under local nominal rigidities induced larger volatility in the real exchange rate and lower variability in the terms of trade.

Goldberg and Hellerstein (2008) analyzed the issue of incomplete ERPT in a structural theoretical framework for the US economy through a detailed review of evidence. The fundamental focus of the paper was to theoretically locate the contribution of markup, marginal cost, and nominal-rigidity in explaining incomplete ERPT to US import prices. Both the reduced-form and the structural form approaches were investigated. An important insight from the

theoretical analysis in this study was that intensity of competition could explain incomplete ERPT only to the extent that markups were variable. This required observing markups of foreign sellers and this made the task of the analyst difficult. The authors proposed that exchange rate variability could be used to indirectly measure the variations in markups. Importantly, the authors noted that the functional form of the underlying import demand function played a pivotal role in shaping the behaviour of the markups. The choice of the functional form of this demand function would considerably determine the extent of ERPT observed in studies using micro-level data as it would directly impact the variations in markups and thus the extent to which exchange rate variations are absorbed by marginal costs of import suppliers or passed over to local currency import prices. In summary, the authors found that nontraded costs were the most important determinant of incomplete ERPT after reviewing key literature on this issue. Markup variations and nominal rigidities were not found to be as important as nontraded costs in explaining incomplete ERPT.

Adopting a diametrically different narrative, Gopinath and Rigobon (2008) analyzed the role of nominal rigidities in explaining incomplete ERPT to US import and export prices using commodity-level data on prices and other macroeconomic variables 'at the dock' from 1994 to 2005. They investigated the extent to which US import and export prices were 'sticky' and provided empirical estimates for the same. They found that prices were sticky in US dollars and thus US imports were locally priced while exports were priced in producer currency. They found that import prices remained sticky for 10.6 months while export prices remained so for 12.8 months on-an-average. They also found that import prices were fairly rigid in US prices and that the ERPT to import prices was very low, at around 22 percent. They also found that larger exchange rate movements induced lower pass-through to import and export prices.

Ito and Sato (2008) examined the dynamic relationship between exchange rate, monetary policy and domestic inflation for selected Asian economies with special reference to the post-crisis period. The primary focus of the study was on the implications of ERPT for trade balance adjustment following an exogenous exchange rate shock. Indonesia, Korea, Thailand, Phillipines and Malaysia were covered for the period 1994:M1 to 2006:M12. Pass-through to import prices and CPI were examined. VAR framework was used for this analysis. Other than CPI, PPI was also used to test for robustness of the results. The VAR system consisted of oil prices, the output gap, money supply, NEER and domestic prices which were proxied by both CPI and PPI. The Cholesky

decomposition was used to generate structural shocks in terms of exchange rate variable and then study the impulse responses of the variables in the macroeconomic VAR system. It was found that the pass-through effect was the highest for import prices and lowest for the CPI, thus implying that ERPT fell across the pricing chain. The largest response to exchange rate shock was observed for Indonesia. In terms of the response of the monetary policy to NEER shock, Indonesia displayed the highest response, while other countries did not show any significant monetary policy response to NEER shock.

Sek and Kapsalyamova (2008) analyzed the impact of exchange rate shocks on domestic prices in four Asian economies, namely – Korea, Malaysia, Singapore and Thailand, for the period 1991:M1 to 2007:M5 which was divided into two sub-periods 1991 to 1997 and then 1999 to 2007 using monthly data. Both the single-equation and Structural VAR approaches were used. In terms of domestic prices, import unit value index, PPI and CPI were used, while NEER was used as an exchange rate variable in the estimation exercises. A six-variable VAR system was used which included oil price index, Output Gap, M1, NEER, import price index, PPI and CPI. After establishing a significant cointegrating relationship among the chosen variables, the long-run ERPT coefficients were estimated using different VAR ordering of variables to check for robustness of results. In terms of the single equation approach, there were not any significant differences between the OLS and two-stage least squares estimates. Similarly, for the structural VAR approach, results showed that ERPT was incomplete for all the economies and that it was the highest for import prices and lowest for the retail consumer prices. Both the single-equation and structural VAR approaches showed largely similarly results for all the four economies.

Coulibaly and Kempf (2010) studied the impact of inflation targeting on the extent of ERPT in emerging economies using a panel VAR framework. The authors used quarterly data for the period 1989 to 2009 for 27 emerging countries, consisting of 15 inflation targeting and 12 non-targeting economies. Due to the possibility of the fixed effects in the panel data forward mean differencing was employed to handle the same. Further, the impulse response functions were estimated using a Cholesky decomposition, while bootstrapping was undertaken to build confidence intervals for the impulse response function estimates. The VAR model consisted of five variables, namely – world oil prices, output gap, money supply, NEER, and CPI. Additionally, VAR model was also estimated with 2 more variables, i.e. the import price index and the PPI. It

was found that inflation targeting countries experienced a significant decline in ERPT across all price variables. It was also found post-1999, when inflation targeting was formally adopted in the 15 targeting countries, that the extent of ERPT was significantly higher for targeting economies as compared to non-targeting economies for import and producer prices while there was no significant difference in case of consumer prices. The variance decomposition analysis revealed that the importance of exchange rate shocks to domestic price fluctuations was significant and higher for targeting countries while it was largely insignificant for the non-targeting economies.

Devereux and Yetman (2010) built an open economy model linking the slow ERPT to domestic prices and the slow rate of adjustment in the prices of imported goods. The authors then calibrated the model that generated estimates that were consistent with the then extant wisdom. By modelling the price setting function and the exchange rate function in a simultaneous dynamic system of equations, the authors solved for the domestic price level and specified the ERPT function. This exercise was undertaken under the assumptions of both exogenous and endogenous frequency of price changes in the domestic economy. The simulated parameter estimates were then compared with estimates from actual data. In the empirical exercise, 144 countries were included. A two-stage regression was estimated for each country to examine not only the extent of ERPT but also the determinants of the same. The authors found that nominal price stickiness was the most important factor causing slow pass-through of exchange rate changes to domestic prices. Other than it, the persistence of exchange rate shock was found to be an important determinant of the observed degree of ERPT.

Goldberg and Campa (2010) examined the matter of ERPT to consumer prices and specified the domestic price function using a two-country model with wage stickiness for 21 advanced economies. The authors theorized the aggregate pass-through as a weighted average of ERPT elasticities of traded and non-traded aggregates. The weights were defined as contingent on elasticity of substitution between the tradable and non-tradable goods, and the equilibrium shares of tradable and non-tradable goods. Distribution margins and imported inputs were introduced into the baseline model to specify the ERPT relationship. The ERPT to domestic prices were calibrated with assumption of monopolistic competition while accounting for distribution margins, imported inputs and trade exposure of the importing countries. ERPT to import prices were also estimated with different assumptions about the distribution margins, imported inputs and trade exposures, as

also were the elasticity of domestic CPI to import prices. Across all calibrations, the extent of ERPT to import prices was considerably high but that of ERPT from import prices to CPI were very low across all countries.

Gopinath et al. (2010) examined the relationship between the currency of pricing of goods and the degree of ERPT. In particular the authors focused upon the differentials in ERPT to goods priced in dollars and non-dollars. The study also analyzed the evolution of ERPT to import prices after different lags. This was undertaken at both the aggregate and commodity-level data. Monthly data from 1994 to 2005 were utilized for the analysis. The data consisted of detailed information on import prices in dollars and non-dollars along with the countries of origin. Firstly, the standard aggregate pass-through function was estimated and it was found that ERPT to import prices was very low – around 0.21 to 0.22, for the pooled regression estimates. Similarly, ERPT to import prices for dollar-denominated and non-dollar denominated import prices at commodity level data was estimated. The estimated ERPT to dollar import price index was far lower than the non-dollar import price index and it was slower in case of dollar-denominated import price index. This gap between the dollar and non-dollar import index also showed considerable persistence across time. Similar conclusions were drawn for commodity-level analysis. The commodity level ERPT to import prices was also estimated within a staggered price setting.

Saha and Zang (2010) analyzed the issue of ERPT to import, export, producer and consumer prices for India, China and Australia using a structural VAR model for the period 1990-2011. Seven variables were used in the VAR system – namely oil price inflation, interest rate, industrial output, import price, bilateral exchange rate, PPI and CPI. Unit value indexes for imports and exports were used as a measure of imports and exports prices. PPI and CPI were used to measure domestic prices. Monthly data was employed in the study. The exchange rate variable was defined as bilateral INR per US dollar rate. The impulse responses of price variables to exchange rate shocks were examined for up to 20 months of lag. The estimation was carried out at industrial level groupings of commodities – namely the manufacturing, agriculture, mining and natural resources, and other commodity groupings. There were considerable differences in the responses of prices to exchange rate shocks among the selected countries. In terms of instantaneous ERPT, for India, an exchange rate shock (appreciation shock) induced a large and negative response while compared to Australia. In terms of the CPI, the ERPT was found to be low while

the results for Australia were conflicting as the import prices and the Australian CPI reacted in an opposite manner to an exchange rate shock. In terms of dynamic ERPT, i.e. the pass-through adjusted for time path of the impulse responses, pass-through was incomplete for all the economies, though it was highest for import prices and reduced across the pricing chain.

Takhtamanova (2010) examined the relationship between aggregate prices and exchange rate for 14 OECD economies using a Seemingly Unrelated Regression (SUR) Model and Feasible Generalized Least Squares (FGLS). Exchange rate variable was defined in real terms. The ERPT model was derived from the open-economy version of the Phillips curve relationship. Control variables included output gap, and food and energy prices. Both the short-run and long-run ERPT coefficients were estimated. The sample period ranged from 1980 to 2007 using quarterly data. REER was used as the exchange rate variable while the OECD CPI was used as the price variable. It was found that there was a decline in short-term ERPT and it was statistically significant for at least half of the chosen economies. In terms of the long-run ERPT, there was a decline across the two sub-periods, namely the 1980s and the 1990s, but it was not statistically significant for most of the economies. In terms of the determinants of ERPT, it was found that in the long-run, average inflation for the decade had a significant impact on the ERPT coefficient.

An and Wang (2011) estimated the ERPT to import, producer and consumer prices for 9 OECD economies using a VAR approach using the sign restrictions on impulse responses as suggested in the previous works by Uhlig, among others. The analysis was undertaken using monthly data across 1980 to 2007. The findings showed that the ERPT to all the prices was partial. It was also inferred that ERPT felt across the supply chain. In terms of the factors explaining the behaviour of ERPT, smaller size of economy, higher share of imports in domestic consumption basket, higher degree of persistence in exchange rate, higher volatility in monetary policy shifts, larger initial growth rate of aggregate native prices and stable aggregate demand were found as the key causes for a larger ERPT to import and domestic prices.

Junttila and Korhonen (2012) examined the issue of ERPT to import prices for nine OECD countries with a special focus on the relationship between import-price ERPT and the inflation regime in the importing countries. The standard mark-up model explaining the pricing behaviour of an imperfectly competitive exporting firm was used to specify the import price function. The study hypothesized a positive relation between the ERPT to import prices and the initial level of

inflation in the economy. The differential impact of the low versus high inflation regimes on ERPT to import prices was examined. Non-linear threshold-based model was estimated to examine the impact of inflation regime on import-price ERPT. Thus, it was theorized that when inflation is nearer to the threshold level, the ERPT to import prices will be lower while it would be higher for countries where inflation was much higher than the threshold level. The nonlinear exponential and logistic smooth transition regression models were employed. Monthly data from 1975 to 2003 were used. CPI and import price index from the IMF were used to measure the prices while the NEER was used to measure exchange rate. The short-run ERPT coefficient was found to be 0.48 while the long-run ERPT, defined as the cumulative ERPT coefficients for 12 months, was found to be 0.74. It was also found that ERPT had declined across the study period on-an-average for the economies under consideration. The threshold level of inflation for the economies showed considerable differences.

Bussiere (2013) explored the nature of ERPT to trade prices in terms of its symmetry and linearity. ERPT to both the import and export prices were analyzed in this study for the G7 economies using quarterly data from 1980 onwards. The author examined the various possible sources of asymmetry and non-linearity in ERPT to export and import prices within the pricing framework of imperfectly competitive firms. Four important microeconomic pricing dimensions were analyzed which could become possible sources of non-symmetrical behavior in ERPT. The first was the case of downwards rigidity in export prices wherein exporters will increase the prices much more during depreciation than they would decrease it during appreciation. Similarly, larger appreciation of exporter's currency will be not be fully passed over to importing currency prices and the ERPT to import prices, i.e. of the importing country, will be lower. The second microeconomic case was that of upwards quantity rigidity wherein following depreciation of their currency, exporters will not be able to increase the production if they decide to keep importing currency price constant. Thus, in the short-run, there will be incentive to increase the mark-up and pass a larger portion of the depreciation to the importing country's prices. However, if the depreciation is substantially large, than exporters would probably invest on increasing their capacities and take advantage of the lower prices for importing country to increase their market share. The third case was about exporting firms that were concerned with market shares. In this case, depreciation of home currency would not induce the exporters to react much in terms of their price in importing currency terms; i.e., they would allow the prices to fall in importing currency

so as to increase their market share. However, appreciation of their currency would induce the exporters to reduce their prices in importing currency terms so as to absorb the rise in importer's prices and maintain their market share. The fourth case was that of menu and switching costs. Given positive menu costs, exporters would avoid changing prices unless the exchange rate change is large enough to overcome the menu costs, in which case prices will be changed in importing currency terms. Similarly, exporters would change their prices only when the exchange rate changes are large enough to induce importing customers to switch to other brands. If the switching costs are low, ERPT to import prices will be lower, while it will be higher if the switching costs are high. Thereafter, the author explains the different functional forms along with their economic assumptions that can capture non-linearity and asymmetry in ERPT to trade prices. The quadratic, cubic, and threshold forms were examined. The author defined threshold as being equal to one standard deviation of the absolute change in quarterly exchange rate series. The author found that ERPT to import prices was larger than that to export prices for the sample of countries selected in this work. The average elasticity of import prices to exchange rate changes was found to be fifty five percent with considerable differences across the countries. The author found evidence of large appreciations showing a greater extent of ERPT to export prices as compared to larger depreciation across the sample of countries.

Halka and Kotlowski (2013) estimated the relationship between output gap and inflation within a small-open economy Phillips curve model for the Polish economy. Their analysis was based on estimating disaggregated Phillips curves for non-food and non-fuel categories. Their fundamental economic model was posited in terms of domestic inflation rate being the function of its lagged values, the lagged value of output gap, lagged value of the nominal effective exchange rate and a set of control variables. Such an equation was specified for 110 commodities. OLS approach was employed for estimating these equations for each individual commodity. The study period ranged from the 1st quarter of 1999 to the 2nd quarter of 2012. The ERPT to domestic prices of non-durables and services was found to be the weakest while the durable and semi-durable commodity groupings showed larger pass-through effects. The authors also found that the large majority of commodity groups that were sensitive to exchange rate movements, were also sensitive to output gap movements.

Aron et al. (2014) synthesized a sizeable amount of literature on the ERPT issue in both the industrialized and emerging economies with a special focus on the diverse methodologies employed by analysts. First, the authors analyzed the nature of ERPT and its types in terms of the so-called Stage-I, Stage-II and the complete ERPT process. Attention was driven to the issue of microeconomic versus macroeconomic nature of the ERPT relationship. They located the microeconomic approach to ERPT in the studies delving on the pricing strategies of exporters in imperfectly competitive international markets where the variations in the mark-ups of exporters could explain the variations in the ERPT coefficients. In other words, this approach recognized the mark-ups of exporters as the mechanism for absorption of exchange rate variations. Variations in mark-ups would signify incomplete pass-through while constancy of the same would suggest complete pass-through to importing country's prices. Other than mark-up variations, changes in marginal costs and various nominal rigidities such as menu costs and switching costs were located as key microeconomic factors explaining the observed degree of ERPT to the domestic prices of importing countries. The factors affecting the mark-ups, marginal costs and nominal rigidities were then explored in terms of the well-known works. The macroeconomic approach was attributed to the seminal works of Obstfeld and Taylor.

The aggregate approach to ERPT was found to have culminated into the new open economy macroeconomic literature that recognized the Local Currency Pricing (LCP) and Producer Currency Pricing (PCP) models. The authors also appraised the ERPT relationships in current period and over time, and suggested that the design of optimal monetary and exchange rate regimes strongly depended on the extent of ERPT to domestic prices. The relationship between monetary policy and the expenditure-switching role of exchange rates was surveyed under the new open economy macroeconomic approach. Literature was surveyed which revealed that the reaction of firms, rather than consumers, is more important in this regards and thus one must estimate the stage-I and the complete ERPT coefficients separately to gain a clearer understanding of these matters. Moreover, the extent of ERPT to local prices may be less-than-proportional to exchange rate changes due to non-traded costs as well as higher share of service items in the aggregate price index. Such concerns were highlighted in the paper.

The arguments for and against the extreme LCP and extreme PCP were considered and both were found to have been rejected in the literature. Rather, a mixture of both these approaches

was at the heart of the less-than-complete, yet, more-than-zero ERPT coefficients in most of the empirical studies focusing on emerging economies. Thereafter, the implications of the Taylor's hypothesis were reviewed. The author found that this hypothesis explained the observed low levels of ERPT to import prices in emerging economies quite well. Inflation level, inflation persistence, permanency of the exchange rate change, and credibility of monetary policy were found to be the foundations of the macroeconomic approach to ERPT estimation. Thereafter, the macroeconomic sources of the mark-up variations are investigated. Subsequently, the authors analyzed the frequent misspecifications in ERPT estimation observed in the reviewed literature. One was the omission of important control variables such as those related to domestic costs. Another source of misspecifications was the usage of non-stationary data in level form for undertaking regression-based estimations without checking for co-integrating relationships.

The authors found that majority of the studies surveyed in their paper used the variables in first difference form. Third issue in this regards was the dependency on partial equilibrium single equation models that assumed exchange rate changes as exogenous shocks. The authors rather favoured the use of general equilibrium systems methods that allowed for feedbacks to and from exchange rate into the ERPT process. In particular, the former approach would estimate ERPT coefficient without adjusting for feedback effects from monetary policy shocks. The authors note that the literature has used systems methods for cointegrating vectors of the key variables, thus allowing for estimating ERPT coefficient through the impulse responses while accounting for feedback effects. Within the systems framework, the literature was found to have largely employed the VAR model in difference form. This implied the estimation of short to medium run ERPT while missing out the long run ERPT relationship. However, the authors stated that the short and medium run ERPT was a rather more important parameter for monetary policy formulation than the long run pass-through. Furthermore, the single and systems methods to ERPT estimation were examined through the review of literature.

Lastly, Aron et al. (2014) delved into the nature of the key price variables popularly employed in the ERPT literature. Major caveats in using unit value indexes and bilateral exchange rates were particularly focused upon. The paper also discussed the problems in using other macroeconomic variables such as proxies for the marginal cost variable in the mark-up equation, demand pressure proxies – particularly at higher frequencies, output gap measurement using the

Hodrick Prescott filter, and other related variables. The authors also examined the diversity of results in the empirical studies and located some stylized facts on these findings. First, they found that most studies concluded that ERPT to trade prices in both advanced and emerging economies was incomplete and that the diversity of empirical results was far more heterogenous in case of developing economies. Second, the evidence was overwhelmingly against the extreme LCP and PCP hypotheses. Third, the pass-through declined substantially from trade prices to consumer prices. Fourth, they took the case of the South African economy and found high degree of differences in the final ERPT estimates across different studies – thus pointing out the implications of using different proxies, methods and theoretical models. Fifth, they found that invoicing switching was a critical element in explaining the marked changes in ERPT to trade prices for several emerging economies such as Indonesia, South Africa and others. Sixth, they found that ERPT coefficient underwent substantial changes during regime changes – in terms of exchange rate, monetary policy and trade policy regimes in emerging economies.

Aziz et al. (2014) tested the hypothesis of whether ERPT to import prices for emerging economies if complete, as generalized in the extant wisdom at that time. The undertake this analysis for the economy of Bangladesh using error correction model for the period 1978 to 2007 using annual data. The study estimated the NEER using import share-weights instead of trade share-weights by using export countries' data on amount of imports and share in total imports of Bangladesh. The traditional new open economy mark-up model of exporting firms is used to derive the import price function for estimating the extent of ERPT. The results showed that ERPT to import prices and producer prices was statistically significant and displayed a higher degree of pass-through, while the transmission of exchange rate changes to consumer prices was not significant statistically. The observed ERPT to import prices was the highest amongst all three price variables. The study could not reject the hypothesis that ERPT to import prices was complete in both the short and long runs. However, with regards to producer and consumer prices, pass-through was found to be incomplete. Lastly, trade openness was found to have had a significant negative impact on ERPT to import prices and consumer prices in both the short and long run.

Shioji (2014) examined the various empirical evidence on ERPT to import prices and domestic inflation specially focusing on the Japanese economy. The paper examined the nature of ERPT process in a low-inflationary economy such as Japan, the major factors affecting the same,

and the role of ERPT in the monetary policy transmission mechanism in Japan. The study highlighted the dominant use of single equation structural models and systems-based VAR models in the ERPT literature on Japanese economy. The broad consensus from the literature was that the pass-through to both import and export prices has fallen across time, implying the weakening of the ERPT channel in the monetary transmission process for Japan. The author discussed at length the mechanics of the VAR framework and the identification of structural shocks within the framework. The paper estimated a standard VAR model for the period February 1970 to June 2013 using monthly data and incorporating Exchange Rate, Import Price Index, and various industry-specific Corporate Goods Price Indexes. While the results pointed towards a fall in ERPT to import and consumer prices across the full sample period, the analysis at sub-sample levels revealed that the extent of ERPT increased after January 2000, i.e. in the third sub-period. Thereafter, the study estimated the extent of ERPT through a Time Varying Parameter version of VAR whose primary advantage was stated as its ability to locate important shifts in the relationship between exchange rate and prices across the whole period without any arbitrary *a priori* splitting of the sample period. In this case, it was found that while ERPT felt for a considerable time, it began rising after 2012. The analysis of the economic rationale behind these findings was found in the fall and the subsequent rise of imported inputs in the overall domestic cost structure of Japan. The fall and the later rise in ERPT was found to be positively related with the changing importance of imported inputs in domestic production of Japan during the period under consideration.

Ozkan and Erden (2015) undertook the estimation of time-varying ERPT for 88 countries across the period 1980 to 2013 using monthly data. Inflation was measured by CPI while exchange rate was measured by the bilateral US Dollar price of each country's currency. The Dynamic Conditional Correlation-Generalized Autoregressive Conditional Heteroskedasticity (DCC-GARCH) was employed to estimate the time-varying ERPT along with estimating the macroeconomic determinants of the same. The authors highlighted the fundamental debate in ERPT literature on the non-congruence between microeconomic and macroeconomic factors affecting the degree of the price impact of exchange rates. They specifically focused on the macroeconomic factors within the new open economy macroeconomic models of imperfectly competitive exporting firms. The macroeconomic factors focused upon in this study included inflation persistence, volatility in inflation and exchange rate, degree of trade openness, and output gap. The study found that the ERPT to domestic prices in the selected countries largely remained

low during the study period with a few spikes in the mid-1980s, early periods of the 1990s and late 1990s. They also observed that the 2007-08 financial crisis lowered the speed of the secular fall in ERPT. Analysis at both - monthly and quarterly data, revealed similar insights. Furthermore, the analysis for country-groupings showed considerable heterogeneity. ERPT to emerging economies was found to be higher than advanced economies, while it was incomplete for both of them, though the variability across time was higher for emerging economies. Thereafter, panel regression approach was employed to delineate the macroeconomic determinants of ERPT to domestic inflation. The panel model was found to explain approximately 40 percent of variations in the domestic inflation, i.e. CPI. Inflation volatility was found to be increasing ERPT while output gap seemed to lower the ERPT. This was particularly prominent for developing economies though not for the advanced economies. Similarly, the average inflation rate impacted ERPT positively for developing economies while it did not have a significant impact for advanced economies. Finally, exchange rate variability was found to have negative impact on ERPT across all countries and their groupings.

Jašová et al. (2016) studied the extent to which the global financial crisis induced a change in the degree of ERPT to domestic inflation, as measured by CPI, for 22 emerging and 11 advanced economies over the period 1994 to 2015 using quarterly data. The dependent variable was specified as the log differenced quarterly and seasonally-adjusted CPI. NEER was used as the measure of exchange rate in log difference form. Macroeconomic control factors were accounted for in terms of output gap, oil prices, global output gap, and inflation expectations to account for ERPT within a New-Keynesian Phillips curve framework. A dynamic panel GMM model was employed. Furthermore, asymmetric ERPT behavior was captured by incorporating quadratic and cubic changes in exchange rate variable in the panel model. ERPT for instantaneous changes in exchange rate for next three quarters was incorporated. The empirical analysis showed that ERPT had fallen substantially after the crisis for emerging economies while the pass-through coefficient remained stable and low for the advanced economies throughout the full study period. The temporal stability of ERPT coefficient was examined using rolling regression method. In terms of the explanatory factors for the lower ERPT, lower level of inflation was found to be significant. The authors did not find sufficient evidence for the existence of non-linearities.

Lopez-Villavicencio and Mignon (2016) focused on the emerging economies and estimated the price impact of exchange rate changes on consumer prices in 15 emerging importing nations for the period 1994-2015. The authors specified the domestic inflation equation to estimate ERPT by utilizing the Goldberg and Knetter specification and incorporated not only the impact of exchange rate changes but also the impact of interactions between exchange rate and average inflation level and volatility into the modelled ERPT process. The study further accounted for the impact of inflation targeting, exchange rate targeting and the quality of central bank institutions into the domestic inflation function, while allowing the exchange rate changes to interact with all these three dimensions. Inflation was measured by the CPI, Exchange rate was proxied by the NEER and thereafter IIP and trade-weighted foreign prices which was derived using the definition of the REER variable. Monthly data on year-to-year changes in logarithmic form were employed after seasonal adjustments where necessary. The broad and general conclusion across all countries was that the ERPT to consumer prices was incomplete while it was positive and statistically significant. The analysis of the stability of ERPT coefficient revealed that across the emerging economies in the sample, the ERPT had declined throughout the sample period. Furthermore, the level of inflation in the past, showed a positive impact on ERPT to consumer prices. Similarly, inflation volatility was found to increase the extent of ERPT to consumer prices. Both inflation and exchange rate targeting regimes were found to weaken the extent of ERPT to countries that adopted such monetary policy stance.

Bussiere et al. (2020) was an examination of the trade balance adjustment process via exchange rate changes for 51 advanced and emerging economies for the period 1995 to 2012 using commodity-level data on 5000 products under the COMTRADE database. The study estimated ERPT elasticities for export and import quantities, as well as export and import prices. The primary focus of the authors was to estimate the trade balance adjustment mechanism of the chosen economies in terms of the exchange rate elasticities of trade prices and quantities. Estimation of ERPT to import prices was one component of the larger framework in this study. The fulfillment of the Marshall-Lerner conditions was particularly focused upon. The import-price ERPT elasticities were low and incomplete for all countries on-an-average with the average cross-country estimate being 0.48. There were no significant differences in the import prices ERPT for advanced countries versus emerging economies. The study also found that when the impact of exchange rate changes on mark-ups of exporters in accounted into the import-price ERPT, the estimated pass-

through increased significantly, almost doubling from the case where the mark-up impacts of exchange rate changes were ignored.

Focusing on the issue of size and direction asymmetries, Balcilar et al. (2019) investigated the asymmetry in the ERPT process for the BRICS economies including India for the period 1986 to 2018 using monthly data. The range of the time period varied for Brazil and India from 1986 to 2018 while for China and South Africa it was from 1990-2018, and lastly for Russia the time period was from 1995 to 2018. The main issue under consideration was whether ERPT and Oil price pass-through were asymmetric and state-dependent for the selected economies. Exchange rate was measured by the NEER while domestic inflation was measured by CPI. The authors employed the non-linear Vector Smooth Transition Autoregressive (VSTAR) model to test for the existence of asymmetry in the ERPT process. Estimation was done using non-linear least squares method. The study also employed the Generalised Impulse Response Functions based on bootstrap method was employed. One thousand bootstrap repetitions were performed to estimate the impulse response parameters. This approach was undertaken to locate the threshold value and thus divide the data set into lower-than-threshold and upper-than-threshold regimes. This was done to better account for non-linearity in the transmission impact of exchange rate on domestic inflation. The analysis focused on regime switching and hence the estimates of a unit shock of NEER on oil and consumer prices were examined for the upper and lower regimes, both. It was found that when exchange rate and oil price shocks were above the threshold level, the extent of ERPT was considerably larger than when the shocks were below the threshold. However, non-linearity was located in the ERPT relationship in both the lower and upper regimes periods.

Chen et al. (2022) was a novel attempt to study the economic and empirical implications brought by a vehicle currency for the import-price ERPT for the UK economy during the period 2010-2017. The study utilized transactions-level import data and thus was able to achieve a high degree of disaggregation in the analysis. After analysing the major currencies in which the UK's trade was largely invoiced, the authors found that neither the Sterling Pound, not the exporter's currency were the popular choice in the international trade arena. The US Dollar was found to be having the highest share as the preferred vehicle currency for importing commodities by the UK consumers with its share being 88.50%. However, vehicle currency pricing accounted for only 54.54% of the total transactions studied in this work. Other preferred currency invoicing models

were the Local Currency Pricing (LCP, in pound sterling) and Producer Currency Pricing (PCP, in currencies of the exporters). The estimation of the ERPT was undertaken by specifying a standard import price function where the import prices were proxied by the Import Unit Value Index, and exchange rate by the bilateral exchange rates specific to each exporting nation. Furthermore, the difference brought by currency invoicing approach to ERPT process was examined by including separate dummy variables for the three invoicing models located earlier in the study The short-run pass through to import prices was found to be low at 17.9 percent only. The long-run pass-through, after 8 quarters, was found to be 41.3%. In the long-run PCP showed the highest pass-through coefficient while LCP showed the lowest one, while VCP caused ERPT coefficient in the intermediate range. In all cases, however, ERPT was incomplete to the import prices of UK.

2.3. Review of Evidence at the Domestic level

Krishnamurthy and Pandit (1996) built a large-scale macroeconomic model to study the determinants of trade flows and trade balance in India. Their analysis was mainly directed towards building a simultaneous equation model with demand and supply equations for aggregate imports and exports to analyze the impact of external and policy-induced shocks of the trade balance. The authors included the ERPT relation into their structural specification and examined both the stage I and stage II pass through effects of exchange rate changes on domestic prices. ERPT was found to substantially alter the effects of exchange rate movements on trade flows and trade balance. Particularly, the authors concluded that different sizes of exchange rate changes caused different impact on domestic prices and thereby produced different implications for trade flows and domestic economic adjustments following an exchange rate shock.

Dholakia and Saradhi (2000) studied the phenomenon of ERPT for India using quarterly data from 1980 to 1996 and focused upon an aggregate analysis of the phenomenon. The authors analyzed the subject of pass-through in consonance to the role of exchange rate as an adjustment mechanism for achieving the desired changes in the trade balance. The primary focus of this paper was on examining the effects of exchange rate and its volatility on price and quantity adjustments for exports and imports. The paper mainly provided an empirical assessment of the elasticity approach to balance of trade adjustment with income effect under a partial equilibrium framework. Using the Johansen cointegration approach, the authors found evidence of complete pass-through

to import prices but incomplete pass-through to export prices. The quantity adjustments in imports were found econometrically insignificant while similar conclusion was drawn for export price adjustments following an exchange rate shock. The study concluded that India was a price-taker in the imports segment while its local exporters had considerably market power in the export segment. They also found that exchange rate volatility was fully passed-over to Indian importers on account of lack of any market power.

Singh (2002) estimated a macroeconomic model for India's trade balance for the period 1960 to 1995 with a special focus on the role of exchange rate and aggregate income. The study employed both the Johansen ML estimator and the optimal single equation estimators as developed during the early 1990s by various authors. The determinants of the trade balance were theorized using a reduced-form model of a system of import and export demand and suppy equations. While this study did not directly account for ERPT, the analysis of trade balance's sensitivity to different exchange rate variables was an important contribution from the perspective of the current study. The author found strong evidence for the efficacy of the trade-weighted real exchange rate in explaining the long-run and short-run behaviours of India's trade balance. An important inference implicit in this study was that the trade-balance effects of exchange rate movements are in large part determined by the ERPT coefficients. Higher ERPT would allow better quantity effects for the aggregate imports and exports when an exchange rate shock occurs as a price change is necessary for a quantity response. In a similar vein, Arora (2003) examined the J-curve effect in Indian trade balance following an exchange rate shock. The analysis also revealed that a higher and quicker price-response to an exchange rate depreciation was necessary to induce a larger quantity response in aggregate imports and exports, and thus possibly shorten the "curve" in the J-curved recovery of India's trade balance.

Choudhri et al. (2005) estimated the ERPT to five different prices for the G-7 economies using a VAR framework. The authors utilized the new open economy macroeconomic approach to ERPT and estimated the same for not only import and consumer prices but also for export and producer prices, and wage index. The sample period ranged from 1979:Q1 to 2001:Q3. The VAR model consisted of seven endogenous and two exogenous variables. Endogenous variables consisted of interest rate, exchange rate, the import price index, the export price index, the producer price index, the consumer price index, and the wage rate. Exogenous variables consisted of the

foreign interest rate and foreign consumer prices. The authors used the trade-weighted NEER for the analysis. The study built a general nested model for the relationship between exchange rate and prices and thereafter estimated various nested variants with differing assumptions for undertaking sensitivity analysis of the final results. Primarily, the LCP versus PCP, sticky versus flexible and zero distribution to costs versus non-zero costs variants were explored and the ERPT was estimated under these specifications. The study found that the LCP variant of the general model with distribution costs and sticky wages provided better fit than other specifications when explaining the ERPT to consumer, producer and wage prices.

Ghosh and Rajan (2007a) analyzed the full pass-through of exchange rate movements to consumer prices for Indian economy at the aggregate level using quarterly data from 1980 to 2005. Specifically, the authors focused upon the issue of stability of ERPT to consumer prices since 1991 when the economic reforms programme largely began in India. Both the NEER and the bilateral – US Dollar exchange rates were used. Control variables were utilized for the ERPT equation in terms of US Producer Price Index, World CPI, Indian Industrial Production, bilateral exchange rate and NEER. The dependent variable was Indian CPI. The quarterly variables were seasonally adjusted using Census X-12 methodology. OLS regression was used to estimate long-run ERPT which was found to be 43 percent when bilateral exchange rate was used while it was found to be statistically insignificant when NEER was used instead. Short-run ERPT was estimated using Error Correction Models (ECM) and it was found to be very small relative to long-run ERPT. In either case, NEER continued to provide statistically insignificant results. A slightly higher ERPT was found for the second sub-period implying that post-economic reforms, the degree of ERPT increased in India. The results for the sub-periods revealed no significant degree of pass-through in the short-run. To estimate the dynamic stability of ERPT, the authors used Kalman-Filter methodology and found no significant evidence of any temporal shift in the same.

Ghosh and Rajan (2007b) estimated the extent of ERPT to CPI in India for the period 1980 to 2006 using quarterly data at the aggregate level. They also studied the extent to which macroeconomic factors affect ERPT as well as the existence of asymmetry in the response of domestic inflation to exchange rate appreciation versus depreciation. Bilateral US Dollar exchange rate and NEER were used. Exchange rate volatility, measured by the moving average standard deviation of the exchange rate series, is found to be significantly and negatively affect domestic

inflation while other factors such as money supply growth and lagged inflation rate were found to be insignificant. The authors also tested for asymmetry in ERPT and found that appreciation led to higher ERPT than depreciation. ERPT in itself was found to be incomplete.

Raj et al. (2008) studied the extent to which Indian economy imported inflation from industrialized and oil-exporting countries for the period 1950-51 to 2007-08. Cointegration and VECM analyses were used to examine the extent of ERPT for the Indian economy. A six-variable VECM was specified that consisted of domestic price index, import price index, bilateral exchange rate, GDP at factor cost, call money rate and capital flows in the stated order. The stage-I pass-through effect was found to be statistically significant and economically meaningful. The authors found that ERPT to import prices declined significantly in the 2000s as compared to the earlier decades. The pass-through to domestic prices was lower than to the import prices and it was incomplete in both the cases.

Srinivasan et al. (2009) studied the nature of the response of the Reserve Bank of India in terms of foreign exchange reserve accumulation with reference to the differences in exchange rate movements. The policy reaction function of the RBI was solved with the objective function that the RBI reacts differently to exchange rate appreciations and depreciations. Weekly data from November 2000 to February 2006 were used to estimate Generalised Method of Moments (GMM) estimators for the monetary policy reaction function to exchange rate shocks. The empirical solution to the hypothesized monetary policy reaction function showed that RBI reacted much more strongly to appreciations than depreciation. While this study did not directly investigate the issue of ERPT, it provided important insights into the issue of asymmetry in response of RBI to exchange rate movements.

Rajan and Yanamandra (2015) estimated ERPT to aggregate import prices and CPI using monthly data from 2003 to 2013. They also examined the issue of non-linearity and asymmetry in ERPT. VECM model was used to estimate both the short-run and long-run ERPT to import prices. Asymmetry was analyzed using dummy variables for appreciation and depreciation in exchange rate, and non-linearity was estimated similarly. Bilateral trade-weighted NEER was used for measuring the exchange rate variable while import unit value index was used for measuring the import prices. Both the short-run and long-run ERPT coefficients were found to be more than complete and were statistically significant. The study also found statistical evidence for

asymmetric response of import prices to appreciations versus depreciations in exchange rate though the economic significance of the same were not equally high. However, the response of import prices to large versus small exchange rate changes was not statistically different. Alternative models and measurements were tested for and the results were largely robust.

Dash and Narasimham (2011) investigated the issue of ERPT to aggregate Indian imports and exports price by deriving the ERPT function in terms of the pricing behaviour of an imperfectly competitive exporter. The authors adopted the mark-up model and specified the ERPT function to explain the empirical connections between exchange rate movements and Indian import and export prices at the aggregate level. The 36-currency trade-weighted NEER was used to measure exchange rate, while the unit value indexes were used to measure import and export prices. Quarterly data from 1993 to 2004 were employed for the analysis. The Johansen-Juselius method was used to determine the existence of co-integrating relationship among the chosen variables. Error Correction Model was employed to combine the long-run relationship with short-run adjustment dynamics to estimate ERPT to export prices, via the Pricing-to-Market model, and to import prices, via the mark-up model. It was found that ERPT to export prices was less than complete, while it was more than complete to import prices.

Sohrabji (2011) estimated ERPT to domestic prices for the Indian economy for three periods – namely, 1975 to 1986, 1992 to 1998 and 1999-2007. This was done to study the differences in ERPT under different economic environments in India, mainly in terms of the persistence of inflation, and the exchange rate and trade regimes. A recursive VAR model was employed with world oil prices, world food prices, output gap, exchange rate, domestic prices and short term interest rate. This was done for each of the three periods. Monthly data were employed for all three periods. Domestic prices were proxied by CPI and the exchange rate was measured by the INR per US$ bilateral rate. ERPT to CPI was found to be the highest for the third period where India experienced higher globalization and thus trade openness as well as a more stable inflationary environment. Given this empirical finding, it was concluded by the study that openness had a higher impact on the extent of ERPT as compared to inflationary environment. In terms of the variance decomposition of the VAR results, it was found that the importance of exchange rate in inducing changes in the CPI increased considerably during the third period, again implying that

increased openness had a larger role to play in explaining the ERPT mechanism for the Indian economy.

Kapur and Behera (2012) analyzed the monetary transmission mechanism in India for the period 1996:Q1 to 2011:Q1 using the New Keynesian framework and estimating the short-run Phillips curve, the IS Curve and the monetary policy reaction function with alternative specifications employing aggregate as well as industry-level data on growth, inflation and other related dimensions. While the paper had a larger scope than estimating the empirical extent of ERPT, the ERPT relationship was modelled within the short-run Phillips Curve equation, representing aggregate supply. The ERPT to domestic inflation, as measured by the WPI for all commodities and WPI for non-food commodities was examined. This was undertaken in order to check for the distortions brought by agricultural volatility in India into the pass-through estimate and the larger transmission mechanism. The study did not delve deep into the estimation of the ERPT process, but provided important insights on the same by contextualizing ERPT within the larger process of monetary transmission in India. The authors estimated ERPT to both the WPI for all commodities as well to the WPI for non-food manufactured products. The study found incomplete ERPT to domestic inflation in both the short run and long-run wherein long run period was defined as the sum of the ERPT coefficient for four-quarter lags of the exchange rate variable. The short-run ERPT coefficient was 0.06 while the long-run coefficient was 0.12. Both the bilateral Rs. Per US Dollar rate and the NEER were employed and the results remained largely the same. This study delved more deeply into the monetary transmission issues rather than specifically analyzing the ERPT issue. The analysis was the ERPT relationship was undertaken through the Phillips-curve framework using OLS. Attention was not put on the larger ERPT dynamics such as the factors affecting the same, the import-prices ERPT and the issue of non-linearity and asymmetry in the pass-through process.

Khundrakpam and Jain (2012) also undertook an empirical estimation of the monetary transmission process for India while examining the various channels of transmission and their relative effectiveness in transmitting monetary policy rates to the interest rate structure and thereafter to the real sector, particularly the growth in GDP. A structural VAR approach was employed for the analysis while controlling for external factors. The authors analyzed the interest rate, credit, exchange rate, asset price, and expectations channels. Among these channels, the

authors examined the exchange rate channel for transmission of monetary policy shocks via its impact on the exchange rate. Both NEER and REER was accounted for. It was ascertained that the pass-through of monetary policy shocks to inflation was dampened when the exchange rate channel was allowed to work. Specifically, the depreciation of REER, while producing a positive impact on net exports, also induced a larger pass-through to import prices, which did not allow the full positive impact of REER depreciation. The source of this finding was located in the higher ERPT to import prices and thereafter into the domestic prices, which acted against the initial interest rate shock and the subsequent positive effects of real effective exchange depreciation. In other words, the interest rate rise to dampen inflation was distorted by a high ERPT which did not allow the initial interest rate shock to fully transmit into reduced inflation rate. This study was mainly concerned with the transmission of monetary policy impulses to the real sector via various transmission channels as enlisted above. The exchange rate channel was the weakest amongst these, but ERPT to import and domestic prices played a non-negligible role in countering the interest rate shock.

Patra and Kapur (2012) was an attempt to empirically construct the monetary transmission mechanism in India using the new Keynesian framework. ERPT to domestic prices was incorporated into the Phillips curve specification which was an open economy version of the same within the new Keynesian framework. ERPT was defined as the unit impact of exchange rate variations, measured by the bilateral rupees per dollar exchange rate, on domestic inflation measured by both the GDP deflator and the WPI. Quarterly data from April 1996 to September 2009 were employed. Both the OLS and the Generalized Methods of Moments (GMM) approaches were used to estimate the individual equations of the monetary transmission model. The authors found that the ERPT to domestic inflation was low, ranging from 0.03 to 0.06. The study concluded that this finding indicated that monetary policy was credible. However, no further empirical insights were provided into this assertion.

Saha and Zhang (2013) was an attempt to estimate the extent of ERPT to import prices and consumer prices for the economies of Australia, China and India for the period 1990-2011 using a structural VAR approach. The VAR system consisted of six variables, namely oil price inflation, interest rate, industrial output, import price, exchange rate, and CPI. Data were in monthly terms and were not seasonally adjusted to avoid changing the persistence properties of uni-variate series

and thus affect their possible co-integrating relationships. As the monthly data were not seasonally adjusted, along with the Augmented-Dicky-Fuller (ADF) and Phillips Perron (PP) tests, the test for seasonal unit roots using the Hylleberg, Engle, Granger and Yoo (HEGY) test for unit roots at seasonal frequencies. The lag ordering was based on the AIC. Import prices, consumer prices and producer prices were used to check the degree of ERPT across the pricing chain in the selected economies. Exchange rate was defined as the NEER, while robustness check was performed by replacing the same with REER also. The short run ERPT was defined as the immediate response of the prices to exchange rate shocks as estimated by the impulse response functions, whereas the authors also studied the ERPT to different prices across a 20-months period after the exchange rate shock. The study concluded that ERPT to import prices was the highest in all the three economies, while the same to other domestic prices was moderate to low. The signs of the responses by import prices and CPI in India and China were opposite of what was theoretically expected. The authors did not delve into the reasons for such a finding. In terms of the Variance Decomposition of each of the price variable, it was found that in case of India, the exchange rate shock accounted for a mere 0.3 percent variations in import prices during the study period, while PPI and CPI were found to be explaining 9 percent and 2 percent variations in import prices. The robustness check using REER instead of NEER for proxy the exchange rate shock did not much change the results.

Patra et al. (2014) studied the impact of the Global Financial Crisis on the persistence of inflation in India using a new Keynesian Phillips curve approach to specify the inflation determination process. The study focused upon intrinsic, extrinsic and expectations-based persistence in inflation. The period ranged from April 1982 to March 2013 and the authors employed both quarterly and monthly data. Generalized Methods of Moments was employed. The ERPT in the short-run and long-run was estimated within the aggregate Phillips curve framework. Both the long-run and short-run pass-through were incomplete and considerably low. However, the financial crisis was found to have significantly reduced the pass-through in both the short and long runs.

Ranadive and Burange (2015) estimated the empirical extent of impact on import and domestic prices of the exchange rate changes in India for the period April 2009 to May 2013 using an unrestricted VAR on monthly data. The VAR system consisted of oil prices, output gap, the exchange rate, interest rate, money supply, import prices, wholesale prices and consumer prices.

The structural shocks were identified using Cholesky decomposition. The pass-through effects of exchange rate on import prices and domestic prices were identified through the impulse response functions and forecast error variance decomposition. The lag length was chosen to be two lags and this was done using various information criteria. The shock cycle was chosen to be twelve months and accordingly the impulse response function estimates were estimated. Both the instantaneous and contemporaneous effects of exchange rate on various prices were estimated. The pass-through to import prices was the highest while the same to consumer prices was the lowest. It was found that the price impact of exchange rate variations across the distribution chain in India had weakened.

Rajan and Yanamandra (2015) investigated the issue of ERPT to domestic inflation for the Indian economy for the period January 2003 to March 2013. The study employed the error correction model to estimate both the short-run and long-run ERPT coefficients. Thereafter, asymmetry and non-linearity were introduced into the empirical model by incorporating additional variables that represented the large changes, small changes, appreciation episodes and depreciation episodes separately. Import prices were measured by the import unit value index. Exchange rate was measured by the 36-currency bilateral trade weighted NEER. The VECM model estimated by the authors yielded more-than-complete ERPT to import prices in both the short-run and long-run. This finding was consistent with the theoretical expectations in case of a small open economy such as India as far as the imports sector was concerned. The long-run coefficient was found to be varying between -1.059 to -2.290 across four different model specifications with minor differences, but the estimates were not significant even at 10% level. While, the short-run ERPT was found to be varying between -1.102 to -1.337 and all the ERPT coefficients across the four different model specifications were significant at 10% level. Thus, this study could not find evidence for long-run pass-through while there was some evidence on short-run pass-through. The analysis of the differential impact of exchange rate appreciation versus depreciation, and small changes versus large changes, did not reveal any significant differences. The study was inconclusive on these aspects and one may infer that ERPT process had been rather linear and symmetric for the chosen time period. The authors also estimated the temporal stability of ERPT and found that ERPT to import prices was consistently more-than-complete across the study period.

Yanamandra (2014) examined the impact of exchange rate variations on import prices in India for the period 2003 to 2013 using monthly data and focused on not only working out the ERPT coefficients but also the matters of asymmetry and non-linearity. After establishing the existence of long-run cointegrating relationship between the variables chosen for the analysis- namely, the import price index of India, the foreign price index, IIP and turnover in National Stock Exchange (NSE). Accordingly, an Error Correction Model (ECM) was estimated in the log-difference form. The short-run ERPT coefficient was defined as the coefficient of the first lag of the exchange rate variable while the long-run coefficient was worked out by normalizing the lagged coefficient of exchange rate on the lagged coefficient of the dependent variable in the import price function. Furthermore, the asymmetries in direction and size were estimated using appropriately defined exchange rate variables to separately examine the impact of appreciation versus depreciation, and small versus large changes within the ECM framework. Non-linearity was defined in multiple ways by incorporating information on both the mean and standard deviation of exchange rate variable into the ECM analysis. Import unit value index was used to proxy import prices, and both the bilateral Rupees – US Dollar and NEER was used to measure exchange rate. For the aggregate analysis, both the short-run and long-run ERPT was found to be more than complete. The possible rationale of such a finding was located in the so-called hysteresis induced effect. Irrespective of the different specifications employed in the study, ERPT was found to be more than complete across all of them, indicating robustness of the results. With reference to the asymmetric impact of exchange rate changes, the impact of large depreciations was found to be the highest. Disaggregated analysis of the issue was undertaken at sectoral level data. Results indicated that ERPT in the short and long runs using the ECM framework at sectoral level were statistically insignificant.

Mendali and Das (2017) was an attempt to uncover the extent of ERPT with reference to the 2007 crisis and its impact on the pass-through to domestic prices. The author employed monthly data and the sample time horizon ranged from 1992 to 2010. The estimation of the ERPT coefficient was undertaken within a VAR framework and the impulse response functions were estimated to trace the per unit impact of exchange rate shocks on domestic prices in India. The Vector Auto Regressive system in their study model consisted five variables including the price of the Indian currency, output gap and the WPI, among others. The ERPT to import prices and domestic prices were found to be incomplete and the study found that there were significant lags

in this transmission process. With reference to the factors determining the observed extent of ERPT, it was located that rising WPI and oil price shocks were the most significant factors. Furthermore, evidence of structural break was found in November 20007, that signified the important role played by the Global Financial Recession. Their inference was that the Global Financial Crisis had a meaningful impact on the nature of the ERPT transmission process in India. The study also found that the aggregate size of the imports, higher composition of inputs in the import bill, exchange rate volatility and moderate levels of domestic inflation were the primary causes of the low ERPT.. The study, however, focused on the WPI only and did not account for the PPI and the CPI inflation. Largely, the study's fundamental framework was based on the impulse response function estimates and a structural approach could have provided better insight into the nature of the ERPT relationship.

Going further than the estimation of ERPT coefficients, the work of Patra et al. (2018) focused on the presence of asymmetry, non-linearity and temporal stability of the ERPT relationship for India during the period 2005 to 2016 by utilizing monthly data. The theoretical model was specified via the mark-up model of exporting firms under the assumption of imperfect competition for a small open economy importing nation. The New Keynesian variant of the model was used to specify the domestic inflation equation. Empirically, the Error Correction Model was employed. The non-linearity in size and direction was captured by incorporating quadratic and cubic terms into the domestic inflation equation and also by interacting these terms with exchange rate changes. The study found evidence of asymmetry in the response of ERPT as small depreciations were found to be causing the largest impact on domestic inflation as compared to larger depreciations and appreciations. The study also found that small changes caused a higher ERPT as compared to larger changes while ERPT was observed to be unstable across time. Robustness checks were also performed by re-estimating ERPT using Structural VAR approach with additional variations in the variables, particularly the control variables. The estimates from the structural impulse response functions were estimated and the results were found to be broadly consistent with the single equation approach employed earlier in the study. The nature of asymmetry in size and direction was also fairly robust to alternative econometric methodologies. Small depreciations were found to have a larger impact from small appreciations as defined in the study. Interestingly, smaller depreciations and appreciations were found to have a larger impact than larger changes, which was considerably at odds with the findings of previous studies. In terms

of the stability of ERPT coefficient across time, evidence suggested considerable instability in the ERPT estimates across the study period particularly after 2013-14.

The analysis undertaken in Dua and Goel (2021) was directed on the issue of ERPT within their larger analysis of the macroeconomic determinants of inflation in India. The period of study ranged from April 1966 to March 2017. The macroeconomic determinants of the domestic inflation in India were examined by developing an aggregate supply curve within the New Keynesian approach. The aggregate Phillips Curve was specified in the forward-looking. The study attempted to account for both the supply and demand side factors at the aggregate level that were expected to induce variations in domestic inflation. Inflation was measured in terms of both the WPI and CPI-Industrial Workers (CPI-IW), while the exchange rate was measured in terms of both the bilateral exchange rate and the NEER. Using cointegration analysis, they found that there existed a long-run relationship among the macroeconomic factors that were modelled as possible determinants of domestic inflation in India. Thus, VECM approach was utilized to estimate the Philips curve relationship. Evidence was found that the chosen factors, including exchange rate, granger caused inflation in terms of both the variables, i.e. WPI and CPI-IW. The exchange rate was found to be an important determinant of domestic inflation in terms of the normalised variance decomposition. However, its impact was observed to be incomplete, as illustrated by previous studies. The determinants of food inflation were also analyzed and it was found that international oil and fuel price shocks were the most essential determinants of the same rather than exchange rate variations.

2.4. Issues stemming from the Review of Evidence

Synthesizing together the various evidences examined above, this section locates the analytical issues that have served as the anchors of the ERPT literature. While some matters have garnered a high degree of attention, some have not. The theoretical, empirical and philosophical issues that emerge from the survey of literature conducted in Section III, are presented here.

2.4.1. Matters in the pass-through literature that have been prominently debated in India

There are questions in the ERPT literature that have been at the heart of the research work done so far. How does one define ERPT? Which measure is ideal to capture the variables involved in the ERPT relationship? What are the factors that affect the behavior of ERPT across space and time?

Is ERPT driven by microeconomic determinants such as the mark-ups and marginal costs of firms or is it mainly driven by macroeconomic forces such as inflation, output and exchange rate volatility? These are some of the most debated aspects of the ERPT literature, both internationally and in the Indian context. While the survey of works undertaken in the previous sections focus on both the international and Indian evidences, the following discussion largely centers around the matters most debated in the Indian context. Similarly, attention is also brought towards issues that have not garnered much debate, but are important nonetheless.

2.4.1.1. Empirical definition of the ERPT relationship

The fundamental idea behind ERPT is that of a causal relationship between different prices. Three key elements are synthesized to define the pass-through relationship. First is the foreign exchange rate. The foreign exchange rate is the price of one currency expressed in terms of either another single currency or a group of currencies, under the assumption that the currencies are monetary units in their respective countries. In other words, foreign exchange rate is the price of one form of money against another. When only two currencies are involved, the consequent price of each currency is called the bilateral exchange rate. If one currency is valued against a basket of currencies, the consequent exchange rate is called the Nominal Effective Exchange Rate (NEER) and is expressed in Index terms. If the NEER is adjusted for differences in the general price level of the country of interest and those of the foreign countries, the resulting rate is known as the Real Effective Exchange Rate (REER). Literature in the Indian context has oscillated between the bilateral exchange rate and the NEER, but so far the NEER appears to have been the most frequently employed measure. The second element in the ERPT relationship is the aggregate import price and this has been proxied solely by the import unit value index at the aggregate level of analysis in the Indian setting. This is due to the lack of any economically sound measure of aggregate import price index. At the disaggregated levels of analysis however, researchers have used import price data to construct import price indexes. The third and last element in the ERPT framework is the domestic price, and in the Indian context, literature has utilized the Wholesale Price Index and the Consumer Price Index both.

The causal interrelationship between these three prices is conceptualized as ERPT. The chain of causation flows from exchange rate to import prices and thereafter from import prices to wholesale and consumer prices. Conversely, in empirical terms, the primary interest has been to

estimate the so-called ERPT coefficient which is defined as the changes in the import or other prices due to one unit change in the exchange rate variable. Such a relationship could be expressed in level form of the variables, thereby implying a causal effect of exchange rate variations on the price index of interest. As the price data are largely in index form, the very concept of ERPT in this sense is defined in terms of change in the price level relative to its base, due to the change in exchange rate. Literature has utilized this approach, and has conceived it as the ERPT relationship. The interpretation of the ERPT coefficient under this approach is further complicated when index variables are used for both – the exchange rate and domestic prices. In this context, the ERPT coefficient is now defined as the change in the price index relative to its base caused by a change in the exchange rate relative to its base. The very idea of 'change' here does not correspond to the natural temporal ordering but is specified in terms of the base year. Thus, one-unit change in exchange rate induces an impact on import prices, but in this case, the impact is estimated with reference to the base period and not across each consecutive period, which is what is generally understood by the term 'change'. Thus, the literature has avoided this approach. Another important motivation for not choosing variables in level form has been the issue of non-stationarity which could become a source of unreliable estimates on ERPT coefficients. The natural response to this issue has been to use the variables in log-difference form. Proponents who favour using the variables in log difference form within the ERPT estimation argue that it helps address the issue of non-stationarity and thus produce reliable estimates. However, those who argue against log differencing the variables suggest that this procedure causes information loss and also deviates from the theoretical meaning of the ERPT relationship, which is defined in level form, rather than in log difference form. Due to the inevitability of using import unit value index in the Indian setting, studies have generally engaged in estimating the impact of a unit change in exchange rate variable on import unit value index, which is turn is defined relative to its base period. Thus, log differencing both the variables, i.e. the exchange rate and import price proxies, helps to bring them to a more easily comparable scale. However, in this case, one shall be estimating the impact of one percentage change in exchange rate on the percentage growth rate of import unit value index. This measurement of the ERPT coefficient comes closest to the theoretical definition and has generally been the most favoured approach in the domestic literature. The ERPT coefficient is then defined as the percentage change in import unit value index or the domestic price index caused by one percentage change in the exchange rate variable.

Consequent to the above discussion, the shift from level form to log-difference form of variables in the ERPT estimation results in the ERPT coefficient as an elasticity measure. Thus, the literature has largely engaged in estimating the pass-through elasticity of import or domestic prices in terms of the exchange rate variable. The inevitability of employing index numbers either on one side or on both the sides of the ERPT definition, and the presence of non-stationarity in those variables, have made the elasticity approach to ERPT measurement the most frequently employed approach in the Indian and also the international literature. Emergence of the elasticity definition of the ERPT coefficient has also caused several criticisms. One of them has been that the usage of log difference data can introduce larger variability into the estimation process which may affect the econometric efficiency of the regression estimates. Another grey area has been the loss of the information on trend in the data which is necessary for long-run ERPT estimation. These concern have been addressed in the literature by relying cointegration tests to test for long-run equilibrium relationship between a set of non-stationary data and thereafter the estimation of ERPT coefficients through the Error Correction Models (ECM). The ECM models do not suffer from the information loss argument and are capable of estimating both the short-run and long-run pass-through coefficients. Another approach favoured in the literature has been to employ the VAR approach and estimate the impulse response coefficients to capture the ERPT coefficients. However, this procedure has been criticized for deviating from the natural definition of 'change', as it measures the pass-through coefficients per unit 'shock' which is different than the changes in exchange rate over time. As discussed further in this chapter, one needs to be extremely careful to define in advance the kind of variations in exchange rate that are expected to impact the price variable. Economic shocks are not typical changes that occur over the natural ordering of time. These are induced, uncertain and surprising economic variations whose impact is inevitably dissimilar as compared to the typical movements observed in exchange rate data over time.

2.4.1.2. Measures of exchange rate in the empirical estimation of ERPT

As noted above, the ERPT relationship is composed of three key elements – an exchange rate variable, a proxy measure for import prices and a proxy measure for domestic prices[2]. The first and foremost debate in this context has been on the correct measure of the exchange rate variable. Literature has oscillated between the bilateral exchange rate and the effective indexes of exchange rate. Bilateral exchange rates have been found suitable when a large bulk of international trade

transactions is invoiced largely in terms of a single currency. The US Dollar has been the preferred choice in this regards internationally, followed by the pound sterling. When a nation invoices its transactions in multiple currencies, the use of bilateral exchange rate distorts the true extent of appreciation or depreciation of the domestic currency against foreign currencies. Indian traders, for example, are faced with multiple currencies as invoicing currencies such as the US Dollar followed by the Pound Sterling, and analysts have favoured the use of NEER instead of the Rupee-USD rate. However, in the Indian context, the results on pass-through coefficients have been largely robust to the choice of bilateral or NEER measures of exchange rate. This has not been the case in the international context, particularly for other emerging economies such as China, Indonesia or Brazil. Possibly, India's international trade is still largely invoiced in the American dollar and in cases where other currencies are involved, probably the US dollar may be functioning as the vehicle currency.

Literature has pondered on the implications of using the bilateral versus the effective exchange rates. In theoretical terms, ERPT coefficient to import prices can be different depending on which exchange rate measure is employed. The extent of exchange rate changes that are transmitted into the import prices (or for that matter into the export prices) has been found to vary considerably depending on the choice of the exchange rate variable. In the context of emerging economies, the bilateral rate against US Dollar has performed much better and has yielded larger estimates of the ERPT coefficient for import prices. In case of India, though, the NEER has provided on-an-average larger estimates of the ERPT coefficients for both the import and consumer prices as compared to the Rupee-USD rate, though a few studies found otherwise, nonetheless. Researchers have also argued that using NEER can provide a better fit in the estimated ERPT regressions as the effective exchange rate index captures performance of Indian currency against a host of currencies while accounting for their relative contribution to India's trade. A common line of debate in this regard has been on the use of trade-share weighted versus import-share weighted NEER index. In India, trade-share weighted and export-share weighted NEER data are available, while the import-based NEER can be constructed using disaggregated data. Ideally, in import price pass-through estimations, an import-share based NEER should be employed where the import-shares of partner countries are used as weighting factors to better capture the movement of Indian currency in India's import market. Data limitations have generally prevented such an

approach in the Indian setting. Hence, the use of trade-weighted NEER has dominated the literature.

2.4.1.3. Measures of domestic prices in the empirical estimation of ERPT

Other than the exchange rate, there are two key elements in the ERPT relationship, namely – the import price variable and the domestic price variable. While the import prices are proxied largely by the import unit value index in India within the aggregate ERPT analysis, there are multiple measures that literature has employed to capture domestic prices. Producer prices, wholesale prices and consumer prices are the measures employed by literature in the India setting to measure domestic prices. Each of these price variables represents a particularly point in the value-chain of the aggregate production. Producer prices account for prices in factor markets and have generally been employed as measures of the marginal cost element in the import price pass-through equations usually employed in the import price ERPT studies[3]. Some studies, however, also used this variable to measure the domestic prices. This trend has been limited and the WPI and CPI have been the more prominent choices in this regard. Wholesale prices have been employed as the proxy for domestic prices representing prices at the level of distributors and suppliers. WPI is the measure used to proxy the level of inflation in the markets where bulk trading occurs. The retail markets source their inventories from these markets and WPI measures the inflation level in these markets that are spread across the breadths of the country. Use of WPI as a measure of domestic price inflation for ERPT analysis in the Indian context has been limited as compared to the use of CPI. The rationale behind this may be located in the fact that CPI measures the prices of the final goods and services, i.e. at the end of the aggregate value chain, while, WPI focuses on prices in the wholesale markets where firms trade with other firms rather than with individual consumers. Nonetheless, those who have favoured WPI have argued that non-traded goods occupy a large share in the CPI and thus the pass-through estimates are bound to be lower and possibly biased.

An interesting debate that has emerged from these concerns has been the behavior of ERPT across the value chain, starting from the import prices and all the way to consumer prices. The consensus in this regards has been clear in the Indian domain – namely that ERPT falls across the pricing chain. As one moves from the import prices all the way to the final retail prices, the influence of currency vicissitudes subsides as seen within the Indian setting. While the pass-through to import prices is partial as found by most of the studies, it further slides downwards

towards retail prices. This has been one of the prominent debates in the Indian context. Literature has attempted to explain this phenomenon in terms of mark-up variations of distributors, wholesalers and retailers, who may absorb the impact of exchange rate changes into their profit levels, thus preventing the pass-through further down the pricing chain. Another explanation advanced for this phenomenon of falling pass-through across the pricing chain is menu costs. Sellers may absorb the exchange rate shocks if they are small and do not exceed the costs associated with price revisions. Presence of such costs has also been considered as the main reason behind asymmetry in size and direction of exchange rate changes. The issue of size and direction asymmetries has been an active area of research in the recent decade within the ERPT literature. A primary area of incongruity has been the measurement of the threshold value in exchange rate changes that may provide the breakpoint in the linear relationship between exchange rate and domestic prices. The ERPT coefficient above and below this threshold point is expected to be statistically and economically different and much of the present research in India has been directed on locating the correct threshold value[4].

While the ERPT relationship is defined in terms of price levels, in practice, the impact of percentage changes in exchange rate on the rate of inflation is estimated. Hence, the domestic price variable enters into the estimation in growth rate form. The inflation dynamics are very different for wholesale and consumer prices, and one of the thorns in the ERPT estimation has been to choose which measure to employ for pass-through measurement. The variability in both the measures is also different and thus their usage as substitutes is unwarranted. However, many studies have undertaken robustness checks for their results by estimating ERPT to both the wholesale and consumer prices and have compared them to establish consistency of their results. Such a comparison is problematic because the nature of inflation is different in both the cases and attempting to establish robustness in this manner implies treating both the measures of inflation as similar.

2.4.1.4. Currency invoicing and the degree of pass-through

International trade among nations is invoiced in different currencies depending on the trading partners, their relative market power to negotiate the contracts in local currency and the relative value of the currencies of those trading nations. Depending on the currency chosen, the degree of pass-through from exchange rate variations to domestic prices will vary. Generally, not all

contracts are of a particular nation are invoiced in the same currency. Invoicing refers to the determination of the price of exports and imports in terms of a particular currency, thereby preventing exchange rate changes from affecting the agreed price as far as possible. In a competitive international market, none of the trading partners shall be able to negotiate their currency as the invoicing standard, unless it commands a strong and consistent value against all major currencies. In this case, the generally accepted currency such as the US dollar is used. In many cases, large importing or exporting countries are able to negotiate trade contracts into their local currency and immune themselves from uncertainties of a volatile exchange rate. However, in case of a small open economy such as India, evidence suggests that there is little room for local currency invoicing which has resulted in the dominance of the American dollar, Pound Sterling, Saudi Riyal and Russian Ruble as the preferred invoicing currencies for contracts in various goods traded by India with rest of the globe. As a result, the nature of ERPT in India is driven by the value of these currencies against the Indian rupee and the fluctuations in the same over time.

Invoicing of trade contracts plays a critical role as an explanation of the ERPT to import prices and the literature has debated three forms of currency invoicing – namely, Local Currency Pricing (LCP), Producer Currency Pricing (PCP), and a more recent debate has been ignited on Vehicle Currency Pricing (VCP). All these three approaches have been investigated in the international literature while the Indian studies have mainly focused on the implications of PCP and VCP on the degree of import price pass-through. LCP models of ERPT assume that the currency contracts are invoiced largely in the importer's currency and thus the degree of pass-through shall be zero. PCP models assume the opposite and thus imply complete pass-through to prices of the importing nation. VCP on the other hand opens up the possibilities of an intermediate outcome as the degree of pass-through shall be conditional upon the value of the vehicle currency and the pricing decisions of the exporters (Chen et al., 2022). If the vehicle currency moves favourably, the changes may not be passed into the import prices, while if the changes are unfavourable, the changes may be passed completely into the importing nation's prices. Indeed, the degree of market power of importers and exporters shall play an important role in the pass-through process as also will the mark-up variations of the exporting firms. Studies have found that in the Indian setting, the pass-through to import prices is incomplete and while this finding may seem to be pointing towards the higher market-power of Indian importers, literature has also given equal weightage to the possibility that exchange rate shocks are absorbed into the mark-ups of

exporters and thus prevented from passing over to import prices. Studies that have focused on cross-country analysis by including India within their samples, have generally found strong evidence against both the extreme LCP and extreme PCP hypotheses (Aron et al., 2014). The broad consensus seems to be that the market power is lower for Indian importers but the mark-up variations by exporting firms has contributed to the incomplete pass-through to Indian imports.

The explanation for the incomplete pass-through to domestic prices has been rather more debated as there have been several macroeconomic explanations advanced for the same. First, inflation persistence and degree of pass-through have been found as positively related. When the average past inflation is consistently low, with limited volatility, the pass-through is also generally low as the monetary policy is perceived as credible and the central bank is expected to ward-off any excess inflation. On the other hand, if the inflation has been persistently high, pass-through is found to be rapid and higher due to lack of credibility of the monetary policy or the expectations that higher inflation shall be tolerated by domestic economic agents. Second, inflation volatility has been argued as a prominent factor in shaping the transmission of exchange rate shocks to domestic prices. Higher volatility has been found to cause higher pass-through as uncertainties about the value of the currency and the fear of excessive fluctuations in the export prices induce exporters to adopt the PCP model to avoid unexpected variations in their price. Similarly, lower inflation volatility has generally been associated with lower pass-through to import and domestic prices. Third, exchange rate volatility has been traced as a source of higher import price pass-through in India and subsequently transmission to domestic inflation. In periods when the rupee saw high volatility, pass-through was also seen to be higher, with the studies finding that in such time periods, exporters preferred PCP and avoided much mark-up variations. All these three explanations have been linked with the three currency invoicing models as discussed in this section. The above discussion has focused on the issues specific to aggregate level analysis and the disaggregated analyses would allow a richer examination of all the three invoicing models as there is heterogeneity in how trade contracts are worked out across different industries and firms.

2.4.1.5. Diversity in the empirical estimates of the pass-through coefficients

ERPT literature in the Indian setting has been in a broad agreement that the pass-through to domestic prices including the import prices has been incomplete, particularly after the financial crisis of 2007-08. However, the empirical estimates of ERPT have seen considerable variation across studies with the values ranging from near zero values to more than one. However, on the

average, ERPT estimates have been in the intermediate range. The primary debate in this context has occurred on the sensitivity of the ERPT coefficients to the choice of time period, econometric methodology, variables used to proxy exchange rate and domestic prices, and finally the controls used in regressions of pass-through equations.

With reference to the time period, studies have found evidence of structural breaks in the early 1990s due to the economic reforms and foreign exchange policy changes such as those related to capital account convertibility. Structural break in the ERPT coefficient has also been seen in the late 2000s due to the global financial crisis. The studies that have focused on time periods up to the mid-2000s have found mixed evidence with a broad finding being that ERPT to import prices has been almost complete, while it has been incomplete to consumer prices. When the time period has been expanded to account for recent years too, the pass-through to import prices has been incomplete while the same to consumer prices has seen an even smaller size. This has resulted in the debate on the need for accounting structural breaks in exchange rate, import price inflation and domestic price inflation variables to correctly identify the true extent of ERPT. Those works that accounted for such structural breaks in their estimation, were able to observe rather higher size of the pass-through coefficient, at least the first-stage pass-through. Generally, studies have used dummy variables in the empirical pass-through equation to account for the impact of such breaks on the ERPT mechanism. With reference to the econometric methodology, the debates have raged on the usefulness of single equation versus systems-based methodologies, with a surprising result for the Indian scenario being that the size of the pass-through coefficient stays incomplete irrespective of the method employed, with slight variations in its quantitative extent across both the methods[5]. Thirdly, the choice of variables has been situated as an important explanation for the variations in the empirical estimates by the studies. In the Indian context, the NEER has performed much better in achieving statistically significant relationship in the ERPT models while the CPI has performed better than WPI as a representation of domestic price inflation. Lastly, the choice of control variables, in single equation models, and the exogenous factors in systems approaches, have been a key element in the heterogeneity of results. Analysts have time and again warned the policymakers to deeply introspect on the various results available in the empirical literature on pass-through analysis, particularly putting emphasis on checking the control variables employed by the analyst (Aron et al., 2014). This concern becomes all the more robust when studies tend to take one of the two major approaches to pass-through analysis – namely, the

microeconomic or the macroeconomic approach. Comparisons of the pass-through estimates derived from these two diametrically different approaches can result into spurious inferences as warned by Aron et al. (2014), among others. This remains a matter of debate and reconciliation of the large number of ERPT estimates in literature continues to be a challenge for the monetary policymaker.

2.4.1.6. Theoretical framework for specifying the ERPT relationship

Literature on the ERPT analysis has evolved into at least three different directions. The first has been to ground the pass-through analysis into the pricing decisions of imperfectly competitive exporting firms by decomposing their price into two components – namely the marginal costs and the mark-ups. Under perfectly competitive markets, this approach suggests that the price charged by the exporters should be equal to their marginal costs without any room for mark-up variations. However, as soon as imperfections in the competitive model are permitted, in the form of unequal market powers between exporters and importers, various costs such as the menu costs, transaction costs and local non-traded costs; the mark-up component gains prominence and exporters engage in absorption of exchange rate shocks as and when necessary given their objectives. The mainstreaming of this approach into the ERPT literature has been credited to the works by Campa and Goldberg, though several authors had worked on similar lines earlier but were unable to pitch the model into the mainstream debates. This approach has been considered primarily microeconomic in nature as it derives its structure, parameters and interconnections within the standard microeconomic theory of pricing in imperfectly competitive markets. It has been particularly dominant in the stage-I pass-through analysis, though studies have used it to derive the full pass-through equations also. In case of the complete pass-through analysis, the domestic inflation is treated as the dependent variable and a host of variables are chosen as the regressors, one of them being the import price inflation. Using the stage one pass-through specification, the domestic inflation function is expanded to account for the mark-up and marginal cost proxies of exporting firms at the aggregate level. The other control variables are generally measures for the domestic cost of production, usually proxied by the PPI; a measure of domestic prices to account for substitutability between imported and local goods, and some measure of menu costs, switching costs and possibly local transaction costs. The analysts adopting this line of work have generally found near-complete import price pass-through in the Indian as well as international contexts. Estimation under this theoretical model has largely been undertaken using single equation

regressions within partial equilibrium and stock adjustment specifications. An advantage of this specification is that it can be employed for both aggregate and disaggregate data.

The second line of analysis in this regard has been the so-called macroeconomic approach which specifies the ERPT relationships for import price and domestic price inflations using the framework that was initiated in Taylor (2000) and later on developed rigorously by Obstfield and others. This approach has been termed 'macroeconomic' as it derives the structure of the model in terms of macroeconomic variables and their interrelationships with the domestic inflation. As discussed earlier, three important variables have dominated this strand in literature – namely, inflation persistence, inflation volatility and exchange rate volatility. At times, oil price has also been included to account for cost shocks from international markets to the Indian economy, given that India is a large importer of oil. This approach has been more prominent in the analysis of domestic inflation pass-through rather than the import price pass-through in the Indian context. The findings from this approach have generally yielded less-than-complete estimates of ERPT coefficient and this stands in stark contrast to the aforementioned models that have grounded their specification in the microeconomic pricing theories.

A new and emerging trend in the literature has been to merge both the approaches and specify a hybrid ERPT equation by accounting both the mark-up and marginal cost oriented variables on the one hand, and macroeconomic forces such as inflation and exchange rate volatility on the other hand. Such studies have produced mixed results with majority finding incomplete pass-through. This implies that the finding of incomplete pass-through has been a fairly consistent conclusion across all specifications though exceptions do exist. It is also important to point out that studies that have included ERPT as one of the components in the larger macroeconomic issues such as within the monetary transmission mechanism, have at times found evidence of complete or even more-than-complete pass-through into domestic prices. It thus emerges that the results of ERPT analysis are considerably heterogenous and the three factors discussed in section 4.1.5, have contributed to this variety of results.

2.4.1.7. Short run versus Long run impact of exchange rate variations on domestic prices

Exchange rate variations are transmitted into domestic prices including the import prices over a period of time and the behavior of ERPT coefficient has been found to vary across lags of the exchange rate variable. This has given rise to the idea of immediate price impact and across time

from currency movements, as well as the temporal instability of pass-through coefficients. Different arguments have been forwarded to estimate and explain the instantaneous ERPT versus the pass-through across time when economic adjustments are allowed and sufficient room exists for the purchasing power parity to reestablish. The impact of instantaneous exchange rate variation on the inflation – whether import price or domestic price, in the same period is termed as short-run pass-through, while the combined effects of exchange rate across different lags on the current period inflation is termed as long-run pass-through. Debate has been primarily directed on the number of lags to be included in the ERPT estimation so as to sufficiently capture the long-run dynamics of pass-through process. The choice on this aspect is governed by the frequency of data employed in the estimation. For studies using yearly data, lags of up to two years have been found to sufficiently capture the long-run pass-through coefficient. For the studies that employ quarterly data, lags of up to 4 quarters have been considered optimum for the estimation of long-run pass-through, while for monthly data, lags of up to 12 months have been used in studies to estimate the long-run ERPT coefficients.

The definition of the long-run coefficient has been a primary issue of debate in this context. Different econometric methodologies and theoretical specifications warrant alternative definitions of long-run coefficients. While some studies define long-run ERPT as the summation of the individual pass-through coefficients across the lags of exchange rate variable, others have used novel ways of defining the same. In partial equilibrium stock adjustment models, such as the one used by Yanamandra (2015), long-run pass-through coefficient is defined as the ratio of the sum of pass-through coefficients across the lags of exchange rate, and the sum of lagged coefficients of the dependent variables subtracted from unity. In studies employing the VAR models, long-run pass-through is estimated via the impulse response estimates with appropriate lags accounted into the estimation. The diversity in defining and estimating long-run ERPT has resulted in multiple estimates which are directly incomparable due to different methodologies, control factors and estimation procedures. In the Indian context, though, the agreement is that irrespective of econometric methodologies employed, the long-run pass-through is larger than its short-run counterpart and while also being incomplete.

2.4.1.8. Size and directional asymmetries in the pass-through process

Transmission of exchange rate changes to import prices and from there on to the prices across the distribution chain of the importing economy is generally assumed to be symmetrical with reference to the size and direction of exchange rate changes. This is the primary reason why studies estimate a single ERPT coefficient and not multiple coefficients for large versus small changes, and for appreciation versus depreciation. However, literature has begun debating the efficacy of the symmetry assumption in the behavior of pass-through process. A voluminous literature has emerged that has debated the existence of possible asymmetries and has examined the reasons behind the same. The Indian literature on this aspect is rather limited and much scope remains open for further investigation.

Two major debates have emerged on this matter in the Indian context. One is locating the threshold values for size asymmetries. Second is finding the main explanations of asymmetric behavior of pass-through. The first issue has been a critical debate because there are multiple ways to define the threshold value. Some analysts have used the information on mean value to define the threshold. Others have used standard deviation as a criterion to define the threshold value. Yet other analysts have defined the threshold value for differentiating small from large changes by using a subjective criterion. There have been attempts where analysts have used econometric methods to identify the threshold levels. Such methods include the threshold regression approaches, threshold VAR, and Vector Smooth Transition Regression (VSTAR) models. An advantage of these econometric methods is that they allow the data to reveal thresholds and non-linearities rather than imposing them on the data through subjective choice of the researcher. However, the Indian strand of literature has seen limited application of these methods and the subjective approaches have been largely used. In terms of the factors explaining the asymmetric behavior of ERPT in size and direction, there have not been much works that investigate such dimensions. Theoretically, meu costs, switching costs and nominal rigidities have been considered as the reasons for non-linear behavior of ERPT. However, there aren't any studies that empirically investigate these factors within the asymmetric pass-through framework.

2.4.2. Issues in the pass-through literature that have not been prominently debated in India

While the dimensions explored above have been actively investigated in the Indian context with much scope available for further research, some matters have not been scrutinized with equal

attention. These matters may be considered as the scope for further research and the advancement on these aspects will improve the collective understanding of ERPT mechanism in India.

2.4.2.1. Examination of the ERPT to import prices

The exchange rate transmission process to domestic prices is generally conceptualized in a two-stage framework. In the first stage, exchange rate variations cause variations in the import prices of a country. In the second stage, the variations induced in import prices are further transmitted into various domestic prices finally culminating into the changes in consumer prices. The two stages together is considered as the full pass-through process. In a simultaneous equation framework, the need to separate the two stages would not arise. However, the large majority of studies use partial equilibrium approach and do not enter into the realm of simultaneous determination of the first stage and second stage pass-through processes. Hence, this classification is important to contextualize the large number of studies available in the Indian ERPT domain.

While the full pass-through process has been rigorously debated in India, the first stage pass-through remains a grey area and the amount of evidence in this regard is quite limited. One explanation for this observation may be that after the adoption of 'managed floating' by the RBI, exchange rate has generally not been regulated and sterilization efforts are undertaken to smoothen any excessive volatility. Given this stance to exchange rate changes, impact on import prices is also a matter that is left for market forces to decide. Moreover, import prices in India are regulated via tariffs. Hence, analysts have generally diverted attention to the impact of exchange rate variations on domestic inflation rather than import prices. Furthermore, the primary focus of monetary policy is price stability and with substantial agreement that import price pass-through is partial and low, research efforts have been directed towards the analysis of domestic inflation dynamics within the ERPT framework. Nevertheless, sound analysis of exchange rate's impact on domestic inflation is conditional upon the knowledge of the import price pass-through.

2.4.2.2. Analysis of pass-through effects of import prices on domestic prices

For the complete transmission process to occur, it is necessary for exchange rate variations or shocks to pass into the retail price structure of an economy. The progression from exchange rate to consumer prices requires that import prices impact consumer prices as they are the primary channel of transmission in the full ERPT process. Literature seems to have neglected the analysis

of how consumer prices react to import prices and the factors that are important to this process. The so-called stage two pass-through is at times wrongly defined as the full pass-through process itself. In reality it is the impact of import prices on consumer prices that should occupy the stage two component in the complete pass-through process.

Literature has debated the mechanisms through which import price variations can seep into domestic inflation, though the empirical coefficient linking import prices to consumer prices has generally not been undertaken in the Indian context. Import prices can impact consumer prices due to several reasons. One of them is that imported commodities are a part of the consumption basket used to build the CPI. Thus, changes in the price of imported commodities will result in changes in the consumer price variable. The main debate on this issue has centered on the weightage of imported commodities. In countries where imported commodities are assigned a larger weight in the final consumption basket, import price variations will naturally generate a larger response from consumer prices as compared to the nations where imported commodities have low weightage. In this sense, the relationship between import prices and consumer prices appears to be a matter of definition only. However, other arguments have been proposed that move beyond definitions and recognize the behavioural impact that import prices can have on consumer prices. Changes in the price of imported inputs can induce an impact on the cost of production, which may cause changes in the prices charged at the retail level. This can also explain the links between import prices and wholesale prices. It has also been suggested that price variations in imported goods can cause price variations in domestic substitutes, thereby changing the CPI. However, this argument is dependent on the degree of substitutability between imported and domestic goods, which in itself is an empirical question rather than a theoretical digression. Equally important is the existence of a strong home bias which can weaken this connection while weaker rigidity in preference of domestic production shall increase this impact (Obstfeld and Rogoff, 2001). These aspects have not been examined satisfactorily in the Indian literature on pass-through. Another topic that has not been much deliberated is that exchange rate can impact domestic inflation through channels other than import prices, though their contribution would not be as significant as that of the import price channel. Export price pass-through could cause changes in domestic inflation and so can monetary policy reaction to exchange rate changes, if the central bank of a country sterilizes to control the value of currency. In the Indian scenario, such concerns may partially be true and the pure impact of exchange rate on domestic inflation would necessitate adjustments for such

transmission channels so as to pinpoint the true extent of pass-through via import prices into the domestic prices.

2.4.2.3. Monetary policy and ERPT

The two strands of ERPT modelling that were highlighted earlier, namely the approach grounded in microeconomic pricing theory of imperfectly competitive firms, and the more aggregative approach grounded in macroeconomic conceptions of pass-through, look at monetary policy very differently. The microeconomic approach specifies the ERPT relationship in terms of the mark-ups and marginal costs of exporting firms whose pricing decisions will determine the prices faced by the importing nation. Monetary policy in this framework is determined independently from ERPT. While, in the macroeconomic approach, both the monetary policy and pass-through process have been found as endogenously determined (Ozkan and Erden, 2015). The macroeconomic school gives a high credence to the role of monetary policy in shaping the nature of pass-through coefficients and thus ascribes prime importance to the behavior of central banks. ERPT in itself is also a component of the larger monetary transmission mechanism and thus may be determined endogenously with monetary policy itself (Aron et al., 2014). The literature in the Indian setting has not provided the attention necessary for this issue and has rather focused more on the outcomes of monetary policy – such as inflation persistence and volatility, rather on the monetary policy actions themselves. ERPT analysts could account for the monetary policy stance and its credibility as direct factors determining the extent of pass-through, but such evidences have been limited.

2.4.2.4. Pass-through of changes versus shocks in exchange rate

Theorization of exchange rate movements can be undertaken from at least two perspectives. One is to focus on the natural changes in exchange rate that occur due to the regular shifts and movements of the demand and supply in the international forex market. Such changes can be random but are within the expected range and are well-anticipated by markets. Second is to emphasis on abnormal fluctuations in exchange rate particularly on changes that are sizeable and unanticipated. Such changes are broadly considered as shocks in the econometric literature on ERPT. The pass-through from changes and that from shocks can have very different theoretical mechanisms at work. Hence, the pass-through coefficients for changes in exchange rate and for shocks in exchange rate cannot be treated similarly. Most of the studies in the Indian picture have focused on pass-through of exchange rate changes. Some works have focused on the effects of

exchange rate shocks and such works have largely employed a VAR framework to induce artificial shocks and study their impact through impulse response functions. The literature in India has not debated this matter at all and many a times, the pass-through coefficients from these two kinds of exchange rate movements are treated as comparable. Furthermore, there may be episodes when exchange rate changes have been abnormal, possibly due to structural breaks induced by important events. Some works have investigated the impact of such changes on domestic prices, but mostly this issue remains unaddressed in India.

2.4.2.5. Other important matters in this regard

There are some other questions in the ERPT literature whose investigation has seen limited attention in the Indian context. First is the issue of measurement errors and statistical noise in pass-through estimations. The aggregate level analyses on ERPT employ data that pass from multiple stages of sampling, aggregation and adjustments. Despite these efforts, such data are at best estimates whose reliability in conditional upon their quality. The problem in the aggregate pass-through literature in India has been the strong reliance on proxy measures for prices, which in turn are imperfect representatives of the true underlying prices. This may introduce unnecessary statistical noise in data and could reduce the reliability of pass-through estimates. While one cannot avoid relying on the available data in empirical analysis, the extent to which it distorts the true picture should also be ascertained after empirical estimations are over. Such an exercise may be considered as post-mortem of data and this is necessary to ensure that results are useful for policymaking. Unquestioned reliance on the aggregate macro data may prove to be fatal when available evidences are synthesized to inform the policymaker. Measurement errors are inevitable in aggregate data, all the more when such data are based on surveys rather than census. If such errors are systematic, then they can produce spurious associations or even mask the true associations under the guise of statistical insignificance (Peltzman, 2000). If these errors have a larger random component, then the same may be dealt with appropriately in the econometric estimations.

Second dimension that needs to be a part of the mainstream discourse on pass-through estimation is the impact of REER on import and domestic inflations. Unlike the bilateral or nominal effective exchange rates, the real effective exchange rate adjusts for price differentials and thus may be interpreted as the real value of one currency, i.e. the nominal value adjusted for

inflation, in terms of a basket of currencies. The impact of REER on import prices and thereafter to the entire pricing chain up to the retail prices is also one dimension that has not been actively examined in the Indian context. Two major uses of the real effective index has been seen in the domestic literature. Some studies have undertaken robustness tests by checking the pass-through coefficients for real effective index instead of the nominal effective index of exchange rate. Comparability of pass-through estimates from nominal and real exchange rates is a matter of debate, hence, the robustness tests so performed may not yield reliable insights. Secondly, REER has been used as a proxy for competitiveness of the importing economy in the international markets and has been incorporated into the pass-through estimation along with the bilateral US dollar – rupee exchange rate. Other than these, REER finds very little place in the pass-through literature in India.

Third dynamic of the ERPT literature in India has been the limited study of disaggregated pass-through to import and domestic price inflations. Disaggregation can be achieved in terms of the industries, commodities, and transactions. Granular data on import transactions are extremely difficult to obtain in the Indian context. Commodity-level data are available for import unit value index and quantities, but other relevant micro and macroeconomic variables are not available. For illustration, a study estimating pass-through to import prices at commodity-level will require measures for domestic cost of production, foreign costs of production, mark-ups of the import suppliers, prices of substitutes, and a host of industry-specific variables whose data are not available in India. However, relevant proxy measures can be constructed and variables that may indirectly be associated with the concerned industry or commodity-grouping can be employed. The PPI, for illustration, has been a popular choice to proxy domestic costs of production in stage one pass-through estimations at industry-level in India. Despite the possibilities of such analytical permutations, literature has largely avoided the debates on pass-through at granular level. One explanation for this may be that ERPT is essentially an aggregate-level phenomenon, as its historical roots suggest. Another reason for the limited attention of disaggregate dynamics of pass-through can be data issues. The foreign trade, trade prices and domestic prices data in India are highly sensitive to the sampling procedures, aggregation methodologies, and weighting factors used. While the well-known aggregate variables have a sound statistical basis and have been subjected to multiple levels of scrutiny, at disaggregate levels, the analyst may have to rely on data that are relatively less scrutinized and possibly more problematic. The splendor of the statistical

machinery in India is that the aggregate level data pass through a large number of cleaning and adjustments processes, thus yielding estimates that are based on more reliable statistical foundations as compared to the relatively 'raw' disaggregate data.

Lastly, the ERPT to service industry at the sectoral and disaggregated levels has been largely missing in India. Given that services have occupied the highest share in the aggregate GDP of India, it becomes necessary to see how this sector reacts to exchange rate shocks. Particularly, trade in services has also picked up in the recent decade, both internationally and domestically. Service industries are no more immune to external shocks due to a complex web of interconnections across the globe. With the advent of trade in services, the extent of price impact of exchange rate on service imports is also a matter worth deliberating. Due to the non-tradable nature of many services, and the lack of reliable service sector-specific import and domestic price indexes, analysts have not delved into this dimension. In the international arena, however, this issue has gained momentum and possibly with better data available in India, interest in this matter will rise.

2.5. Summary and concluding remarks

This chapter has covered a sizeable amount of literature on the pass-through analysis in international and domestic contexts. The review was then complemented with a narration of issues that have been actively focused by analysts as well as those matters that have not received equally vociferous attention. Estimation of the pass-through coefficients for import prices and for a host of domestic prices have been at the center-stage of the Indian literature. Many questions emerge from this primary concern that have been investigated using a host of theoretical frameworks and econometric methodologies. Some of the questions which have been actively investigated are enlisted here. What is the correct way to empirically measure pass-through relationship in the short and long runs? Which variables are the most representative measures of the key elements in the pass-through mechanism? Which theoretical approach best captures the aggregate pass-through dynamics for the Indian economy? How does currency invoicing impact the extent of price impacts induced by exchange rate on domestic prices? Why is the pass-through relationship not always linear and displays size and directional asymmetries? What is the menu of econometric choices available to analysts and why are some methods given precedence over others? These are some of the major areas of active debate in the Indian context and were examined in this chapter.

Not all questions deserving due attention have been attended to, in the Indian setting. How do exchange rate variations impact import prices? Is there primarily a microeconomic process of pricing decisions at play as argued by Campa and Goldberg (2005)? Or is there an equally valid case of macroeconomic forces shaping the stage one pass-through as argued by Taylor (2000) among others? Through which channels do import price variations translate into domestic price changes? Is their relationship purely definitional or are there behavioural dimensions at play? Is monetary policy exogenous to the pass-through mechanism? How does one reconcile the simultaneous determination of pass-through and monetary policy? Which approach to ERPT estimation best captures such concerns? Can the changes in exchange rate be treated similar to the shocks in exchange rate? Are the ERPT mechanism and the pass-through coefficients interpretable in a similar fashion when looking at changes versus shocks of exchange rate? What is the price impact of exchange rate on service imports and how does it percolate into final retail price structure? Lastly, what is the diversity in the price impacts of exchange rate movements on disaggregated levels of analysis? These are some of the major concerns that have not been debated actively and a host of factors may justify it. Such issues were also highlighted in this chapter.

Lastly, a central idea that emerges from this chapter is that empirical sophistication can improve theoretical accuracy, though this depends on the tightness with which empirical methods are anchored to sound economic theory. The nature of pass-through process is complex and determined by dynamically changing forces – both aggregate and disaggregate, whose examination is albeit challenging. Studies have innovated on the methodological front but have been blocked by the nature of macroeconomic data that is available in India. Lack soundly constructed and meaningfully weighted import price index, for example, is a serious data limitation which is difficult to overcome even if one constructs it using disaggregated commodity-level data because the sources of data shall remain the same irrespective of the level of aggregation at which existing data are employed in empirical analysis.

Methodological innovations have indeed helped uncover deeper insights into the pass-through process. For illustration, the increasing recognition of size and directional asymmetries in the pass-through process is a direct product of the econometric sophistication visible in the Indian ERPT literature since the mid-2000s. It has allowed analysts and policymakers gain better understanding of the price impacts of exchange rate variations. VAR modelling, for example, has

allowed the examination of the dynamic paths of exchange rate shocks while they culminate ultimately into the final retail prices of the country and has permitted policymakers to trace the impact of monetary policy impulses on the exchange rate channel in the transmission process. The use of threshold regressions and VSTAR models, as another example, have allowed researchers to locate the space and time specific threshold values in exchange rate changes, above and below which the pass-through effects may be different. Emergence of the Dynamic Stochastic General Equilibrium models in the pass-through literature has permitted analysts to shed the partial equilibrium specifications and adopt a more complex, interconnected conception of the ERPT mechanism. Despite such econometric improvements, the pass-through estimates have continued to display incompleteness and broad temporal stability. One may argue that sophistication in this sense has not increased the stock of knowledge, but the explanations and interrelationships that have been uncovered by these improvements have made the existing estimates more reliable and to some extent more trustworthy. The sheer diversity of empirical estimates on pass-through coefficients is compensated by the emergence of a broad and clear picture of how exchange rate variations are percolating into the Indian economy, particularly in the domestic price structure. It is inevitable that exactly similar point estimates cannot be obtained from studies using diverse time periods, methodologies and theoretical frameworks. However, if a comprehensive empirical picture of the pass-through process is emergent, then it may not be incorrect to suggest that sophistications in methods have helped in achieving improvements in empirical accuracy.

The next chapter shall examine the macroeconomic background of the Indian economy, especially for the period 1991-92 to 2021-22, which shall be the period of study. It is necessary to contextualize the larger macroeconomic movements in exchange rate, monetary policy, inflation, output, and employment to provide the necessary background for the empirical analysis and more importantly the economic interpretation of the results contained in chapters thereafter.

Notes

[1] While Dornbusch's works reignited the interest in the price impacts of exchange rate variations, authors before him too had shed some light on the same. Works of analysts such as James Meade also focused on this aspect. However, these works were unable to garner enough attention to the volatile nature of exchange rates and thus could be considered as inputs into what Dornbusch framed in his overshooting model.

[2] The variables employed are considered as proxies for at least two reasons. One, they do not represent price levels *per se* but measure the level of change in price level relative to the base period. Second, in case of import prices, variable used is the unit value index rather than an index of import prices. However, studies that have focused on disaggregated data – such as on commodities, industries, or even import transactions, have used import price indexes rather than the unit value index. Such studies are visible in the international setting but are generally not seen in the Indian literature on ERPT analysis.

[3] An alternative measure of marginal cost employed in literature is credited to the works of Campa and Goldberg, and which has been used in Barhoumi, 2006 (pp. 929), which is defined as the product of the REER and WPI divided by the NEER. However, in the Indian context, PPI continues to be the dominant measure of the cost component in the import price pass-through estimations.

[4] Further analysis on this point will be presented in the sub-sections later in this chapter.

[5] Further comments on this aspect are provided later in this chapter.