Chapter 7

Summary, Limitations and Concluding Perspectives

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Chapter 7

Summary, Limitations and Concluding Perspectives

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7.1. Contextualizing the findings

This study has investigated the subject of Exchange Rate Pass-Through, i.e. ERPT, to import prices as well as domestic prices in India for the period 1991-92 to 2021-22 at the aggregate level using both quarterly and annual data. Quarterly information was utilized for the analysis of pass-through to domestic prices, while annual information were employed for the analysis of import price pass-through. This study has contributed to the extant wisdom in several ways.

First, the analysis of both the import price and domestic price pass-through from exchange rate variations in a single work provides a well-articulated framework of studying the price impacts of exchange rate alterations. Generally, literature in the Indian context has treated both the dimensions of pass-through mechanism separately with some studies focusing exclusively on the import price issue while others attending the pass-through phenomenon from the standpoint of domestic prices. By undertaking an assessment of both the stage one and the full pass-through process, this work has provided a more coherent perspective that can be utilized to compare how exchange rate interacts with the different sets of prices in India. Second, as explained in chapter two, the literature on this subject-matter is rather limited in the Indian setting. There is a large scope for addressing the various aspects of the pass-through process and provide fresher perspectives on how exchange rate variations interact with trade and domestic prices. The present study is an attempt in that direction. Third, the analysis of ERPT to import prices has been much more limited in the Indian arena relative to the focus given to domestic prices. This study has provided a larger and more exhaustive perspective on the nature of pass-through mechanism with regards to import prices using a longer time series data, capturing the entire period after the reforms, and adopting novel theoretical and methodological approaches. More importantly, it provided perspectives not only on the basis of baseline models, but incorporated multiple perspectives to gauge the sensitivity of pass-through to different specifications.

Fourth, the nature of import price behaviour is critical to properly capturing the extent of ERPT. Very few studies have elaborately examined the determinants of the import price inflation in India while locating ERPT as one channel within this larger issue. The present study has undertaken this task in chapter four. Fifth, the extent of ERPT to import prices under different theoretical specifications has not been actively studied in the Indian context. This dimension has been covered in this work. Sixth, the determinants of import price pass-through coefficient, both

from the indirect approach in terms of interactive dummy variables and the direct approach wherein the pass-through coefficient is itself utilized as a dependent variable, is an area where large scope of analysis has remained open. Some progress in that direction has been advanced in this study. Seventh, the time-varying nature of the import price pass-through coefficient has been investigated in this study while also focusing on its determinants. This is another fresh dimension contributed by the present work. Eighth, the scrutiny of the temporal behaviour of the pass-through coefficient using multiple econometric methodologies is another unique aspect of this study and provides a fresh perspective on the subject.

The second fundamental concern of this work was the nature of pass-through to domestic prices from exchange rate variations. Several focal issues were deliberated in chapter five on this subject. First, this study has estimated the short and long run pass-through to domestic prices for a considerably longer study period, ranging from the economic reforms till date. This period captures the liberal era of the Indian economy and accounts for several structural changes – both in policy and the institutions. The estimated results represent the nature of pass-through during this era and the scope of the chapter is considerably larger than many of the studies undertaken so far. Second, the estimation of pass-through using both the quarterly and annual data provided an opportunity to reflect on the sensitivity of results to the frequency of data. It was found that the extent of pass-through remains largely invariant to this dimension.

Third, the stability of the impact of exchange rate alterations on domestic prices was investigated using different econometric approaches, which suggested a time-invariant pass-through to domestic prices, unlike in the case of import prices where pass-through coefficient increased over time. Fourth, the dynamic interactions and the complex feedback relationships between exchange rate and domestic prices were captured through the SVAR model. The entire period after the economic reforms was captured in this framework and important insights were obtained on this issue. Fifth, chapter five synthesized multiple dimensions of the pass-through mechanism into a single analytical framework, allowing meaningful comparatives to be drawn from the empirical results. The holistic perspective provided in chapter five contributes a more coherent perspective on the subject matter in the extant literature.

The fourth fundamental subject-matter examined in this study was the non-symmetrical behaviour of the price impacts emanating from exchange rate variations. Chapter six addressed

this issue by adopting multiple definitions of directional, size and composite asymmetries while also adopting multiple analytical approaches. In contrast to the extant literature, this study investigated asymmetry issue for both the import price as well as domestic price pass-through in India within a single volume. Furthermore, consistency with the previous models was maintained to allow extend the linear econometric models to capture nonlinear dimensions while permitting comparison across diverse methods and inferences. With the entire period after economic reforms under consideration, the inferences yielded by the estimates of chapter six provided a coherent and broader perspective on the issue of nonlinear pass-through in India. The issue of asymmetries was extended to alternative baseline models to gauge the sensitivity of asymmetries to alternative methods, definitions and econometric approaches. The analytical apparatus developed in chapter six provides a unique perspective on size, directional and composite asymmetries, while drawing comparatives between the pass-through to import prices and domestic prices. While being parsimonious in its approach, the findings provided credible evidence on the existence and nature of nonlinearities in the transmission of price impact emerging from exchange rate movements.

7.2. Summarizing the initial findings

Chapter one introduced the subject-matter by surveying the theory of ERPT in both global and Indian perspectives. The fundamental motivations of the study were laid down in this chapter. The primary objectives and the key hypotheses to be tested were explored. The macroeconomic data environment of the study was laid down and the critical perspectives on macroeconomic measurements, their importance and pitfalls were elaborated. The chapter also explained the time period to be adopted for the empirical analysis and scrutinized the rationale for adopting the same. The importance of the post-reforms period for macroeconomic analysis in general, and for the examination of ERPT in particular, was established therein.

Chapter two substantiated the theoretical and empirical foundations of this study by systematically exploring a large volume of evidence on the subject under consideration. First, the evidences at the international level that cut across cross-sections of nations, regions and other spaces were explored beginning from 1976 and till date. Second, the evidences in the Indian context were surveyed from 1996 onwards. A large body of literature was summarized in this chapter. Third, thematic debates and perspectives that emerged from the review of evidences were

explored while contextualizing the extant literature in the global context. Similarly, the key issues in the Indian context were examined thereafter.

Chapter three provided the macroeconomic background to the study undertaken in this chapter. The issue of ERPT is subsumed under the larger macroeconomic debates and dilemmas pertaining to diverse matters such as trade balance adjustment, BoP adjustment, monetary policy and transmission mechanism, and other allied matters. Hence, understanding the larger macroeconomic environment prevailing in India during the sample period is necessitated to contextualize the major economic developments with the empirical analysis which was to be conducted later. By decomposing the entire period into five-yearly sub-periods, key macroeconomic developments in India, especially pertaining inflation, monetary policy and the external sector were examined while also focusing on other important components of the macroeconomic story of India. Theoretical expectations on the nature of the ERPT process were partly laid down through this chapter.

7.3. Summarizing the empirical inferences

7.3.1. Short-run exchange rate pass-through

Chapters four and five addressed the first fundamental issue – namely the determination of the short-run pass-through effects of exchange rate variations with reference to aggregate import prices in India and domestic prices respectively. In chapter four, the analytical setup was pitched through the markup pricing model modified for aggregate analysis. The baseline model was specified by juxtaposing import price inflation as a function of key cost and demand side factors while also incorporating the exchange rate variable. The specification was expanded to account for a richer set of determinants of import price behaviour while also enabling their use as control variables for deriving the pass-through coefficient. Implicitly, the sensitivity of the import price pass-through coefficient to alternative specifications was nested in these exercises. In a similar spirit, two baseline models were estimated in chapter five to capture ERPT coefficient in India to domestic prices. Analysis was not restricted, however, to these baseline models but alternative specifications were examined to gauge the sensitivity of the price impact from exchange rate alterations.

Short-run pass-through has been estimated within the single equation dynamic partial adjustment framework in chapters four and five. Pursuant of the approach in literature, the short-run elasticity of prices with reference to currency movements was defined as the current period coefficient of the exchange rate variable. Table 7.1 exemplifies the key findings from chapters four and five with regards to the extent of short-run ERPT to import prices and domestic prices.

Table 7.1: Grid of short-run pass-through coefficients from exchange rate to prices in India

Source of pass-through	***Impact variable***	
	Import Prices	Domestic Prices
NEER		
Baseline Model – I	-1.25	-0.18
Baseline Model - II	-1.21	-0.18
RSUSD		
Baseline Model – I	0.73	0.10
Baseline Model - II	0.95	0.11

Notes: % represents the extended baseline model. Except Baseline-I for RSUSD, which was significant at 10% level, all other coefficients were significant at 1% level.

Is pass-through complete or incomplete? The answer to this question is straightforward with regards to the domestic prices: ERPT to domestic prices has been incomplete whether looked from the perspective of the effective index of exchange rates or the bilateral exchange rate. However, the answer to this question is slightly complicated with regards to the import prices. On the one hand, pass-through is more than complete in case of the NEER. The baseline coefficients of pass-through are 12.50% and 12.10% for every 10% increase in the effective index of exchange rates. Clearly, the pass-through is more than complete and the 'incompleteness hypothesis' can safely be rejected. However, the results show incompleteness when the bilateral exchange rate is used. For the first baseline model, the pass-through is only 7.3% for every 10% increase in the exchange rate while it is nearly complete at 9.5% for the second baseline model. Clearly, the extent of short-run pass-through is sensitive to the specification of the exchange rate variable. The relative difference in the completeness of pass-through for import prices and domestic prices reflects a host of macroeconomic and microeconomic factors that might at play resulting into this divergence. These factors were debated in chapters four and five. In summary, the microeconomic explanations

for this phenomenon could emerge from the absorption of the exchange rate shock at different levels in the aggregate distribution chain; menu and switching costs that could induce different agents in the pricing chain to absorb the inflationary impact in order to avoid adversely impacting their market share or profit; interventions by the Government to prevent inflationary momentum from oil prices, and other such related factors. The macroeconomic explanations could emanate from the endogeneity of ERPT to monetary policy itself, captured by the Taylor's hypothesis for which evidence has been observed in the Indian context as per findings reported in both chapters four and five. The impact of monetary policy stance on pass-through is a critical factor in explaining why despite a complete or near-complete pass-through for import prices, the same has been largely low and incomplete for domestic prices.

7.3.2. Long-run exchange rate pass-through

The extent of short-run pass-through is important to delineate how prices and exchange rates interact in a comparative static framework. The issue of lagged impact of exchange rate alterations on prices is ignored by short-run pass-through analysis. However, exchange rate impulses may impact prices over time, thereby inflating the total impact which would generally be underestimated by short-run pass-through estimates.

Table 7.2: Grid of long-run pass-through coefficients from exchange rate to prices in India

Source of pass-through	***Impact variable***	
	Import Prices	Domestic Prices
NEER		
Baseline Model – I	-	0.24
Baseline Model - II	1.03	0.24
RSUSD		
Baseline Model – I	-	0.14
Baseline Model - II	-	0.15

Notes: % represents the extended baseline model. Except Baseline-I for RSUSD, which was significant at 10% level, all other coefficients were significant at 1% level. Results are unavailable for long-run coefficient of the first baseline model for NEER, and both the baseline models for RSUSD for import prices as the partial adjustment term was insignificant at 10% level.

In order to address this issue, chapters four and five estimated the long-run ERPT on lines of Koyck (1954) and Nerlove (1958) by utilizing the partial adjustment model Koyck (1954). Table 7.2 summarizes these findings from chapters four and five. The results in table two indicate that pass-through with respect to domestic prices has been incomplete. However, when compared to the estimates contained in table 7.1, the extent of pass-through is larger in the long-run indicating that with sufficient time for economic adjustments at both the price and quantity levels, exchange rate tends to have larger price implications for the Indian economy. These results are very much consistent with the literature in the Indian context as narrated in chapters two and five.

The picture is, however, slightly different for import prices where the longer-run pass-through is marginally lesser than the short-run pass-through but continues to be complete. Perhaps, once price and quantity adjustments emerge with time, import prices tend to stabilize to the value of unity. It may be possible that the overshooting in exchange rate could be responsible for the higher short-run pass-through as compared to the long-run pass-through. Pass-through in the long-run also continues to be complete in case of import prices. The results in table 7.2 indicate that the backward-looking framework may not always be suitable for analysing import price variations. However, there is a strong evidence of backward-looking persistence in the behaviour of domestic inflation as explained in chapter five, and is also indicated in table 7.2. This is testified by the significant partial adjustment term for all specifications on domestic prices.

7.3.3. Determinants of import price inflation

The analysis of ERPT has been conducted within the framework of the empirical models examining the variations in aggregate imports price as well as aggregate domestic price. Hence, implicit in the analysis of pass-through is the assessment of what macroeconomic factors determine the behaviour of import prices and domestic prices. This study has addressed such dimensions in chapters four and five while utilizing these variables as control factors for estimating the extent of price impacts emanating from exchange rate alterations. Accordingly, the important factors impacting aggregate import prices and aggregate domestic prices are highlighted here.

Demand pressures on aggregate imports emanating from real output growth showed a strong and sizeable impact on import prices as presented in table 8 in chapter four wherein the extended baseline model was estimated. Real output movements are relevant in shaping the level of imports demand (Menon, 1995; Dash and Narasimham, 2011), as well as shape the extent of

expenditure switching between imported commodities and domestic substitutes. A positive sign of this coefficient would imply that an expansionary output path leads to larger influence on aggregate import demand and precedes a rise in the aggregate import prices. On the other hand, a negative coefficient could imply that expansionary output movements tend to increase the extent of expenditure switching and perhaps that there is a higher degree of substitutability between imported and domestic commodities. The sign of this coefficient was found to be negative. Successive governments have pushed imports substitution as a key agenda in their quest for pushing economic growth in India. Possibly, these efforts could be responsible for the negative sign of this coefficient, leading one to believe that there is a tendency to move towards domestic consumption since the reforms in India. There may be other mechanisms that could explain this finding equally well. An alternative perspective could argue that increased output growth domestically leads to a larger scope for expanding the market share by foreign firms, this motivating them to reduce the price of imports during expansionary phases in the destination markets.

One may correlate this finding with the observations made in chapter 6 wherein small appreciations showed larger impact on import prices than all other changes. Foreign firms may possibly be engaging in exploiting the opportunities to percolate into the Indian markets during expansionary phases, where the most relevant scope for increasing market shares are generally prevalent. The next major factor impacting import price behaviour was the ERPT channel. External sector remains a prevalent source of variations in import prices, though the domestic factors seem to be having an equally large impetus too. Exchange rate alterations have been a prevalent source of inflation in aggregate imports since the economic reforms began indicating that the increasing international trade and financial integrations are also binging inflationary implications for the domestic macroeconomic balance. The third major factor was found to be the global financial crisis which has shown a negative impact on import prices, perhaps suggesting that the crisis led to a contraction of import demand along with a generalized slowdown in global trade which could have enabled the disinflationary tendencies during the crisis. The other important determinant included the world inflation level which continued to fuel inflationary impulses for the domestic economy via the imports price movements. It also represents the cost conditions in the major advanced economy that are large suppliers of India's imports. The rise in cost conditions in the source countries has generally resulted into pass-over of these cost impulses into the Indian

markets, though it has been partial rather than complete. This phenomenon of 'cost pass-through' remains a relevant area of debate and its interactions with the exchange rate transmission channel is a vibrant area of future research.

7.3.4. Determinants of domestic inflation

While the present study has preoccupied its attention with the issue of price nexus between external and domestic sectors, the nature of the aggregate inflation process remains a critical area of debate within which the theory of E RPT is generally pitched. Chapter five addressed some dimensions on this account and looked into the macroeconomic orientation of the inflation phenomenon in India. The two baseline models provided insights into how inflation has behaved and what factors have driven it vis-à-vis the domestic and external sector movements. Alternative specifications were also examined to highlight the nature of pass-through relationship and the inflation process under different macroeconomic perspectives within the Phillips curve framework. Both the quarterly and annual data were employed for this purpose.

The role of monetary policy remained dominant in shaping the temporal movements in aggregate local prices during the sample period. Across all specifications – whether emerging from the first or the second baseline model, monetary policy movements as measured by the growth in the nominal stock of broad money, remained the dominant driver of aggregate local prices in India. However, the results were not heartening when monetary policy was measured by the short-term interest rate instead. The second significant factor in driving the inflationary momentum in India was located to be the persistence in inflation as captured by the lagged term of inflation itself. While the one-period lagged term cannot thoroughly capture the phenomenon of persistence, it does indicate that inflation tends to resist immediate divergences from its evolutionary path. It also indicates, perhaps, that adaptive expectations may be playing a much more significant role than other forms of expectations formulation. The same models were also estimated with the one-period, two-period, three-period and four-period lead values of the inflation term, but the results were not statistically significant. Inflation appears to be largely backward-looking in the case of the India (Patra et al., 2020). The third important factor was located to the inflationary impact of currency variations, i.e. the ERPT coefficient. External sector has been playing a concerning role in driving inflation in India since the reforms. Increasing trade openness, gradual integration into the global financial architecture, shift to the floating regime, relaxed norms on capital and current

account convertibility, and increasing demand for imports induced by rising domestic output could be some of the factors explaining this finding.

7.3.5. Factors shaping the behaviour of exchange rate pass-through relationship

Chapter four examined the major factors that could explain the extent of observed pass-through to aggregate import prices in India. Two approaches were utilized on this account. The first approach delved into an 'interaction variables' approach wherein the possible determinants of ERPT were interacted with the exchange rate variable itself within the import price function. The second approach looked into this subject by studying the key macroeconomic forces shaping the stability of the pass-through coefficient over time. The first approach suggested that the lagged value of inflation, volatility in inflation, exchange rate volatility and trade openness were responsible for increasing the impact of exchange rate on import price inflation in India. In particular, lagged value of inflation, exchange rate volatility and inflation volatility showed strong positive impact on aggregate import prices. The implications of trade openness were rather modest as compared to these factors. The second approach suggested that movements in real output and the level of inflation were the primary drivers of the aggregate ERPT to imports. On the contrary, trade openness, the introduction of the FIT regime, and exchange rate volatility were responsible for reducing the price implications emanating from currency fluctuations. While both the approaches are not directly comparable, the level of inflation and volatility in exchange rate remained critical factors implicating the price effects of exchange rate.

7.3.6. Stability of exchange rate pass-through over time

This study also studied the time-path of the ERPT coefficient for both the aggregate imports and the changes in the local general price levels. A stable transmission of price impulses from currency fluctuations would allow the identification of generalizable behavioural models of pass-through within the linear time-invariant econometric framework. However, an unstable pass-through relationship would translate into uncertain economic relationship and the econometric estimates from the partial equilibrium models would require further modifications. These exercises were undertaken in chapters four and five.

With regards to the import price pass-through relationship, pass-through was found to be rather stable from the rolling regression perspective. However, as explained in chapter four, this

method cannot capture the time-variability of coefficients within the rolling windows and is constructed using a time-variant framework itself. Hence, further attestation of the findings were warranted. This was undertaken using the time-varying coefficients model of Schlict (2021) and a Varying-Coefficients (VC) model was estimated using the baseline model wherein all the coefficients except the dummy variable, were permitted to vary over time. This econometric approach led to the finding that the impact of alterations in the currency's value have rather enlarged over time. In particular, the ERPT coefficient for import prices continued to rise up till 2009-10 after which there was a reversal in the trend. Since 2009-10, the pass-over from exchange rate alterations to aggregate import prices has reduced marginally.

As explained in section 7.3.5, the issue of stability in import price pass-through coefficient was also addressed in terms of the determinants of the same within a macroeconomic setting. World inflation level, real output growth, exchange rate volatility, trade openness, the global financial crisis, and the introduction of the FIT regime, were juxtaposed as important determinants of the stability in pass-through coefficient for import prices. Global inflationary pressure and domestic demand pressure showed the highest impact on the stability of pass-through, while exchange rate volatility showed the lowest impact. Other important factors such as inflation volatility and inflation persistence were also used but the results were not significant statistically speaking. An important factor that could explain the stabilization of the import price pass-through coefficient over time was the introduction of the FIT regime which showed a significantly negative impact. Perhaps, the commitment of the RBI to a stable inflation regime with explicitly defined targets has led to the fulfilment of the Taylor's hypothesis laid down in Taylor (2000). In summary, external supply-side and domestic demand-oriented pressure points were located as contributing to the increase in the price impact of currency variations on aggregate imports. Similar exercises were undertaken with regards to the price impact of currency value variations on aggregate domestic prices in chapter five. Both the rolling regression and the time-varying coefficients models were utilized. In stark contrast to the findings for import price pass-through, the estimates revealed that the impact of currency rate on aggregate local prices remained stable over time. The possible rationales for this finding were elaborated in chapter five.

7.3.7. Directional Asymmetry

Symmetrical pass-through is generally presumed in the literature unless one hypothesizes or suspects its existence in advance. The symmetry is established in terms of consistent impact from exchange rate changes – irrespective of their direction, size or both. This leads to three kinds of asymmetries that might exist in the pass-through process at the macroeconomic level. These are the directional, size and composite asymmetries.

Each of these asymmetries were investigated in chapter six by expanding the models estimated in chapters four and five, thereby allowing continuity and consistency in the empirical exercises. On account of directional asymmetry in import price pass-through, appreciations showed larger impact on aggregate import price variations as compared to depreciation. This finding was consistent from both the dummy variables approach and the polynomials approach adopted in the chapter. The consistency of this result was also examined for both the baseline model and the extended baseline model and the findings remained robust to their alternative specifications also. Similar exercise was undertaken in chapter five with regards to the price implications of currency variations on local inflation. In contrast with the import prices, findings indicated that depreciation had a larger impact as compared to appreciations in exchange rate. The difference in the asymmetric impact of exchange rate alterations on different prices indicated more complex mechanisms at work that could be causing this divergence. These mechanisms were also elaborated in chapter six. The finding remained consistent for both the dummy variables and the polynomials approaches.

7.3.8. Size Asymmetry

On similar lines, the issue of asymmetry from the size of exchange rate changes was addressed in chapter six by expanding on the models from chapter four and five. The issue of defining the correct size variable was found to be a strongly debated issue as compared to the measurement of exchange rate' direction. Three approaches were adopted to define the 'threshold size' of change in the currency's relative value while employing the nominal effective exchange rate.

The first approach defined large and small changes in terms of one standard deviations around the mean, whereby any change in exchange rate – depreciation or appreciation, which was above one standard deviation of the average was defined as large; otherwise it was specified as a

small change. The second approach consisted defining the threshold level by considering appreciations and depreciations above three percent as large; otherwise as small changes. Relevant dummy variables were constructed to account for these dimensions. The third approach consisted of the polynomials approach wherein the cubic term of growth of the exchange rate variable was considered.

With regards to the variations in the aggregate import price, the findings revealed that small changes in the effective value of the Indian currency had a larger impact than large changes on the import price inflation. This inference was robust to alternative specifications of the baseline model. With the second approach under consideration, the finding continued to display robustness and small exchange rate changes were revealed as having larger implications for aggregate import price as against the large changes. The third approach also revealed the same inference. On similar lines, the size asymmetry in pass-through to changes in the local general price level was also studied. The findings were not robust to alternative specifications and the methodological approach. While the dummy variables approach revealed that smaller changes had slightly higher impact than larger exchange rate alterations, the polynomials approach favoured large changes rather than the small ones. In the case of the first baseline model, there was hardly any evidence of asymmetric pass-through while the second baseline model showed evidence that was slightly in favour of smaller changes. The polynomials approach was however consistent in revealing that larger changes had a stronger effect than smaller variations in the currency's effective value.

7.3.9. Composite asymmetry in the price impact from exchange rate alterations

This work also scrutinised the subject of composite asymmetry in the ERPT mechanism with regards to both the variations in the aggregate import prices and local general price level. In this case, both the directional and size asymmetries were combined to gain a coherent and synthesized perspective on the nature of pass-through relationship when nonlinearities in size and direction were permitted concurrently. The models estimated in chapters four and five were extended to address this matter.

The findings on the import price front showed that across the alternative models, it was small depreciations that were inducing the strongest impact on prices as against other composite asymmetric relations such as large depreciations, small appreciations and large appreciations. This finding was largely invariant to the alternative methods and specifications. However, the second

strongest impact emerged from multiple sources across the different models. In some cases, large depreciation showed the second strongest price implications than the other candidates while in other cases, small appreciations were dominant. Similar dimensions were addressed for the asymmetry in pass-through to local prices. The finding were considerably different between the two baseline models as adopted from chapter five. The first baseline model did not reveal any trace of composite asymmetry. The second baseline model showed that large depreciations had the strongest price implications followed by small depreciations. The results seem to be suggest that depreciation remains a critical concern for domestic inflation in India irrespective of its size, though larger depreciations tend to be passed-over in higher proportion than smaller depreciations. With regards to the pass-through to domestic prices, the extent of price impact form currency fluctuations remained incomplete irrespective of the nature of asymmetries investigated.

7.3.10. Dynamic short-run exchange rate pass-through to domestic inflation

The issue of price impact to the variations in the local aggregate price level was expanded to account for richer set of dynamics, feedbacks and interrelationship that the partial equilibrium dynamic single equation models would perhaps not be able to do justice. Literature in the Indian setting has argued that there can be considerable differences in the estimated relationships if one approaches the ERPT issue from single equation versus systems approaches (Mendali and Das, 2017; Patra et al., 2018).

Hence, to allow the incorporation of complexities of the dynamic interrelated feedback mechanisms that might be underplay within the pass-through process, a Structural Vector Auto Regression (SVAR) approach was utilized. Both the short-run and long-run pass-through impacts were estimated within this framework while addressing several other macroeconomic dimensions. This analysis was undertaken by accounting for the nature of pass-through to wholesale and consumer prices both. The pass-through from exchange rate movements to domestic inflation after one quarter and four-quarters represented the short-run horizon in chapter five. ERPT to wholesale price inflation was found to be consistently lower than the pass-through to aggregate consumer prices. Moreover the dynamic elasticity of pass-through after four quarters also revealed the same finding wherein the dynamic impact of exchange rate shock on consumer prices was more than double its impact on wholesale prices. This finding raised the expectation of there being a larger and quicker pass-over of exchange rate impulses from wholesale to consumer prices and the results

in table twelve of chapter five testified this expectation. More than fifty percent of the exchange rate impulses were transmitted within the first quarter from wholesale markets to the retail markets.

7.3.11. Dynamic long-run exchange rate pass-through to domestic inflation

Similar to the previous sub-section, the long run price impact of exchange rate alterations on domestic inflation were investigated in chapter five. The analysis showed that while the price impulses from a one standard deviation structural shock in currency's effective value peaked after five quarters in case of the wholesale prices and then subsided rapidly, the same increased consistently and stabilized at a stable and higher level in case of consumer prices. This was shown through the estimated the impulse response functions for structural shock in the exchange rate variable.

The long-run behaviour of pass-through relationship ingrained in the estimated impulse response functions indicated that the impact from exchange rate shock dissipated after twelve quarters in case of the wholesale prices, while it took considerably longer time for the shock to wear-off its impact from consumer prices. Retail markets were found to be responding with much more persistence that the wholesale markets and the finding that there was a large and rapid transmission of the exchange rate impulses from wholesale to retail markets further attested these observations. The results indicated that pass-through increases up to only four quarters for wholesale prices after which the entropic reduction in the impulses from the structural shock in exchange rate occurs. However, this was not the case with the consumer prices where the stabilization of the initial structural impulse of currency shock took about fourteen quarters to stabilize. The long run pass-through was indicated to be higher than its short-run counterpart, testifying the belief that with sufficient time for economic adjustments, exchange rate shocks can impose larger inflationary momentum if not met by appropriate counteractions. There was, however, a stark difference in the findings from the single equation versus the SVAR models. The price impact from exchange rate variations showed a much lower inflationary implication when allowance is made for dynamic interactions and feedback effects within the ERPT macro process. Possibly, the feedback effects are able to subdue the inflationary consequences of currency alterations and fears associated with market-oriented exchange rate regimes may not be as worrisome as suggested by the single equation estimates. However, another philosophical question emerges in this regards. The idea of 'theoretical purity' of an impact is captured by the single

equation regression coefficients that restrict feedback relations and impose the ceteris paribus condition. The impact of one variable on another emerges from the non-hindrance of any other factors including the cross-interactions. Such an approach naturally demands abstraction from the complexities of the socio-economic structures that prevail in the actual reality in order to locate the simple determinations that can be effectively used to rebuild the macroeconomic process into a "totality of many determinations and relations" (Little, 1982; Marx, 1939). The conception of the ERPT mechanism within this perspective requires abstraction from these complexities and rather locate the pure forms of economic relationships which is generally captured by the single equation regression coefficients. Even from a positivist point of view, such estimates of ERPT could represent the unadulterated impact of currency variations on domestic prices that are unhindered by the real-world complexities. On the other hand, the actual ERPT process occurs within the actual economic reality which is continuously evolving within a complex web of interrelations and feedbacks with various macroeconomic processes. A more 'realistic' empirical view could perhaps be obtained when these real-world considerations are permitted to play a meaningful role in the estimation of pass-through relationship. Both the approaches seem to provide alternative perspectives on the macroeconomics of ERPT. The relevance of these approaches – namely the single equation and system-based frameworks, must be deciphered from the context, objective and motivations underlying an analysis rather than from a-priori beliefs.

7.4. Critical inferences

The previous section underlined the key findings across each of the fundamental theme addressed in this study. However, the unidimensional perspective needs to be complemented with a cross-dimensional overview that can link the major findings across the issues investigated in the present work. Each of the theme in the previous section has important linkages with the other macroeconomic concerns. The present section provides a critical outlook on these linkages.

The nature of price impact from the vagaries of the foreign exchange market embody themselves differently when the scope available for economic adjustments is limited which is generally the case in the short-run. Pass-through to import prices are more than complete in the short-run as seen in chapter four while it stabilizes to unity in the long-run indicating completeness. However, the pass-through to aggregate local prices is incomplete even in the long-run. The imbalance between the extent of price implications of currency market variations for imports and

the domestic economy indicate more complex absorption mechanisms at play once the imported commodities percolate into local markets. As explained in chapter five, the producer and wholesale markets may be conceptualised within the mark-up variations framework and the agents may be engaging in preventing the full brunt of pass-through to import prices. This kind of behaviour would invite attention to the pricing dynamics in domestic markets occurring across different points in the aggregate supply chain. How do producer markets react to the inflationary or disinflationary exchange rate shocks? To what extent are these impulses passed-over to the wholesale markets? How do wholesale and consumer markets interact with regards to the dispersion of exchange rate variations into domestic prices? Are there nonlinearities in these dynamics? The theory of ERPT can be expanded to account for more disaggregated pricing dynamics which could possibly rationalize the divergence in completeness of pass-through to import prices versus the domestic prices.

Further complications are introduced by asymmetric response of prices to currency fluctuations. As seen in chapter six, the asymmetric nature of pass-through embodies itself quite differently for import prices versus for domestic prices. Appreciation has had a larger impact on import prices while depreciation has shown larger implications for domestic prices. The inflationary momentum built by exchange rate alterations at the level of imports are passed into domestic markets much more prominently than the disinflationary impetus of the same. Interestingly, the short-run pass-through is larger than the long-run pass-through to import prices, and with appreciations having larger implications, the ability of exchange rate variations in inducing disinflation is potentially high – at least in the short-run. However, this potential is not fully realized in domestic markets due to the absorption of the disinflationary push from currency changes. It is matter of further research to explore how this absorption occurs. The role of the monetary policy may be a prominent factor in this regard. The Taylor's hypothesis has been incorporated into the empirical framework in chapters four and five. Import price inflation has reduced on account of the introduction of the flexible inflation targeting regime and the same result has been seen for domestic prices also. This could suggest that the monetary policy regime change has been able to reduce the extent of pass-through for prices in local markets as compared to the prices faced at the dock by importers. The results, however, did not ascribe the complete extent of reduction in the inflationary impact from currency rate solely to the monetary policy regime change. Considerable scope is still allowed for other mechanisms to function. Further research can

investigate this aspect by incorporating larger number of markets between imports and final domestic consumption to unearth how exchange rate movements are transmitted into the price formation process in these markets.

Contrastingly, the impact of currency changes on domestic prices are dominated by depreciations rather than appreciations. The nature of directional asymmetry has important implications for the inferences that may be drawn from the short-run and long-run estimates of pass-through in this study. Once sufficient time is permitted for price and quantity adjustments in the domestic markets, exchange rate changes producer larger pass-through than the short-run as found in chapter five. Given that depreciations have a higher impact on domestic prices, in the longer run, the ability of currency movements to cause higher inflation is further extrapolated. The fears about market-driven exchange rate regimes are accentuated under the kind of directional asymmetry observed in the present work. The inference on account of size asymmetry in chapter six, where the impact of larger changes is relatively more than that of smaller exchange rate changes only solidifies the inflationary woes from the currency markets. In case of composite asymmetries, the conclusion drawn in chapter six indicated that large depreciations have the highest pass-through effects followed by small depreciations. If large depreciations are the primary contributors in the inflationary implications of exchange rate, then, the "fears of floating" (Bianchi and Coulibay, 2023) are still very much prominent in the Indian setting.

Nonetheless, the manifestation of incomplete price impact from the exchange currency rate provides a respite for the policymakers who are faced with kind of asymmetries located in chapter six. On the one hand, the pass-through of exchange rate fluctuations to aggregate import price is complete in case of depreciation, while the similar effects on domestic prices are dominated by large depreciations, only highlight that the external channel continues to pose threats to price stability via its dispersion across the domestic markets. Given that the long-run ERPT is larger, these inflationary concerns from the external channel are enlarged and its capability in inducing macroeconomic distortions cannot be ignored or avoided. The commitment of the RBI to a well-defined target along with its credibility in maintaining a stable inflationary environment are critical to the continuance of the 'incompleteness hypothesis' in India. Even a short-term inability to ensure these macroeconomic balance could perhaps result into sizeably large inflationary impulses

that could cause large imbalances in trade, the level and composition of domestic consumption, and finally in the very structure of domestic production.

Another critical inference drawn through the empirical findings in chapters four, five and six is the sensitivity of the nature of pass-through to the definition of the exchange rate variable itself. Both the extent and asymmetry in the pass-through relationship are considerably shifted by the choice of the bilateral nominal Rupee-US Dollar rate versus the NEER. Given the differences in their definitions and construction, such sensitivity is perhaps natural. However, there may be important behavioural dimensions to this empirical sensitivity. The bilateral rates present the actual observed market movements. These are the exchange rates that economic agents observe and possibly incorporate into their microeconomic decisions. However, at the aggregate level, several bilateral rates could be playing a meaningful role in shaping the behaviour of different commodity markets that are engaged in trade. The representation of the sum total of effects from exchange rate on all these different markets may not be fully captured by a single bilateral rate. Hence, the NEER presents a useful alternative for aggregate analysis. As expected, the NEER has shown larger inflationary implications than the bilateral rate of Rupee-US Dollar. The extent of both the immediate ERPT and the same over the lengthier horizon are larger in case of domestic prices when looked from the vantage of the effective index rather than the bilateral rate. A coherent approach to ERPT analysis at the aggregate level would need to account for the effective indexes rather than solely relying upon any individual bilateral exchange rate.

This chapter also reflected on the determinants of aggregate import price inflation and aggregate domestic price inflation in India. Chapters four and five addressed these concerns respectively. Section 4.8.2 addressed this dimension in chapter four for aggregate import price while sections 5.7.1 and 5.7.2 examined this matter while engaging in the estimation of ERPT to domestic prices. Both the frameworks found that oil price variations, exchange rate movements and the behaviour of real output share common linkages between import prices and domestic prices at the aggregate level. Both the supply and the demand side forces have been prominent in shaping structure and growth of prices at the national level since reforms. However, the embodiment of these factors has been differently paced at the different levels of prices. For the aggregate import price variations, oil inflation has had a much larger implications as compared to domestic prices. The rationalization of this finding could emerge from the nature of oil price pass-through in India

which has been an active area of research (Bhanumurthy et al., 2012). Oil price inflation could be inducing impact on growth through import price variations – such as by impacting the trade level and composition of trade and hence aggregate demand; or it could be impacting the aggregate demand through domestic consumption itself via its effects on aggregate domestic prices. Given the findings in chapters four and five, the first channel could be playing a more prevalent role.

The implications of exchange rate for aggregate import price variations and domestic price variations have been thoroughly debated, compared and narrated earlier. The implications of the behaviour of real output for imports and domestic consumption has shown contrastingly different impacts. While increased output growth has shown a disinflationary effect on import price variations, whose possible explanations were elaborated in chapter four earlier, the same variable in the form of output gap has shown an inflationary impact on domestic consumption. It seems that the ability of output to induce inflation is restricted to domestic prices only and it is rather permitting stabilization of the price momentum for aggregate imports – perhaps via expenditure switching or other mechanisms speculated in chapter four. It will be necessary reconcile these opposing tendencies of output in shaping inflation in India – at the level of trade versus for domestic sector in the future research. Prima-facie, what emerges in this work is that the inflationary potential of output movements are different when looked from the vantage point of aggregate imports as against domestic economic activities. If one puts together the pieces of evidences in chapters four and five together, then it is clear that the disinflationary momentum built through output growth at the level of imports is not sufficient enough to overcome the inflationary thrust from the same to the domestic sector.

While there are some common macroeconomic processes at work in determining the nature of prices in India at the aggregate level, there are equally important differences too. Factors such as world consumer price inflation, trade openness, inflation volatility, exchange rate volatility and the global financial crisis seem to have played a larger role in determining import price inflation. However, macroeconomic forces such as output gap, money supply movements and the economic impact following the corona pandemic prevailed as major forces in the evolution of domestic inflation in India. The role of external factors such as trade openness, volatility in the currency market and the global financial crisis are larger push-factors in case of import price inflation which is clearly more dominated by external sector as is expectedly so. Domestic price behaviour on the

other hand is largely driven by money supply and particularly by its own persistence and lagged value. This brings an important point of difference: the impact of lagged aggregate import price on itself is found to be negative while the partial adjustment coefficient in case of aggregate domestic price is positive. Expectations and inertia are playing diametrically opposite roles in these two cases. While there is a disinflationary tendency visible in case of imports, there is a strong inflationary momentum in-built in aggregate domestic inflation itself. There appears to be a self-correction process in case of import prices and it seems to stabilize to lower levels with time, if not hindered by other macroeconomic factors. This kind of behaviour could be originating from the ways in which foreign firms exporting to India are determining their prices. It could also emerge from policy interventions designed to prevent the import of inflationary tendencies to essential inputs and consumption commodities. The concerns necessitate a larger research framework and perhaps the future research can address these issues more meticulously.

7.5. Some policy implications

Macroeconomic analysis grounds itself deep into policy concerns that are shaped by the trade-offs between the pursuit of output, inflation and employment. The genesis of the Keynesian revolution laid in the economic crisis which necessitated an intellectual revolution that would allow policy as a means to achieve what market were unable to. Concomitantly, the responses of the classical school resonated the inherent superiority of the market mechanism in advancing prosperity and development as against an interventionist design that would rather worsen the coordination 'errors' committed by markets. An extremist view on this issue emerged in the Austrian school led by Mises (1966) who argued that the apparent coordination failures alleged by the Keynesian school were actually the manifestations of interventionist policies that prevented markets to reset to their self-equilibrating path following a crisis. These debates have led to a voluminous literature on how effective policies are in promoting the prosperity and growth. For an emerging economy like India, the challenges portrayed by its current macroeconomic state are large and perhaps a sole reliance of market forces would not permit the rapid resolution of these constraints. A pro-active market-oriented framework defines the current macroeconomic policy environment in India. Such a milieu is capable of incorporating the external sector effectively as a means to achieve the core macro objectives of growth, stability and employment. It is with this spirit that the results obtained in the present study should be contextualized.

India has shifted to a floating currency system since the introduction of the Liberalized Exchange Rate Management System (LERMS) in the 1990s. The RBI has increasingly preoccupied itself with the management of the variability in the value of Indian currency while allowing its trend to emerge through the market logic. The shift to a floating regime has opened an additional channel that could transmit inflationary consequences. The inflationary implications of exchange rate are not only due to the change in its level but also due to its volatility. As investigated in chapters four and five, exchange rate volatility can affect both the trade and domestic prices as well as the extent of pass-through itself. Exchange rate management is one of the cornerstones of the modern times that the central bank in India has to undertake. The central bank is concerned with not only the rate of exchange but also the volatility in the same. Chapter four assessed how currency volatility impacts aggregate import price inflation. It was found that there is an inflationary impact on imports emanating from volatility in currency rate. The magnitude of this impact was small but statistically significant. For a 10% increase in the volatility of exchange rate, about 1.1% to 1.2% increase in import prices was observed during the sample period. Chapter four further found that volatility in currency is not only responsible for directly imposing inflationary pressure but also increases the extent of pass-through effects of exchange rate. The interaction term of exchange rate and its volatility in the import price function suggested that a volatile rupee is capable of putting upwards pressure on not only import prices but also the extent of pass-through.

Hence, the transmission of currency impulses to inflation is further accentuated when the exchange rate is more volatile. Consequently, the first and second moments of the distribution of exchange rate variations over time are critical in assessing the price implications of currency movements in India. The central bank is very much justified in stabilizing the variability of the currency value but this must be undertaken while also accounting for the trend in the exchange rate and more importantly, the interlinkages between the value of the currency and its volatility. Clearly, the inflationary potential of exchange rate still remains a serious issue for exchange rate management. Inflation is not restricted to trade prices and is a larger issue when considered from the perspective of domestic prices. Chapter five investigated the linkages between exchange rate alterations and aggregate local prices. Across alternative empirical specifications, exchange rate shifts continued to impose upwards pressure on domestic prices. The inflationary tendencies of currency fluctuations have continued to rendezvous the policymaker in India since the economy

began restructuring itself to a more open and liberalized macro environment. The pass-through impact remained incomplete throughout the sample period. Hence, while import prices were strongly shaped by exchange rate shocks, the inflationary impulses from import prices have not been fully dispersed into the domestic markets, perhaps demonstrating the absorption of adverse currency movements across the aggregate distribution chain.

Inflation management is another area where the findings of this study could provide important insights and indications. Stability in the general price level is necessary to ensure a stable and less uncertain macroeconomic environment for individuals, firms and institutions to interact effectively in the markets. The central bank undertakes this task through the monetary policy that includes a host of quantitative and qualitative tools including the variations in the stock of money and the credit policy. The external sector has been impacting the domestic markets through both the trade prices as well as through the interaction of currency fluctuations with other macroeconomic variables such as the level of inflation itself, inflation volatility, exchange rate volatility and trade openness. The fact that the pass-through to aggregate local prices is incomplete indicates the success of the central bank in containing the inflationary impulses of exchange rate. However, this also implies that the current stance must be maintained to ensure that the pass-through remains low. Furthermore, the stability of the ERPT coefficient to domestic prices was found to be high, with a largely time-invariant inflationary impact of currency variations. However, import prices remain a critical area of concern which could trigger a larger pass-through if not controlled for. The pass-through coefficient for aggregate import prices was found to have risen over time as shown in chapter four. There is good amount of inflationary pressure manifested in the import prices in India. These manifestations are not transmitted fully into the local prices but the real implications of these price pressures could translate into other channels through which currency variations could cause higher inflation in local prices. There may be quantity channels at play that could very well transmit the inflationary impulses built at the level of import prices to the domestic prices (Laflèche, 1996). Further research can pursue this line of thought and estimate the pass-through impact of currency alterations via both the price and quantity channels. Perhaps, this could allow better incorporating of the external channel of inflation in monetary management in India.

A special theme associated with inflation management is the role of the change in monetary regimes on inflation and the pass-through from currency to local prices. Since October 2016, the RBI has adopted the Flexible Inflation Targeting (FIT) regime, whereby the central bank has committed itself to a pre-specified quantitative target for the tolerable level of inflation. This event has resulted in the direct testing of the so-called Taylor's hypothesis ascribed to Taylor (2000). The present study examined this matter in chapters four and five. The findings in chapter four suggested that the transmission of inflationary momentum from changes in the value of currency to imports has reduced sizeably since the introduction of the FIT regime. While there is a clear evidence of inflationary pressure being manifested at the level of import prices, the ability of a credible monetary policy in reducing the inflationary consequences of the external sector testifies the Taylor's hypothesis in case of India. Chapter five looked into the role of this regime change in affecting domestic prices. The evidence again testified the hypothesis that ERPT is endogenous to monetary policy. The central bank can continue to control the percolation of upward price pressures from trade prices to domestic prices by strictly adhering to the well-defined quantitative inflation target. Chapter five also portrayed the persistence[1] in domestic inflation in India. This is a matter of concern and the persistence in inflation could result into further acceleration if the credible commitment to the inflation targets are not honoured. It may also be possible for the pass-through effects from import prices to domestic prices rise if large deviations from the targeted inflation rate are tolerated for longer durations. It is also evident from chapter five that inflation in India has reduced due to the introduction and continuation of the FIT regime. While the disinflationary gains were small in this case, it nevertheless showed that despite the higher momentum built at the level of trade prices, credibly committed monetary policy can contain the same and prevent their manifestation on the local price structure.

Currently, India has been promoting exports while pushing for rationalization of imports. The policy objective of recalibrating the trade composition is in part conditional upon the extent of pass-through. Higher pass-through effects could allow a larger scope for changing the trade composition in favour of exports given a higher price elasticity of imports and exports. Alternatively, the trade composition could worsen under these circumstances if the exchange rate appreciated instead of depreciating. The Indian currency has been depreciating since the reforms began in the early 1990s as shown in chapter three. Hence, exchange rate depreciation has been more frequent than appreciation and there exists considerable scope to discourage imports while

pushing the exports in the international arena[2]. Contrastingly, if the pass-through is low, then the ability of the government in pushing a shift in trade composition in favour of exports following a depreciation is constrained. The policymakers might need to incentivize exports and discourage imports through non-market interventions such as tariffs which tend to distort the trade flows and could produce unexpected consequences such as trade and consumption biases among others. Such policies could also alter the domestic production structure by unnaturally shifting the composition of trade in suboptimal directions. Given that the pass-through to import prices is complete, there exists comfortable room for inducing compositional changes in the aggregate trade by utilizing the inflationary impact of exchange rate on imports while containing its further transmission into the local price structure.

Inflation has shown a backward-looking behaviour in the Indian context along with being largely driven by money supply and currency variations. The open economy framework highlights the role of the external sector in shaping the local price structure in India both at the wholesale and consumer price levels. Chapter five addressed this dimension and found that inflation is considerably impacted by external forces while being dominantly shaped by internal sources. The finding that inflation is backwards looking also indicates the need to thoroughly account for the role of adaptive expectations in monetary policy formulation[3]. As explained earlier in this section, if inflation is indeed persistent, mismanagement in one period could continue to cause ripples of its consequences over a longer time period in the future, thereby rendering monetary policy ineffective in stabilizing the prices. On the other hand if persistence is utilized as an opportunity to transmit stability from one period to the next, then ensuing that pass-through remains low and incomplete is a necessity. If higher pass-through seeps into the domestic price structure, it could result into inflationary impulses that last longer than expected, warranting much more aggressive contractionary stance that could hinder the growth objective. Coherent coordination between the monetary and fiscal goals need to be established while accounting for the extent of pass-through, the reasons for its incompleteness and its stability over time. Under such a policy design, the external sector would not cause as much inflationary distortions as it would were the nature of pass-through not accounted for.

In chapter five, the pass-through process was synthesized with the real sector to allow the price transmissions from exchange rate to culminate and conclude into the quantity adjustments.

Monetary policy framework must not only scrutinize the price relationships ingrained in the ERPT conceptualization, but also the quantity adjustments that underlie these price interconnections. While chapter five addressed the interactions between the monetary and real sectors in the pass-through process, a larger macro model of ERPT that accommodates more complex quantity relationships and their feedbacks and interactions with the price relationships could shed much better light on how exchange rate movements interfere with domestic macro objectives of growth, price stability and employment. The attempt made in section 5.7.4 provided a compact perspective on this matter. The extent of pass-through was considerably lower for wholesale prices but showed relatively larger implications for consumer prices when a dynamic framework with the real sector was adopted. The differential impact of currency fluctuations on different prices has been debated off-lately in the Indian context. But the findings have not been in agreement. Furthermore, the studies addressing the impact of exchange rate changes on different prices tended to ignore the real sector. Better policy inferences can be drawn if both the monetary and real sectors are allowed to interact in shaping the pass-through process.

Lastly, the interactions between the wholesale and consumer markets is a critical dimension that emerged from the dynamic structural analysis conducted in chapter five through the SVAR framework. It was found that the price momentum induced by currency alterations were in large part pass-over from wholesale markets to the retail markets. The dynamic elasticity of consumer prices with respect to the wholesale prices and the impulse response function of CPI indicated these observations. The dynamics at play in the interaction between wholesale and consumer markets is a critical area of concern for monetary policy in its pursuit for stabilization of prices. If consumer prices are targeted but the source of inflationary momentum resides in wholesale price movements, then perhaps it is the wholesale market whose reactions to external and domestic shocks that should be examined in order to contain the price dispersion at the retail level. There is a larger scope for price shocks to disperse in the retail markets and given that the consumers do not display much of monopsony behaviour, the pass-over from wholesale to retail markets is rapid and unhindered. On the other hand, the wholesale markets present a different picture wherein the agents are larger in scale, may command market power and could influence the price discovery process itself. Monetary policy design should accommodate these features of the wholesale markets while also accounting for its dynamic interaction with the consumer markets so that any

feedback cycles between these markets are prevented, which otherwise could induce a self-propelling inflation process that distorts the pursuit of macro price stability.

7.6. Caveats, emerging themes and an agenda for further research

Any study that synthesizes theory with empirics to decipher a complex macroeconomic process such as the ERPT is ought to be undertaken under restrictions – both analytical and empirical, whose clarification is necessary to establish the scope of the empirical inferences. While errors are not tolerable, the idea of limitation rather points to the constraints under which a research project is undertaken (Krishnaswamy et al., 2012). The present study has operationalized its fundamental concerns within several such constraints. Furthermore, every research effort needs to delineate its theoretical boundaries and adhere to this analytical boundary in its empirical quests. Not every issue and dimension can be addressed in a single volume, particularly on a macroeconomic subject such as ERPT which has a large number of unresolved issues still lurking in the corridors of academia and policymaking. Hence, the scope, depth and intensity of the issues are predefined while leaving other dimensions for the future research to address. In this spirit, the major limitations and caveats in this work are explained herewith.

This work has employed aggregate level analysis while assuming the complex microeconomic interplays in terms of markets, institutions and agents within the ceteris paribus assumption. The nature of macroeconomic empirics is such that an analyst must sacrifice the micro-level complexities to locate the larger patterns, insights and processes that culminate out of the complex interactions of the microeconomic decision-makings but are not a symmetrical and linear aggregation of these decisions. One is thus reminded of the fallacy of composition that was warned against by Keynes along with many other economists. The behavioural processes and outcomes that may be prevalent in firms, households and institutions may not be able to explain their aggregated outcomes which could emerge from a different economic process altogether. This issue has been at the heart of the debates on whether macroeconomic reality exists as a separate analytical plane as compared to the microeconomic processes. The shift in literature towards establishing micro foundations of macroeconomic processes has not concluded this debate. Rather, further disagreements have emerged that seem to suggest an oscillation to the recognition of macroeconomics as an empirical reality in itself, cleanly separated from its microeconomic counterpart.

The present study investigated the aggregate ERPT phenomenon which emerges from the aggregation of a large number of markets and firms. The quality of these aggregations are critical in deriving economically sound inferences. This study has employed the official secondary macroeconomic data and these information are the best available sources in the present setting. While official secondary data may not be suitable for all macroeconomic undertakings, the literature in the Indian setting has generally found these data to be reliable and consistent in throwing coherent light on the pass-through mechanics. Furthermore, the statistical noise is also negligible in these data and this permits their use in macroeconomic analysis. The nature of the aggregation function underlying these macroeconomic data is a larger issue of debate. The reorientation of macroeconomic theorizing caused by Lucas (1976) has led to continuous re-examination of how well aggregate analysis can capture actual economic behaviour which is inherently disaggregated in nature. On the other hand, empirical evaluations of Lucas' evaluation have not provided a conclusive argument in favour of the critique. Empirical results have not found much evidence in favour of the key macroeconomic models being endogenous to policy designs themselves, leading to the concomitance of the critique as an issue of philosophical reflection in macroeconomic theorizing rather than as an empirical truth (Favero and Hendry, 1992; Linde, 2001). Macroeconomic empiricism continues to be the cornerstone of economic analysis and policy evaluations and the issue of ERPT remains a rich ground for aggregate analysis while also permitting disaggregated approaches.

An interesting area of future research can be to incorporate disaggregate data into the analysis of ERPT mechanism. One can approach this issue either by incorporating large disaggregated data sets into the macroeconomic models, or by explicitly examining disaggregate level pass-through processes. These processes can be conceptualized at the level of firms, commodities, and industries. The nature of the price impact of currency variability would embody itself differently given the spatial level of the cross-sectional unit at which analysis is conducted. While the present study has regarded the aggregate of these micro level processes, it would be interesting to study how exchange rate manifests itself at the level of firms, commodities and the industries. Such an approach would demand rigorous data that are able to capture the heterogeneity of the exchange rate itself as well as the prices which are relevant at the disaggregated levels. While the aggregate average exchange rate is useful for larger macroeconomic analysis, the rate of foreign exchange used at the levels of firms, for example, may not be the observed market rate

but a particular combination of different rates depending on the currency invoicing pattern practised by the firms in that industry. Similarly, different combinations of observed exchange rate may be constructed to reflect the true level of foreign exchange rates experienced at the level of commodities, firms or industries. A compatible approach will also be needed to construct the appropriate the micro level prices. Alvaraz et al. (2019) is an interesting study that studies the pass-through phenomenon at micro level using daily exchange rate data and highly disaggregated prices. Such frameworks can be constructed for each critical imported commodity and then aggregated using well-defined aggregation functions to derive the macro level pass-through coefficients. The estimated pass-through through these forms of empirical exercises could account for richer heterogeneity in pricing decisions across a cross-section of commodities, firms and industries. Analysts could utilize the input-output tables, if consistent data are available, to estimate the disaggregated prices and thereby study the pass-through from either the constructed exchange rate variable or the observed foreign exchange rate to such micro level prices. An indicative work on this account could be Aydoğuş et al. (2018).

Exchange rate pass-through literature has evolved into a voluminous stock of knowledge where large number of issues have been debated ranging from measuring the extent of pass-through to its inter-temporal dynamics and determinants. Analysts have been able to address many hypotheses on the nexus between exchange rate and prices – both at the trade level and for local aggregate prices. With the diversity in economic analysis, there has been a diversity in the econometric analysis also. Wide range of methodologies have been used and tested on diverse macroeconomic data sets to unearth the extent and determinants of pass-through effects of currency fluctuations in India. A classic debate that has generally garnered attention in the Indian context has been the use of time-series approaches versus the structural approaches. In recent times, one can note a rise in the time-series frameworks on pass-through analytics in India. Researchers have been employing a wide range of methods such as vector autoregressive models, vector error correction models, and autoregressive distributed lag models, among others. Another strand of literature has focused largely on the structural approach by linking the data generating process underlying the pass-through phenomenon to well-established theoretical models such as the mark-up pricing models, Taylor's hypothesis, and the new open economy models of pass-through approaches. Both the approaches present their own set of merits and restrictions. The

present study has largely adopted the structural framework given its objectives and fundamental motivations as laid down in chapter one.

Another area of debate on the methodological front has been the use of single equation versus the systems-based approaches. Results could be sensitive to these two approaches (Patra et al., 2018). The present study attempted to capture the pass-through dynamics within the single equation dynamic models, while also assessing its robustness in chapter five by employing the SVAR approach. However, the primary focus of this work was on examining the extent of pass-through, its determinants and its stability over time. These matters seem to have been sufficiently captured by the methodological approach presented in this work. As seen in chapters four and five, a sizeable amount of variation in the prices are captured by the estimated models despite these models being single-equation in nature. Moreover, the models used for estimating pass-through coefficients were specified within well-established theoretical frameworks such as the mark-up pricing theory in chapter four and the open economy Phillips curve in chapter five. This has provided an opportunity to address the chief concerns while lending the estimates comparable with literature which has actively used these theoretical structures in estimating the pass-through dynamics – both in India and internationally.

Further research can investigate how the nature of pass-through varies between the single equation and the systems approaches while setting-up the analysis within the same theoretical framework to allow comparability. Such research is scarce in the Indian context. A meta-analytic study of the evidence that can be rendered comparable could also allow such an analysis. However, considerably large number of studies are required to make a meaningful usage of these ideas. Empirical exercises on these could perhaps be undertaken at the aggregate level given the availability of consistent macroeconomic information. Such a study would estimate the ERPT coefficient using single equation models such as the ones presented in this study while also subjecting the same data to a systems-based approach such as the VAR or VECM or other approaches depending on whether the short-run or long-run pass-through is being investigated. The analyst could then iterate this exercise for multiple specifications within a given theoretical model. Such an analysis could provide richer insights into how price impacts from currency fluctuations vary across different specifications and contrasting methods. Policymakers could derive better understanding about the inflationary implications of exchange rate when presented

with empirical inferences that are robust to specifications and methodologies. Such an attempt has been presented in chapter five of this work as discussed earlier.

A more coherent methodology that could address a larger set of economic dynamics as compared to the single equation and systems-based approaches could be the simultaneous equation model. Several issues pertaining to this matter were highlighted in section 5.7.4 in chapter five. This framework would allow the modelling of much more complex processes while permitting the derivation of more concrete pass-through estimates which are resolved for simultaneity, endogeneity and other dynamic concerns which the single equation frameworks might not be able to capture. However, the use of the simultaneous equation framework is necessitated when the primary concern is to study the dynamics and interrelations within the pass-through mechanism. The fundamental motivations of this study was rather restricted to studying the extent of pass-through in the short and long run, its stability over time and its determinants. The single equation approach provides a coherent method to address these concerns, while the structural vector auto regression framework permits incorporating some of the dynamics and interrelations into the estimation of pass-through. Literature has employed the single equation approach frequently both in the international and domestic contexts.

The use of the simultaneous equation approach has rather been scarce in the international and also the Indian contexts in the ERPT analysis. However, the few evidence that are available also provide similar insights and inferences – pass-through remains incomplete for several small open emerging economies like India with the long-run price impact being larger than the short-run impacts. Future research in the Indian context can attempt to build a large scale simultaneous equation model capturing the imports demand, imports supply, domestic aggregate demand and supply and other relevant sectors through individual equations for each of these macroeconomic components of the pass-through mechanism. By simultaneously solving these equations, one would be able to incorporate much more dynamics and complex interconnections and thus come up with new perspectives on the price impact of exchange rate alterations. The present study was more concerned with a comparative static analysis of the pass-through process and restricted its attention to the quantum of price effects of exchange rate while also delving into its stability and determinants. A single equation structural approach has allowed deriving useful insights that are largely in consonance with the literature while advancing fresh perspective on the issue. If the

fundamental concern of the pass-through analyst is to study the detailed dynamics and interconnections among different components of the pass-through process then, perhaps, the simultaneous equation approach could be very useful. One of the few studies which utilized this method to ascertain the pass-through coefficient in the Indian context was Dholakia and Saradhi (2000). There has not been any well-cited study thereafter in the Indian setting which has used the simultaneous equations method to study the pass-through phenomenon in India. The challenges constructing, specifying, identifying, and solving multiple equations using macroeconomic data is a strong impediment that an analyst would have to cross before emerging with newer inferences. Data availability in the Indian context might be another such impediment which might need to be complemented with diverse sources of information including reconstruction of information where necessary to establish consistency in data. Without crossing these barriers, the use of simultaneous equations model could prove to be problematic and challenging.

The present study has occupied itself with annual data in chapter four and both the annual and quarterly data in chapter five. It would be interesting to investigate how the variations in frequencies of data can affect the estimated pass-through relationship. One such attempt was undertaken in this study in 5.7.2 in chapter five. With the theoretical model remaining the same, the use of annual and quarterly frequency of data did not display any meaningful implications for the ERPT coefficient. It continued to hover around -0.18. The attempt was limited to only annual and quarterly data. Higher frequencies of information such as monthly, weekly or even daily, could be used to look at the sensitivity of results. Strictly from a theoretical point of view, one would expect the pass-through coefficient to behave similarly across different frequencies as the underlying economic process is not expected to diverge with data frequency. However, with higher frequency macroeconomic information, more complex variables could be constructed and a richer theoretical model could be tested to assess the inflationary implications of exchange rate alterations. As noted earlier, Alvarez et al. (2019) is one such attempt in the international context. Furthermore, use of higher frequency data could permit the estimation of the extreme price impacts of exchange rates along with their probability distribution which could serve as a useful tool in monetary policy wherein one could predict extreme inflationary consequences from external channel. Higher frequency data allow the possibility of capturing extreme tails of the exchange rate and price variables whose sample size would be very small in lower frequency data (Dacorogna et al., 2001). Data paucity for higher frequencies on key macroeconomic indicators

make it difficult to engage in such empirical exercises. However, several interpolation methods exist that allow the estimation of higher frequency data from lower frequency information such as the one laid out in Vinayagathasan (2014) among many others. This could serve as a means to reconstruct the granular information; though the efficiency and consistency of such estimates would be questionable if one indulges in interpolating very high frequency estimates from much lower frequency data.

Asymmetric bearing of currency fluctuations on local inflation were investigated in the current study in chapter six. Directional, size and combined effects were ascertained within different approaches across alternative empirical specifications. However, the analysis was conducted within the linear coefficients framework and there is considerable scope to utilize explicitly nonlinear models such as smooth transition models, threshold regression, regime switching models, nonlinear auto regressive distributed lag models, among some others. Balcilar et al. (2021), for example, utilized the Vector Smooth Transition Auto Regressive (VSTAR) model to capture nonlinear relations between the value of currency and the domestic prices across the BRICS economies. The use of an explicitly nonlinear econometric framework could provide a better approach to handle the nonlinear complexities of the pass-through nexus. Future research can engage in estimating the extent of asymmetries – directional, size and combined, across different linear and nonlinear models, and assess the variations in the extent of these asymmetries due to different econometric approaches. Such a study could shed light on how much of the evidence on asymmetric pass-through emerges from the economic rationale versus from econometric differences.

Another fascinating dimension which was not investigated in the present study is the temporal stability of the asymmetric pass-through coefficients themselves. For illustration, it may useful to assess whether the differential impact of depreciation on prices itself changes over time. In other words, one could study how the different asymmetries, measured by the asymmetric pass-through coefficients as estimated in chapter six, themselves change over time. If the asymmetry is stable across time, its implications could very well be manageable as compared to the situation where the asymmetry itself is temporally unstable. Such a situation could introduce much more uncertainties and complexities into the pass-through estimation. To the best of the author's knowledge, no study has engaged into such a dissertation till now in the Indian context. Similarly,

another interesting arena of debate could be how asymmetries behave at disaggregated levels of analysis – for illustration at the level of commodities, industries or even firms. Such exercises are theatrically plausible but demand much deeper and denser macroeconomic data which is perhaps not adequately available in the Indian setting. However, analysts could adopt databases on commodity level price data while constructing disaggregated measures of exchange rate that suit the firm, market or industry under consideration. The UN Comtrade database could be one such resource.

Chapters four, five and six incorporated policy dimensions through dummy variables such as those for the changes in monetary policy regimes, pandemic, and the financial crisis. However, the role and implications of policy designs on the pass-through mechanism could present much more complexities than what are permissible within the intervention approach adopted in this study (Enders, 2014). Further research could engage in studying how different policy variables impact the pass-through relationship itself. For illustration, while studies have looked into how ERPT behaves within the monetary transmission mechanism or how the pass-through could be endogenous to inflationary environment itself, a more concrete framework could incorporate different dimensions of not only monetary policy but also of fiscal, trade and tariff policies into the pass-through process. The resultant models could provide a pure policy-driven perspective on the nexus between currency alterations and variations in trade and local prices.

Lastly, a major theoretical constraint of the present attempt is that it largely focuses on the relationship between prices, while not exhaustively accommodating quantity adjustments into the macroeconomic model of ERPT. Theoretically, the concept of pass-through is a relationship between prices – price of currency, trade prices and local prices in the destination country. While the partial equilibrium analysis conducted in this study looks into the empirics of this relationship in the Indian context at a macroeconomic level, the price impulses originating from currency alternations also generate quantity responses which could then feed back into the price relationship within a mutually determinative system. The SVAR approach in chapter five attempted to capture this dimension by incorporating the real sector into the pass-through process. However, the quantity adjustments within the pass-through process could embody themselves at different levels – such as in trade quantities, in substitution between imported and domestic output, in the substitution between domestic output and output of competing nations, within the adjustments in

domestic capacities to accommodate exchange rate impulses, and other such spheres. The theoretical challenges in modelling price and other macro relationships in open economies with quantity constraints are well captured Amos (2009). However, fully accounting for all such dimensions within a single framework is difficult not only due to empirical and data constraints but also from a theoretical point of view. The principle of parsimony in model selection[4] argues that if a lesser parameterized model is capable of explaining the phenomenon of interest well, then one should perhaps tread carefully in increasing its complexity unless strong theoretical reasons necessitate it[5]. Further research could, however, look into multiple quantity adjustment dimensions and allow their interactions with the pass-through mechanism to capture a more realistic view of the price implications of exchange rate alterations. The recognition of the interdependence of price and quantity impacts of exchange rate can provide richer insights into the nature of the pass-through coefficient, its temporal stability and the macroeconomic determinants underlying it.

We live in permanently inflationary societies. Macroeconomic policy designs are constructed across the world while thoroughly accommodating this fact. Indian economy has been integrating into the global economic order by expanding its international presence in terms of trade in goods, services, assets and ideas. This integration has brought its own merits and constraints. Exchange rate pass-through as a phenomenon presents both for the policymakers. If analyzed properly, it can act as a means to the central macroeconomic objectives of growth, price stability and employment. On the other hand, if its mechanics are not thoroughly appreciated, the costs of not accounting its nature and behaviour could prove fatal. The literature in the Indian context clearly suggest that this phenomenon has been receiving increasing attention in the last two decades. Moreover, the empirics presented in this study show that till now the exchange rate channel has been well-articulated into monetary policy design and it has not been a source of large inflationary momentum for domestic prices. However, it continues to lurk at the economic borders of India by manifesting itself into trade prices which are awaiting their chance to seep into the country with their full might and force. Exchange rate pass-through is always anticipating its turn to knock the doors of the policymakers.

Notes

[1] The persistence in this context is defined rather broadly in terms of the significant lagged term of inflation rate in the equation specified for explaining its determinants. A more rigorous definition of inflation persistence should account for longer lags to assess the memory or the length of the persistence.

[2] This is conditional upon the price elasticities of imports and exports. The fulfilment of the Marshall-Lerner condition is necessary to obtain these outcomes. The literature has generally indicated that the condition is fulfilled in the Indian context.

[3] As noted in chapter five, the forward-looking specifications were also tested for, but the bulk of the evidence pointed towards the backward-looking specification as being more relevant in explaining the variations in inflation.

[4] More specifically, this principle states that when two models are equally capable of explaining a given phenomenon well, then "the one that is described by a fewer number of parameters will have better predictive ability" (Seasholtz and Kowalski, 1993, pp. 165).

[5] The necessity of searching for parsimonious models is a direct result of the inductive reasoning process within which much of the macroeconomic analysis is conducted. Induction imposes the need for model selection based on the parsimony principle as multiple vantage points can provide statistically meaningful explanation for the same observed information (Gori, 2018).