Investment, Exchange Rates and Relative Prices: Evidence from Emerging Economies

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Thesis Abstract

In open economies, external factors have an important effect on real and nominal macroeconomic variables, and hence on economic welfare. For example, external factors such as the degree of trade openness and the level and variability of the exchange rate are important for the determination of domestic investment and domestic prices. Several aspects of the external sector and their impact on the domestic economy form the main themes that are investigated in this thesis of four main empirical chapters. Firstly, we investigate the determinants of business investment for a panel of emerging economies. We take an open economy framework incorporating the exchange rate as an important factor in a simple stylised model. To test the model implications we utilise sectoral industry data and endeavour to take account of panel heterogeneity and endogeneity in our estimation. In the empirical section of this chapter a rise in the exchange rate, a domestic currency appreciation, was found to be positively related to investment for some of the countries. We posit that this is due to the importance of the cost channel for firms. In the next chapter, we examine the impact of exchange rate volatility on sectoral investment for emerging economies. Volatile exchange rates make investment decisions in open economies difficult due to uncertainty. Our approach is robust to four different measures of exchange rate volatility. The empirical results show that permanent exchange rate volatility measure has a strong positive impact on domestic investment in the long run, which could possibly imply investors in small open economies with better financial markets are able to diversify risks. Volatility may also be more important than the level of the exchange for investment. The next chapter in this Thesis on Open Emerging Market Economies considers the extent of exchange rate pass through to import prices. In a stylized model, import prices are dependent upon the exchange rate, marginal cost and the mark up. Our results show that the average response of import prices to movements in the exchange rate is negative and incomplete. However, once we take account of exchange rate asymmetry, important differences such as market share and mark-ups exist between Latin America and Asia. The fifth chapter, and final main empirical chapter, investigates whether increased trade openness dampens relative producer prices in a panel of Indian manufacturing sector. We purport that the import share, average labour productivity and the mark-up are the key determinants of sectoral wholesale relative producer prices. After accounting for endogeneity, our main result is that, there is some evidence that rise in import share decreases the relative producer prices, but only feebly influences the decline across the sectors in India.

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Declaration

I declare that the thesis does not include any work-formatting part of a thesis presented successfully for another degree. I declare that the thesis represents my own work except where referenced to others.

Abbreviations

ADF	Augmented Dicker Fuller
BIS	Bank for International Settlements
CEPAL	United Nations Economic Commission for Latin America and the Caribbean
CGARCH	Component Generalised Autoregressive Conditional Heteroskedasticity
DPD	Dynamic Panel Data
EMEs	Emerging Market Economies
ERP	Effective Rate of Protection
FAO	Food and Agricultural Organisation
FE	Fixed Effects
GARCH	Generalised Autoregressive Conditional Heteroskedasticity
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GMM	Generalised Method of Moments
IFS	International Financial Statistics
IMF	International Monetary Fund
IPS	Im Pesaran and Shin
LA	Latin America

LLC	Levin Lin and Chiu
MC	Marginal Cost
MOSPI	Ministry of Statistics and Planning of India
NAFTA	North American Free Trade Association
NEER	Nominal Effective Exchange Rate
OECD	Organisation of Economic Cooperation and Development
PMGE	Pooled Mean Group Estimation
PP	Phillips Perron
RBI	Reserve Bank of India
RE	Random Effects
REER	Real Effective Exchange Rate
SEZ	Special Economic Zones
SMEs	Small and Medium Enterprises
UNIDO	United Nations Industrial Development Organisation
WB	World Bank
WDI	World Development Indicators

Chapter 1

General Introduction

1.1 Background and Motivation

The growth in international trade has resulted in increased economic integration in international markets and thus attracted tremendous attention throughout the world. Both economists and policy makers believe that trade openness plays a crucial role in achieving economic growth. The merits of trade openness and its contribution to economic growth are widely debated across economies. Initial empirical work done in this direction was primarily focused on industrialised economies with overreaching conclusions that trade openness inevitably led to industrialisation and economic growth through investment (see Branson, 1986; Buffie, 1986). Since the 1980s, emerging economies, particularly Asian and Latin American economies have been undergoing a continuous process of structural adjustment. These include elimination of trade barriers, import substitution policies and the privatisation of domestic markets. Several economists such as (Srinivasan and Bhagawati 1999) conclude that trade openness would enhance opportunities for investment and growth in the emerging market economies. However, it is important to recognise that such widely professed policy reforms would not actually translate into desired economic growth without the presence of a strong domestic market capable of withstanding shocks from the external economy. The empirical evidence in this regard is not straightforward. Cross country studies conducted by Levine and Renelt (1992) concluded that trade openness is correlated with higher investment rates. In general, economies that adopted the international trade approach have experienced faster economic growth through investment and those that rejected it were slow to progress. For such economies engaged in trade, external sector and exchange rates played a crucial role in materialising the effects of investment into growth. But, since the recent episodes of financial instability in the developing world during the last two decades, the focus of research shifted towards the prevailing exchange rate regimes in the form of intense debates and open criticism of policies.

This thesis highlights the importance of exchange rates in small open economies by examining its relationship with investment, import prices and relative producer prices through various channels of transmission. Exchange rates are routinely very volatile, especially in times of financial instabilities like the Asian Crisis of the Global Financial Crisis (2007-09). They would appear to be important for real and nominal macro variables. Therefore it is an important theoretical and empirical topic. Similar questions such as, what is the extent of the impact of imported input costs on firms' profitability, investment and prices? What is the impact of exchange rates on the prices of imported goods in emerging economies and finally, in what way do the exchange rates and extent of import share of production influence relative producer prices in the domestic economy. These issues are further expanded upon and analysed through the various transmission channels and key empirical findings.

Several authors such as Levine and Renelt (1992) and Demers et al. (2003) have highlighted the importance of investment in driving economic growth. Levine and Renelt (1992) concluded that fixed investment as a share of GDP is the most robust determinant of a country's economic growth. Demers et al. (2003) state that investment being the most variable component of GDP, there is a need to understand its determinants in order to gauge its cyclical effect on the economy. In this regard, several theories were developed over the years explaining firm level investment dynamics. The neo-classical model, Q-theory investment model with adjustment costs and Pindyck and Dixit (1994) model of irreversible investment and uncertainty are some of the popular theories that have received lot of research attention in the literature.

In the typical Jorgensen (1963) neo-classical model of investment, firms are assumed to own capital stock to make optimal investment decisions in order to maximise their present value of cash flows subject to a capital constraint. Such models imply that firms choose level of capital stock rather than the rate of investment and those firms adjust their capital stocks to the desired or optimal level. However, several studies have concluded that the neo-classical model was based upon the improbable case of perfect competition and hence do not fit emerging economies data. Tobin's (1969) Q for a company is a ratio of the market value of capital to its replacement cost. This theory states that when the ratio Q is greater than one, it is profitable for the company to make the investment. However, several criticisms arose about the Q-theory of investment. Gilchrist and Himmelberg (1995) state that Tobin's Q has low explanatory power of cash flow for financially constrained firms. The true value of a firm's Q could not be accurately quantified because it could not exactly determine the market value of capital and thereby could lead to misleading conclusions.

However, none of these models explained how exchange rates would affect decisions on investment, output and prices at the disaggregate level. It was not until the late 1980s to the early 1990s that micro-founded open economy models began to incorporate exchange rates. Some such early studies were done by Buffie (1986) and Serven (1990, 1992). These studies essentially examined investment using neoclassical models by incorporating the exchange rate as an explanatory variable into the external sector. Such models were widely used by subsequent researchers like Campa and Goldberg (1999), Nucci and Pozzolo (2001), IMF (2006) and Landon and Smith (2007) because of their ability to explain the various channels of transmission of the effects of exchange rates on to the dependent variable. According to IMF (2006) Openness as a result of globalisation is the overarching theme through which the transmission of the effects of exchange rates takes place. On the one hand, due to the trade openness of emerging market economies exchange rates influence investment activities through their interaction with import prices. Several transmission channels are expounded in the literature by Campa & Goldberg (1999), Nucci and Pozzolo (2001) and several others wherein, they state emphatically that exchange rate pass through transmission occurs via the import prices and finally affects sector level investment.

Theoretically, exchange rate pass through transmission occurs wherein, a real currency depreciation leads to a rise in investment through two main channels; firstly, a domestic currency depreciation renders the exports competitive in the international market and thereby results in greater export revenues. This further leads to a rise in investment through increased profitability of exporting firms. Secondly, real currency deprecation also increases the costs of imported inputs for domestic firms.[1] This would reduce the profitability of more open firms and hence reduce investment overall. But, Landon and Smith (2007) state that the exact impact of this change on investment is uncertain as it would depend on the degree of substitutability between the imported intermediate inputs and capital. Furthermore, Serven (1990) states that a real deprecation of the domestic currency increases domestic investment if import content of capital goods is higher relative to the degree of capital mobility.[2] His work also highlights that in the long run, the real exchange rate affects domestic investment through the changes in the cost of new capital goods. Empirical evidence on emerging economies in this regard is not uniform. Appreciations of the real value of the Chilean currency might have led to increases in investment due to its on investment. Some other authors such as Campa and Goldberg (1999) and Nucci and Pozzolo (2001) indicate alternate channels through which exchange rate affects investment. For example, Green (2004), Serven (1999) and (2003) indicated that the relationship was more related to the volatile environment in which the firms operate rather than the level of the exchange rate itself. Following Serven (1999) and (2003) we too distinguish between the level of exchange rate and the volatility of exchange

[1] It is assumed in our study that firms in small open economies do not have access to some inputs and therefore rely on imported inputs for production.

[2] He also states that if there is higher capital mobility, real currency deprecation could lead to a fall in the domestic investment as firms transfer capital to foreign assets.

rates and their effect on investment. With the gradual integration of financial markets across the different economic blocs of the world, any exchange rate shocks are quickly transmitted across to trading partners. Therefore, it is not only the level of the exchange rate, but also their volatility in general that can exert a significant influence on the investment decisions in emerging economies. Hence, it is necessary to control for the influence of exchange rate volatility when studying sector level determinants of investment in emerging market economies.

In this regard, the relation between exchange rate volatility and investment has been a subject of intense debate over the years, but has attracted renewed attention due to the periods of financial instability during which several emerging economies' currencies depreciated heavily. A general consensus is that increased volatility negative influences investment. However, several theoretical and empirical works point out the fact that the true direction and magnitude of the relationship is ambiguous. The notion that an uncertain business climate will prevent businesses from investing or will delay the investment was first highlighted by Pindyck and Dixit (1994). Their finding which made a substantial contribution to the literature on irreversible investment and uncertainty highlights the value of an option for the firm to invest or wait for better investment conditions. They explain that the two most important characteristics of investment expenditure are; firstly, much of the investment expenditures are irreversible, which implies there exist sunk costs that cannot be recovered. Secondly, the investments can be delayed, thereby giving an opportunity for the investor to wait for the information on output, prices and exchange rates before making the decision to invest. However, delayed investment and waiting affected expected profitability.

Along similar lines, other works such as Serven (1990), Abel and Blanchard (1992), Campa and Goldberg (1995) come to a consensus that disaggregate investment is a function of the expected profitability, volatility and cost of capital good imports. These studies point out to the various channels through which exchange rate volatility affects investment. Firstly, volatility positively affects investment through its influence on profits from domestic or export sales. Secondly, volatility negatively affects investment through imported capital goods (Campa and Goldberg 1995; Abel and Blanchard 1992). Some of the major works that reviewed the recent developments in exchange rate volatility and investment are Carruth et al. (2000) and Serven (2003) who present evidence of a strong negative empirical relationship between exchange rate volatility and investment across both developed and emerging economies. Serven (2003) states that the theoretical link between exchange rate volatility and investment is ambiguous, but he presents empirical evidence suggesting that in general, a rise in exchange rate volatility creates an negative environment for investment, profits and also the cost of capital goods (mainly imported goods). Recent studies conducted by Krugman (1999) during the periods of financial instability involving disaggregate investment and exchange rates suggest a greater role of financial factors such as the external debt. This channel is well known as the Balance Sheet Effect, first studied by Krugman (1999), explains how higher levels of external debt negatively affects disaggregate investment in the long run by decreasing the net worth, which further leads to loss of profitability and investment. Since then the role of financial factors in the investment decisions became more firm or industry specific.

In this thesis we not only consider the impact of the exchange rate on real variables, but also we examine the impact of exchange rate pass through to import prices. Several authors suggested that the exchange rates also exert their influence on prices at the disaggregate level. This brings to light the issue of pricing by the firms engaged in international trade. When goods produced by foreign firms are sold in the domestic (importing) country, the common strategy employed is Local Currency Pricing (LCP), wherein, the goods are sold in the domestic currency terms. In this process, there is a pass through of the exchange rates on to the prices of the imported goods. Studies such as Campa and Goldberg (1999), Khundrakpam (2004) and Bahroumi (2006) suggest that the degree of exchange rate pass through depends upon various factors and is complete (one-for-one) in developed economies, whereas, incomplete in emerging economies.

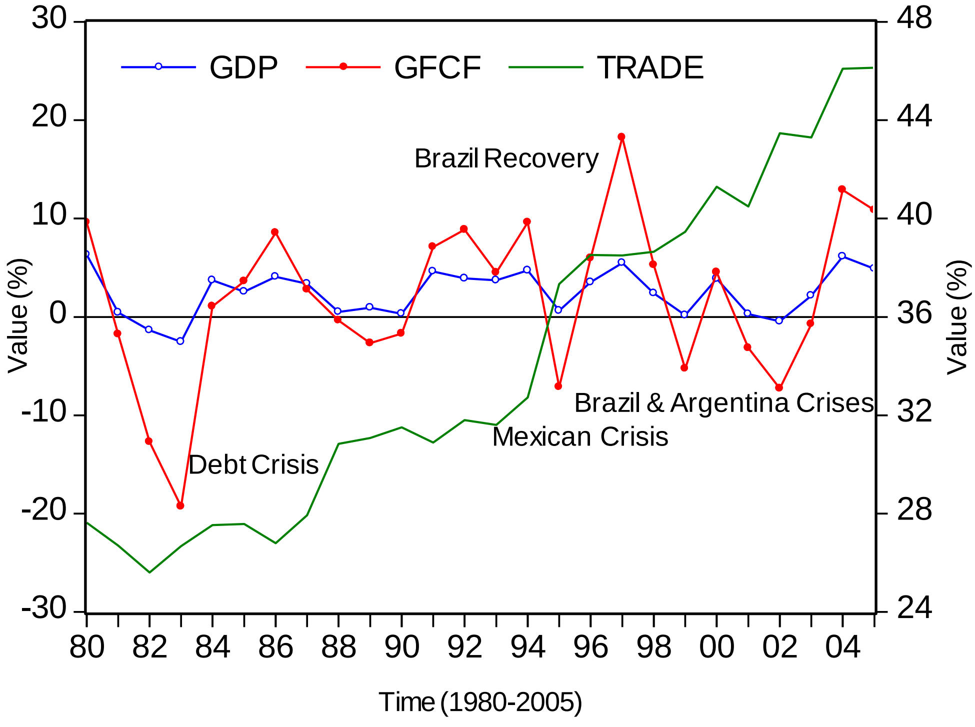
Sources of asymmetry in exchange rate pass through have been identified as numerous by some researchers such as Peltzman (2000) and Pollard and Coughlin (2004). Pollard and Coughlin (2004) also state that theoretically, appreciation of currencies can lead to either a higher or a lower pass through than depreciation. In order to maintain or increase market shares firms might adjust their mark-ups during the event of a domestic currency appreciation. But, instead they hold on to the market share and do not mark-down during phases of depreciation. Froot and Klemperer (1989), Marston (1990) and Knetter (1994) claim that the latter strategy is one of the causes for asymmetry in exchange rate pass through. Similarly, if a firm switches production process from domestic inputs and imported inputs depending upon the relative cost to hire them then pass through depends upon the elasticity of inputs during phases of depreciation or appreciation (see Ware and Winter 1988). Capacity constraints limit the ability of foreign firms to increase sales in the importing (domestic) country during a domestic currency appreciation by reducing their prices, but do not control the price rise during phases of depreciation. This causes asymmetry in the pass through of exchange rates (see Khundrakpam 2004).

Similarly, openness also forms the basis upon which, the exchange rates operate influencing relative prices and investment simultaneously. For example, domestic currency depreciation would result in increased import prices and further lead to a rise or fall in the relative producer prices depending upon the import composition of the various sectors. This in turn could affect the investment in ways more than one. Firstly, exchange rate pass through to import prices arising from openness could raise the cost of production for the importer by sheer currency translation effects, which could lead to a fall in investment. Secondly, while some sectors witness a relative price rise, other sectors that do not rely on imported inputs may not be affected. This situation could result in those sectors gaining a competitive advantage in terms of lower relative prices, which could further attract profitability in the short run thereby boosting investment.

Whether sectors are exposed to international pressures may also influence relative sectoral prices, and we examine this issue in this thesis. Trade openness leads to a rise in price competition and reduction in the barriers between the domestic market and the rest of the world. Thereby, prices of traded goods decline relative to the general price level. As sectors are exposed to foreign competition and witness rising import shares of production, the exchange rate affects sectoral composition which is reflected onto the producer prices see (IMF 2006). Therefore trade openness may have a significant effect on relative prices across industrial countries. Exposure to foreign competition has resulted in declining relative prices. Other key channels through which trade openness influences relative prices are discussed and analysed in the thesis. We now present some economic background of the countries under study.

A closer look at the economic background indicates that the 1980s was characterised by recession for Latin America. Rising international oil prices during 1979 was accompanied by high inflation with the region. Higher interest rates to control inflation induced a recession for Latin American economies with rising debts and low trade openness according to Figure 1.1. Proposed structural adjustment programs worsened the crisis in the domestic sectors with only the major firms gaining the lion's share of investment and industrial credit see Green (2004). One of the major consequences of the Mexican debt crisis during 1982 on the rest of Latin America was the flight of capital which paved the way for a prolonged recession highlighting the importance of capital flows and economic openness for development. The negative GDP growth during the early to mid 1980s in Latin America from the Figure 1.1 indicates the economy of the entire Latin America had shrunk in real terms. Chile recorded the biggest fall of GDP per capita by about 15% in just one year. Most of the economies pursued active domestic currency

Figure 1.1 Key Macroeconomic Trends in Latin America and the Caribbean[3]



devaluation policies during the 1980s based on the proposition that a competitive exchange rate is essential to boost exports and ensure economic growth. This temporarily resulted in stronger manufacturing export growth particularly in countries like Chile, Brazil and Mexico. The rising trend of trade as a percentage of GDP up until 1990 from Figure 1.1 depicts a strong increase in trade surpluses through increases in export earnings for Latin America as a group. However, this spurt in growth did not translate into a sustained growth pattern as the trade surplus was still being used to clear the accumulated external debt. A study by CEPAL (1988) suggests that devaluation also led to an immediate increase in inflation through a rise in the prices of imported goods. Argentina experienced a rise in inflation from 131% in 1981 to 434 % by 1983, in Brazil inflation shot up from 19% to 179% and from 58% to 131% during the same period for the entire Latin America as a region. This resulted in a vulnerable domestic economy with virtually no investment

[3] Nominal Gross Domestic Product (GDP) and Gross Fixed Capital Formation (GFCF) are measured in annual percentage growth terms respectively and Trade Balance is measured as exports minus imports (B.O.P. US$ Billions).

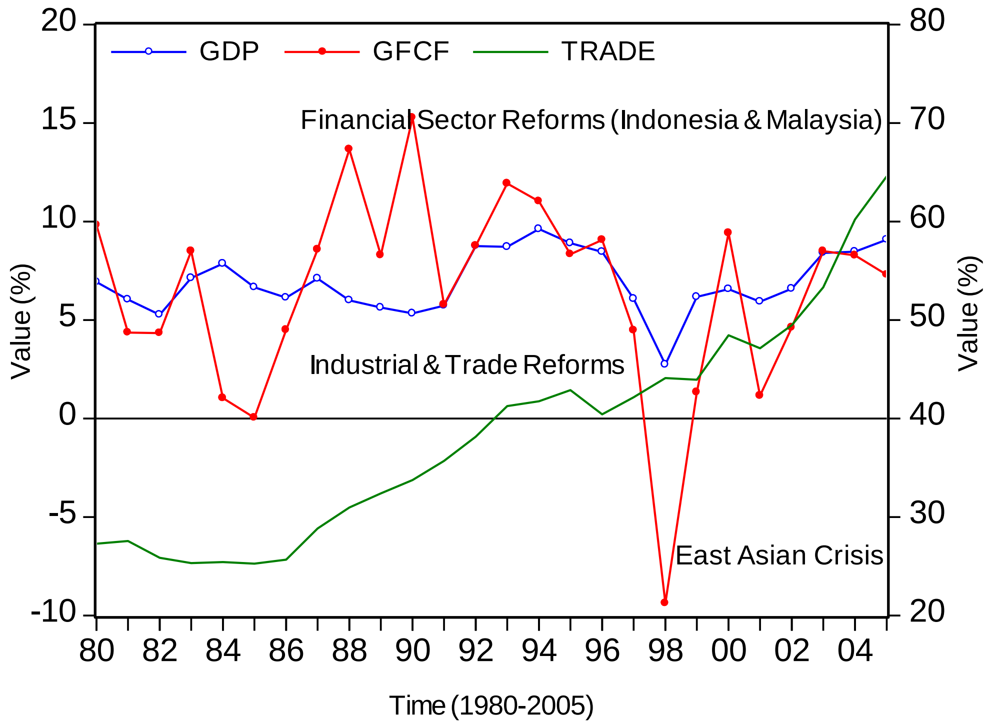
activity and bank loans dried up and gross domestic investment fell from about US$213 billion to about US$136 billion by mid 1980s.

However, during the early 1990s, Brazil led the economic recovery with a strong growth trend in the manufacturing sector which paved the way to recovery for the other Latin American economies. Increasing inflows of foreign capital in the early 1990s helped to ease inflationary pressures by checking the rapid increase in import prices. Consequently, inflation in Brazil fell from 930% to 22% by 1994 and eventually Argentina recorded a massive decline in its inflation from about 4923% in 1989 to about 18% by 1991. The investment driven growth of the early 1990s ended with the Mexican crisis of 1994 that rapidly spread through the other Latin American economies. Successive episodes of financial instability in East Asia, Russia and also in Brazil in the late 1990s eventually slowed down the investment across most emerging economies. Kuwayama et al. (2000) state that only Chile achieved the required rate of investment at 28% of GDP in the 1990s.

Also the fact that during the same period four of the largest economies, Argentina, Brazil, Colombia and Mexico had investment rates lower than the average for the previous decade suggests a cause for concern. By 2000 Ecuador dollarised its economy based on the view that a floating bilateral exchange rate with the dollar is volatile and has a negative direct effect on inflation. However, this policy change did not curb inflation which instead eroded export competitiveness. Kuwayama et al. (2000) state that for Latin America as a group, the slump in the gross fixed capital formation as a share of GDP during the 1980s did not recover until early 2000s. Traditional sectors such as garments and textiles which provided much of the employment across Latin America declined and gave way to manufacturing firms with more capital intensive techniques of production.

However, Green (2004) claims that amidst the stagnation during the 1980s, only Chile amongst the other big economies in Latin America, experienced rising investment in all its major sectors like chemicals, steel and petrochemicals. In such a context, the role of domestic investment led growth came to the limelight. Investment is one of the crucial mechanisms linking trade openness to economic growth. Several studies support the claim that increased trade openness stimulates domestic demand for capital by maintaining high domestic barriers and lower foreign barriers. This demand for capital further spurs investment led economic growth. Based on the overall macroeconomic trends in Latin America,

Figure 1.2 Key Macroeconomic Trends in Developing Asia[4]



one can safely conclude that the desired effects of the widely proclaimed strategy of trade openness through export promotion and import substitution did not trickle down to the sectors.

The long run effects of industrialisation are often considered as the path to economic growth. The process of industrialisation in Asia has not been even. While some economies like Japan, Singapore and Korea have experienced rapid economic growth in the 1980s, other economies like India have been virtually dormant during the same period. According to international trade theory, the degree of trade openness of any country can exert a great influence on its pattern of industrialisation see for example Shafaeddin

[4] Includes Bangladesh, China, India, Indonesia, Malaysia, Maldives, Mauritius, Nepal, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam.

(2006). During the 1980s, India experienced low economic growth coupled with falling goods price levels since the international oil shocks in the previous decade. Unlike some Asian economies like Indonesia and Malaysia which grew rapidly during 1987-1996, India was caught in political instability and weak governance.

The average growth in real GDP during the 1980s in India was about 6%. Following the trade and industrial reforms of 1991 with the reduction in import tariffs, quantity restrictions and investment in the manufacturing sector, economic growth increased. Aghion et al. (2003) concluded that India's manufacturing sector experienced the bulk of economic growth during the 1990s with increasing trade. During the period 1991-2001, the trade to GDP ratio grew from about 21% to 31%. The fact that the East Asian Financial Crisis did not have much impact on India's economic growth is commendable. Before 1997, Indonesia's GDP grew at a robust 6%. Gross fixed capital formation increased steadily from about 20% during the early 1980s to about 36% until 1996. A clear shift of strategy from oil based revenues to finance industrialisation to export promotion and privatisation resulted in a diversified manufacturing sector. Hofman et al. (2004) state that trade reforms such as reduction of import duties in export oriented firms coupled with financial sector reforms which allowed foreign private banks to operate in Indonesia was a clear indication that trade openness contributed to economic growth. However, after the 1997 collapse, the Indonesian Rupiah overshot by about 75%. But, as Aswicahyono and Feridhanusetyawan (2004) and World Bank (2006) emphasise, low and medium technology manufacturing has grown and also the share of machinery and transport in the manufacturing sector grew from 13% in 1980 to 22% in 2002. This suggests that diversified industrialisation with openness has definitely rectified the economy since the crisis. Despite the world stagflation in the late 1970s, Malaysia experienced robust economic growth at about 7% to 8% all the way up until the crisis in 1997-98. Economic growth was slower at about 5% since 1998 but a large private sector expansion attracted investments that grew at nearly 42% of GDP since 1996.

From the Table 1.1 below, we can compare the key macroeconomic indicators of GDP, GFCF and Trade Openness across countries and regional averages. During the 1980s, most of the Latin American economies (Argentina, Bolivia and Venezuela) experienced negative growth rates in GDP and GFCF. During the same time period only Chile experienced above average growth rates for the region as a whole. Another striking feature during the 1980s from Latin America is that despite high volume of trade, investment (GFCF) and economic growth was absent. To some extent this could be attributed to the fact that countries were using up all the export revenues to clear up the external debt during the 1980s. Whereas, during the same time period, Asian economies (Malaysia, Indonesia and Thailand), were far ahead in terms of investment and growth rates. Coming to the next decade, owing to several trade liberalisation programmes of the early 1990s, investment climate and economic growth rate improved tremendously in Latin America with Chile, Argentina and Mexico leading the way. Similarly, opening of domestic markets to international competition in Asia, led the economic recovery for India during the 1990s. However, owing to the East Asian financial crisis, Indonesia and Thailand in particular experienced a slump in investment climate. Finally, during the last decade, i.e., since 2000, most of the economies across both the regions achieved commendable growth rates with Colombia, Ecuador, Venezuela and India registering double digit growth rates of investment (GFCF).

Table 1.1 Aggregate Macroeconomic Indicators

	1980s			1990s			2000s		
Region/ Countries	GDP[5] (%)	GFCF[6] (%)	Trade[7] (%)	GDP (%)	GFCF (%)	Trade (%)	GDP (%)	GFCF (%)	Trade (%)
Latin America & Caribbean	*1.80*	*-1.11*	*27.84*	*2.95*	*4.54*	*35.50*	*3.63*	*5.71*	*45.13*
Argentina	-0.72	-4.55	15.21	4.52	8.04	18.70	3.87	8.58	35.25
Bolivia	-0.43	-3.09	47.43	3.99	10.56	48.71	3.74	2.65	52.70
Brazil	2.98	0.21	17.85	1.69	1.07	17.22	3.66	5.04	26.13
Chile	4.39	8.33	52.24	6.37	7.71	57.45	4.22	9.79	67.91
Colombia	3.40	3.17	28.22	2.86	3.21	35.44	4.39	13.03	37.76
Ecuador	2.27	-1.91	52.50	1.84	-0.77	56.45	4.76	10.27	59.17
Mexico	2.29	0.24	29.40	3.28	6.72	48.97	2.84	4.75	56.60
Venezuela	-0.16	-4.71	45.27	2.46	12.00	52.35	4.73	10.97	50.77
Developing Asia[8]	*8.04*	*7.55*	*27.47*	*8.20*	*10.64*	*41.17*	*8.73*	*10.51*	*58.68*
India	5.68	6.11	13.97	5.62	7.19	20.92	7.09	11.10	32.52
Indonesia	6.11	7.24	47.82	4.13	3.87	57.56	5.85	8.64	62.95
Malaysia	5.87	8.07	112.01	7.24	8.50	178.13	5.49	6.72	206.63
Pakistan	6.86	5.84	34.51	3.97	1.92	36.41	4.80	6.43	31.24
Philippines	2.01	1.92	50.92	2.78	3.81	82.36	4.96	2.79	103.55
Thailand	7.29	8.15	54.68	5.27	1.97	87.07	6.07	6.16	130.20

Source: (a) World Development Indicators (WDI) database. (b) Based on author's calculations, values are the averages for the years 1980-89, 1990-99 and 2000-08 respectively.

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[5] Nominal GDP measured in annual growth terms.

[6] Gross Fixed Capital Formation measured in annual growth terms. Data for Colombia on GFCF in annual growth percentage terms is not available, instead Gross Capital Formation was chosen.

[7] Exports plus Imports as a percentage of GDP is a broad measure of trade openness of the economy.

[8] Includes Bangladesh, China, India, Indonesia, Malaysia, Maldives, Mauritius, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, and Vietnam.

Several Financial Crises since the last three decades across both Latin America and East Asia highlight and provide motivation to study the importance of exchange rates and sector level investment in ensuring economic growth. One of the focuses of this research is to expand upon the existing empirical literature on investment by carrying out a combined study of emerging economies after incorporating the exchange rate as one of its determinants at the sector level, which has received little attention so far. Most of the existing empirical literature relating investment and exchange rates in emerging market economies is based on region wise studies or country level studies. This study puts together the theoretical framework and conducts a dynamic panel analysis on the extent of the uniform impact of exchange rates on sector level investment across Latin American and Asian economies by distinguishing between the various channels of transmission. The findings of this research would be an aid to policy making by closely examining the various channels of transmission and fabricating appropriate policies to minimise any outcomes that could depress investment activity among emerging economies.

This research also extends the earlier issue by examining the impact of exchange rate volatility on sector level investment by differentiating between types of exchange rate volatility. By incorporating the additional explanatory variable; external debt, this study attempts to explain the Balance Sheet Effect as put forward by Krugman (1999). Exchange rate asymmetry and exchange rate pass through to import prices are closely examined phenomenon in this thesis. Furthermore, this research also looks at how an increased trade openness impact upon relative producer prices and it also incorporates a new dimension to the study by considering the sectoral credit as an additional determinant.

1.2 Research Objectives and Thesis Outline

In general, both the Latin American and Asian economies provide a fertile ground to investigate the research studies in this thesis. The key research questions are identified to provide a lead to the overall research work. How have exchange rates influenced investment activity, particularly in manufacturing in Latin America and Asia? Is there a role for the exchange rate volatility in influencing sector level investment decisions in the emerging economies considered in our study? How effective is the Local Currency Producer (LCP) pricing in determining the extent of the Exchange Rate Pass Through (ERPT) phenomenon in emerging economies? And has the advent of globalisation through increased trade openness influenced producer prices?

The above mentioned research questions can further be expanded into sub topics while dealing with them in four different chapters.

The first chapter deals with investment and exchange rates and some empirical panel evidence from Latin America and Asia. This chapter tackles the following questions: Can emerging economies from different regions be pooled together to study the combined impact of exchange rates on investment? Is the influence of exchange rates on sector level investment uniform across the entire panel of countries? Has the exchange rate differently influenced sector level investment in Asia than it has in Latin America? Finally, this section also looks at how is the effect of exchange rates on investment including periods of disinvestment different from the effect on investment excluding periods of disinvestment in the emerging economies considered in our study?

The second chapter in this thesis studies the relationship between investment and exchange rate volatility by providing empirical evidence from emerging market economies. Several issues that are dealt in this chapter are as follows: what is the impact of exchange rate volatility on investment in emerging economies in this study? What are the different types of exchange rate volatility and how are they measured in this study? How do different types of exchange rate volatility affect investment in emerging market economies? Finally, what is the role of external debt on sector level investment in Latin America and Asia?

The third chapter looks at exchange rate pass through to import prices with some empirical evidence from Latin America and Asia. The important questions addressed in this chapter are; what are the channels of transmission of the phenomenon of exchange rate pass through to import prices in emerging market economies? Has the exchange rate pass through phenomenon been uniform across both Latin America and Asia? And how has exchange rate asymmetry influenced the exchange rate pass through to import prices across these regions?

Finally, the fourth empirical chapter examines relative producer prices and trade openness with some empirical evidence from Indian manufacturing sector. The key issues in this chapter are; how has globalisation through trade openness influenced relative producer prices in emerging market economies in general? What are the various channels through which trade openness affects relative producer prices? What is the influence of domestic demand on relative producer prices in the context of trade openness? Has trade openness led to an increase or a decrease in relative producer prices in India's manufacturing sector? And what is the influence of access to private sector credit on the relative producer prices in India's manufacturing sector?

The four main empirical chapters covering different aspects of international open macroeconomics can be outlined in more detail as follows:

In Chapter 1, the economic background of the emerging economies in our study is analysed and economic trends are discussed. This chapter presents a framework within which the various channels that relate exchange rates to investment and import prices and trade openness to relative producer prices are discussed.

Chapter 2 primarily examines the effect of exchange rates on sector level investment (i.e., Gross Fixed Capital Formation) in Latin America and Asia. This chapter also looks at the other potential determinants of investment in these two regions. A formal micro-founded theoretical framework is laid out which incorporates the open economy within the neoclassical model of investment. We go on to empirically examine the determinants of disaggregate investment in selected emerging economies. Stationarity of the data is tested using various panel unit root tests. Applied econometric work is carried out in the form of a dynamic panel analysis using Pooled Mean Group Estimation (PMGE). This technique tests for the existence of a long run equilibrium relationship by assuming homogeneity of long run parameters and allowing the short run parameters to vary across cross sections.

In the context of the recent episodes of financial instability in emerging economies during the last 30 years, Chapter 3 highlights the deeper role of exchange rates (i.e., exchange rate volatility) on disaggregate investment. This chapter improves upon the previous chapter in two distinct ways, firstly, by empirically investigating the combined impact of exchange rate volatility on sector level investment. Secondly, we also bring to fore the issue of external debt in the context of investment in emerging economies. Some of the popular exponents of this approach were Krugman (1999), who termed the effect of external debt on firm level investment as the 'Balance Sheet Effect'. Methodologically, this chapter also differentiates between types of volatility used in this study. They are the basic standard deviation measure and the GARCH measures.

Chapter 4 emphasises the impact of the exchange rate pass through on to import prices in the emerging economies considered in our study. This chapter lays out a basic theoretical framework which serves as guideline for the empirical investigation of the pass through phenomenon. This chapter provides another dimension to the concept of exchange rate pass through by incorporating asymmetry and investigating it in a dynamic panel approach. In this study we also distinguish between the two regional economic blocks by conducting long run poolability tests. With lack of evidence that supports uniform pass through phenomenon to import prices, we split the panel into Latin America and Asia to further examine this phenomenon. Poolability tests accept the long run equilibrium relationship.

India being a small open economy and a net importer in the international market, the impact of increased trade openness on relative prices in Indian manufacturing sector is investigated in Chapter 5. In this chapter, trade openness is represented by import share of production. Changes in import shares are expected to affect relative prices of traded goods by altering the combination of inputs involved in production. Relative prices are also influenced by other determinants such as labour productivity, mark-up and sectoral credit. Sector specific credit often turns out to be a key variable when examining disaggregate data in manufacturing sector in any emerging economy. Our empirical study shows that import share of output could only weakly influence the relative producer prices in Indian manufacturing. But the credit variable was significant to some extent in explaining a decline in the relative prices.

Chapter 6 lays out the general conclusions and possible policy recommendations. It also lists out the drawbacks of this study and provides avenues for future research work to be carried out.

Chapter 2

Investment and Exchange Rates: Panel Sectoral Evidence for Emerging Economies

Chapter Abstract

This chapter investigates the determinants of business investment for eight emerging economies. We set out the determinants of business investment within a small open economy model. Here the exchange rate is a key determinant, consistent with previous evidence in the literature for Industrial Countries. In particular we utilise a panel data approach for eight emerging economies over the period 1980 to 2004 using sectoral industry data. We endeavour to take account of cross sectional panel heterogeneity using Pooled Mean Group Estimation and endogeneity using Dynamic Panel Data Estimation. Standard panel unit root tests provide some evidence of stationarity at first differences. In the long run we find that investment is positively related to exchange rate. Typically we find that our sample of emerging market economies have similar determinants of investment. There was evidence of poolability for the split panels only.

2.1 Introduction

Investment is essential to short run and long economic development. It allows an increase in the capital stock and hence GDP. It also encourages the development of skills when new investment is implemented. Two emerging economic regions, Asian and Latin American, have recently witnessed commendable growth patterns following the financial crises in the 1990s. Investment played a crucial role in turning this revival into dynamic and sustained growth. Bosworth and Collins (2008) recently suggested that investment in physical capital made an important contribution to growth for a sample of Asian economies. Given that prospective economic prosperity is inextricably linked to physical investment, investment determinants are crucially important for future economic success for Asian and Latin American countries. In a world of substantial interdependencies, emerging economies are impacted by developments not only by domestic developments but also by external factors.

The recent literature on the determinants of investment has sought to examine the impact of external factors on investment in industrial countries using aggregate data. Given the central role of the exchange rate for sectors that engage in international trade, studies across industrial countries examine the importance of the exchange rate for investment at sector level.[9] However, utilizing aggregate investment data may mask developments in individual sectors, given that degree of openness differs across sectors. Work on the importance of the exchange rate for investment has been conducted at sectoral level in industrial countries by Campa and Goldberg (1999), Nucci and Pozzolo (2001) and Landon and Smith (2007). Serven (1990) states that in the long run there is a possibility for the capital stock to increase in traded goods which implies that more open economies witness greater investment growth than less open economies. Serven (1990) and Forbes

[9] See also Clarida (1997) for a discussion of the impact of exchange rate on the profitability of US manufacturing firms.

(2002, 2007) look at the importance of the exchange rate for aggregate data and consider the impact of devaluations on investment. But, in general, there is a paucity of literature on the determinants of physical investment for emerging market economies at the sectoral level.

In this study, we attempt to examine the relationship between sectoral investment and exchange rates across a panel of Asian and Latin American economies. The exchange rate in this study is primarily defined as foreign currency units per unit of domestic currency. Among the several factors influencing investment in open economies, the debate on the relation between sector level investment and its interaction with exchange rates is a long standing issue. Our study attempts to address two important issues.

Firstly, to investigate the empirical relationship between investment and real exchange rates. This often is noticed through two channels in the literature. On the one hand, real currency depreciation increases the value of domestic export revenue and hence causes the firms to increase production for export.[10] This increases profitability and leads to higher investment. On the other hand, real currency depreciation increases the price of tradable capital inputs, which tends to decrease investment through increased cost of imported capital inputs. These two effects may offset each other. Secondly, there is sound reason to expect the presence of long run equilibrium relationships between investment and the exchange rates to be similar across cross sections due to common technologies or arbitrage conditions affecting cross sections in a similar fashion (see also Pesaran et al., 1999). Therefore, this study would like to test for the poolability of the long run parameters across various sectors for each of the economies. This could reveal the nature of the long run relationship across groups.

[10] It also assumes that exports are priced in foreign currency terms. Alternatively if export goods are priced in local currency, a domestic depreciation leads to a rise in revenue, if demand is elastic. We investigate LCP later.

The rest of the paper is laid out in this manner. In the next section, we discuss relevant issues to modelling investment behaviour from related literature. Section 2.3 lays out the model to be estimated. Section 2.4 provides a brief discussion of developments in our sample of Latin American and Asian economies and also we discuss data trends in aggregate investment and the real effective exchange rate. Section 2.5 discusses the empirical methodologies such as stationarity of panel data, pooled mean group estimation and robustness tests for potential endogeneity. Section 2.6 analyzes the results. Finally, Section 2.7 concludes the work with some suggestions for future research.

2.2 Literature Review

Clearly a number of approaches can be taken to modelling investment behaviour. While most of the literature covering industrial economies can be categorized based on the assumption of perfect competition, studies on investment in emerging market economies requires relaxing such an assumption on the goods market due to lack of integration or the presence of unorganised sectors.[11] In the light of several episodes of financial instability that have repeatedly hindered economic growth in the developing world, two crucial factors come into the picture here: exchange rates and adjustment costs. In this regard, the existing relevant literature on factors influencing disaggregate investment could be classified into two broad approaches. Firstly, the standard neo-classical approach of investment highlighted the importance of sector specific characteristics such as adjustment costs and cash flows (see also Abel (1980), Hayashi (1982), Gilchrist and Himmelberg (1995)) and secondly, open economy models that have specifically considered the role of exchange rates in determining aggregate investment. (see also Serven (1990), Goldberg

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[11] For example see Narayanan and Vashisht (2008) who state that the manufacturing sector in India is highly unorganised.

(1993), Campa and Goldberg (1999), Nucci and Pozzolo (2001), Forbes (2002), Love (2003), Forbes (2007) Landon and Smith (2007)).

Some of the earliest studies that highlighted the neoclassical investment theory with convex adjustment costs were done by Abel (1980) and Hayashi (1982).[12] Hayashi's work emphasized the role of convexity of adjustment costs in influencing investment and formalized the idea that investment as a function of marginal productivity of capital is dependent on marginal adjustment costs that are convex in nature. A study by Gilchrist and Himmelberg (1995) on disaggregate investment with convex adjustment costs highlighted the role of access to capital markets in determining investment dynamics. They suggest that neoclassical investment models are compatible with the data for those firms that have complete access to capital markets. Capital market constraints highlighted the role of unobserved firm specific characteristics such as credit constraints or adjustment cost parameters in influencing investment decisions.

In neoclassical theory of investment with adjustment costs, firms' market value and investment are simultaneously determined. In a study looking at the role of fundamentals and adjustment costs in investment, Barnett and Sakellaris (1999) highlighted the importance of convex adjustment costs in their work and state that costs of setting up new capital are approximately in the range of 10% to 13% of the total investment costs. In their work, adjustment costs which are fundamental signals are crucial to the responsiveness of investment to profitability. Mairesse et al. (1999) also find that the real wage has a consistent negative effect on investment and this coincides with the findings of several other researchers such as Campa and Goldberg (1995), Goldberg and Klein (1995), Alesina, Perotti and Schiantarelli (2002) and Landon and Smith (2007).

However, more recent studies on disaggregate investment look at open economy models by examining the role of exchange rates along with adjustment costs. In this regard,

[12] We expect convex adjustment costs because costs of investment rise with rising investment. See Gilchrist and Himmelberg (1995) who state that emerging economies face convex adjustment costs.

Serven (1990) concluded that fluctuations in capital stocks depend on real exchange rate changes because they can alter the timing of planned investment and therefore provide incentives for reallocations of investment in the long term. His study showed two differing effects in the presence of real depreciation. Due to a relatively closed capital account and high import content of investment, Chile experienced rise in investment levels during the early 1980s. On the other hand, during the same time period Uruguay with higher financial openness experienced a drop in investment levels due to higher capital mobility which prompted flight of capital to foreign assets. Along similar lines, Campa and Goldberg (1999) have shown for manufacturing industry in the USA that exchange rate plays a crucial role in the responsiveness of investment which varies over time and is positive for higher export shares and negative with respect to higher imported inputs in production.

Their findings strongly support the significant role of exchange rates in export oriented firms. Since then several authors have worked with such models incorporating exchange rates at the firm's optimization level. Nucci and Pozzolo (2001) investigated the manufacturing firms in Italy following a similar framework and were of the view that changes in exchange rates influence investment in open firms through three different channels. Firstly, the export revenue channel wherein, greater export shares result in higher investment through higher export revenues in the case of a domestic currency depreciation. Secondly, the opposing effect of rising cost of imported inputs that depresses investment in the case of a domestic currency depreciation. However, Nucci and Pozzolo (2001) also claim that a third channel is the monopoly power of the firms which adds to the effect of exchange rate variations on profits and thereby on investment. Changes in the firm pricing policies have direct effects on the level of realized and expected profits and, as a result, on the level of investment. Goldberg (1993), Campa and Goldberg (1995 and 1999) and Nucci and Pozzolo (2001), among others, lend strong support to the view that firms investment decisions are influenced by exchange rate movements. Moreover, they show that, to a large extent, this relationship is shaped by the firms' market power and the different pricing strategies in response to exchange rate fluctuations. Dornbusch (1987) has initially shown that the higher is the monopoly power of the price setter firm, the closer to minus one is the pass-through elasticity. On the other hand, the more a firm is endowed with monopoly power, the greater is the extent to which it can adjust the mark-up in response to an exchange rate shock.

Love (2003) and Forbes (2007) studied investment determinants in emerging market economies in general terms and Forbes (2002) analysed the role of exchange rates in Chile for both short run and long run capital formation of the export oriented firms. They observed two main channels of transmission of exchange rate effects on the investment. Firstly, a domestic currency depreciation would increase the exports of the firms, thus leading to greater revenue, which would have a positive spill-over effect on their investment. This can be considered as the revenue channel. Secondly, a domestic currency depreciation would also increase the cost of imported inputs that are employed in production and hence depress investment among firms. In our attempt to model both the effects of adjustment costs and the real exchange rates on aggregate investment, we present the theoretical model now.

2.3 Theoretical Model

Our model expands upon previous work by Landon and Smith (2007) and Forbes (2002). The representative firm in sector *i* at time *t* utilizes both domestic and imported inputs to produce its total nominal output denoted by Q_t^T to be sold in the domestic market as Q_{it}^d and in foreign market as Q_{it}^f respectively with weight θ of output to the foreign market and the rest $\left(1\text{-}\theta\right)$ of output to the domestic market.

$$Q_t^T = Q_{it}^d + Q_{it}^f = \left(1\text{-}\theta\right)Q_{it} + \theta Q_{it} \tag{2.1}$$

We employ a general production functional form with two inputs capital K_{it} and labour L_{it} which can be expressed as:

$$Q_{it}=F\left(L_{it},K_{it}\right) \tag{2.2}$$

The assumptions that underline our model are the following. First, markets are not perfectly competitive and hence firms may experience decreasing returns to scale (see also Forbes, 2002). Second, the firms employ both domestic capital and imported capital.[13] Third, in this process of adding new machines to the existing production, the firm faces adjustment costs that are small for low levels of investment and increase with the increase in investment. Fourth, the adjustment costs are assumed to be quadratic in nature because they indicate rising costs for increasing investment and also imply that the marginal costs of adjustment are linear to investment, which can be expressed as $S_t bP_{it}^{If} I_{it}^2$: where, b is a positive constant and it denotes a positive proportion of the total cost of new machines.[14] I_{it} is the level of gross investment by the firm, P_{it}^{If} is the foreign price of new machines and S_t is the nominal exchange rate. In the model, S_t is the nominal exchange rate defined as domestic currency units per unit of foreign currency. Therefore a rise in S_t is a domestic currency depreciation. Our definition enables us to ascertain the export revenue generated in domestic (importer) currency terms.[15] Fifth, the price of new machines is $S_t P_{it}^{If} I_{it}$ and sixth, R is the time invariant discount factor at market rate that is applied to the firm's maximization problem. The profits of the representative firm at time period t are defined as:

[13] In this regard several authors have highlighted the importance of imported capital inputs for our sample of countries (see inter alia Coe and Helpman, 1995, Abel and Eberly 1996, Eaton and Kortum, 1996, Xu and Chiang, 2005, Khan, 2006).
[14] See Gilchrist and Himmelberg (1995).
[15] Note that we use the converse definition of the exchange rate in the empirical section of this chapter. Here we use the more standard exchange rate definition. All the sectors in each country face the same exchange rate. Export oriented firms consider nominal exchange rate changes in their decisions to maximise revenues in domestic markets. (see, Nucci and Pozzolo, 2001).

$$\Pi_{it} = \left(\frac{P_{it}\left(1\text{-}\theta\right)Q_{it}}{P_t} + \frac{S_t P_{it}^{f} \theta Q_{it}}{P_t} - \frac{W_{it} L_{it}}{P_t} - \frac{S_t P_{it}^{If} I_{it}}{P_t} - \frac{S_t b P_{it}^{If} I_{it}^{2}}{P_t} \right) \tag{2.3}$$

Where, Π_{it} is the profit earned by the representative firm. P_{it} is the domestic price of the output, $\left(1\text{-}\theta\right)Q_{it}$ is the output sold in the domestic market and $\left(1\text{-}\theta\right)$ represents the share of the total output to be sold in the domestic market. θQ_{it} is the volume of output sold in the foreign market, where θ represents the share of the total output to be sold in the foreign market. The nominal wage cost is W_{it} and L_{it} is the labour employed by the firm. Hence, total real wage costs are $\left(W_{it} L_{it} / P_t\right)$. The revenue from the foreign market in domestic currency terms is $S_t P_{it}^{f} \theta Q_{it}$. The domestic price of new machines is $S_t P_{it}^{If} I_{it}$ and $S_t b P_{it}^{If} I_{it}^{2}$ is the adjustment cost for the firm. And, P_t denotes the price deflator. Therefore, equation (2.3) represents the profit of the firm expressed in real terms.

The firm maximizes its expected present value of net cash flows and value of the firm can be expressed in real terms as follows:

$$\Lambda_0 = E_t \left\{ \sum_{t=0}^{\infty} \frac{1}{\left(1+R\right)^t} \left(\frac{P_{it}\left(1\text{-}\theta\right)Q_{it}}{P_t} + \frac{S_t P_{it}^{f} \theta Q_{it}}{P_t} - \frac{W_{it} L_{it}}{P_t} - \frac{S_t P_{it}^{If} I_{it}}{P_t} - \frac{S_t b P_{it}^{If} I_{it}^{2}}{P_t} \right) \right\} \tag{2.4}$$

subject to

$$K_{it+1} = \left(1\text{-}\delta\right) K_{it} + I_{it} \tag{2.5}$$

where, equation (2.5) is the standard relation between investment and capital stock and δ represents the rate of depreciation of the capital stock. Thus, equation (2.5) implies that investment becomes productive in the next time period. A final note on the firm needs to be mentioned here. The firm’s choices on investment and capital are interrelated rather than independent because the capital accumulation identity lays out the path of capital stock once the path of investment is chosen. And, given that the firm has some installed initial capital stock, the choice variable on capital for the firm is only in the next time period along with new machines that are being imported. (see also Heijdra and van der Ploeg, 2003). Therefore the firm's choice variables are L_{it} , K_{it+1} and I_{it} , given the prices in both domestic and foreign markets as P_{it} and P_{it}^{f} respectively.

Finally, following Heijdra and van der Ploeg (2003), the intertemporal Lagrangian expression can be given as:

$$\ell_0 = E_t \sum_{j=0}^{t-1} \{...\} + E_t \left[\begin{array}{l} \left(\frac{1}{1+R}\right)^t \left(\frac{P_{it}(1\text{-}\theta)Q_{it}}{P_t} + \frac{S_t P^f{}_{it}\theta Q_{it}}{P_t} - \frac{W_{it}L_{it}}{P_t} - \frac{S_t b P_{it}^{If} I_{it}}{P_t} - \frac{S_t b P_{it}^{If} I_{it}^2}{P_t} \right) \\ -\frac{\lambda_t}{(1+R)^t}\left(K_{it+1} - (1\text{-}\delta)K_{it}\text{-}I_{it}\right) \end{array} \right]$$

$$+E_t \left[\begin{array}{l} \left(\frac{1}{1+R}\right)^{t+1} \left(\frac{P_{it+1}(1\text{-}\theta)Q_{it+1}}{P_{t+1}} + \frac{S_{t+1} P_{it+1}^f \theta Q_{it+1}}{P_{t+1}} - \frac{W_{it+1}L_{it+1}}{P_{t+1}} - \frac{S_{t+1} b P_{it+1}^{If} I_{it+1}}{P_{t+1}} - \frac{S_{t+1} b P_{it+1}^{If} I_{it+1}^2}{P_{t+1}} \right) \\ -\frac{\lambda_{t+1}}{(1+R)^{t+1}}\left(K_{it+2} - (1\text{-}\delta)K_{it+1}\text{-}I_{it+1}\right) \end{array} \right] + E_t \sum_{j=t+2}^{\infty} \{...\}$$

(2.6)

First order conditions with respect to choice variables L_{it} , K_{it+1} and I_{it} are as follows:

$$0 = \frac{\partial \ell_0}{\partial L_{it}} : \frac{1}{(1+R)^t}\left(\frac{P_{it}(1\text{-}\theta)Q_{Lit}}{P_t} + \frac{S_t P^f{}_{it}\theta Q_{Lit}}{P_t} - \frac{W_{it}}{P_t} \right) \tag{2.7}$$

$$0 = \frac{\partial \ell_0}{\partial K_{it+1}} : -\frac{\lambda_t}{(1+R)^t} + \frac{1}{(1+R)^{t+1}}\left[\frac{Q_{Kit+1}\left\{P_{it+1}(1\text{-}\theta) + P_{it+1}^f \theta\right\}}{P_{t+1}} \right] + \frac{\lambda_{t+1}(1\text{-}\delta)}{(1+R)^{t+1}} \tag{2.8}$$

or $$0 = \frac{\partial \ell_0}{\partial K_{it+1}} : \frac{1}{(1+R)^{t+1}}\left[\frac{Q_{Kit+1}\left\{P_{it+1}(1\text{-}\theta) + P_{it+1}^f \theta\right\}}{P_{t+1}} \right] + \frac{\lambda_{t+1}(1\text{-}\delta)}{(1+R)^{t+1}} - \frac{\lambda_t}{(1+R)^t} \tag{2.9}$$

and $$0 = \frac{\partial \ell_0}{\partial I_{it}} : \frac{1}{(1+R)^t}\left(-\frac{S_t P_{it}^{If}}{P_t} - \frac{2 S_t b P_{it}^{If} I_{it}}{P_t} + \lambda_t \right) \tag{2.10}$$

Where, $Q_{L,it}$ is the marginal productivity of labour and $Q_{K,it+1}$ is the marginal productivity of capital in the next period.

From equation (2.10) we get the value of λ_t as,

$$\lambda_t = \left(\frac{S_t P_{it}^{If}}{P_t} + \frac{2S_t b P_{it}^{If} I_{it}}{P_t} \right) \tag{2.11}$$

And its value in the next time period is

$$\lambda_{t+1} = \left(\frac{S_{t+1} P_{it+1}^{If}}{P_{t+1}} + \frac{2S_{t+1} b P_{it+1}^{If} I_{it+1}}{P_{t+1}} \right) \tag{2.12}$$

Substituting the expressions for λ_t and λ_{t+1} into the first order condition for the capital stock in equation (2.9), we get:

$$0 = \frac{\partial \ell_0}{\partial K_{it+1}} : \frac{1}{(1+R)^{t+1}} \left[\frac{Q_{K,it+1}\left\{P_{it+1}(1+\theta) + P_{it+1}^{f}\theta\right\}}{P_{t+1}} \right] + \left(\frac{S_{t+1} P_{it+1}^{If}}{P_{t+1}} + \frac{2S_{t+1} b P_{it+1}^{If} I_{it+1}}{P_{t+1}} \right) \frac{(1\text{-}\delta)}{(1+R)^{t+1}}$$
$$- \left(\frac{S_t P_{it}^{If}}{P_t} + \frac{2S_t b P_{it}^{If} I_{it}}{P_t} \right) \left(\frac{1}{1+R} \right)^t$$

(2.13)

Collecting terms for I_{it+1} and I_{it}, equation (2.13) can be expressed in the form of a difference equation as,

$$0 = I_{it+1} \text{-} \left(\frac{S_t P_{it}^{If} P_{t+1}(1+R)}{P_t (1\text{-}\delta) S_{t+1} P_{it+1}^{If}} \right) I_{it} +$$
$$\frac{1}{\left\{2bS_{t+1}P_{it+1}^{If}(1\text{-}\delta)P_{t+1}(1+R)^{t+1}\right\}} \left[\frac{Q_{K,it+1}\left\{(1\text{-}\theta)P_{it+1} + S_{t+1}\theta P_{it+1}^{f}\right\}}{P_{t+1}(1+R)^{t+1}} + \frac{S_{t+1}P_{it+1}^{If}(1\text{-}\delta)}{P_{t+1}(1+R)^{t+1}} - \frac{S_t P_{it}^{If}(1\text{-}\delta)}{P_t(1+R)^t} \right]$$

(2.14)

From the above expression it is clear that the coefficient of I_{it} is greater than one, thereby making the equation unstable. By setting $I_{it+1} = I_{it} = I$, normalising the time period t = 0 and dropping the index *i*, i.e., $P_{it+1}^{If} = P_{it}^{If} = P^{If}$, $P_{it} = P_{it+1} = P$, $P_{it}^{f} = P_{it+1}^{f} = P^{f}$ and $S_t = S_{t+1} = S$; the steady state solution for investment after solving for investment is given as

$$I = \frac{Q_K\left\{(1\text{-}\theta)P + S\theta P^f\right\}}{2bSP^{If}(R+\delta)} \tag{2.15}$$

The expression in equation (2.15) explains that the value of the marginal productivity of capital is directly related to the investment and if it is greater than the price of capital along with the rate of depreciation, then the firm should make the decision to invest. In the alternative case where $b=0$, there are no adjustment costs and the value of the marginal productivity of capital is equal to the rental price of capital $Q_K\left\{(1-\theta)P+S\theta P^f\right\} = SP^{If}(\rho+\delta)$.

In general terms marginal productivity of capital can be expressed as

$$Q_K = f(Q,W,K,S) \tag{2.16}$$

We can see that the marginal productivity of capital is a function of output, wage, capital and the real exchange rate (see Love, 2000 and Heijdra and van der Ploeg, 2003).[16] Therefore, the investment theory presented so far can be summarized by a general functional form as in Heijdra and van der Ploeg (2003) in real terms as:

$$\frac{I_{it}}{P_t} = I\left(R,\delta,b,\frac{Q_{it}}{P_t},\frac{W_{it}}{P_t},S_t\right) \tag{2.17}$$

Therefore equation (2.17) shows that real investment is a function of real output, real wage, real exchange rate and the discount factor.

However, it is important to note the net effect of the real exchange rate on investment. From equation (2.15), we see that the nominal exchange rate S_t appears in both the numerator and the denominator. Authors such as Campa and Goldberg (1999), Nucci and Pozzolo (2001) and Landon and Smith (2007) have concurred on the different channels through which the real exchange rate effects firm's decisions on investment.

The effect of the exchange rate on firm level investment is observed through two main channels.[17] Firstly, a domestic currency depreciation (fall in S_t) increases the value of

[16] See Appendix for details.
[17] A third channel is highlighted by Landon and Smith (2007). Real currency depreciation increases the price of other imported intermediate inputs. But this effect on investment is ambiguous as it depends on the degree

domestic exports and hence causes the firms to increase production for export. This increases profitability and leads to higher investment. Secondly, domestic currency depreciation increases the price of tradable capital inputs, which tends to decrease investment. It is an empirical matter which channel will dominate and to this matter we now turn.

2.4 Data and Empirical Methodology

The annual data used in this study for Gross Fixed Capital Formation $\left(I_{it}\right)$, wages $\left(W_{it}\right)$ and output $\left(Y_{it}\right)$ at the 3 digit level was obtained from the United Nations Industrial Development Organization (UNIDO) database covering 8 countries and 11 sectors. [18] All quantities are measured in US$. The time dimension for the panel study is 1980-2004 as it covers the time frame during which most of the recent episodes of financial instability, liberalisation and reforms have occurred in the developing world. Since our study examines the determinants of real investment across economies, we employ the real effective exchange rate in our empirical analysis. In this empirical section the exchange rate (S_t) is defined as foreign currency units per unit of domestic currency. Consequently, a rise of S_t in this empirical section of the chapter is a domestic currency appreciation. This is the standard definition for effective exchange rates used by statistical agencies. In our study both the investment series and S_t have a common base period for the year 2000 = 100. GDP Price deflators were obtained from the World Development Indicators (WDI) database. We have looked at incorporating the other important variable, interest rates in determining sector level investment behaviour for our study on emerging economies. But,

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of substitutability between the domestic and imported inputs. Data was unavailable for intermediate goods for our sample of countries and industries.

[18] Any missing values for sectoral Gross Fixed Capital Formation were interpolated using available series of aggregate Gross Fixed Capital Formation taken from the World Bank's World Development Indicators database.

studies such as Dixit and Pindyck (1992) and Calvo and Reinhart (2002) have highlighted some drawbacks for interest rates in emerging economies. Dixit and Pindyck (1992) state that access to credit at sector level or firm level plays a bigger role than interest rates in studying disaggregate investment data for emerging economies, given the fact that most of the interest rates for developing nations prior to liberalisation were heavily regulated.

Calvo and Reinhart (2002) highlight the fact that nominal and real interest rates in emerging economies such as India are about four times as variable as in the United States; for Mexico, interest rates are about twenty times as variable, and Peru holds the record at 11 times. Chile's and Mexico's recent example of use of high interest rates as a means to limit exchange rate pressures despite a markedly slowing economy and an adverse terms-of-trade shock. Brazil's central bank hiked interest rates in the midst of a recession and an energy crisis to halt the slide of its currency, the real. Therefore, in our study we considered sector level credit disbursed by the commercial banks.

Following Landon and Smith (2007), Gross Fixed Capital Formation (GFCF) is taken as the measure of sectoral investment in our study. It is crucial to note that since GFCF is a broad definition of physical capital stock, according to OECD (2007) and FAO (1996), fixed assets comprise both tangible and intangible assets which are re-used in production for more than a year. GFCF includes both positive and negative values. New purchases of assets or through barter acquired as transfer of capital adding up to existing assets is termed as positive fixed capital formation. Whereas, disposal of depreciating assets or damaged assets due to natural disasters are recorded as negative values. Such a pattern of alternating positive and negative values of GFCF data was observed in Colombia, Ecuador and Mexico in our sample. The occurrence of several episodes of financial instabilities in the last three decades, makes the choice of countries a fertile ground to examine the dynamics of relationship between disaggregate investment and exchange rates. However, some of the economies that bore the brunt of the major economic crises in the past such as Argentina, Brazil and Thailand could not be included in our sample largely due to the paucity of disaggregate sector specific data and Chile, Colombia, Ecuador, India, Indonesia, Malaysia, Mexico and Venezuela are included.

Our study also looked into the aspect of sector level issues that might influence investment. In this regard, recent literature such as Landon and Smith (2007) have highlighted that majority of the investment or capital goods that go into production in the manufacturing sector in emerging economies comes from either Germany, USA or Japan, as these economies are the leading suppliers of investment goods at the industry level. In this regard, authors such as Nucci and Pozzolo (2001), Landon and Smith (2007) and Mallick and Marques (2009) have stressed that in emerging economies, there is a significant amount of variation in the level of capital intensive production at the sector level. While some sub-sectors within manufacturing are more capital intensive, others are relatively lesser dependent on high end capital goods. Also, Mallick and Marques (2009) state that some sectors are less open to international trade than others. This implies that those that have greater openness have a higher share of non-tradable than the other sectors. Hence, this finally influences firm level investment decisions through the channel of imported inputs being costlier during depreciation periods of domestic currency and cheaper inputs during periods of appreciation. Empirically, this issue or sector level effects are difficult to capture given the severe data constraints at sector level for emerging economies. However, following the footsteps of several authors, we have included sector level dummies in all our estimations across all the chapters as the thesis entirely deals with sector level data.

From the Table 2.1 we can compare the region wise summary statistics of data used in this chapter. It is broadly divided into two time periods to analyse the situation in the 1980s prior to trade liberalisation, and since the onset of trade and industrial reforms (1990 onwards) in most of the economies in our study. As suggested by the OECD (2007) study that some economies such as Colombia and Ecuador experienced periods of disinvestment, this is evident in the decline in manufacturing investment in the 1980s, from a value of 6.83 billion dollars to 0.32 in the 1990s in the case of Colombia and only a marginal increase in investment from a meagre 0.40 billion to 0.60 billion dollars in the case of Ecuador.

Most of the Latin American economies in our study experienced declining trends of investment during the 1980s due to a negative impact of the debt crisis on domestic demand. This is evident from the common low trend of gross fixed capital formation across Latin American economies in Appendix 2.7. Rising levels of debt as a percentage of GDP hampered investment through a decline in domestic demand in Venezuela in the 1980s which is evident from the declining trend in Appendix 2.7 during that period. Despite phases of disinvestment, debt crisis in the eighties and exchange rate crisis in

Table 2.1 Summary Statistics

	1980-1989			1990-2004		
Region/ Countries	GFCF[19]	Output[20]	Wages	GFCF	Output	Wages
Latin America & Caribbean	*248.77*	*235.76*	*0.77*	*326.70*	*306.61*	*1.55*
Chile	0.40	13.31	0.99	2.08	33.18	2.63
Colombia	6.83	17.83	1.28	0.32	27.82	2.00
Ecuador	0.40	3.74	0.44	0.60	7.29	0.37
Mexico	1.15	44.51	3.47	6.76	106.05	7.81
Venezuela	1.97	30.14	3.86	4.40	29.81	1.78
East Asia & Pacific	*136.61*	*118.32*	*0.20*	*464.54*	*432.88*	*2.37*
India	6.19	93.67	7.91	12.53	169.96	9.95
Indonesia	1.52	18.45	1.27	18.57	69.76	4.13
Malaysia	1.22	19.44	1.44	12.85	84.65	5.56

Source: (a) UNIDO, WDI and based on author calculations. All data is in $US bn.

[19] Gross Fixed Capital Formation measured in annual growth terms.
[20] For comparison purpose the figures for Latin America & Caribbean and East Asia & Pacific are manufacturing value added due to lack of data on output. See appendix for the definition of manufacturing value added.

1994, Mexico's privatization and deregulation efforts attracted volumes of investment into the manufacturing sector.

Mexico's investment in total manufacturing is at $US6.76 bn, an increase by about seven times its average value of the 1980s. However, despite the debt crisis that reverberated throughout Latin America, Chile's timely structural reforms have boosted its investment and converted a GDP growth rate of -14.5% in 1982 to 0.7% in 1985. This incredible turn around in the economic growth was largely possible due to Chile's overall economic performance during the period 1986-1997. The performance of manufacturing output in these economies typically hinged upon the performance of the export sector primarily due to the early efforts to open up domestic markets to international trade. While, Chile experienced strong growth in manufacturing output and wages during this period due to its wealth of natural resources, Colombia and Ecuador registered relatively low growth in manufacturing output largely because production favoured labour intensive consumer goods such as food products and textiles over capital goods, which composed about 50% of total production.

However, during the 1990s, the pattern of industrial production shifted to intermediate and capital goods and gradually manufacturing sector contributed to their economic growth. Favourable government policies in Mexico helped its manufacturing sector to grow rapidly and gradually Mexico became one of the most vibrant manufacturing bases with a turnover of over 100 billion dollars by the 1990s. Much of Venezuela's industrial boom in the 1980s was due to its revenues from oil exports and a gradual shift of production from traditional goods to a wide range of manufactured goods by early 1990s. However, due to reduction of import barriers and rising competition, its economy witnessed a decline in real wages and output levels in manufacturing since the last decade.

In comparison to Latin America, Asian economies fared better in terms of economic recovery driven by manufacturing sector since the 1990s onwards. This is clearly evident from the growth in investment, output and wages in Table 2.1. Industrial growth in India during the 1980s was largely under a protected environment that kept international competitors out of its market while much of the manufacturing sector was classified as unorganized. Its fixed exchange rate regime until 1991 did not help India's manufacturing sector either. However, since the economic reforms of 1991 and floating of its exchange rate, its manufacturing sector witnessed a tremendous pattern of growth in investment and output. Ariff and Khalid (2004) report that the rate of investment in India gradually improved since the reforms from about 20% in the 1980s to 27% over the period 1993-2000 largely due to better sources of financing for the industrial sector. Gradually, living standards improved with rising real wages since the last decade. Earlier to the crisis, Indonesian economy was characterized by low inflation, high investor confidence, good trade surplus and a stable banking system. Indonesian corporations had low debt levels due to the rising value of the Rupiah. According to Ariff and Khalid (2004), a sudden change of the exchange rate system to free floating following the events that broke out in Thailand in 1997 the Indonesian Rupiah lost 55% of its value vis-à-vis the US Dollar. This further resulted in increased corporate debts and brought in fears of insolvency. Other serious consequences for Indonesia were sudden hike in the food prices and fall in its real GDP value by nearly 13% in 1998. Huge capital inflows to both Indonesia and Malaysia in the presence of effectively pegged nominal exchange rates led to a massive lending boom in the wake of financial liberalization process.

Malaysia experienced huge investment prior to the 1997 crisis but the current account deficit was at a high level of 5% of its GDP. A sudden attack on the Ringitt by speculators plunged its value drastically by about 50% and Malaysia experienced its first major recession in many years. As a result its manufacturing sector suffered a downward trend in the investment visible from Appendix 2.4. Like Venezuela, Malaysia refused recourse to the IMF, it went about restructuring corporate debt, imposed capital controls and eventually the current account deficit turned into surplus and sustainable growth was visible in the last decade. Stiglitz (2002) is of the view that small open economies exercising control over capital mobility like India were not much affected by the financial crisis contagion. In general, a common trend that is visible throughout both the regions of Latin America and Asia is that manufacturing sector growth led the economic recovery through a shift in pattern to capital intensive production over the years. Sectors like telecommunication, automobiles, machinery, iron and steel, and rubber thrived and these were the key drivers of economic growth in the economies in this study.[21]

Appendix 2.6 shows the variation in the data across countries and sectors in this study.[22] In general, Asia witnessed greater investment levels than Latin America for the entire sample period of 1980-2004. There is also cross country variation in real investment, real output and real wages. While some countries like Ecuador registered a minimum of -0.19 (disinvestment) in beverages, others such as India and Malaysia recorded heavy investment and output in food products, textiles, rubber, iron and steel and electrical machinery. As a result such key sectors also witnessed higher wage levels. The presence of high correlation among the explanatory variables suggests potential econometric issues to which we now turn to in the next section.

[21] Refer to footnote 6.

[22] Additional correlation statistics and graphs show the expected positive correlation between real investment and real output and a negative correlation between real investment and real effective exchange rate. However, as Landon and Smith (2007) suggest some primary and allied sectors such as food products, textiles and beverages undergoing tremendous reforms in some of the Latin American economies could muddle the expected negative correlation between real wages and real investment.

2.5 Econometric Framework

We employ a panel estimation methodology to capture the dynamics of investment and its determinants at the disaggregate level across emerging economies. Panel data is appropriate in this context because it contains information across dimensions, time and cross section. Econometric techniques such as PMG estimation and GMM estimation explain the dynamics of adjustment through lags and short run adjustments.

2.5.1 Panel Unit Root Tests

In this study we use the panel unit root tests from Im, Pesaran and Shin (2003) (IPS) and Levin, Lin and Shin (2002) (LLC) to test for potential non-stationarity in a panel context. Although our subsequent methods are robust to a mixture of stationary and non-stationary regressors, they are not robust to stationary dependent variable and non-stationary regressors. We start with a first order AutoRegressive AR (1) process for the panel time series y_{it} of the form:

$$y_{it} = \rho_i y_{it-1} + X_{it}^{'}\delta + u_{it}, \tag{2.18}$$

where $i = 1,2,...,N$ cross section units that are observed over T time periods $t = 1,2,...,T$. The matrix X_{it} represents the deterministic component in the model and could include any fixed effects or individual trends. ρ_{it} are the autoregressive coefficients and u_{it} are the error terms that are mutually independent. If $\rho_i < 1$, y_{it} is considered to be weakly stationary. But, if $\rho_i = 1$, y_{it} contains a unit root. There are other variants of this AR (1) form that combine the individual unit root tests to arrive at a panel specific result. The panel unit root test proposed by Im et al. (2003) typically allows the ρ_{it} to vary across cross sections. The t-statistic (IPS) test is based on a separate Augmented Dickey Fuller (ADF) regression for each cross section.

$$\Delta y_{it} = \rho_i y_{it\text{-}1} + \sum_{j=1}^{p_i} \varphi_{ij} \Delta y_{it\text{-}j} + \mathbf{x}'_{it}\delta + u_{it} \tag{2.19}$$

$$u_{it} = \sum_{j=1}^{p_i} \varphi_{ij} \Delta u_{it-j} + \varepsilon_{it} \tag{2.20}$$

This process tests the null hypothesis $H_0 : \rho_i = 1$ for all *i* against $H_\alpha : \rho_i < 1$ for at least one *i*. The t-bar test statistic is the average for the ρ_i from the ADF regressions.

$$\bar{t}_{NT} = \frac{1}{N} \sum_{i=1}^{N} t_{\rho_i} \tag{2.21}$$

In the general case where the lag order in equation (19a) is non zero for some cross sections, Im, Pesaran and Shin (2003) show that $\bar{t}_{NT}$ asymptotically follows the standard normal distribution as is given as $W_{t_{NT}} \sim N\,(0,1)$.

2.5.2 Pooled Mean Group Estimation

Given the nature of available data at sector level for each of the countries in our study, we have a panel data set. Pesaran et al. (1999) and Schich and Pelgrin (2002) have emphasized the importance of the right choice of econometric methodology in dealing with panels data. Pesaran et al. (1999) have proposed the Pooled Mean Group Estimation (PMGE) approach in handling unbalanced panel data, who state that PMGE is advantageous since it incorporates both long run and short run effects by adopting an Autoregressive Distributive Lag (ARDL) structure and estimating this as an Error Correction Model. The short run coefficients are estimated by averaging the cross sectional estimates while the long run coefficients are pooled since economic theory typically have stronger implications for long run relationships rather than dynamics of adjustment as is the case in this study. The homogeneity of long run coefficients is tested by a joint Hausman test, which is distributed as χ^2.

Pesaran et al. (1999) state that irrespective of the order of integration of the explanatory variables and the dependent variable, by taking sufficient lags in the ARDL structure, we can still trace the effect of the explanatory variables on the dependent variable, and thereby can overcome the problem of spurious regression. Also the error correction mechanism (ECM) integrates the short run dynamics and the long run equilibrium without losing crucial information about the long run. The PMGE is based on an autoregressive distributed lag ARDL (*p*, *q*, *q*… *q*) model of the type

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij} y_{it-j} + \sum_{j=0}^{q} \delta_{ij}^{'} \mathbf{x}_{it-j} + \mu_i + \varepsilon_{it} \qquad (2.22)$$

Where $X_{it}\,(k \times 1)$ is the vector of explanatory variables for group i, μ_i represents the fixed effects, λ_{ij} are the scalars which are the coefficients of the lagged dependent variables and δ_{it} are $(k \times 1)$ coefficient vectors. *T* must be large enough to accommodate the estimation for every cross section.

Again equation (16) can be conveniently re-parameterized as:

$$\Delta y_{it} = \varphi_i y_{it-1} + \beta_i^{'} \mathbf{x}_{it} + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta y_{it-j} + \sum_{j=0}^{q-1} \delta_{ij}^{*'} \Delta \mathbf{x}_{it-j} + \mu_\iota + \varepsilon_{it} \qquad (2.23)$$

where

$$\varphi_i = \left(\sum_{j=1}^{p} \lambda_{ij} - 1 \right) = -\left(1 - \sum_{j=1}^{p} \lambda_{ij} \right), \beta_i = \sum_{j=0}^{q} \delta_{ij}, \lambda_{ij}^{*} = -\sum_{m=j+1}^{p} \lambda_{im} \text{ and } \delta_{ij}^{*} = -\sum_{m=j+1}^{q} \delta_{im} \qquad (2.24)$$

As the PMGE technique adopts the autoregressive distributed lag model (ARDL) in estimating a dynamic relationship between the dependent variable and the explanatory variables, in our study the ARDL model could be specified as;

$$\Delta y_{it} = \varphi_i y_{it-1} + \beta_i^{'} \mathbf{x}_{it} + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta y_{it-j} + \sum_{j=0}^{q-1} \delta_{ij}^{*'} \Delta \mathbf{x}_{it-j} + \mu_i + \varepsilon_{it} \qquad (2.25)$$

Where y_{it}, the dependent variable is the log of real investment (GFCF) and X_{it} is the vector of explanatory variables for group i. In more explicit terms,

$$\Delta y_{it} = \varphi_i y_{it-1} + \beta_i^{'} \mathbf{x}_{it} + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta y_{it-j} + \sum_{j=0}^{q-1} \delta_{ij}^{*'} \Delta \mathbf{x}_{it-j} + \mu_i + \varepsilon_{it} \tag{2.26}$$

2.5.3 Dynamic Panel Data: Generalised Method of Moments (GMM) Estimation

Under certain assumptions about serial correlation of error terms, the dynamic specification with lagged explanatory variables turns out to be valid instrument candidates according to Easterly and Serven (2003). Typically, if the error term is serially uncorrelated and the explanatory variables are not strictly exogenous, then higher order lags become valid instruments as they are uncorrelated with future values. Within estimators reflect country specific effects but do not control for endogeneity or measurement errors. They invariably give inconsistent misleading estimates with measurement errors. Therefore, Arellano and Bond (1991) purported that the GMM estimation uses different instrument sets at lags and levels. We report GMM with (*t*-2) differences and also system GMM with (*t*-3) estimation. The system GMM estimation combines both levels equation and first difference equations. In general, they produce coefficients of higher magnitude with significance. Validity of the instruments is tested by Sargan test and the Hansen test.

Sargan tests of orthogonality show validity of the instrumental variables and is used to check for the over identifying restrictions in the model. Sargan test states that residuals should be uncorrelated with the exogenous regressors if the set of instruments are exogenous. This test rejects the validity of an instrument with a probability value of less than 0.05. In such cases it turns out to be a clear misspecification problem.

2.5.4 Empirical Specification

We are interested in identifying the empirical determinants of investment in a panel of emerging economies at the sectoral level using annual data from 1980 to 2004. Consequently we have N = 86 cross sections and potentially T = 25 time series observations in our unbalanced panel. We adopt this disaggregate approach primarily because aggregate data could mask many of the sectoral developments in an economy. Therefore from the equation (2.26), we can represent the ARDL model for estimation purposes as;

$$ln\, I_{ijt} = \theta_{0ij} + \theta_1 \, ln\, Q_{ijt} + \theta_2 \, ln W_{ijt} + \theta_3 \, ln\, S_{ijt} + \varepsilon_{ijt} \qquad (2.27)$$

Where, subscripts *i, j* and *t* indicate country, sector and time respectively. To avoid notational clutter in expression, we supress subscript *j*. However, more importantly, the sector dimension is accounted for during all our estimations. Therefore, throughout this chapter $ln\, I_{it}$ denotes real investment, $ln\, Q_{it}$ denotes real output, $ln W_{it}$ denotes real wage and $ln\, S_{it}$ denotes real effective exchange rate. We expect the following relationship between the explanatory variables and the dependent variable. Logged real output $ln\, Q_{it}$, is an important determinant of current investment decisions. Therefore, it is also expected to bear a positive and significant coefficient. The next variable logged real wage $ln W_{it}$ is a cost to the firm, and therefore we expect it to carry negative coefficients through the different lag specifications. But, logged real effective exchange rate $ln\, S_{it}$ is a variable that can be expected to hold varied sign on its coefficient. This is due to the several channels of transmission of it effect onto investment as discussed in the theoretical section.

2.6 Results

This section contains our main empirical results. Firstly we include our panel unit root test results. These help us consider whether we have a potentially spurious or unbalanced regression. Then we present our Pooled Mean Group Results which allows us to examine our empirical investment function and the impact of the exchange rate. Finally we examine whether our results are results are robust to potential endogeneity, using panel GMM.

2.6.1 Panel Unit Root Tests

In Table 2.2 the panel unit root tests results are presented. We conducted both the LLC and the IPS tests to validate the theoretical specification of equation (2.19) and to check for the presence of unit root in the panel. The same null hypothesis of a unit root in both the tests makes it easy to compare. For both the LLC and IPS tests, only the exchange rate is stationary throughout all the specifications. The dependent variable is $ln I_{it}$, and the other explanatory variables lnY_{it} and lnW_{it}, are non stationary at levels in both the unit root tests but are stationary at first differences in both the tests. This result enables us to employ the error correction methodology under the PMGE framework to carry out the panel regression in first differences. Additional panel unit root tests of the ADF – Fisher type are presented in the Appendix 2.5. Under this test, $ln S_{it}$ is stationary throughout as it rejects the null hypothesis of unit root for all specifications and the other variables are stationary only at first differences. However, in all our dynamic panel estimations in this

Table 2.2 LLC and IPS Panel Unit Root Tests

	Levin, Lin and Chu (2002)				Im, Pesaran and Shin (2003)			
	Level		First Difference		Level		First Difference	
	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
$ln I_{it}$	-1.02 [0.15]	-0.41 [0.34]	**-1.87 [0.03]**	**-27.15 [0.00]**	-0.31 [0.37]	1.80 [0.96]	**-14.13 [0.00]**	**-13.25 [0.00]**
$ln Q_{it}$	1.49 [0.93]	1.70 [0.95]	**-31.60 [0.00]**	**-32.18 [0.00]**	3.79 [0.99]	6.25 [1.00]	**-12.29 [0.00]**	**-11.73 [0.00]**
$ln W_{it}$	0.96 [0.83]	0.96 [0.83]	**-34.41 [0.00]**	**-32.02 [0.00]**	3.72 [0.99]	6.19 [1.00]	**-33.79 [0.00]**	**-30.63 [0.00]**
$ln S_{it}$	**-12.56 [0.00]**	**-14.31 [0.00]**	**-7.32 [0.00]**	**-7.72 [0.00]**	**-23.77 [0.00]**	**-23.97 [0.00]**	**-20.55 [0.00]**	**-20.43 [0.00]**

Note: (a) Specification [1] indicates intercept only and [2] indicates trend and intercept. (b) Null Hypothesis is unit root (H_0 : I (1)) and Alternate Hypothesis is no unit root (H_1 : I (0)). (c) Robust t-statistic with a probability value in square brackets of more than 0.05 indicates acceptance of the null at 5% level. (d) Bold and asterisk (*) when reject null. (e) $ln I_{it}$ stands for logged real investment, $ln Y_{it}$ is the logged real output, $ln W_{it}$ denotes logged real wages and $ln S_{it}$ denotes logged real effective exchange rate.

chapter, the variables are transformed to first differenced variables thereby we ensure stationary variables in our estimation.

2.6.2 PMGE Estimates

Firstly, we utilise Pooled Mean Group Estimation (PMGE) and Table 2.3 sets out these results for three different panel specifications. The chosen specification has an ARDL model where the optimal lag length is determined by the Schwarz Bayesian Information Criteria and data is cross sectionally demeaned. Following Pesaran et al. (1999) we concentrate on cross sectionally demeaned data because it accounts for the periods of common shocks across countries. Therefore, cross sectionally demeaned specification is the result in our interest and we present the same for different regional panels; combined, Latin America and Asia. Clearly as seen from the Hausman test statistic in Table 2.3, the null hypothesis of homogeneity of long run coefficients is rejected in the combined specification.

Table 2.3 PMGE Estimates of Investment Relationship excluding disinvestment

Variable/Model	Combined Panel	Latin America	Asia
Long Run Coefficients			
lnQ_{it}	**1.669*** **(21.850)**	**1.659*** **(20.233)**	**0.388*** **(4.042)**
lnW_{it}	**-0.537*** **(-9.640)**	**-0.593*** **(-9.409)**	**0.465*** **(5.307)**
lnS_{it}	-0.005 (-0.213)	-0.025 (-1.115)	**0.235*** **(5.651)**
Short Run Coefficients			
Error Correction (ϕ)	**-0.834*** **(-23.300)**	**-0.911*** **(-25.263)**	**-0.862*** **(-18.600)**
ΔlnQ_{it}	-0.329 (-1.870)	-0.484 (-2.227)	0.273 (2.068)
ΔlnW_{it}	**0.472*** **(2.980)**	**-0.505*** **(-2.797)**	0.112 (0.598)
ΔlnS_{it}	0.403 (1.660)	-0.105 (-0.599)	**0.841*** **(3.767)**
Hausman Test	**10.57*** **[pval=0.01]**	4.13 [pval=0.25]	2.48 [pval=0.48]
Number of Observations	1595	954	661
Number of Cross Sections	86	55	33

Notes: (a) This table presents Pooled Mean Group Estimates for a panel of the total manufacturing sector. (b) t-values in parenthesis. (c) Sample period is 1980-2004. (d) Eight countries are included in the combined panel: Chile, Colombia, Ecuador, Mexico, Venezuela, India, Malaysia and Indonesia. Latin America comprises Chile, Colombia, Ecuador, Mexico and Venezuela and Asian comprises India, Malaysia and Indonesia. (e) Asterisk and bold indicates significance at the 5% level. (f) The chosen specification is an ARDL model with cross sectionally demeaned data and the lag length determined by the Schwarz Bayesian Information Criteria to be 1. (g) Time and cross section dummies are included in the estimation. (h) Hausman test examines the homogeneity of the long run coefficients of the panel, probability values [pval] less than 0.05 reject the null hypothesis of homogeneity. (i) Dependent Variable is logged real investment excluding disinvestment.

This implies that in general the investment demand differs across emerging economies in our sample study. Therefore, we split the combined panel region wise into Latin America and Asia and the null hypothesis of poolability of long run coefficients is not rejected for both the regional panels. The dynamics suggest that short run adjustment coefficients from the Error Correction Model (ECM) are negative and significant throughout and the speeds of adjustment to equilibrium are quite fast. From Table 2.3 we can see that the estimated coefficient on the real output term is positive and significant in the long run across all the three panel specifications. This implies a strong effect of the rise in domestic demand onto investment in the long run. But in the short run, the coefficients for the combined panel and

Latin American panel were negative. This could suggest that output fluctuations prevail in the short run in emerging economies. The coefficients of S_{it} are negative but insignificant in the long run for the combined panel and Latin American specifications but positive and significant for Asia.

This suggests a stronger effect of real exchange rates onto real investment through the cost channel. An appreciation of the domestic currency renders the cost of imported capital goods cheaper. This leads to a rise in the profitability which further results in higher investment. This result coincides with the conclusions of Landon and Smith (2007) who state that appreciation of the domestic currency in real terms could potentially boost investment by reducing the production costs. In general the response of investment demand to changes in exchange rates vary across emerging economies. Although we do not find evidence of a significant exchange rate effect, this may be due to the cross sectional heterogeneity. Wages, the major input cost of any firm was significant and negative in the long run for both the combined panel and Latin American panel specification but its coefficient was positive for Asia. However, previous studies by Goldberg (1998) have shown that the impact of real wages on real investment could be intertwined with the effect of real exchange rates on real investment for open market economies and hence could produce some inconsistent estimates. In the long run as firms grow, they tend to reduce their dependence on labour input, thus gaining more capital intensity invariably as a result of increase in the imported input costs. Alternative cheaper substitutes in the form of imports

Table 2.4 DPD-GMM: Investment Relationship excluding disinvestment

Variable/Model	Combined Panel	Latin America	Asia
lnI_{it-1}	**0.664*** **(192.35)**	**0.597*** **(268.99)**	**0.666*** **(332.60)**
lnQ_{it}	**0.278*** **(42.95)**	**0.206*** **(85.39)**	**0.250*** **(79.01)**
lnW_{it}	**0.050*** **(7.85)**	**0.131*** **(56.56)**	**0.029*** **(10.34)**
lnS_{it}	**0.063*** **(58.40)**	**0.013*** **(28.86)**	**0.024*** **(23.92)**
Sector Dummies	**Yes**	**Yes**	**Yes**
Time Dummies	**Yes**	**Yes**	**Yes**
m2[pval]	0.166	0.571	0.293
Sargan[pval] Hansen[pval]	**0.00*** 1.00	0.29 **0.00***	**0.00*** **0.00***
Number of Observations	1509	967	624
Number of Cross Sections	86	53	33

Notes: (a) This table presents Pooled Mean Group Estimates for a panel of the total manufacturing sector. (b) t-values in parenthesis. (c) Sample period is 1980-2004. (d) Countries included are Chile, Colombia, Ecuador, Mexico and Venezuela. (e) Asterisk and bold indicates significance at the 5% level. (f) The chosen specification is an ARDL model with cross sectionally demeaned data and the lag length determined by the Schwarz Bayesian Information Criteria to be 1. (g) The Sargan and Hansen tests examine the validity of instruments and mis-specification of the model, probability values [pval] less than 0.05 reject the null hypothesis of homogeneity. (h) Dependent Variable in [1] is logged real investment excluding disinvestment, dependent variable in [2] is real investment excluding disinvestment at levels and the dependent variable in [3] is real investment including disinvestment at levels. (i) Time and sector dummies are included in the estimation.

might also be a factor for the opposing signs of the real wages. The consistent negative sign of the coefficients for the real wages coincides with the findings of several other researchers such as Campa and Goldberg (1995), Goldberg and Klein (1995), Alesina, Perotti and Schiantarelli (2002) and Landon and Smith (2007). However, it was found to be relatively insignificant in the short run with opposing signs from the different specifications. In this regard, we believe there is a need to take account of endogeneity in the model to delineate the impact upon real investment. We now present results from DPD-GMM estimation.

2.6.3 DPD-GMM Estimates

Table 2.4 presents the results of the GMM estimation excluding periods of disinvestment using logarithmic values. Thereby, the coefficients of the explanatory variables are interpreted in terms of elasticities. After we have accounted for endogeneity in the model by estimating the GMM estimation, the positive sign on the exchange rate S_t clearly indicates that the cost channel effect of the exchange rate onto investment is prominent throughout the three different specifications. This set of results is quite consistent with the estimates in Table 2.3 in the sense that after the robustness exercise was carried out using GMM estimation; the cost channel effect on real investment is highlighted. As expected, the lagged dependent variable was positive and significant across all the models in Table 2.4. The coefficients on output were significant and positive across all specifications indicating increases in output lead to rises in investment for each of the panels. Across all the three specifications, the coefficient on wages was positive and significant. As Narayan (2008) states that the labour cost could produce a positive effect on investment if wage rises were due to increases in productivity levels. The positive effect of wages on investment implies that the productivity effect surpasses the negative labour cost effect. Others such as Wheeler and Mody (1992) and Wei (2000) also find a positive link between wages and investment in emerging economies.

However, for some of the investment climate variables such as wages and productivity, endogeneity is intrinsic and we expect wages to be correlated with investment in our study. Also, with other things remaining the same, an exogenous increase in investment might lead to a rise in the investment per worker, which results in rising labour productivity. This can further have an indirect positive effect, thereby increasing wages. Another issue is the missing variables bias that often plagues studies related to investment behaviour. In our study, this issue has been addressed by the usage of sector specific and country specific dummies. We acknowledge the importance of additional policy variables, which when included, may mitigate the omitted variable bias. But, given the paucity of data for our panel of emerging economies, our study is limited to the usage of sector dummies in this aspect.

Sargan test shows that our instrument set is not valid with a probability value less than 0.01 and therefore we reject the null hypothesis. But, an additional robustness check for misspecification from the Hansen test indicates that we do not reject the null hypothesis. Hence, conclude that there is a need to consider better instruments that are rather strictly exogenous. As Levine et al. (2000) pointed out in their study that including instruments of the lagged explanatory variables could eliminate parameter inconsistency due to simultaneity bias. In this regard, Levine et al. (2000) suggested difference dynamic panel estimator. Also, weak instruments induce a finite sample bias into the estimation and are not asymptotically precise. Moreover; there is no indication of higher second order autocorrelation in the model as we do not reject the null hypothesis of the m2 statistic, which implies that the error disturbances are not serially correlated at lags.

Table 2.5 DPD-GMM: Investment Relationship excluding disinvestment at levels

Variable/Model	Combined Panel	Latin America	Asia
$I_{it\text{-}1}$	**0.734* (94.50)**	**0.645* (364.83)**	**0.714* (231.63)**
Q_{it}	**0.046* (19.38)**	**0.032* (82.96)**	**0.046* (45.79)**
W_{it}	**-0.335* (13.15)**	**-0.259* (-53.71)**	**-0.310* (-24.97)**
S_{it}	**566.807* (19.08)**	**-968.860* (-44.59)**	**172.95* (18.22)**
Sector Dummies	**Yes**	**Yes**	**Yes**
Time Dummies	**Yes**	**Yes**	**Yes**
m2[pval]	0.606	0.606	0.673
Sargan[pval] Hansen[pval]	**0.000*** 1.000	**0.000*** **0.000***	**0.000*** 1.000
Number of Observations	1512	968	624
Number of Cross Sections	86	53	33

Notes: (a) This table presents Generalised Method of Moments (GMM) estimates. (b) t-values in parenthesis. (c) Sample period is 1980-2004. (d) Eight countries are included in the combined panel: Chile, Colombia, Ecuador, Mexico, Venezuela, India, Malaysia and Indonesia. (e) Asterisk and bold indicates significance at the 5% level. (g) The Sargan and Hansen tests examine the validity of instruments homogeneity of the long run coefficients of the panel, probability values [pval] less than 0.05 reject the null hypothesis of homogeneity. (h) Dependent variable is real investment excluding disinvestment at levels and (i) Time and sector dummies are included in the estimation.

2.6.4 DPD-GMM Estimates excluding disinvestment at levels.

We carried out additional robustness exercises by splitting the combined panel region wise into Asia and Latin America. Table 2.5 shows the DPD-GMM results for the Asian panel using three different specifications. Similar to Table 2.4, the coefficient on the lagged dependent variable in Table 2.5 was positive and significant throughout. Real output also showed a positive and significant effect on the real investment in all the three models. The sign of the coefficients on real wages was negative and significant throughout all the three panel specifications implying higher production costs hamper investment. The positive signs on the coefficients of the exchange rate S_t clearly indicate the operation of cost channel effect of the exchange rate onto investment.

Appreciation of domestic currency (a rise in S_t) leads to a lower cost of imported capital goods, thereby reducing production costs which further leads to rise in investment via profitability. The exchange rate coefficients for all the three specifications are also much bigger than other coefficients in the table. This might suggest that the effect of exchange rate on investment is quite strong at levels. From the probability values of m2 test we do not reject the null hypothesis of no second order serial correlation in the residuals. However, there is mixed evidence on validity of instruments in our model as we do not reject the null hypothesis of the Hansen test, whereas, Sargan test shows that our instruments set (lagged values of investment, output, wages and exchange rates) are fully valid and there is a need for strictly exogenous instruments which would not be correlated with the error terms at higher lags.

2.6.5 DPD-GMM Estimates of Investment relationship including disinvestment

Table 2.6 shows the DPD-GMM results for the Latin American panel using three different specifications. Similar to the previous results, the coefficient on the lagged dependent variable was positive and significant throughout. Real output also showed a positive and significant effect on the real investment in all the three models. The sign of the coefficients on real wages were also negative and significant for all the specifications implying higher production costs hamper investment. But, the variable of prime concern S_{it} holds high positive coefficient values and was also statistically significant across all specifications. On the one hand, the positive signs on the coefficients of the exchange rate S_t clearly indicate the operation of cost channel effect of the exchange rate onto investment. But, on the other this means that firms engage in simultaneous purchase of new capital recorded as positive values and sale or disposal of depreciating assets or damaged assets that are recorded as negative values. Colombia, Ecuador and Mexico exhibited such a pattern of positive and negative periods of investment from the data. This pattern of active trading in capital stock in the presence of frequent changes in the real exchange rates could plausibly have had a significant influence on investment. From the probability values of m2 test we do not reject the null hypothesis of no second order serial correlation in the residuals. However, results suggest mixed evidence on validity of instruments in our model as we do not reject the null of the Hansen test, whereas, Sargan test shows that our instruments set (investment, output, wages and exchange rate) are not valid and there is a need for strictly exogenous instruments.

Table 2.6 DPD-GMM: Including disinvestment at levels.

Variable/Model	Combined Panel	Latin America	Asia
I_{it-1}	**0.733*** **(90.59)**	**0.676*** **(260.72)**	**0.770*** **(199.00)**
Q_{it}	**0.047*** **(18.94)**	**0.030*** **(62.67)**	**0.042*** **(32.90)**
W_{it}	**-0.334*** **(-12.14)**	**-0.254*** **(-42.73)**	**-0.303*** **(-24.97)**
S_{it}	**604.598*** **(20.97)**	**596.519*** **(42.11)**	**680.63*** **(40.05)**
m2[pval]	0.589	0.785	0.530
Sargan[pval] Hansen[pval]	**0.00*** 1.00	**0.00*** 1.00	**0.00*** 1.00
No. of Observations	1600	971	629
No. of Cross Sections	86	53	33

Notes: (a) This table presents Generalised Method of Moments (GMM) estimates. (b) t-values in parenthesis. (c) Sample period is 1980-2004. (d) Eight countries are included in the combined panel: Chile, Colombia, Ecuador, Mexico, Venezuela, India, Malaysia and Indonesia. (e) Asterisk and bold indicates significance at the 5% level. (g) The Sargan and Hansen tests examine the validity of instruments homogeneity of the long run coefficients of the panel, probability values [pval] less than 0.05 reject the null hypothesis of homogeneity. (h) Dependent variable is real investment excluding disinvestment at levels and (i) Time and sector dummies are included in the estimation.

2.7 Conclusions

Employing a panel methodology, our paper has attempted to model the determinants of investment for different sectors in key emerging market economies from both Latin America and Asia. Confirming with previous works such as Landon and Smith (2007), Nucci and Pozzolo (2001), Serven (1990) and Campa and Goldberg (1999), the main conclusions from the PMG estimation are: firstly, the effect of a depreciation of the domestic currency rate on investment is negative but insignificant in the long run. However, after splitting the panel region wise into Latin America and Asia, some of the positive effect on investment could be attributed to a fall in the cost of imported goods following a real currency appreciation. Active trading in capital stock in international markets could also be influenced positively by changes real exchange rates. Secondly, the negative effect of real wages on investment in the long run is consistent with the fact that increased input costs reduce firm profitability and thus reduce investment. However, it takes time for such an effect to be evident. Thirdly, we reject the long run poolability of cross sections when we allow for different lag length and cross sectionally demean the data. But, accept the long run poolability in the split panels of Asia and Latin America.

And from the dynamic panel estimation, it is clear that again output and wages performed as expected with significant t-statistic values. An appreciation of the domestic currency in the long run could have induced higher imports of new machines, thereby giving off positive effect on the investment. This could mean that the price of the new machines that are determined abroad have been falling, thus making it cheaper to import better machines despite the appreciating exchange rates. However, we also noticed that the instruments did not pass the Sargan test. It may also be an interesting conclusion that in emerging economies in our study, real exchange rates do not fit in as valid instruments in explaining investment due the fact that they may be correlated with the residuals. Finally, we have seen some evidence for the uniform effect of level of exchange rates on sector level investment among a panel of emerging economies. But, given the fact that firms in emerging economies are constantly opening up to international markets, as Serven (1999) and (2003) and several others put forward the argument that the volatile nature of exchange rates stemming from increasingly integrated financial markets worldwide might play a bigger role in influencing sector level investment than just the level of exchange rates. It is to this issue that we turn next in the subsequent chapter.

Appendix 2.1 Model Simplification

Using the generalized version of the Euler identity (see also Love (2003)), we have

$$MPK \times K + MPL \times L = n * F(K,L) \tag{2.28}$$

or $$MPK = \frac{n * F(K,L) - MPL \times L}{K} \tag{2.29}$$

Where, MPK is the marginal productivity of capital, which can also be expressed as Q_K. MPL is the marginal productivity of labour, which can also be expressed as Q_L. n is the degree of homogeneity. Again $F(K,L)$ can be expressed as Q. Therefore, equation (2.28) means that the relation between the sum of the factors of production multiplied by their respective marginal productivities and the production function is homogenous of degree n. If $n = 1$, the production function exhibits constant returns to scale. If $n > 1$, the production function exhibits increasing returns to scale and $n < 1$ implies decreasing returns to scale. Hence, equation (2.29) can be rewritten as

$$Q_K = \frac{n * Q - Q_L \times L}{K} \tag{2.30}$$

or $$Q_K = \frac{n * Q - \left(\frac{W}{P}\right) \times L}{K} \tag{2.31}$$

Therefore, a generalized form of the marginal productivity of capital from equation (2.31) would be a function of output, wages and the factor inputs which can be expressed as in equation (2.15).

Appendix 2.2 Data Description

Variable	Definition	Source
Investment	Gross Fixed Capital Formation (GFCF)	United Nations Industrial Development Organisation (UNIDO)
Real Effective Exchange Rate (Sit)	Foreign currency per unit of domestic currency.	Bank for International Settlements (BIS)
Output	Total Production	UNIDO
Wages	Wages in US$	UNIDO
External Debt	Total external debt as a share of GDP in US$.	World Development Indicators (WDI)
GDP Deflator	GDP deflator index	WDI
Real Investment	Investment/GDP Deflator	Based on author calculations
Real Output	Output/GDP Deflator	Based on author calculations
Real Wages	Wages/GDP Deflator	Based on author calculations
Standard Deviation Volatility Measure	Annualised average standard deviation.	REER from BIS, based on author calculations
Conditional Volatility Measure	GARCH conditional variance	REER from BIS, based on author calculations
Temporary Volatility Measure	Component GARCH volatility	REER from BIS, based on author calculations
Permanent Volatility Measure	Component GARCH volatility	REER from BIS, based on author calculations

Note: Countries included in this panel study are Chile, Colombia, Ecuador, India, Indonesia, Malaysia, Mexico and Venezuela. Sectors included in this study are Foods, Beverages, Tobacco, Textiles, Leather, Paper, Industrial Chemicals, Rubber, Plastics, Iron and Steel and Electrical Machinery.

Appendix 2.3 Cross Correlation Matrix of Main Variables at levels.

Variable	$ln I_{it}$	$ln Q_{it}$	$ln W_{it}$	$ln S_{it}$
$ln I_{it}$	1.00			
$ln Q_{it}$	0.85	1.00		
$ln W_{it}$	0.80	0.93	1.00	
$ln S_{it}$	-0.35	-0.42	-0.41	1.00

Note: $ln I_{it}$ is logged real investment. $ln Q_{it}$ is logged real output, $ln W_{it}$ is logged real wage and $ln S_{it}$ is logged real exchange rate.

Appendix 2.4 Cross Correlation Matrix of Main Variables at first differences.

Variable	$ln I_{it}$	$ln Q_{it}$	$ln W_{it}$	$ln S_{it}$
$ln I_{it}$	1.00			
$ln Q_{it}$	0.18	1.00		
$ln W_{it}$	0.11	0.42	1.00	
$ln S_{it}$	-0.07	-0.08	0.09	1.00

Note: $ln I_{it}$ is logged real investment. $ln Q_{it}$ is logged real output, $ln W_{it}$ is logged real wage and $ln S_{it}$ is logged real exchange rate.

Appendix 2.5 ADF-Fisher Panel Unit Root Test

Variable / Test	ADF-Fisher			
	Levels		First Differences	
	[1]	[2]	[1]	[2]
$ln I_{it}$	18.21 [0.31]	10.33 [0.84]	**222.25*** **[0.00]**	**188.84*** **[0.00]**
$ln Q_{it}$	10.81 [0.82]	6.79 [0.97]	**558.99*** **[0.00]**	**535.00*** **[0.00]**
$ln W_{it}$	12.17 [0.73]	7.48 [0.96]	**637.53*** **[0.00]**	**571.46*** **[0.00]**
$ln S_{it}$	**488.59*** **[0.00]**	**457.55*** **[0.00]**	**415.43*** **[0.00]**	**384.72*** **[0.00]**

Note: (a) Specification [1] indicates intercept only and [2] indicates trend and intercept. (b) Null Hypothesis is unit root (H_0: I (1)) and Alternate Hypothesis is no unit root (H_1: I (0)). (c) Robust t-statistic with a probability value in square brackets of more than 0.05 indicates acceptance of the null at 5% level. (d) Bold and asterisk (*) when reject null. (e) $ln I_{it}$ is logged real investment. $ln Q_{it}$ is logged real output, $ln W_{it}$ is logged real wage and $ln S_{it}$ is logged real exchange rate.

Appendix 2.6 Country and Sector Summary Statistics

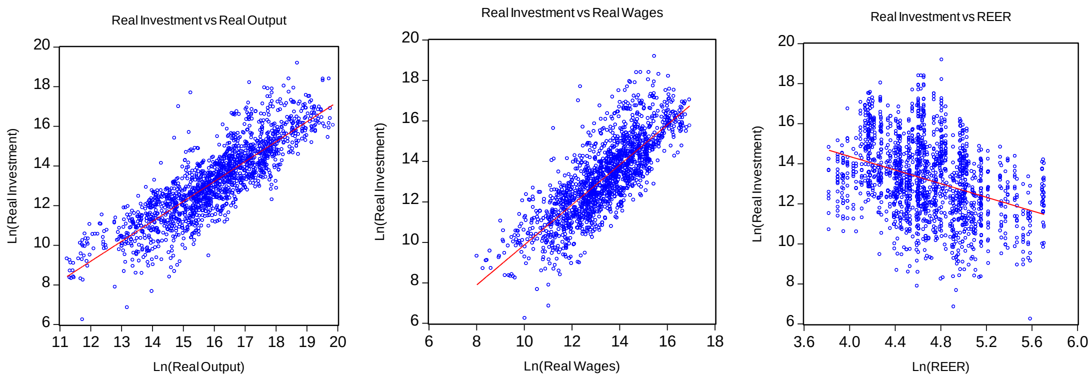
	Real Investment $(ln I_{it})$			Real Output $(ln Q_{it})$			Real Wages $(ln W_{it})$		
Panel/Country/Sector	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
Combined Panel	6.40	0.22	7.04	45.92	2.38	82.17	2.75	0.17	5.14
Latin America	0.82	0.22	1.61	13.38	2.38	32.94	1.04	0.17	2.57
Asia	2.91	6.06	7.04	25.58	26.16	82.17	1.68	1.05	5.14
Chile	0.49	0.00	9.64	8.76	0.48	79.50	0.70	0.05	5.19
Colombia	0.40	0.00	2.40	10.35	0.72	60.30	0.64	0.04	2.96
Ecuador	0.22	-0.19	2.87	2.38	0.07	40.00	0.17	0.01	1.17
India	6.06	0.07	42.80	82.17	4.21	417.00	5.14	0.24	18.90
Indonesia	7.04	0.02	216.00	26.16	0.25	131.00	2.05	0.01	22.60
Malaysia	6.09	0.00	97.80	29.42	0.08	381.00	1.05	0.01	6.19
Mexico	1.61	0.01	8.62	32.94	0.59	177.00	2.57	0.04	11.80
Venezuela	1.39	0.03	20.70	12.49	0.98	75.30	1.14	0.04	4.59
Food products	6.10	0.16	216.00	78.65	7.66	417.00	3.85	0.55	12.70
Beverages	1.16	-0.19	48.30	12.53	1.05	75.70	0.93	0.08	5.51
Tobacco	0.64	0.00	31.30	10.37	0.12	73.10	0.53	0.01	2.98
Textiles	4.58	0.04	68.30	36.37	1.48	256.00	3.49	0.07	18.90
Leather products	0.28	0.00	24.30	2.10	0.07	12.30	0.14	0.00	0.49
Paper products	2.93	0.03	48.20	13.91	0.95	57.60	0.92	0.09	2.81
Industrial chemicals	5.42	0.01	62.50	34.23	0.44	268.00	1.74	0.03	9.48
Rubber products	1.71	0.01	80.90	10.77	0.35	43.30	0.87	0.02	9.28
Plastic products	1.43	0.02	18.50	9.75	0.64	55.90	0.82	0.07	4.23
Iron & Steel	4.87	0.00	42.80	35.42	0.55	254.00	2.20	0.02	12.90
Electrical machinery	4.57	0.00	97.80	40.01	0.37	381.00	3.03	0.02	22.60

Note: (a) The variables are measured in US$ millions.

Appendix 2.7 Investment in Manufacturing and Real Effective Exchange Rates

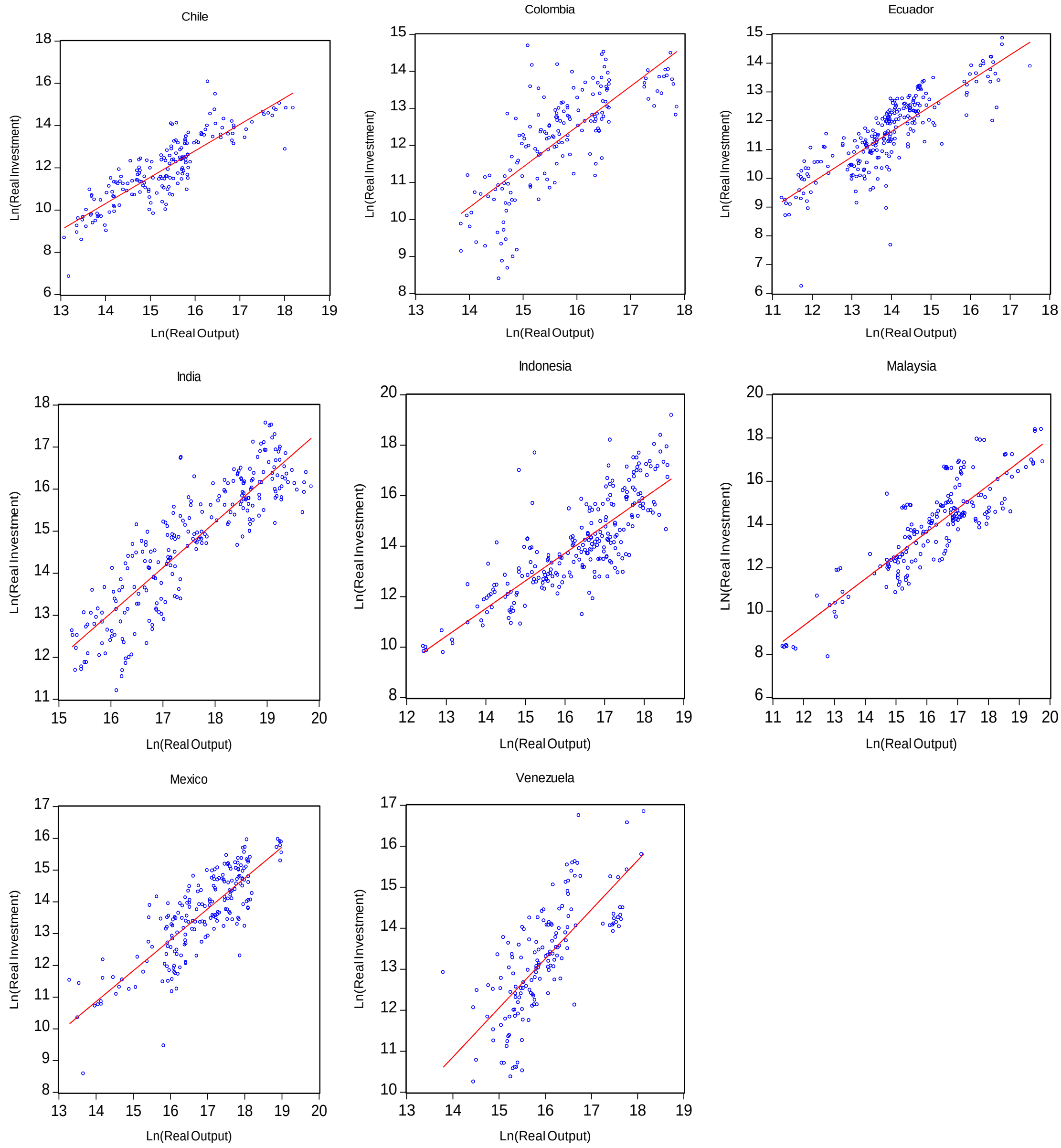
Source: (a) UNIDO, WDI databases and author's calculations. The exchange rate (REER) is defined as foreign currency units per unit of domestic currency.

Appendix 2.8 Scatter Plots of Main Variables



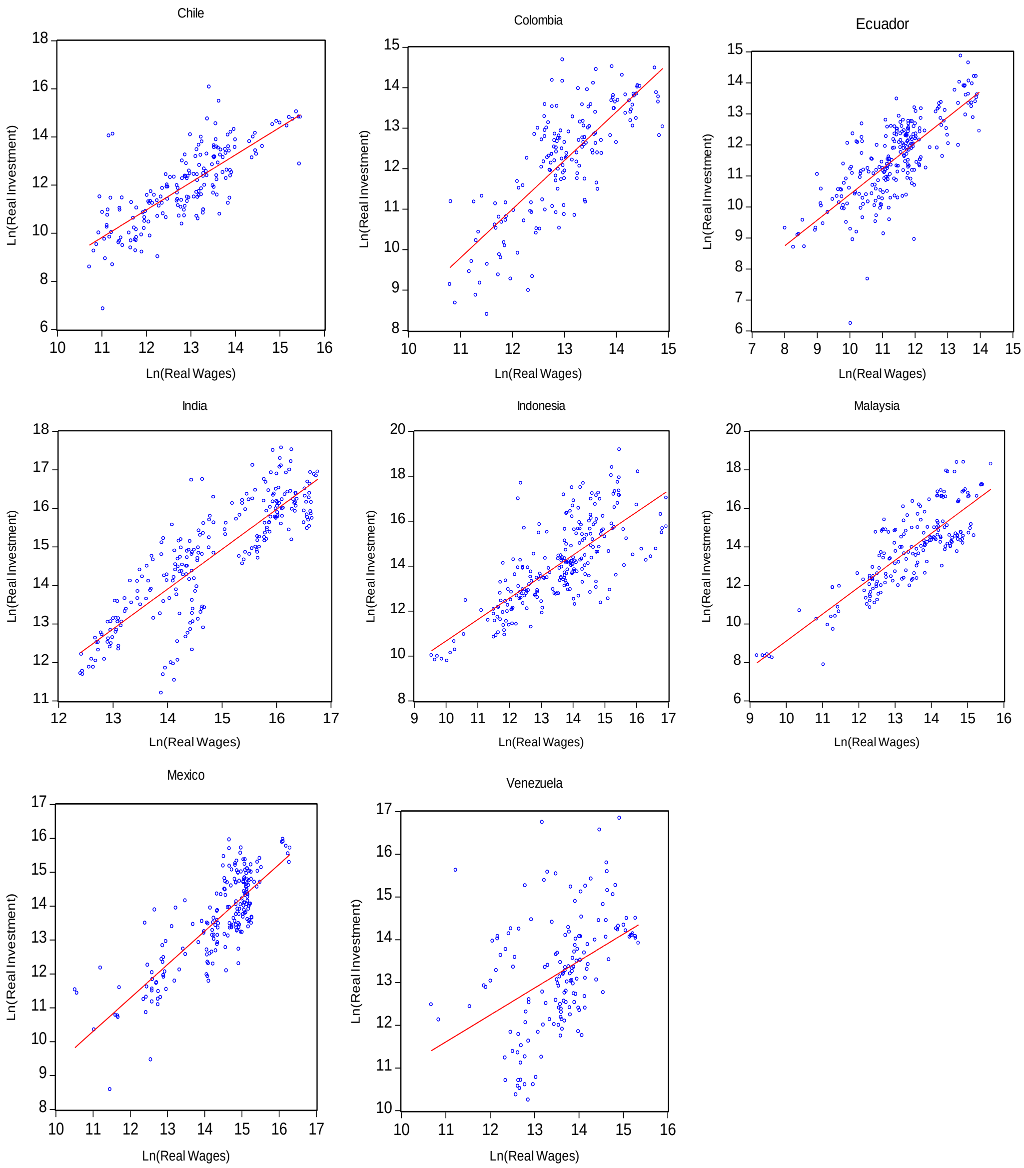
Appendix 2.8 shows the scatter plots of the main variables with a trend line for the combined panel. The first panel posits a positive relationship between real investment and real output in logged terms. The second panel depicts a positive relationship between real investment and real wages but with a steeper slope. The third panel shows the negative relationship between real investment and real exchange rate. In general, this indicates that a depreciation of the domestic currency is associated with a rise in the real investment.

Appendix 2.9 Country wise scatter plots of Real Investment vs. Real Output



Appendix 2.9 depicts the country wise scatter plots of real investment versus real output. All the country panels showed a positive relationship between the two variables. For some countries, the intercept and the slope were higher. This could possibly indicate higher initial (fixed) investment. Whereas, a higher slope is an indication of higher rate of investment in some economies like Venezuela wherein, the investment in oil sector is much larger and boosts the overall investment.

Appendix 2.10 Country wise scatter plots of Real Investment vs. Real Wages



Appendix 2.10 depicts the country wise scatter plots of real investment versus real wages. All the panels show that real investment is positively related to real wages. This implies that a positive effect of rise in wages due increasing productivity levels overweighs the negative effect of the labour costs on investment in our sample of emerging economies.

Chapter 3

Investment and Exchange Rate Volatility in Emerging Market Economies

Chapter Abstract

This chapter investigates the determinants of fixed investment for emerging economies. In particular we employ a panel data approach for eight emerging economies over the period 1980 to 2004 using sectoral industry data. We use a measure of exchange rate volatility based upon GARCH and Components GARCH in our estimation. We endeavour to take account of two issues in our study: cross sectional heterogeneity using Pooled Mean Group Estimation (PMGE) and endogeneity using the Generalized Method of Moments (GMM) approach. The PMGE results show that the response of domestic investment to real effective exchange rate and the permanent component CGARCH measure of volatility is negative in the long run. But after accounting for endogeneity, the positive effect of permanent volatility on investment is prominent and the effect of the level of exchange rate is suppressed. Also we do not reject the null hypothesis of poolability in all specifications from the PMG estimates which implies that the cross sectional estimated coefficients are homogenous.

3.1. Introduction

Emerging Market Economies (EMEs) are often plagued by a high level of macroeconomic volatility. Key macroeconomic indicators like real exchange rates are found to display higher volatility in such economies than in industrial economies (see Diallo, 2007). Phenomena such as exchange rate volatility may impact upon the real economy across the developing world. This leads us to question the relationship between exchange rate volatility and investment and examine the channels through which exchange rate volatility affects investment in developing economies. This chapter attempts to analyze these issues empirically.

Theoretical studies on the link between investment and exchange rate volatility for developed economies have highlighted the options approach; see Dixit and Pindyck (1994) and Darby et al. (1999). By delaying the option to invest in a project, the firm gets a better understanding of the market conditions. The firm makes the investment if the Net Present Value (NPV) of the investment is greater than the value of waiting and delaying the investment. Darby et al. (1999) followed the model by Dixit and Pindyck (1994) and concluded in their empirical work that lower exchange rate volatility does not always lead to an increase in the investment due to opportunity cost involved in waiting. Empirical studies by Goldberg (1993) and Campa and Goldberg (1993) showed that real exchange rate volatility was inversely related to investment in U.S. manufacturing industries and it exhibited a weaker influence on real domestic investment. Their work also emphasizes that exchange rate volatility influences investment through firms' attitude to risk.

The literature relating to emerging economies highlights the mixed effects of real exchange rate volatility on firm level investment. Serven (2003) provides evidence of some effects of the real exchange rate volatility on investment in a panel of emerging economies. According to his study, volatility affects investment only when it exceeds a critical level.

Previous studies have concluded that the theoretical link between exchange rate uncertainty and investment is not explicitly documented in the literature. However, empirically, the effect of exchange rate volatility on investment can be observed through the anticipated fluctuations in the exchange rate, which can be broadly classified into the following channels.

Firstly, volatility in the exchange rate can discourage investment in the short run by increasing the prices of imported capital goods and intermediate goods. This could lead to a fall in the profits of the domestic firms with high costs of capital. Secondly, Dixit and Pindyck (1994) state that volatility in the exchange rates could result in higher adjustment cost in the installation of capital. This is due to imported inputs which could lead to firms to postpone their investment decisions until they perceive a larger critical difference between expected profitability and the adjustment costs. However, some works highlight the positive relationship between macroeconomic uncertainty and investment; see Hartman (1972), Pindyck (1982) and Abel (1983). Hartman states that if a firm faces a linear homogenous production function, then output price uncertainty could lead to increased investment by the firm. Pindyck concluded that in addition to competitive markets, the convex nature of the adjustment cost function determines the positive link between uncertainty and investment. The overall effect of the exchange rate uncertainty on investment is left to empirical testing.

Following works by Bernanke and Gertler (1989) and Krugman (1999), a relatively new strand of empirical literature shows that real currency depreciation in emerging economies can have depressing effect on firms' investment decisions. When a firm resorts to external borrowing, its liabilities are denoted in foreign currency and a real depreciation of its domestic currency results in lower net-worth and investment among those firms. However, real currency depreciation could also boost investment through the export revenue channel. Therefore the net effect on investment is determined by the prevailing influence of either of the channels.

In our paper we examine the empirical link between real effective exchange rate volatility and investment in a panel of emerging economies. This study's major contribution to the existing literature is that the permanent component of volatility negatively influences investment in the long run among emerging economies in our sample. The rest of the paper is organized as follows. Section .3 2 reviews the empirical literature. Section 3.3 describes the data. Section 3.4 presents the empirical methodology. Section 3.5 explains the results and in Section 3.6 the conclusions are laid out.

3.2 Literature Review

For the last two decades there has been a growing interest in studying investment under macroeconomic uncertainty. The underlying intuition of the impact of uncertainty on investment arises from the irreversible nature of investment In this regard, Dixit and Pindyck, (1994) emphasized the options based approach in explaining firm level investment and exchange rate uncertainty. An option for a firm is the difference between Net Present Value (NPV) of an investment project and its current value. As long as a firm's NPV is positive and greater than the value of waiting, the firm will make the investment. But the uncertainty of making the investment could result in the delay of projects, which further leads to a decline in investment. Among several macroeconomic factors, Dixit and Pindyck are of the strong view that firms' options to invest in a project are highly influenced by presence of exchange rate uncertainty. Following a similar approach, Darby et al. (1999) and Goldberg (1993) are of the similar view that uncertainty has a predominant negative effect on investment. However, Darby et al. (1999) also stated that it might be smaller than the effect of the user cost of capital on firms' expected earnings. Caballero (1991) states that presence of both asymmetric adjustment costs and imperfectly competitive markets are essential to the negative relationship between investment and uncertainty due to lower elasticity of demand and higher mark-ups. Empirical work by Ferderer (1993) on the relation between uncertainty and aggregate investment highlights two distinct conclusions. Uncertainty proxied by a risk premium exhibited a significant negative impact upon investment. Secondly, the impact of uncertainty on investment was found to be greater than the effect of cost of capital provided the cost of capital was accurately measured.

In studying investment determinants in emerging market economies, Serven (2003) has investigated factors like liquidity and exchange rate uncertainty. As economies grow and integrate with the rest of the world, their firms are increasingly exposed to external economic factors, of which, exchange rates and uncertainty play a central role. Bond and Estache (1994) studied Latin American and Asian firms that were able to hedge against foreign exchange risks. However, their results suggest that for export oriented firms undertaking investment, hedging against exchange rate fluctuations brought about increased bouts of investment only in the short run.

In this regard, Carruth et al. (2000) have given a detailed survey of the literature on investment under uncertainty. They are of the view that generally the empirical literature has shown that uncertainty has had a significant negative effect on investment in both industrial economies and emerging market economies. Later work by Serven (2003) concluded that the effect of exchange rate volatility on investment in less developed economies is strongly negative and that it might be due to the high non-linearity of the output share of variable inputs, financial market development and trade openness. Investment dynamics at the firm level have been looked at from the open economy perspective only recently. Some of the earlier studies in this regard were done by Goldberg (1993). Campa and Goldberg (1999) have examined the manufacturing industry in the

USA, and the role exchange rate plays investment decisions. Their findings strongly support the significant role of exchange rates in export oriented firms. A study by Guiso and Parigi (1999) concluded that those firms that perceive uncertainty and cannot dispose excess capital stock are likely to experience an inelastic demand for their products which leads to lower investment.

The empirical literature examining the link between exchange rate uncertainty and investment recently gained importance owing to the repeated financial crises in the developing world. Serven (1998) examined the empirical relation between macroeconomic uncertainty and private investment in emerging economies. Various measures of exchange rate uncertainty including basic measures like standard deviation to advanced measures like GARCH measures highlight the negative relationship of exchange rates to investment throughout different econometric specifications. Similarly, Serven (2003) also investigated the empirical link between exchange rate uncertainty and private investment in less developed economies. Uncertainty was represented by the conditional variance from a GARCH (1, 1) process accounted for the persistence in the error terms and results showed that exchange rate volatility was strongly and significantly negatively related to private investment.[23] GARCH measures are employed to account for the non-constant variance over time.

However, some work for the emerging economies provide mixed evidence of real exchange rate uncertainty on investment. Pradhan et al. (2004) investigated the empirical link between real exchange rate volatility and private investment in South East Asia. Their work does not indicate the presence of a long run relationship and therefore employed an error correction model to examine the short run relationship between exchange rate volatility and private investment. It exhibited a strong negative relationship between exchange rate volatility and private investment for Thailand, but this relationship was the

[23] Results indicate that there could even be a positive relation between exchange rate volatility and investment in the presence of low trade openness.

right significance for Malaysia. Hence, their work reported mixed evidence of this relationship in the short run.

A further issue that we consider in our study is the importance of foreign currency debt given that most of the firms in emerging economies resort to external borrowing to finance their investment. Galindo et al. (2003) studied firms in Chile, Colombia and Mexico and reported that foreign currency debt during devaluation periods adversely affected their investment decisions. Similar work by Aguiar (2005) examined the firms in Mexico during the currency crisis period of 1994-95. His work highlighted the balance sheet effect of devaluation in the peso. His results show that export oriented firms with foreign currency denominated debt experienced sharp drops in their net worth during the collapse of the peso. This volatility was reflected onto reduced investment by such firms. It may therefore be necessary to control for the level of foreign debt when examining the relationship between investment and volatility.

3.3. Data

The main aim of this chapter is to explore the empirical relationship between real effective exchange rate volatility $\left(\mathrm{Vol}_{it}\right)$ and investment $\left(I_{it}\right)$ for sector *i*. We have a panel of 11 sectors for 8 countries; Chile, Colombia, Ecuador, India, Indonesia, Malaysia, Mexico and Venezuela and with a time span of 25 years from 1980-2004. Data on nominal gross fixed capital formation, output and wages were taken from the UNIDO database within the ISIC 3 digit classification. Data on $\left(S_{it}\right)$, the exchange rate, is defined as number of units of domestic currency per unit of foreign currency. In our study, the exchange rate index comes from the BIS database, which was constructed based on trade weights. This is advantageous to our entire work as it is consistent with our sector level study of emerging economies as trade weighted indices can capture to some extent the variations in the composition of sectors across different economies in terms of traded and non-traded goods. GDP deflators were taken from the International Financial Statistics (IFS) and data on external debt was taken from WDI. Nominal gross fixed capital formation, nominal output and nominal wages were deflated with the GDP deflator to arrive at their respective real values. The dependent variable in our study is the real gross fixed capital formation. We exclude periods of disinvestment since we log our variables.

The explanatory variables in our study are: Real Output (Y_{it}), Real Wage (W_{it}), Real effective exchange rate (S_{it}), Volatility (Vol_{it}) and External Debt (D_{it}) is denoted in foreign currency terms (US$) as defined in Appendix 3.1. It was selected from the World Development Indicators (WDI) website. From the Appendix The real effective exchange rate (S_{it}) is an index defined as foreign currency units per unit of domestic currency. As in the previous chapter, our measure of the real effective exchange rate was taken from the BIS database, which uses a trade weighted exchange rate index. Hence a rise in (S_{it}) is an appreciation of the domestic currency. To arrive at the different exchange rate volatility measures presented in Figure 3.1, GARCH and Component GARCH estimation was carried out where the difference of the exchange rate follows an autoregressive process: AR (1). The conditional variance as the measure of real exchange rate volatility was extracted from the GARCH model. The CGARCH model decomposed total volatility into temporary and permanent measures that were incorporated as explanatory variables in the estimation. Figure 3.1 depicts the standard deviation measure and the GARCH measure of volatility along with investment for all the eight countries in our panel. Temporary and permanent measures of volatility derived from the CGARCH estimation are plotted against the investment in Figure 3.1 for each of the eight countries in our study. One common observation from the data is that periods of lower exchange rate volatility are consistent with increases in investment among all emerging economies.

Preliminary correlation results presented in Appendix 3.4 shows a high correlation between the level of investment, real output, real wages and debt at levels. However, low correlation between all the variables at first differences makes the data favourable to the estimation procedures carried out in this study.

Figure 3.1 Investment, GARCH and Standard Deviation

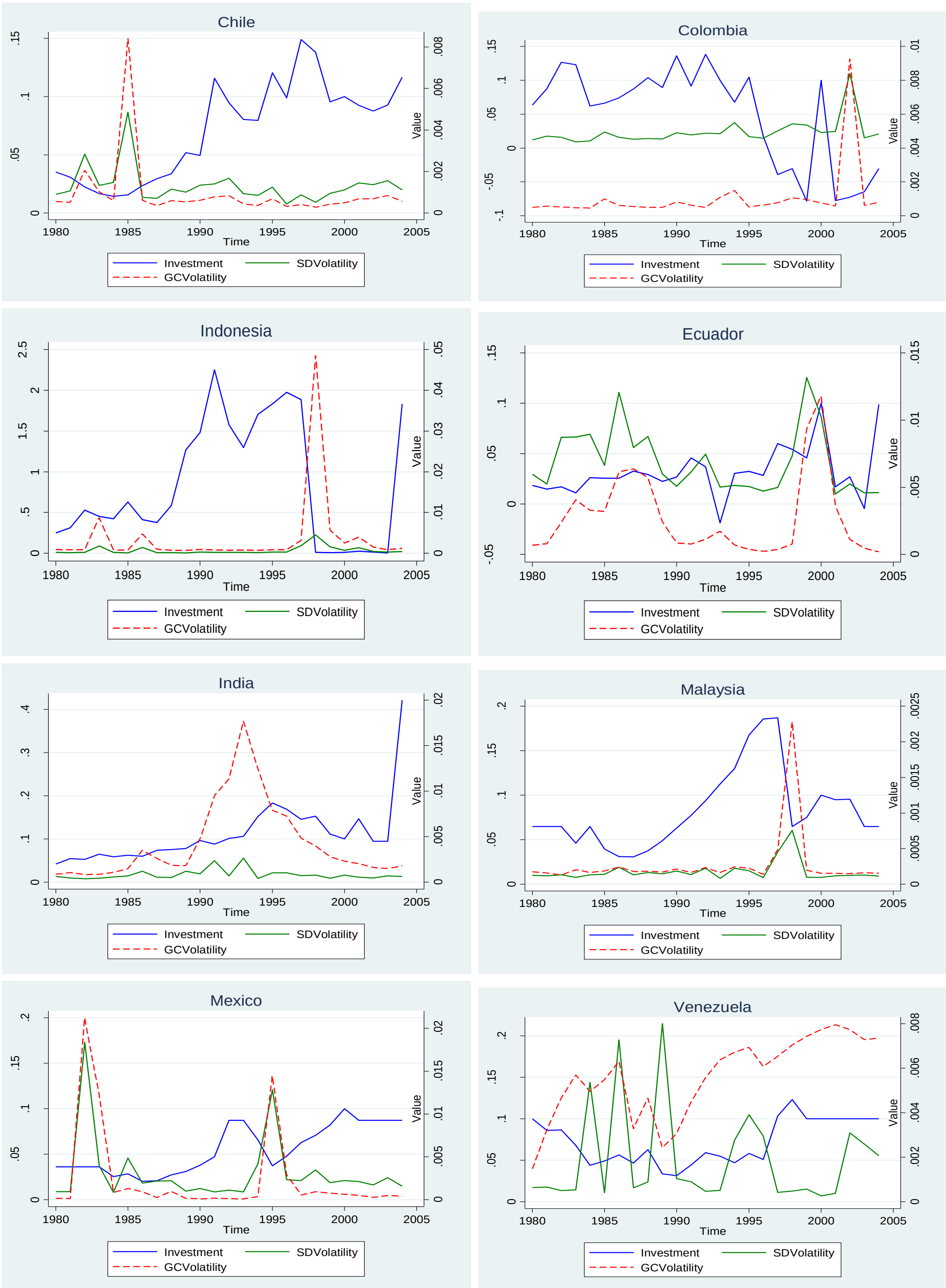
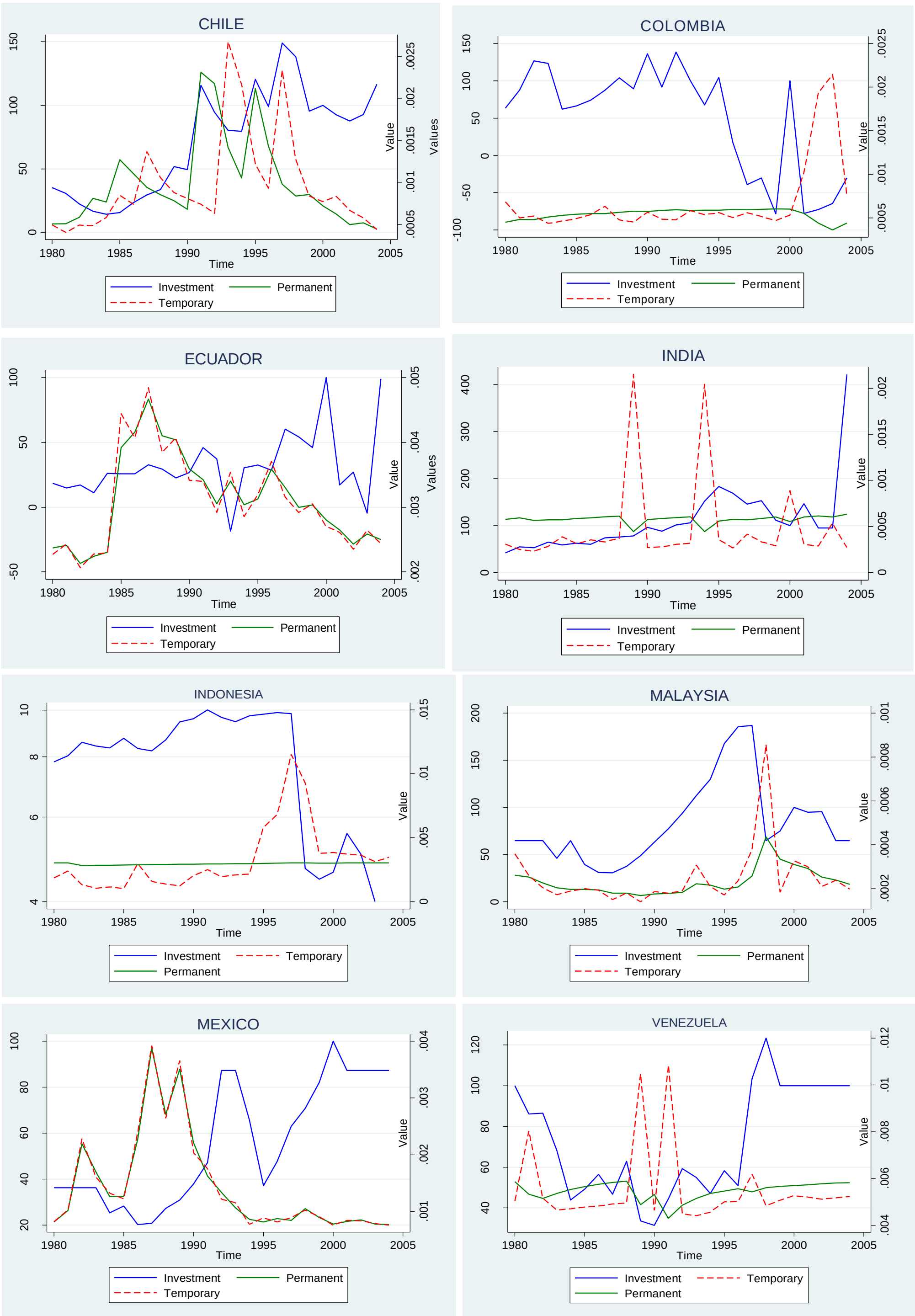


Figure 3.2 Investment, Temporary and Permanent volatility



3.4 Econometric Methodology

In this chapter we employ four different measures of exchange rate volatility to explain its relationship with disaggregate investment across emerging economies in Latin

America and Asia. GARCH measures of volatility are preferred over other methods because they capture the persistence in exchange rates. We also conduct PMG and GMM estimation to examine the determinants of investment in this chapter.

3.4.1 GARCH Volatility Measurement

There are many ways to quantify the concept of uncertainty. The methods are simple standard deviations or variances of the desired series and also time series conditional heteroscedastic models. The common ARCH methodology was introduced by Engle (1982) which was later generalized into the GARCH model by Bollerslev (1986). Since then, these two methods have been heavily employed to quantify uncertainty. Due GARCH models have been the preferred approach to capture the persistence in the volatility of exchange rates by several authors (see Serven, 2003) The general functional form of the conditional mean in the GARCH model is given as

$$\mathrm{E}\{y_t / X_t = x_t\} = x_t\beta \tag{3.1}$$

and the conditional variance of y_t as

$$\mathrm{Var}\{y_t / X_t = x_t\} = \sigma_t^{\ 2} \tag{3.2}$$

Hence the error term is $\varepsilon_t = y_t - x_t\beta$ (3.3)

Bollerslev (1986) expressed the form of GARCH (*p, q*) model in the following way.

$$\sigma_t^{\ 2} = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-j}^{\ 2} + \sum_{j=1}^{p} \beta_i \sigma_{t-j}^{\ 2} \tag{3.4}$$

with ε_t being serially uncorrelated with zero mean, and $\sigma_t^{\ 2}$ the conditional variance that changes through time. For a well defined GARCH (*p, q*) model, all the parameters in the autoregressive process must be non-negative and the roots of the polynomial lie outside the unit circle. That is,

$$\alpha_i > 0 \text{ and } \beta_i > 0 \qquad \forall\ i = 1, 2\ldots q, p \tag{3.5}$$

It follows from this that ε_t is covariance stationary if and only if $\alpha_i+\beta_i < 1$. In our case, we employ a first order GARCH (1, 1) model and hence would require

$$\alpha_i+\beta_i < 1 \tag{3.6}$$

Extending their work on the basic GARCH (1, 1) model, Engle and Bollerslev (1986) state that if the constant can be suppressed to zero and when $\alpha_i+\beta_i = 1$, the underlying GARCH model in equation (3.4) is said to be integrated in variance. Bollerslev (1986) showed that the Lagrange Multiplier test for a *q*th order ARCH is equivalent to the test for GARCH (*i, j*) when $i + j = q$.

Several other authors have modelled volatility or uncertainty using GARCH models including Huizinga (1993), Price (1996) Serven (2003) and Byrne and Davis (2005). Price (1996) examined manufacturing investment in the UK and concluded that uncertainty in output captured by the conditional variance using a GARCH (1, 1) model exhibited a significant negative effect on investment. His work also provided evidence of non-linear adjustments that are significantly affected by uncertainty. Appendix 3.8 presents diagnostic statistics for the equation (3.4). The Log Likelihood (LL) estimates show a strong relation between lagged exchange rates and current conditional exchange rate volatility. Ljung-Box statistics do not show serial correlation and ARCH effects in both, standardised and the squared standardised residuals at higher lags. The fact that the sum of the parameter estimates of $\alpha_i+\beta_i < 1$ in the equation (3.9) are below unity imply that long run mean reversion of conditional variance occurs without much persistence. For Ecuador, India and Mexico, integrated GARCH model was estimated in order to restrict the sum $\alpha_i+\beta_i$ to less than unity.

3.4.2 Component GARCH (CGARCH)

Several authors such as Engle and Lee (1999) and Byrne and Davis (2005) state that the nature of volatility differs from the short run to long run. The conditional variance in the GARCH (1, 1) model reverts to a constant mean for all time. Whereas, the CGARCH model shows a varying mean. Engle and Lee (1999) have represented the conditional variance of the GARCH (1, 1) model developed by Bollerslev (1986) in a modified form as

$$h_t = q_t + \alpha\left(\varepsilon_{t-1}{}^2 - q_{t-1}\right) + \beta\left(h_{t-1} - q_{t-1}\right) \tag{3.7}$$

$$h_t - q_t = \alpha\left(\varepsilon_{t-1}{}^2 - q_{t-1}\right) + \beta\left(h_{t-1} - q_{t-1}\right) \tag{3.8}$$

$$q_t = \omega + \rho q_{t-1} + \varphi\left(\varepsilon_{t-1}{}^2 - h_{t-1}\right) \tag{3.9}$$

where h_t is the conditional variance and q_t is the long run component which follows an autoregressive process. ω is the constant in equation (3.9). $h_t - q_t$ from equation (3.8) is the short run component that explains the difference between the conditional variance and its trend. Also if $0 < \alpha+\beta < 1$, the short run component converges to its mean 0. If $0 < \rho < 1$, the long run component converges to its mean $\left\{\omega/\left(1-\rho\right)\right\}$. Additionally, the model assumes that the long run component is more persistent than the short run component, i.e. $0 < \left(\alpha+\beta\right) < \rho < 1$. However, Byrne and Davis (2005) have stated that CGARCH model assumes symmetry between positive and negative shocks in the manner by which they may affect investment. They state that a negative exchange rate shock may increase the uncertainty. Appendix 3.9 presents diagnostic statistics from the equations (3.7) through (3.9). The Log Likelihood (LL) estimates show a strong relation between lagged exchange rates and current conditional exchange rate volatility. Ljung-Box statistics do not show serial correlation and ARCH effects in both, standardised and the squared standardised residuals at higher lags. The fact that the estimates of ρ in the long run component model are below unity imply that long run mean reversion of conditional variance occurs without much persistence.

3.4.3 Pooled Mean Group Estimation

The nature of available data at sector level for each of the countries in our study, is an unbalanced panel data set. Pesaran et al. (1999) and Schich and Pelgrin (2002) have emphasized the importance of the right choice of econometric methodology in dealing with panel data. Pesaran et al. (1999) have proposed the Pooled Mean Group Estimation (PMGE) approach in handling unbalanced panel data, who state that PMGE is advantageous since it incorporates both long run and short run effects by adopting an Auto Regressive Distributive Lag (ARDL) structure and estimating this as an Error Correction Model. The short run coefficients are estimated by averaging the cross sectional estimates while the long run coefficients are pooled across groups. They also state that irrespective of the order of integration of the dependent variable and the explanatory variables, sufficient lags in the ARDL structure can still trace the effect of the explanatory variables on the dependent variable, and thereby can overcome the problem of spurious regression. Other studies such as Byrne and Davis (2005) and Bahroumi (2005) also have highlighted this advantage. The error correction mechanism integrates the short run dynamics and the long run equilibrium without losing crucial information about the long run. The prime objective of this method is by restricting the long run coefficients to be same across groups; it enables us to test for the homogeneity or in other words poolability of the groups. The null hypothesis of the homogeneity of long run coefficients is tested by a joint Hausman test, which is distributed as χ^2. If the Hausman test statistic is significant with a p-value greater than 0.05, the null is not rejected.

3.4.4 Generalized Method of Moments (GMM) Estimation

When variables are simultaneously determined in an econometric model, there may be endogeneity within the model and one way to deal with it is to make use of valid instruments. Bond (2002) states that the explanatory variable under question may be correlated with current are earlier period shocks but not with future period shocks or be strictly exogenous and uncorrelated with any shocks at all. If the explanatory variable is assumed to be endogenous, then lagged values of upto (t-3) periods would turn out to be valid instruments. This view is also supported by Easterly and Serven (2003). In the case that the explanatory variable is predetermined, then additional (t-1) period lag is available as a valid instrument in the levels equation. Blundell and Bond (1998) state that when estimating autoregressive parameters in dynamic panel models, instrumental variable estimators can be plagued with the problem of weak instruments. But, the system GMM estimator can ensure higher precision.

Sargan tests of orthogonality indicate the validity of the instrumental variables if the probability value is greater than 0.05, in which case we do not reject the null that error terms are uncorrelated with the instruments. Presence of higher order serial correlation can result in inefficient estimates and hence it is critical to test for no serial correlation. m2 statistic tests the null hypothesis of no second order serial correlation respectively in the model. If the p-value is less than 0.05 we reject the null and conclude the presence of serial correlation of the second order. In other words, the model is not misspecified with respect to serial correlation. GMM estimation uses different instrument sets at lags and levels. The system GMM estimation combines both levels equation and first difference equations and we report GMM with (t-3) instruments.

3.4.5 Empirical Investment Model

Following Serven (2003), Pradhan et al. (2004) and Landon and Smith (2007), the empirical long run relationship to be estimated in our study can be laid out in semi-logarithmic terms as follows.

$$lnI_{it} = \theta_{0i} + \theta_1 lnQ_{it} + \theta_2 lnW_{it} + \theta_3 lnS_{it} + \theta_4 \mathrm{Vol}_{it} + \theta_5 lnD_{it} + \varepsilon_{it} \qquad (3.10)$$

Where, I_{it} denotes real investment, Q_{it} denotes real output, W_{it} denotes real wages, S_{it} denotes real effective exchange rate, Vol_{it} denotes the volatility of exchange rate return and D_{it} indicates external debt. From the estimable equation (3.10), we expect the following relationship between the explanatory variables and the dependent variable. Output is an important determinant of investment and therefore its coefficient θ_1 is expected to be positive and significant. Similarly, wages being part of the total cost for the firms, it should have a negative sign because increasing input costs depresses investment. So, we expect the coefficient θ_2 to account for the cost of production effect on investment. The effect of S_{it} and the volatility measure on investment as we have seen from previous literature is debatable and is left to empirical testing. The coefficient θ_3 implies the elasticity of investment to a change in the real exchange rate and thus is expected to capture the imported input cost effect due to changes in the S_{it}. Similarly, θ_4 is the coefficient on the Volatility in S_{it} that is measured by a GARCH (1, 1) conditional variance. The estimated coefficient is expected to be negative as evidenced in the literature. Finally, θ_5 the coefficient of the debt variable is expected to be negative. Rising external debt reduces investment because it would reduce the firm's net worth in the presence of substantial falls in the value of the domestic currency. Consequently, the impact of exchange rate uncertainty may operate through debt, so it is important to control for debt. In this regard, Calvo and Reinhart (2002) have highlighted the fact that typically countries with larger shares of debt denominated in foreign currency might attempt to limit the flexibility of exchange rates. They also note that the largest share of emerging market's external debt is denominated in US dollars. Based upon the cross correlation between debt and exchange rates at -0.51, which is moderate negatively correlated but does not distort our expected results.

3.5 Results

In this section we present the results of the panel unit root tests and later the main results from the dynamic panel estimation of the relationship between investment and exchange rate volatility are presented. To avoid the problem of spurious regression and given that we have an unbalanced panel, it is essential to test for panel stationarity of the variables. Results confirm that the variables in this study were stationary at different specifications. Additional stationarity tests presented in the appendix also confirm that the variables are stationary. Permanent volatility measure turned out to be the most important determinant of investment across our estimation exercises. We now present the results in more detail.

3.5.1 Panel Unit Root Tests

It is essential to check for stationarity in an unbalanced panel in order to avoid the problem of spurious regression. We make use of four different panel unit root tests to check for the presence of a unit root. Results from Im, Pesaran and Shin (IPS) test and Levin, Lin and Chiu (LLC) test at both levels and first differences are presented in Table 3.1. We also present the results from the Augmented Dickey-Fuller (ADF)-Fisher test and the Philips-Perron (PP) test for panel unit root. The length of lags included when implementing the unit root tests are automatically selected by the Akaike Information Criterion (AIC). In Table 3.1 and Table 3.2 the estimates of the unit root tests on the debt variable and the four measures of volatility are presented both at levels and first differences. Real investment (lnI_{it}), real output (lnQ_{it}) and real wages (lnW_{it}) which were checked for stationarity in the earlier chapter were considered. Therefore, in this chapter we only check for the stationarity of the other variables in our estimation. As we can see all the variables are stationary at levels and also at first differences across all the four tests.

Table 3.1 Panel Unit Root Tests

	Levin, Lin and Chu (2002)				Im, Pesaran and Shin (2003)			
	Level		First Difference		Level		First Difference	
	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
lnD_{it}	**-6.16 [0.00]**	**-6.76 [0.00]**	**-58.06 [0.00]**	**-71.76 [0.00]**	**-19.56 [0.00]**	**-19.37 [0.00]**	**-52.70 [0.00]**	**-55.99 [0.00]**
Standard Deviation Measure	**-14.04 [0.00]**	**-16.31 [0.00]**	**-16.54 [0.00]**	**-17.36 [0.00]**	**-25.56 [0.00]**	**-25.99 [0.00]**	**-27.32 [0.00]**	**-27.91 [0.00]**
GARCH Volatility Measure	**-34.39 [0.00]**	**-41.95 [0.00]**	**-9.82 [0.00]**	**-11.00 [0.00]**	**-32.71 [0.00]**	**-33.88 [0.00]**	**-28.76 [0.00]**	**-29.49 [0.00]**
Temporary Volatility Measure	**-38.52 [0.00]**	**-47.30 [0.00]**	**-12.05 [0.00]**	**-13.23 [0.00]**	**-21.97 [0.00]**	**-22.00 [0.00]**	**-33.37 [0.00]**	**-13.23 [0.00]**
Permanent Volatility Measure	**-20.22 [0.00]**	**-24.78 [0.00]**	**-17.22 [0.00]**	**-20.33 [0.00]**	**-22.33 [0.00]**	**-22.39 [0.00]**	**-30.47 [0.00]**	**-31.37 [0.00]**

Note: (a) Specification [1] indicates intercept only and [2] indicates trend and intercept. Null Hypothesis is unit root (H_0 : I (1)) and Alternate Hypothesis is no unit root (H_1 : I (0)). (b) R0bust t-statistic with a probability value in square brackets of more than 0.05 indicates acceptance of the null at 5% level. (c) Bold and asterisk (*) when reject null. (d) ln D_{it} stands for Logged External Debt. (e) IGARCH volatility measures in the case of Ecuador, India and Mexico. (f) Temporary and Permanent volatility measures are derived from the CGARCH models.

(continued) Table 3.2 Panel Unit Root Tests

	ADF-Fisher				Phillips-Perron (PP)			
	Level		First Difference		Level		First Difference	
	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
lnD_{it}	**373.24 [0.00]**	**337.86 [0.00]**	**102.10 [0.00]**	**109.76 [0.00]**	**-19.56 [0.00]**	**-19.37 [0.00]**	**-52.70 [0.00]**	**-55.99 [0.00]**
Standard Deviation Measure	**535.04 [0.00]**	**518.02 [0.00]**	**591.19 [0.00]**	**567.65 [0.00]**	**-25.56 [0.00]**	**-25.99 [0.00]**	**-27.32 [0.00]**	**-27.91 [0.00]**
GARCH Volatility Measure	**679.59 [0.00]**	**690.40 [0.00]**	**636.67 [0.00]**	**615.66 [0.00]**	**-32.71 [0.00]**	**-33.88 [0.00]**	**-28.76 [0.00]**	**-29.49 [0.00]**
Temporary Volatility Measure	**441.12 [0.00]**	**406.52 [0.00]**	**747.14 [0.00]**	**736.11 [0.00]**	**-21.97 [0.00]**	**-22.00 [0.00]**	**-33.37 [0.00]**	**-13.23 [0.00]**
Permanent Volatility Measure	**450.83 [0.00]**	**416.89 [0.00]**	**671.97 [0.00]**	**653.59 [0.00]**	**-22.33 [0.00]**	**-22.39 [0.00]**	**-30.47 [0.00]**	**-31.37 [0.00]**

Note: (a) Specification [1] indicates intercept only and [2] indicates trend and intercept. (b) Null Hypothesis is unit root (H_0: I (1)) and Alternate Hypothesis is no unit root (H_1: I (0)). (c) Robust t-statistic with a probability value in square brackets of more than 0.05 indicates acceptance of the null at 5% level. (d) Bold and asterisk (*) when reject null. (e) ln D_{it} stands for Logged External Debt. (f) IGARCH volatility measures in the case of Ecuador, India and Mexico. (g) Temporary and Permanent volatility measures are derived from the CGARCH models

3.5.2 PMGE Estimates of Investment and Exchange rate volatility

In Table 3.3, we present PMGE regression results for investment under different specifications using four different measures of exchange rate volatility. All the specifications were cross sectionally demeaned in order to account for the common shocks affecting groups in our sample. This is common understanding that similar technology, production processes and sectoral characteristics are prevalent across emerging economies. Exchange rate volatility Vol_{it} was found to have positive coefficients in the long run for both the standard deviation and GARCH specifications. But permanent volatility measure t reflected a significantly negative coefficient. This could be due to the fact that persistence in the exchange rate volatility could have a long run negative effect on investment. This implies that the relationship between exchange rate volatility and investment could be negative if the volatility is permanent in nature. It means that the investors are risk averse, in which case they delay their option to invest once they perceive an uncertain business environment.

The positive signs for exchange rate volatility variable in both the models using standard deviation, GARCH and temporary CGARCH measure are in contrast to several other studies indicating a long run negative relation between exchange rate volatility and investment. If the investors perceive exchange rate volatility in the future periods they would like to add additional capital stock due to the uncertainty of exchange rates which can be magnified through the rise in the cost of imported goods and higher adjustment costs of investment. This result is in line with earlier works by Pindyck (1982), Hartman

TABLE 3.3 Investment and Volatility using PMGE

Volatility Measure	Standard Deviation Measure	GARCH Volatility Measure	Temporary Volatility Measure	Permanent Volatility Measure
Long Run Coefficients				
lnQ_{it}	**0.764*** **(9.74)**	**0.974*** **(10.85)**	**0.828*** **(9.25)**	**0.814*** **(10.57)**
lnW_{it}	-0.082 (-1.34)	**-0.192*** **(-2.83)**	-0.110 (-1.55)	**-0.125*** **(-2.07)**
lnS_{it}	**-1.140*** **(-9.41)**	**-1.021*** **(-5.91)**	**-1.245*** **(-7.80)**	**-1.364*** **(-11.69)**
Vol_{it}	**0.965*** **(3.58)**	**8.844*** **(2.62)**	**12.642*** **(2.86)**	**-9.511*** **(-3.34)**
Short Run Coefficients				
Error Correction	**-0.777*** **(-21.08)**	**-0.586*** **(-14.59)**	**-0.609*** **(-14.73)**	**-0.764*** **(-20.04)**
ΔlnQ_{it}	0.096 (0.57)	0.075 (0.35)	0.061 (0.31)	0.100 (0.57)
ΔlnW_{it}	**0.391*** **(2.48)**	**0.636*** **(3.16)**	**0.743*** **(3.59)**	**0.338*** **(2.05)**
ΔlnS_{it}	**0.375*** **(2.81)**	-0.179 (-0.91)	0.363 (1.23)	**0.623*** **(3.09)**
ΔVol_{it}	0.271 (1.31)	-2.616 (-0.42)	18.387 (1.68)	**13.550*** **(2.60)**
Hausman Test	6.09 [pval=0.19]	6.48 [pval=0.14]	5.48 [pval=0.24]	5.14 [pval=0.27]
No. of Observations	1612	1612	1612	1612
No. of Cross Sections	88	88	88	88

Notes: (a) This table presents Pooled Mean Group Estimates for a panel of the total manufacturing sector. (b) t-values are in parentheses. (c) Sample period is 1980-2004. (d) Asterisk and bold indicates significance at the 5% level. (e) All specifications are ARDL models with lag length determined by the Schwarz Bayesian Information Criteria and data cross sectionally demeaned. (f) Hausman test examines the homogeneity of the long run coefficients of the panel, probability values [pval] less than 0.05 reject the null hypothesis of homogeneity. (g) Logged real investment excluding disinvestment is the dependent variable.

(1972) and Abel (1983) who state that with a convex nature of the adjustment costs in competitive markets, uncertainty could lead to increased marginal profitability and thus result in increased investment.

The coefficient of S_{it} is negative and significant in the long run for all the specifications. This suggests that the effects of exchange rates on investment persist in the long run. This result coincides with the conclusions of several authors such as Campa and

Goldberg (1995, 1999), Nucci and Pozzolo (2001) and Serven (2003), who state that depreciation in the domestic currency will boost investment by the export revenue channel. Thus exchange rates are significant determinants of investment in the long run in emerging economies. The sign on the coefficient of Wages (W_{it}), which are the major input costs were negative throughout all the specifications but was not always significant. This consistent negative sign of the coefficients for the real wages coincides with the findings of several other researchers such as Campa and Goldberg (1995), Alesina, Perotti and Schiantarelli (2002) and Landon and Smith (2007). However, previous studies by Goldberg (1998) have shown that real wages could be correlated with exchange rates for open market economies and hence could produce some varying results.

In the long run as firms grow, they tend to reduce their dependence on labour input, thus gaining more capital intensity invariably as a result of increase in the imported input costs. Alternative cheaper substitutes in the form of imports might also be a factor for the opposing signs of the real wages. Coefficients for real output (Q_{it}) are significant and positive for the long run across all specifications as expected. This indicates the dominant effect of the domestic demand on investment. This result coincides with others such as Nucci and Pozzolo (2001) and Landon and Smith (2007). The Hausman test statistics are small but have high p-values for all specifications. Therefore, we do not reject the null of poolability hence the long run coefficients are homogenous and there are no heterogeneity biases arising from the dynamic panel. From Table 3.3, our preferred specification is the column with the permanent measure of volatility as the key determinant because all the long run explanatory variables confirm to economic intuition and were also significant.

3.5.3 DPD-GMM Estimation

In our attempt to account for potential endogeneity that may arise in the panel estimation because of the fact that several variables are simultaneously determined in the long run, we carried out the system GMM estimation following Bond (2002). Table 3.4 presents the results of the GMM estimation excluding periods of disinvestment throughout the various specifications, the lagged dependent variable was statistically significant and robust. We suspected potential multicollinearity in the initial panel estimates in Table 3.3, but after accounting for endogeneity, the effect of exchange rate volatility on investment is more prominent. However, only the permanent volatility was significant. This particular finding is in concurrence with that of Darby et al. (1999) who state that the firms perceive a bigger opportunity cost in waiting, so a marginal benefit from a rise in the profitability of investment should encourage the firm to invest rather than wait even during periods of uncertainty.

Real Output was not significant across all specifications but its coefficients were positive implying a rise in output often encourages investment activity. Similarly, the Real Wage variable was not significant but had the expected negative sign on its coefficients. This might imply that the cost effect onto investment transmitted through wages is feeble. And the negative sign on the lnS_{it} variable across all specifications implies that domestic currency depreciations boost investment. Sargan test shows that our instrument set is not valid, since the test statistic has a pval less than 0.05 and we can therefore reject the null hypothesis that the error terms are uncorrelated with the instruments. But all the models pass the Hansen test of identification. But, there is a need to consider better instruments that are rather strictly exogenous in order to avoid identification issues. The, m2 statistic for serial correlation has a p-value that is consistently greater than 0.05 throughout all the specifications. Therefore, we do not reject the null hypothesis and conclude that there is no second order serial correlation and that our model is not misspecified with respect to serial correlation

TABLE 3.4 Investment and Volatility using DPD-GMM

Volatility Measure	Standard Deviation Measure	GARCH Volatility Measure	Temporary Volatility Measure	Permanent Volatility Measure
lnI_{it-1}	**0.140*** **(6.814)**	**0.198*** **(7.103)**	**0.232*** **(7.731)**	**0.169*** **(5.940)**
lnQ_{it}	0.754 (1.337)	0.769 (1.163)	0.748 (1.602)	0.762 (1.579)
lnW_{it}	-0.273 (-0.867)	-0.279 (-1.243)	-0.267 (-0.991)	-0.247 (-0.526)
lnS_{it}	-0.453 (0.259)	-0.288 (0.171)	-0.215 (1.194)	-0.277 (1.127)
Vol_{it}	**0.305*** **(2.644)**	**7.980*** **(3.042)**	**10.300*** **(3.927)**	**47.000*** **(2.520)**
m2[pval]	0.255	0.365	0.281	0.219
Sargan [pval]	**0.000***	**0.000***	**0.000***	**0.000***
Hansen [pval]	1.000	1.000	1.000	1.000
No. of Obsvns	1509	1509	1509	1509
No. of Cross Sections	86	86	86	86

Note: (a) IGARCH volatility measure in the case of Ecuador, India and Mexico. (b) The method employed here is the two step system GMM with (t-3) instruments. (c) Heteroskedasticity consistent t-values are in parenthesis. (d) m2 tests for the second-order serial correlation. (e) GMM results are one step and two step (system GMM). (f) Sargan is a test of over identifying restrictions for the GMM estimators, asymptotically follows χ^2. (g) Sample size is 1980-2004 and it excludes disinvestment. (h) Country and Sector dummies are included in the estimation. (i) Logged real investment is the dependent variable.

3.5.4 Investment and External Debt

Krugman (1999) argued that the currency crises among emerging economies in the 1990s displayed different features from the crises of the 1970s and 1980s. This strand of literature on crises is well known as the balance sheet channel that highlights the role of micro factors as an important source of macroeconomic distortions. The balance sheet effect at the firm level operates through currency depreciations mainly in two ways. Firstly, firms with more foreign currency denominated debt should experience a decrease in investment following real currency depreciation as it would erode their net worth and increase the foreign currency denominated liabilities.

Table 3.5 Investment and Debt using PMGE

Volatility Measure	Standard Deviation Measure	GARCH Volatility Measure	Temporary Volatility Measure	Permanent Volatility Measure
Long Run Coefficients				
lnQ_{it}	**0.889*** **(9.468)**	**0.895*** **(9.656)**	**0.894*** **(9.489)**	**0.989*** **(10.800)**
lnW_{it}	-0.124 (-1.703)	-0.107 (-1.503)	**-0.211*** **(-2.857)**	**-0.165*** **(-2.279)**
lnS_{it}	**-1.112*** **(-6.348)**	**-0.838*** **(-4.649)**	**-1.112*** **(-7.154)**	**-1.803*** **(-11.663)**
Vol_{it}	**3.587*** **(3.442)**	**32.197*** **(4.103)**	-0.026 (-0.254)	**-47.620*** **(-4.656)**
lnD_{it}	-0.177 (-1.584)	-0.140 (-1.262)	**3.252*** **(3.649)**	**-0.137*** **(2.897)**
Short Run Coefficients				
Error Correction	**-0.593*** **(-16.462)**	**-0.618*** **(-16.338)**	**-0.615*** **(-15.814)**	**-0.600*** **(-15.332)**
ΔlnQ_{it}	**0.409*** **(2.948)**	**0.317*** **(2.294)**	0.054 (0.281)	**0.356*** **(2.264)**
ΔlnW_{it}	**-0.073*** **(-16.246)**	**-0.066*** **(-16.114)**	**0.608*** **(2.825)**	**-0.099*** **(-15.202)**
ΔlnS_{it}	**0.675*** **(2.907)**	0.405 (1.385)	**0.560*** **(2.405)**	**0.607*** **(2.282)**
ΔVol_{it}	(0.428) (0.513)	-18.68 (-1.706)	0.595 (1.943)	**30.030*** **(3.028)**
ΔlnD_{it}	**0.571*** **(2.004)**	0.404 (1.365)	**2.177*** **(5.135)**	**0.332*** **(2.596)**
Hausman Test	8.52 [pval=0.13]	4.33 [pval=0.50]	1.66 [pval=0.89]	7.01 [pval=0.22]
Number of Observations	1612	1612	1612	1612
Number of Cross Sections	86	86	86	86

Note: (a) This table presents Pooled Mean Group Estimates for a panel of the total manufacturing sector. (b) t-values are in parenthesis. (c) Sample period is 1980-2004. (d) Asterisk and bold indicates significance at the 5% level. (e) All specifications are ARDL models with lag length determined by the Schwarz Bayesian Information Criteria and data cross sectionally demeaned. (f) Hausman test examines the homogeneity of the long run coefficients of the panel, probability values [pval] less than 0.05 reject the null hypothesis of homogeneity.

This is a currency mismatch of liabilities and assets for such firms. Secondly, firms with short term external debt would also experience the same effect due to quicker maturity period.

Several authors have empirically examined this strand of literature for emerging economies. Pratap et al. (2003) studied the balance sheet channel for the case of Mexican firms and found similar empirical evidence. During periods of devaluation, the firms' net worth and investment opportunities are depressed due to increased foreign currency denominated debt. Similarly, empirical work by Aguiar (2005) at the sectoral level in Mexico suggests that the balance sheet effect was evident during the peso crisis of 1994-1995. Large shares of foreign currency debt resulted in sharp drops in net worth and subsequent investment opportunities post devaluation for export oriented firms in Mexico. In our study, we represent this channel by the variable 'external debt' denominated in US$ terms.

In Table 3.5, we have presented results after including the log of external debt $\left(lnD_{it}\right)$ as an additional explanatory variable. Results are also laid out based on different specifications using alternative measures of exchange rate volatility. All the specifications were cross sectionally demeaned in order to account for the common factors across groups in our sample. The estimated long run coefficient on Vol_{it} was negative in the long run for the temporary and permanent component specifications. This could imply that persistence in the volatility depresses investment in the long run. The external debt variable performed reasonably consistently with the negative sign when volatility was split up into permanent component. This suggests that when the nature of exchange rate volatility is persistent in the long run, the external debt has a significant negative impact upon the firms that resort to external borrowing to finance their investment.

This finding coincides with that of Landon and Smith (2007), Campa and Goldberg (1995, 1999), Nucci and Pozzolo (2001) and Serven (2003). The estimated coefficient on Wages (W_{it}), performed reasonably well and was estimated to have a negative sign throughout but was highly significant in the long run only for the specifications using temporary and permanent volatility measures. But growing firms in emerging economies reduce their dependence on labour input, thus gaining more capital intensity. The coefficients of real output (Q_{it}) are significantly positive for the long run across all specifications as expected. The Hausman test statistics indicate that the specifications are not mis specified. They are with high p-values which indicate homogeneity of the long run coefficients across all the groups. Therefore, we do not reject the null hypothesis of poolability of the cross sections and conclude there are not dynamic biases.

3.5.5 DPD-GMM Estimation

Following Bond (2002) we carried out the system GMM estimation to account for endogeneity. Table 3.6 presents the results of the GMM estimation excluding periods of disinvestment and with logged variables. Thereby, the coefficients of the explanatory variables are interpreted in terms of elasticities barring the volatility variable. Throughout the various specifications, the lagged dependent variable was statistically significant. The exchange rate volatility variable was estimated to have positive coefficients and was significant only for the models using GARCH measure and Permanent Volatility measure. This again could be attributed to the reasoning that firms would like to add up capital stock in the wake of perceived uncertainty which could be reflected as a positive effect on the investment. Output variable was not significant across all specifications but was found to have a positive effect on the investment. Similarly, wage costs negatively affected investment although insignificant. This might imply that the effect of input costs on investment transmitted through wages is feeble. Rise in productivity could lead to wage rises which could have a positive effect on the investment activity. The variable representing external debt denominated in US dollars has a feeble, but negative effect on the investment across all the four models. In this regard, our results are fairly consistent with the findings of other works such as Serven (1999), (2003) that firms in emerging economies resort to external borrowing to finance their investment operations, they invariably accumulate debt denominated in foreign currency (in most cases denominated in dollar terms). Over time, rising external debt reduces firms' net worth in the presence of a depreciation of the domestic currency, which further stifles investment activity.

TABLE 3.6 Investment and Volatility using DPD-GMM

Volatility Measures	Standard Deviation Measure	GARCH Volatility Measure	Temporary Volatility Measure	Permanent Volatility Measure
lnI_{it-1}	**0.143*** **(6.829)**	**0.189*** **(6.928)**	**0.190*** **(5.797)**	**0.163*** **(5.940)**
lnQ_{it}	0.871 (0.913)	0.867 (1.142)	0.856 (1.798)	0.813 (1.579)
lnW_{it}	-0.282 (0.200)	-0.280 (0.532)	-0.249 (-0.598)	-0.244 (-0.526)
lnS_{it}	-0.468 (1.414)	-0.119 (1.072)	-0.186 (0.803)	-0.071 (1.127)
Vol_{it}	0.328 (1.270)	**6.970*** **(2.518)**	5.860 (1.492)	**53.400*** **(2.520)**
lnD_{it}	-0.278 (-0.182)	-0.391 (-0.587)	-0.290 (-0.166)	-0.422 (-0.425)
m2[pval]	0.188	0.260	0.286	0.263
Sargan [pval]	**0.000***	**0.000***	**0.000***	**0.000***
Hansen [pval]	1.000	1.000	1.000	1.000
No. of Obsvns	1509	1509	1509	1509
No. of Cross Sections	86	86	86	86

Note: (a) IGARCH volatility measure in the case of Ecuador, India and Mexico. (b) The method employed here is the two step system GMM with (t-3) instruments. (c) Heteroskedasticity consistent t-values are in parenthesis. (d) m2 tests for the second-order serial correlation. (e) GMM results are one step and two step (system GMM). (f) Sargan is a test of over identifying restrictions for the GMM estimators, asymptotically follows χ^2. (g) Sample size: 1980-2004. (h) Time dummies and Country dummies are included in the estimation. (i) Sectors are Foods, Beverages, Tobacco, Textiles, Leather, Paper, Industrial Chemicals, Rubber, Plastics, Iron and Steel and Electrical Machinery.

Sargan test shows that our instrument set is not valid with a pval less than 0.05. Although all the models pass the Hansen test of identification, there is a need to consider better instruments that are strictly exogenous. The m2 statistic indicates a p-value that is consistently greater than 0.05 throughout all the specifications. Therefore, we do not reject the null hypothesis and conclude that there is no second order serial correlation and that our model is not misspecified with respect to serial correlation. Overall, we believe that once the endogeneity in the model has been accounted for, permanent volatility positively influences investment in our study.

3.6 Conclusions

This chapter has attempted to model the determinants of investment for different sectors in key emerging market economies from both Latin America and Asia. We employed the PMGE methodology which allows for short run and long run effects. Confirming with previous works such as Pindyck (1982), our main conclusions are firstly, in the long run, the effect of permanent component of volatility on investment from the mean group estimates is negative. Secondly, the external debt also exerts a negative impact on investment in the presence of exchange rate volatility in the long run. But we must reconcile with the literature along the lines of Hartman (1972), Pindyck (1982) and Abel (1983) that the impact of uncertainty on investment is linked up with the nature of markets. Also we do not reject the long run homogeneity in our study across all the specifications. Any exchange rate shocks arising in that part of the world are believed to affect all emerging economies in that region in our sample.

However, after accounting for endogeneity in the initial model estimations, our results from the system GMM specification showed a positive relationship between permanent volatility, the most significant determinant of investment. Only the lagged dependent variable was found to be statistically significant and positive across the four different specifications. However, one pleasing result is that the sign on the coefficient of external debt variable was negative sign throughout the GMM exercise although being insignificant. Our instruments do not pass the Sargan test of identification as shown by a low p-value. All the four specifications pass the Hansen test but there is still a need to account for better instruments. The models do not exhibit second order serial correlation. We acknowledge the fact that the PMGE results might be plagued by endogeneity issues and therefore some of the true direction of impact of the volatility on investment might be lost. Therefore we reconcile with the PMGE results and are less optimistic about them. However, we would like to make general conclusions in saying that GMM estimators are more relevant given the fact that they overcome the issue of endogeneity that plagued the model when volatility was introduced. Therefore we are more optimistic about the GMM results as they are also more consistent.

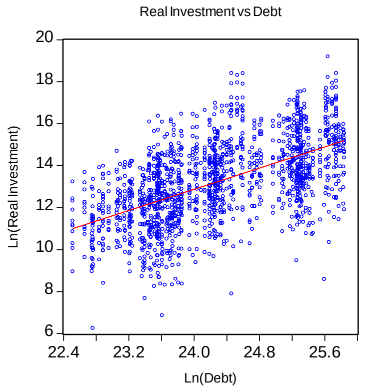
From the policy point of view, our results might actually suggest that real currency depreciation could be beneficial to export oriented firms in emerging economies over a short run, but they need to switch to lower cost of production techniques to maintain their competitiveness in the international market. In addition to that another policy measure for the investors across various sectors would be to diversify their risk in order to minimise the unfavourable effect of exchange rate volatility on investment activities. Along with that a constant check on the external borrowing to finance domestic operations would ensure a productive investment in a risk free environment.

Appendix 3.1 Data Description

Variable	Definition	Source
Investment	Gross Fixed Capital Formation (GFCF)	United Nations Industrial Development Organisation (UNIDO)
Real Effective Exchange Rate (Sit)	Foreign currency per unit of domestic currency.	Bank for International Settlements (BIS)
Output	Total Production	UNIDO
Wages	Wages in US$	UNIDO
External Debt	Total external debt in US$.	World Development Indicators (WDI)
GDP Deflator	GDP deflator index	WDI
Real Investment	Investment/GDP Deflator	Based on author calculations
Real Output	Output/GDP Deflator	Based on author calculations
Real Wages	Wages/GDP Deflator	Based on author calculations
Standard Deviation Volatility Measure	Annualised average standard deviation.	REER from BIS, based on author calculations
Conditional Volatility Measure	GARCH conditional variance	REER from BIS, based on author calculations
Temporary Volatility Measure	Component GARCH volatility	REER from BIS, based on author calculations
Permanent Volatility Measure	Component GARCH volatility	REER from BIS, based on author calculations

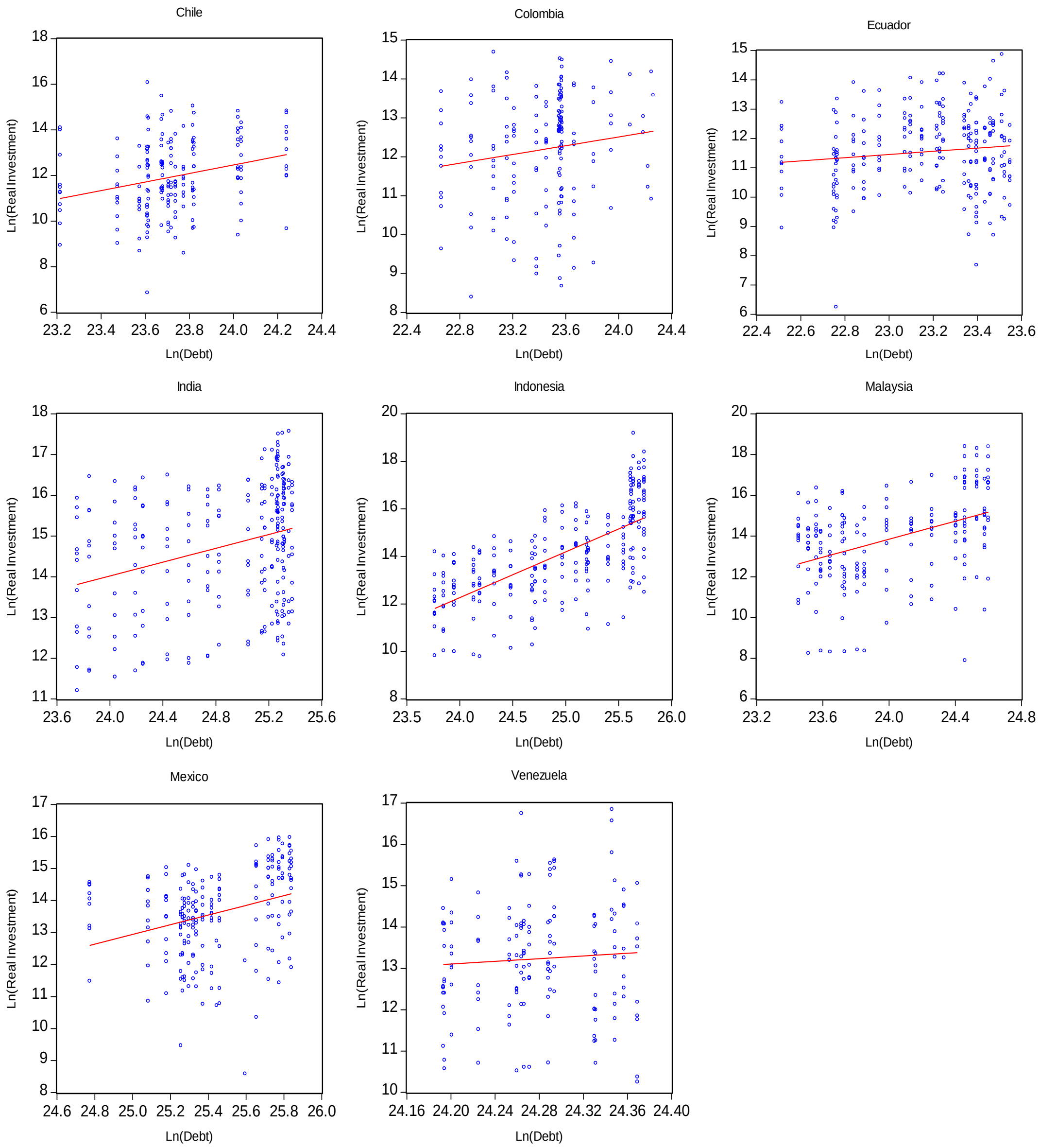
Note: Countries included in this panel study are Chile, Colombia, Ecuador, India, Indonesia, Malaysia, Mexico and Venezuela. Sectors included in this study are Foods, Beverages, Tobacco, Textiles, Leather, Paper, Industrial Chemicals, Rubber, Plastics, Iron and Steel and Electrical Machinery.

Appendix 3.2 Scatter Plot of Real Investment vs. External Debt



Appendix 3.2 above depicts the scatter plot of real investment versus external debt for the combined panel and Appendix 3.3 below depicts the scatter plots of real investment versus external debt for each of the economies studied in this chapter.

Appendix 3.3 Country wise Scatter Plots of Real Investment vs. External Debt



Appendix 3.4 Cross Correlation Matrix of Main Variables at Levels

Variables	lnI_{it}	lnY_{it}	lnW_{it}	lnS_{it}	lnD_{it}	$StdDev_{it}$	$GARCH_{it}$	$TEMP_{it}$	$PERM_{it}$
lnI_{it}	1.00								
lnY_{it}	0.85	1.00							
lnW_{it}	0.80	0.93	1.00						
lnS_{it}	-0.35	-0.42	-0.41	1.00					
lnD_{it}	0.56	0.60	0.58	-0.51	1.00				
$StdDev_{it}$	-0.01	-0.09	-0.07	-0.13	0.03	1.00			
$GARCH_{it}$	0.05	-0.03	-0.03	-0.16	0.13	0.71	1.00		
$TEMP_{it}$	0.02	-0.08	-0.08	-0.15	0.05	0.75	0.94	1.00	
$PERM_{it}$	-0.07	-0.17	-0.16	-0.04	-0.02	0.55	0.56	0.59	1.00

Note: (a) Temporary Volatility Measure and Permanent Volatility Measure are extracted from the CGARCH model.

Appendix 3.5 Cross Correlation Matrix of Main Variables at First Differences

Variables	lnI_{it}	lnY_{it}	lnW_{it}	lnS_{it}	lnD_{it}	$StdDev_{it}$	$GARCH_{it}$	$TEMP_{it}$	$PERM_{it}$
lnI_{it}	1.00								
lnY_{it}	0.18	1.00							
lnW_{it}	0.11	0.42	1.00						
lnS_{it}	-0.07	-0.08	0.09	1.00					
lnD_{it}	-0.02	-0.01	0.03	-0.06	1.00				
$StdDev_{it}$	0.11	0.01	-0.04	-0.30	0.03	1.00			
$GARCH_{it}$	0.10	-0.02	-0.03	-0.50	0.12	0.56	1.00		
$TEMP_{it}$	0.11	-0.01	-0.04	-0.51	0.08	0.61	0.93	1.00	
$PERM_{it}$	0.10	0.44	-0.01	-0.27	0.05	0.42	0.51	0.43	1.00

Note: (a) Temporary Volatility Measure and Permanent Volatility Measure are extracted from the CGARCH model.

In Appendix 3.6 both the ADF and PP tests are presented. They test for the same null hypothesis of the presence of unit root, thus making them comparable. For most of the countries REER was stationary only at first differences under both the ADF and PP tests for alternative specifications of trend and intercept. This implies that REER is integrated of order one. From the GARCH (1, 1) equations are presented. Most of the countries display parameters (alpha and beta) that are positive and their sum $\alpha+\beta$ being less than unity. Ecuador, India and Mexico exhibited high persistence in volatility with the sum $\alpha+\beta$ exceeding unity. Therefore, Integrated GARCH estimation was carried out and the results are reported in Appendix 3.6 correspondingly. Results show that all the exchange rate is stationary at first differences for all the countries in our sample.

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Appendix 3.6 Unit Root Tests on Real Effective Exchange Rate

Country/Test	ADF				PP			
	Levels		First Differences		Levels		First Differences	
	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
Chile	-1.30 [0.88]	-1.53 [0.06]	**-15.02*** **[0.00]**	**-15.00*** **[0.00]**	-1.575 [0.49]	-1.50 [0.82]	**-14.92*** **[0.00]**	**-14.92*** **[0.00]**
Colombia	-1.23 [0.90]	-1.35 [0.08]	**-17.79*** **[0.00]**	**-17.81*** **[0.00]**	-1.46 [0.55]	-1.27 [0.89]	**-17.94*** **[0.00]**	**-17.94*** **[0.00]**
Ecuador	-1.70 [0.74]	-1.86 [0.31]	**-17.08*** **[0.00]**	**-17.07*** **[0.00]**	-1.78 [0.38]	-1.61 [0.78]	**-17.07*** **[0.00]**	**-17.08*** **[0.00]**
India	-2.41 [0.37]	**-3.15*** **[0.00]**	**-13.45*** **[0.00]**	**-12.76*** **[0.00]**	-2.48 [0.33]	**-3.03*** **[0.03]**	**-12.67*** **[0.00]**	**-13.17*** **[0.00]**
Indonesia	-2.06 [0.56]	**-1.85*** **[0.03]**	**-10.81*** **[0.00]**	**-10.82*** **[0.00]**	-1.92 [0.32]	-2.27 [0.44]	**-10.63*** **[0.00]**	**-10.60*** **[0.00]**
Malaysia	-1.98 [0.60]	-0.48 [0.31]	**-14.18*** **[0.00]**	**-14.20*** **[0.00]**	-0.67 [0.84]	-2.37 [0.39]	**-14.31*** **[0.00]**	**-14.30*** **[0.00]**
Mexico	-2.46 [0.34]	**-2.24*** **[0.01]**	**-14.63*** **[0.00]**	**-14.65*** **[0.00]**	-2,44 [0.12]	-2.64 [0.26]	**-14.48*** **[0.00]**	**-14.49*** **[0.00]**
Venezuela	-2.14 [0.52]	**-2.16*** **[0.01]**	**-16.97*** **[0.00]**	**-16.99*** **[0.00]**	-2.18 [0.21]	-2.16 [0.50]	**-17.07*** **[0.00]**	**-17.05*** **[0.00]**

Note: (a) Null Hypothesis is unit root (H_0 : I (1)) and Alternate Hypothesis is no unit root (H_1 : I (0)). (b) Values in parentheses are the respective p-values. (c) * indicates statistical significance at 5% level. (d) Maximum sample size is 300 observations. (e) [1] indicates intercept only and [2] indicates trend and intercept.

Appendix 3.7 Estimates from GARCH (*p, q*) models

	Chile	Colombia	Ecuador	India	Indonesia	Malaysia	Mexico	Venezuela
Conditional Mean								
γ_0	-0.075*	0.001	-0.186*	0.002*	-0.050*	-0.058*	-0.004*	0.003*
γ_1	0.246*	0.315*	0.051*	0.039*	0.373*	0.312*	0.492*	-0.040*
Conditional Variance								
ϕ	0.613*	0.004*	-	-	0.014*	0.005*	-	0.002*
α_1	0.402*	0.705*	0.120*	0.049*	0.562*	0.269*	0.221*	0.009*
β_1	0.593*	0.076*	0.879*	0.950*	0.378*	0.463*	0.778*	0.974*
Diagnostic Statistics								
LL	-684.74	-686.68	-495.29	-734.22	407.37	-853.86	375.08	361.96
Q(1)	2.19	0.18	0.06	0.88	7.49	0.46	1.44	0.45
Q(3)	2.54	0.24	6.06	1.24	8.75	2.00	4.57	8.93
Q(12)	11.61	9.11	19.30	7.95	15.54	8.89	17.26	13.48
Q^2(3)	1.29	0.13	0.79	2.42	0.14	4.74	4.69	0.74
TR^2(4)	1.80	3.81	3.85	2.12	6.77	5.44	4.79	0.10

Note: (a) IGARCH volatility measure in the case of Ecuador, India and Mexico. (b) *p*,*q* represent the order of the GARCH, ARCH terms, respectively. (c) Diagnostic tests are based upon the standardized residuals. LL denotes the maximized log-likelihood value; Q, Q^2 denotes the Ljung-Box test statistic for residual serial correlation and ARCH; TR^2 denotes the test statistic for ARCH. (d) * indicates statistical significance at 5% level.

Appendix 3.8 Estimates from Component GARCH (*p, q*) models

	Chile	**Colombia**	**Ecuador**	**India**	**Indonesia**	**Malaysia**	**Mexico**	**Venezuela**
Conditional Variance								
ϕ	0.003*	0.006*	0.058*	0.015*	0.024*	0.001	0.005*	0.006*
α_1	0.972*	0.358*	0.999*	0.998*	0.998*	0.770*	0.983*	0.556*
β_1	0.451*	0.066*	0.152*	0.346*	0.448*	0.122*	0.419*	0.039*
ρ	0.090*	0.176*	0.163*	0.187*	0.343*	0.136*	0.108*	0.042*
μ	0.011*	-0.272*	-0.381*	-0.659*	0.466*	-0.656*	-0.777*	0.106*
Diagnostic Statistics								
LL	-389.51	-368.84	-310.66	-376.16	-358.95	-395.76	-369.09	254.41
Q(1)	1.53	0.05	0.10	3.03	2.74	1.41	6.99	46.73
Q(3)	2.34	1.44	7.26	3.19	3.14	3.39	9.54	97.04
Q(12)	13.84	10.18	22.80	11.13	12.76	10.24	30.08	28.78
Q^2(3)	0.53	0.49	0.35	3.70	0.77	4.94	9.84	17.88
TR^2(4)	3.56	4.19	3.54	10.85	15.92	12.98	14.75	19.70

Note: (a) conditional mean equation parameters are not presented. (b) *p,q* represent the order of the GARCH, ARCH terms, respectively. (c) Diagnostic tests are based upon the standardized residuals. LL denotes the maximized log-likelihood value; Q, Q^2 denotes the Ljung-Box test statistic for residual serial correlation and ARCH; TR^2 denotes the test statistic for ARCH. (d) * indicates statistical significance at 5% level.

Appendix 3.9 Exchange Rate Volatility Summary Statistics

	Standard Deviation Measure			GARCH Volatility Measure			Temporary Volatility Measure			Permanent Volatility Measure		
Panel/Country	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max
Combined Panel	0.029	0.006	0.225	0.002	0.00008	0.048	0.001	0.0001	0.040	0.001	0.00003	0.012
Latin America	0.033	0.007	0.214	0.002	0.0001	0.021	0.002	0.00003	0.012	0.002	0.0002	0.012
Asia	0.022	0.006	0.225	0.001	0.00008	0.048	0.001	0.0001	0.003	0.001	0.0001	0.040
Chile	0.023	0.007	0.086	0.001	0.0003	0.008	0.0009	0.0004	0.002	0.0009	0.0004	0.002
Colombia	0.022	0.009	0.105	0.001	0.0005	0.009	0.0006	0.0004	0.002	0.0005	0.0003	0.0006
Ecuador	0.041	0.010	0.125	0.002	0.0002	0.011	0.003	0.002	0.004	0.003	0.002	0.004
India	0.023	0.009	0.097	0.000	0.0001	0.001	0.0004	0.0002	0.002	0.0005	0.0004	0.0006
Indonesia	0.042	0.005	0.225	0.003	0.0007	0.048	0.003	0.001	0.011	0.002	0.002	0.003
Malaysia	0.014	0.006	0.060	0.000	0.0001	0.002	0.0002	0.0001	0.0008	0.002	0.0001	0.0004
Mexico	0.029	0.008	0.173	0.002	0.0001	0.021	0.001	0.0007	0.003	0.001	0.0007	0.003
Venezuela	0.050	0.007	0.214	0.005	0.0015	0.008	0.005	0.004	0.010	0.005	0.004	0.005

Note: (a) GARCH models for Chile, Colombia, Indonesia, Malaysia and Venezuela. (b) Models for Ecuador, India and Mexico are Integrated GARCH (IGARCH). (c) CGARCH models denote Component GARCH.

From the Appendix 3.9 above, we can notice the average exchange rate volatility is higher in Latin America than in Asia across all the four measures. Country wise comparisons indicate Venezuela, Indonesia and Ecuador have higher average exchange rate volatility than the rest of the economies in our sample. This is consistent with the fact that Venezuelan economy heavily dependent on oil revenues, often deals with exchange rate volatility. Similarly, higher exchange rate volatility in Indonesia is evident from the fact that its domestic currency was heavily devalued during the East Asian financial crisis. Malaysia had the lowest averages for all the four measures of exchange rate volatility.

Appendix 3.10 Country Variables Summary Statistics

	REER			External Debt		
Panel/Country	Average	Min	Max	Average	Min	Max
Chile	104.55	79.03	184.61	25225.04	12081.24	43803.08
Colombia	114.83	82.58	173.96	22167.70	6940.50	37909.97
Ecuador	159.83	99.50	266.56	12336.28	5997.51	17215.74
India	119.15	93.09	163.35	75672.95	20694.84	124376.61
Indonesia	164.01	71.65	300.89	87612.80	20937.76	151346.84
Malaysia	128.35	94.87	179.45	28626.95	6610.73	52155.74
Mexico	85.80	56.60	114.61	125051.08	57377.61	171162.63
Venezuela	75.47	45.59	116.65	35898.47	29355.62	41953.60

Note: (a) External Debt is measured in US dollars.

Appendix 3.10 shows us the country summary statistics for the exchange rate and external debt. The average exchange rate value for Mexico and Venezuela are lower than any other average values for the other six economies. The external debt figures for Mexico are the highest followed by Indonesia, India and Venezuela, are supported by the fact that Mexican Peso and the Indonesian Rupiah depreciated heavily as a result of the periods of financial instability. A loss of currency value is reflected in the sudden rise in the external debt owed by economies.

Appendix 3.11 PMGE: Panel excluding periods of disinvestment

	Benchmark Model		Extended Model	
	Latin America	Asia	Latin America	Asia
Long Run Coefficients				
lnY_{it}	**1.446*** **(16.75)**	**0.644*** **(4.32)**	**2.158*** **(26.56)**	**0.441*** **(3.02)**
lnW_{it}	**-0.446*** **(-6.67)**	**0.878*** **(7.30)**	**-0.808*** **(-14.71)**	**0.589*** **(4.33)**
lnS_{it}	0.043 (0.68)	**-1.846*** **(-4.24)**	**0.151*** **(4.16)**	**-4.905*** **(-15.59)**
Vol_{it}	-0.006 (-0.23)	0.086 (1.08)	-0.030 (-1.16)	**-0.449*** **(-7.37)**
lnD_{it}	-	-	-0.454 (-1.91)	**-0.540*** **(-2.32)**
Short Run Coefficients				
Error Correction (ϕ)[#]	**-0.933*** **(-28.03)**	**-0.251*** **(-8.77)**	**-0.859*** **(-21.65)**	**-0.250*** **(-4.77)**
ΔlnY_{it}	-0.298 (-1.45)	0.408 (1.12)	-0.252 (-1.46)	0.528 (1.32)
ΔlnW_{it}	**0.332*** **(2.29)**	**0.571*** **(1.99)**	**0.353*** **(2.76)**	**0.571*** **(2.09)**
ΔlnS_{it}	-0.042 (-0.50)	**-1.929*** **(-3.20)**	0.066 (0.94)	**-1.329*** **(-2.18)**
ΔVol_{it}	0.009 (0.66)	-0.255 (1.97)	0.057 (1.93)	-0.255 (0.97)
ΔlnD_{it}	-	-	0.023 (1.36)	-0.153 (-0.89)
Hausman Test	6.89 [pval=0.14]	6.54 [pval=0.16]	8.04 [pval=0.09]	**13.51** **[pval=0.01]**
Number of Observations	954	352	954	352
Number of Cross Sections	55	33	55	33

Note: (a) This table presents Pooled Mean Group Estimates for a panel of the total manufacturing sector. (b) t-values are in parenthesis. (c) Sample period is 1980-2004. (d) Latin American panel consists of Chile, Colombia, Ecuador, Mexico and Venezuela. (e) Asian panel consists of India, Indonesia and Malaysia. (f) Asterisk and bold indicates significance at the 5% level. (g) ARDL lag length is determined by the Schwarz Bayesian Information Criteria and data is cross sectionally demeaned. (h) Permanent measure of volatility is considered in the models in this table. (i) Hausman test examines the homogeneity of the long run coefficients of the panel, probability values less than 0.05 reject the null hypothesis of homogeneity. (j) Logged real investment excluding disinvestment is the dependent variable.

Appendix 3.12 DPD-GMM Estimates of Investment and Volatility.

Variables/Models	[1]		[2]		[3]		[4]		[5]	
	L.A.	**Asia**	**L.A.**	**Asia**	**L.A.**	**Asia**	**L.A.**	**Asia**	**L.A.**	**Asia**
$lnI_{it\text{-}1}$	**0.28*** **(6.82)**	**0.25*** **(4.65)**	**0.52*** **(8.81)**	**0.60*** **(12.0)**	**0.54*** **(7.42)**	**0.60*** **(12.2)**	**0.35*** **(3.12)**	0.04 (0.26)	**0.41*** **(3.05)**	0.11 (0.63)
lnQ_{it}	**0.84*** **(8.11)**	0.18 (0.76)	**0.27*** **(3.82)**	**0.31*** **(3.39)**	**0.25*** **(3.32)**	**0.32*** **(3.57)**	0.88 (2.17)	-0.03 (-0.02)	**0.82*** **(2.10)**	0.09 (0.05)
lnW_{it}	**-0.17*** **(-2.29)**	**0.60*** **(2.76)**	**0.16*** **(2.38)**	0.05 (0.06)	0.15 (2.17)	-0.02 (-0.03)	-0.20 -(0.90)	0.41 (0.35)	-0.05 -(0.30)	1.38 (2.11)
lnS_{it}	**-0.28*** **(-2.67)**	**-5.31*** **(-12.7)**	0.23 (0.21)	-0.67 -(1.94)	0.07 (0.06)	-0.68 (-1.97)	-0.17 -(0.33)	-0.54 -(0.26)	0.05 (0.11)	-0.59 (-0.27)
Vol_{it}	0.01 (0.86)	**-0.62*** **(-7.14)**	**0.10*** **(4.50)**	0.11 (2.27)	**0.10*** **(4.58)**	0.11 (2.16)	0.09 (1.50)	-0.17 (-0.65)	**0.11*** **(2.31)**	-0.22 (-0.77)
m2[pval]	**-**	**-**	0.674	0.361	0.672	0.364	0.857	0.437	0.781	0.484
Sargan [pval]	**-**	**-**	0.236	**0.001***	0.422	**0.001***	0.236	**0.001***	0.422	**0.001***
Hansen [pval]	**-**	**-**	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
No. of Observations	967	341	967	341	967	341	967	341	967	341
No. of Cross Sections	53	33	53	33	53	33	53	33	53	33

Note: (a) Vol_{it} indicates the CGARCH temporary measure. (b) Heteroskedasticity consistent t-values are in parenthesis. (c) [1] is fixed effects, [2] is one step GMM (t-2) specification, [3] is one step GMM (t-3) specification and [4] is two step GMM (t-3) (system) specification. (d) m2 are tests for second-order serial correlation. (e) Sargan is a test of over identifying restrictions for the GMM estimators, asymptotically follows χ^2. (f) Sample size: 1980-2004 and L.A. indicates Latin America. (g) Logged real investment excluding disinvestment is the dependent variable. (g) Time dummies and Country dummies are included in the estimation of all the models.

Appendix 3.13 DPD-GMM Estimates of Investment and Volatility with disinvestment

Volatility Measure	Standard Deviation Measure	GARCH Volatility Measure	Temporary Volatility Measure	Permanent Volatility Measure
$I_{it\text{-}1}$	0.601 (1.323)	0.747 (0.495)	**0.736*** **(12.689)**	0.730 (1.900)
Q_{it}	**0.045*** **(2.341)**	0.055 (0.151)	**0.042*** **(2.000)**	0.042 (0.961)
W_{it}	-0.078 (-1.820)	-0.435 (-0.089)	-0.242 (-0.979)	-0.091 (-0.023)
S_{it}	-100.245 (-1.942)	282.483 (1.756)	823.290 (0.230)	0.402 (1.127)
Vol_{it}	178.522 (1.970)	108.057 (1.864)	0.079 (1.389)	**381.306*** **(2.520)**
m2[pval]	0.999	1.000	0.685	0.999
Sargan [pval]	**0.000***	**0.000***	**0.000***	**0.000***
Hansen [pval]	**0.000***	**0.000***	1.000	**0.000***
No. of Observations	1512	1512	1512	1512
No. of Cross Sections	86	86	86	86

Note: (a) IGARCH volatility measure in the case of Ecuador, India and Mexico. (b) The method employed here is the two step system GMM with (t-3) instruments. (c) Heteroskedasticity consistent t-values are in parenthesis. (d) m2 tests for second-order serial correlation. GMM results are one step and two step (system GMM). (e) Sargan is a test of over identifying restrictions for the GMM estimators, asymptotically follows χ^2. (f) Sample size: 1980-2004. (g) Dependent variable is real investment including disinvestment. (g) Time dummies and Country dummies are included in the estimation. (h) * indicates significance at 5% level.

Chapter 4

Exchange Rate Pass Through To Import Prices: Panel Evidence from Emerging Market Economies

Chapter Abstract

This chapter investigates the size and nature of exchange rate pass through to import prices for a panel of 14 emerging economies. We firstly set out a stylized model in which import prices are dependent upon the exchange rate, marginal cost and the mark up. We employed methods which account for panel heterogeneity, distinguish between long and short run pass through effects and allow for asymmetries. Our results show that import prices respond on average negatively, but incompletely, to movements in the exchange rate. However, there are important differences between Latin America and Asia once we take account of exchange rate asymmetry. Our work also accounts for endogeneity in the model by estimating the dynamic panel data GMM model. Results indicate that with the presence of valid instruments, exchange rate pass through is incomplete but exists in emerging market economies in our study.

4.1 Introduction

The interaction of exchange rates and the prices of traded goods have been extensively studied in the field of international economics (see Isard, 1977, Krugman, 1987, Menon, 1996, Goldberg and Knetter, 1997, and Betts and Devereux, 2001). This chapter examines the extent of exchange rate pass through to import prices in emerging market economies. If pass through is less than complete we have evidence of pricing in the local currency of importers or Pricing To Market (PTM). Incomplete pass through can be due to market structure and product differentiation. In an imperfectly competitive market, firms can charge a mark-up over marginal costs to earn above normal profits in the long run. This mark-up varies depending on the degree of substitution between domestic and imported goods based on the extent of market segmentation (see Krugman, 1987). PTM is important since it can lead to higher exchange rate volatility and a fall in international risk sharing (Betts and Devereux, 2001), both of which emerging economies may be particularly prone to.

There has been some work examining the extent to which pass through occurs for industrialized countries. For example, Menon (1996) studied the exchange rate pass through to the import prices of motor vehicles in USA, taking account of non-stationarity. His findings show that exchange rate pass through is incomplete, even in the long run. The possible explanation is two fold: the presence of quantity restrictions and pricing practices by multinational firms. In the 1990s, many emerging countries had undergone liberalization of trade restrictions, increased openness and the shift to market determined exchange rate system. This resulted in substantial fluctuations in their respective domestic currencies vis-à-vis the US dollar. Indeed exchange rate fluctuations may have contributed to the changing structure of trade among emerging economies (see Campa and Goldberg, 2004).

The effect of exchange rate fluctuations on emerging market trade patterns is an interesting case study. Consequently this paper examines the relationship between import prices and the exchange rates among emerging economies in Asia and Latin America. In particular, we would like to test the extent of exchange rate pass through on import prices.

This paper seeks to make three important contributions to the literature. Firstly, using a stylized model we examine a panel data set of Asian and Latin American countries. Secondly, this study extends the existing literature by examining exchange rate pass through for a panel of emerging economies using the Pooled Mean Group Estimation. This allows us to differentiate the short and long run impact of exchange rate pass through on the import prices in a panel context and also statistically test whether individual countries respond equivalently. Thirdly, we seek to extend the literature on asymmetric responses of import prices to currency appreciations and depreciation to a panel setting. Previous studies conducted by Webber (2000), Bahroumi (2005) and Khundrakpam (2007) have dealt with asymmetric pass through either in a single country or have considered individual country estimation.

The rest of the paper is organized as follows. Section 4.2 describes the empirical literature. Section 4.3 lays out the model and explains the channels of transmission of the exchange rate pass through to import prices. Section 4.4 discusses the data and Section 4.5 outlines the empirical methodology. Section 4.6 explains the results and in Section 4.7 the conclusions are laid out.

4.2 Literature Review

The existing literature on exchange rate pass through to prices can be delineated into three different strands. First generation models based on the Law Of One Price (LOOP) explicitly modelled domestic price as a function of exchange rates, see for example Isard (1977) and Goldberg and Knetter (1997). These models imply that deviations from the Law Of One Price (LOOP) could explain, to some extent, incomplete pass through. Second generation models modelled exchange rate pass through by employing the lagged values of the exchange rates as explanatory variables (for example, see Ohno, 1989). Such an approach may reflect only strategic pricing behaviour of firms as they ignore the role of tradable input costs on the extent of pass through. The third generation models did not necessarily assume perfect competition by utilising Pricing To Market (PTM), thereby capturing low pass through (see Athukorala and Menon 1994, Menon, 1996 and Doyle, 2004). Krugman (1987) suggested PTM could arise due to difference in international trade standards or imperfect competition. Researchers have either hypothesized a full pass through effect underlying the assumption of perfect competition (price takers). Or alternatively have assumed imperfect competition and have modelled export prices based on PTM or local-currency pricing mechanism.

Therefore, PTM is useful rationalising incomplete exchange rate pass through. In this regard, Marston (1990) studied the pricing behaviour of Japanese exporting firms. He finds strong evidence of pricing to market since Japanese exporters will charge a different export price in yen relative to domestic prices. Also, Marston finds that PTM was not linear, since the price differential was higher during periods of appreciation of the yen. He concluded that the firms resorted to pricing to market behaviour in a planned manner to maintain their export price competitiveness. Menon (1996) provides evidence of incomplete exchange rate pass through for the small-open economy case of Australia, taking account of potential data non-stationarity. Indeed, his findings show that exchange rate pass through is incomplete even in the long run. He suggests incomplete pass through is due to the presence of quantity restrictions and pricing practices by multinational firms. Furthermore, Wickramasinghe (1999) studied the exchange rate pass through phenomenon in Japanese manufacturing import prices taking account of nonlinearities. He found strong evidence of significantly different degree of pass through from appreciation and depreciations of the yen.

Taylor (2000) examines the extent of pass through from, for example, exchange rate changes to import prices, in a low inflation environment, like the Great Moderation. He maintains that lower exchange rate pass through may occur due to lower inflation rates and this represents a decline in the pricing power of firms. A recent study on the causes for lower pass through was conducted by Giovanni (2002) who examined the response of American manufactured import prices to changes in exchange rates. His results indicated a low exchange rate pass through in the nineties which implies that appreciation of the U.S. dollar was not translated into a reduction in import prices. However, he also claims that the costs of advertising and other allowances were not represented in the true unit price of imports. Another recent study on Norwegian import prices was conducted by Bach (2002). He re-examined the robustness of the results in Naug and Nyomen (1996) and concluded that differences in the data and construction of variables contributed to the differences in the results. Bach's work does not support the hypothesis of a pricing to market effect and suggests that long run pass through of changes in exchange rates and import prices are complete.

However, there has been only a limited amount of literature differentiating the short run and long run impact of the exchange rate pass through on the import prices across emerging economies. Sahminan (2002) examined the exchange rate pass through among South East Asian countries adopting an error correction approach. His results showed that in the short run for Thailand, domestic demand and foreign price had a significant effect on import price. But for Singapore, only the foreign price had significant impact on import price. Whereas, the exchange rate did not display significant effect on import prices for both the countries in the long run.

It is another question whether exchange rate rises or falls have an equivalent impact on import prices (P_t^M). Asymmetries in exchange rate pass through for many Asian currencies were highlighted by Webber (2000) who concluded that it did not transmit the fall in import prices after the crisis as they had done during the crisis. A recent study by Khundrakpam (2007) who investigated the exchange rate pass through phenomenon to domestic prices in India during the post reform period (i.e., since 1991), found no clear evidence of a decline in the degree of pass through rate. He also concluded that there existed an asymmetry of pass through during the reform period. This could have been due to several factors including increased liberalisation, lower tariffs and quantity restrictions on trade. Apart from these, rising inflation expectations during the late nineties also contributed to the higher pass through in the long run.

The notion that monetary policy influences exchange rate pass through was also evidenced by Ito et al. (2005) who dealt with the exchange rate pass through effects to import prices, producer prices and consumer prices for a few East Asian countries. Their main findings are that firstly, crisis affected countries like Indonesia, Korea and Thailand exhibited large pass through rates to domestic prices. Particularly for Indonesia, both short run and long run pass through rates were found to be large. However, monetary policy changes also had contributed to the pass through of exchange rates to consumer prices in Indonesia.

A recent study on the exchange rate pass through phenomenon to import prices for four Asian countries, viz., Korea, Malaysia, Singapore and Thailand was done by Kun and Zhanna (2008). Their results are that firstly, the degree of pass through is different across countries which highlight the importance of heterogeneity. Singapore exhibited higher exchange rate pass through, which could be due two following. Exchange rate targeting results in lower exchange rate volatility and subsequently higher trade openness. Higher trade openness could get translated into higher pass through rates onto import prices.

Secondly, in general, degree of exchange rate pass through was higher on import prices, medium on producer prices (PPI) and low on consumer prices (CPI).

There are several other mechanisms through which exchange rate pass through might be affected and this is acknowledged by (McCarthy (1999), Choudhri and Hakura (2001), Frankel et al (2005), Devereux and Yetman (2003) and Khundrakpam (2007)). Firstly, firms perceive increases in the cost of production that are more persistent in an environment with high rate of inflation and its volatility, which could lead to higher pass through. However, on the contrary, improved credibility and effectiveness of monetary policy in maintaining a low inflation regime will lower the pass-through, as inflation is anchored at a lower level. Firms are thus less keen to alter prices arising from shocks on cost, as they believe that monetary policy will be successful in stabilising prices. Secondly, while McCarthy (1999) and Frankel et al (2005) argue for a negative relationship, Choudhri and Hakura (2001) and Devereux and Yetman (2003) support a positive relationship between the volatility of exchange rate and the pass through. Thirdly, the larger the share of imports in the consumption basket (the higher the import penetration ratio) the greater the pass-through would be. Also, the greater the proportion of imported inputs in production, the greater the impact of the exchange rate on the producer’s price will be.

Thus, higher the degree of openness of an economy (larger presence of imports and exports), the larger the pass-through coefficient. Fourth, the composition of imports also affects the aggregate pass-through, as the degree of pass-through differs among various categories of imports. For example, pass-through to manufactured products is found to be less as compared to energy and raw material products. Thus, a rise in the share of the former and a fall in the shares of the latter will lead to lower aggregate pass-through even when the pass-through to individual components remains the same. Fifth, trade distortions, resulting from tariffs and quantitative restrictions, act as a barrier to arbitrage of goods between countries and lead to lower pass-through. Also, in the presence of asymmetry, the pass through would depend upon the period of appreciation, depreciation and the size of exchange rate changes during various sub periods. Finally, even factors such as income and transportation costs are also postulated to have a negative effect on pass through.

In addition, if the number of exporters is large in number relative to the presence of local competitors, the exchange rate pass through might be affected by a number of factors. The foreign exporter would set a price in dollars for a delivery at a future date and leave this price unchanged even if the dollar-local currency exchange rate moves between now and the delivery date. The export is then invoiced in dollars, and the price is held constant in dollars. This example represents a case of zero pass-through into import prices in the domestic country, as the dollar price paid by the importer is insulated from near-term exchange-rate fluctuations. An alternative scenario would be for the exporter to allow the dollar price of his goods to reflect exchange-rate movements. This case represents complete exchange-rate pass through, as a depreciation of the dollar creates a proportional rise in the dollar price for the imported goods. While invoicing and exchange-rate pass through need not be tied, they are in practice, with the currency of invoicing also being the currency in which prices are held steady. For instance, a foreign exporter invoicing in dollars not only writes a price in dollars on the contract, but also keeps this price steady in the face of exchange rate movements. Some of these factors such as the effect of invoicing in dollars on the extent of exchange rate pass through, differentiating the impact of pass through between manufactured items and energy and raw materials would be difficult to test for a set of emerging economies as would the effect of trade distortions and tariffs on pass through given the paucity of data.

In some countries much of the imports and exports are invoiced in dollar terms. One of the arguments for invoice currency selection centres on industry characteristics, and in particular stresses that single currencies may be selected for use in the pricing and invoicing of homogeneous goods. It was argued by McKinnon (1979) that industries where goods are homogeneous and traded in specialized markets are likely to have transactions invoiced in a single low transaction cost currency, which invariably would be the US dollar. Krugman (1980) pointed to the presence of inertia in the choice of currency used for this pricing and discussed the disincentives against deviating from the industry norms.

Once a currency acquires prominence, perhaps because of low transaction costs, it may keep this role even if another currency with similarly low costs emerges. Goldberg and Tille (2006) highlighted the industry composition, in particular the extent to which country exports are in homogeneous goods (like commodities) that tend to be reference priced or traded in organized exchanges explain a large part of the remaining gap for using the dollar as an invoicing currency. Country exports to the United States and to other dollar bloc countries explain much of the cross-country variation in dollar invoicing. Overall, the U.S. dollar is likely to maintain its key role as an invoice currency in international transactions. This role is directly tied to the share of the US market as a destination for world production, to the size of dollar bloc countries outside of the United States, to the importance of global trade in commodities and homogeneous goods relative to total trade (which had been declining over time), and to transaction costs that continue to support using the dollar over the euro as a vehicle currency for transactions.

Having discussed the various mechanisms of exchange rate pass through we present the theoretical model and then discuss the empirical approach.

4.3 Theoretical Model

Our model of import price determination closely follows the previous literature by Fujii (2004), Bailliu and Fujii (2004) and Khundrakpam (2007). This allows for a role for the exchange rate, general costs and also the mark-up, in the determination of import prices. In an imperfectly competitive market, the representative foreign firm exports its product to a domestic country. The domestic firm's demand function is expressed as $Q_t\left(P_t^M, P_t^d, E_t\right)$, P_t^M is the price of imported good in domestic currency, P_t^d is the price of the domestic competing good and E_t is the total expenditure on all goods. The total cost of production depends upon output (Q_t) and the inputs (W_t). We can outline a linear relationship for import prices (P_t^M) based upon the static profit maximisation problem of the foreign firm:

$$\underset{P_t^M}{Max}\ \Pi_t^f = S_t^{-1} P_t^M Q_t - C_t\left(Q_t, W_t\right) \tag{4.1}$$

Where, $C_t\left(Q_t, W_t\right)$ is the firm's total cost that is a function of the output (Q_t) and the input costs (W_t). In the model, the exchange rate $\left(S_t\right)$ is defined as domestic currency units per unit of foreign currency. Therefore a rise in S_t indicates a domestic currency depreciation. The term Π_t^f denotes profits accrued by the representative foreign firm expressed in the foreign currency. The nominal exchange rate is defined as domestic currency units per unit of foreign currency.

The foreign firm chooses import prices such that it maximises profits. Hence, maximising equation (4.1) with respect to import price P_t^M gives the first order condition as:

$$\frac{\partial \Pi_t^f}{\partial P_t^M} : S_t^{-1} Q_t + S_t^{-1} P_t^M \left(\frac{\partial Q_t}{\partial P_t^M}\right) - \left(\frac{\partial C_t\left(Q_t, W_t\right)}{\partial Q_t}\right)\left(\frac{\partial Q_t}{\partial P_t^M}\right) = 0 \tag{4.2}$$

where, $\left(\partial C_t\left(Q_t, W_t\right) / \partial Q_t\right)$ denotes the marginal cost (MC_t). Therefore, following the derivation in the appendix, the first order condition can be rewritten to provide a function of import prices:

$$P_t^M = S_t MC_t \mu_t \tag{4.3}$$

Where μ_t is the mark-up in the domestic country over the marginal cost, and is defined as $\mu_t = \eta_t / (\eta_t - 1)$, while η_t is the elasticity of demand for output. Therefore, price in each market is determined in part by the respective mark-up over the marginal cost.

As previous works such as Marston (1990), Pollard and Coughlin (2004) and Campa, Goldberg and Minguez (2005) have shown, the phenomenon of exchange rate pass through occurs by the simultaneous transmission of changes in marginal costs and mark-up factors via the exchange rates onto import prices. Firstly, depreciation in the domestic currency should increase the foreign currency price of imports, thereby raising domestic import prices. Secondly, a rise in the marginal costs in foreign currency terms should also lead to an increase in import prices through the cost channel as the firms would be looking to recover the cost of production by charging higher prices. Thirdly, based on pricing to market by the foreign firms, any increase in the mark-up factors would be associated with a rise in the domestic demand and this would be translated into a rise in the import price. It is also an empirical matter as to whether each of these factors has an impact upon import prices, whether the effect is similar across countries, equivalent in the long and short run and linear. We now examine the data in this regard.

4.4 Data

We examine pass through from exchange rate to import prices in 14 emerging economies: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, India, Indonesia, Malaysia, Mexico, Pakistan, Philippines, Thailand and Venezuela. The sample period is 1980-2004. The variables included in our study are import prices, nominal effective exchange rates, a foreign marginal cost measure, domestic demand measure as a proxy for mark-up factor and the locally available import substitute goods price index. Data availability can be limited when studying emerging economies. Table 4.7 shows the summary statistics for our key variables, aggregated across combined panel, region wise panel and countries. Data on import prices (P_t^M) was taken from IMF *International Financial Statistics* database with a common base period of the year 2000 = 100. Import prices are measured in domestic currency terms. Nominal Effective Exchange Rate (S_t) index for each of the countries in our sample was also taken from IMF *International Financial Statistics* database and rebased to the year 2000 = 100. The Nominal Effective Exchange Rate is the weighted average of the bilateral exchange rate defined as the number of units of foreign currency per unit of domestic currency; therefore an appreciation of the domestic currency is a rise in S_t. As Ito et al. (2005) and Wickremasinghe and Silvapulle (2001) point out the importance of changes in import composition across diversified trading partners in examining the movement of the exchange rate pass-through over time, nominal effective exchange rates are preferred to bilateral rates.

A measure of foreign marginal costs is difficult to obtain, especially for emerging economies. In this regard several authors such as Bahroumi (2005), Khundrakpam (2007) and Fujii (2004) have shown that proxies for foreign marginal cost measures (MC_t) can be constructed from a measure of the wholesale price movements of the major trade partners of any country.[24] We followed this method in our study. Some studies (see Khundrakpam, 2007, and Bahroumi 2005) on exchange rate pass through have constructed the domestic mark-up factors (μ_t) using measures of elasticity of demand. Therefore mark-up factors indirectly depend upon domestic demand conditions. Indices of domestic demand such as

[24] Foreign Marginal Cost (MC_t) is constructed by removing the Nominal Effective Exchange Rate ($NEER_t$) and domestic Wholesale Price Index (WPI_t) from the Real Effective Exchange Rate ($REER_t$). Hence, MC_t = ($REER_t \times WPI_t$)/$NEER_t$. The exchange rate is defined as number of units of foreign currency per unit of domestic currency. In our study both the indices $REER_t$ and $NEER_t$ are based on unit labour costs as given in Bank for International Settlements database and WPI_t was given in the IMF *International Financial Statistics*. Therefore a rise in the marginal cost indicates a rise in the import prices. Bailliu and Fujii (2004) have adopted a variation of the above using country specific unit labour cost measures.

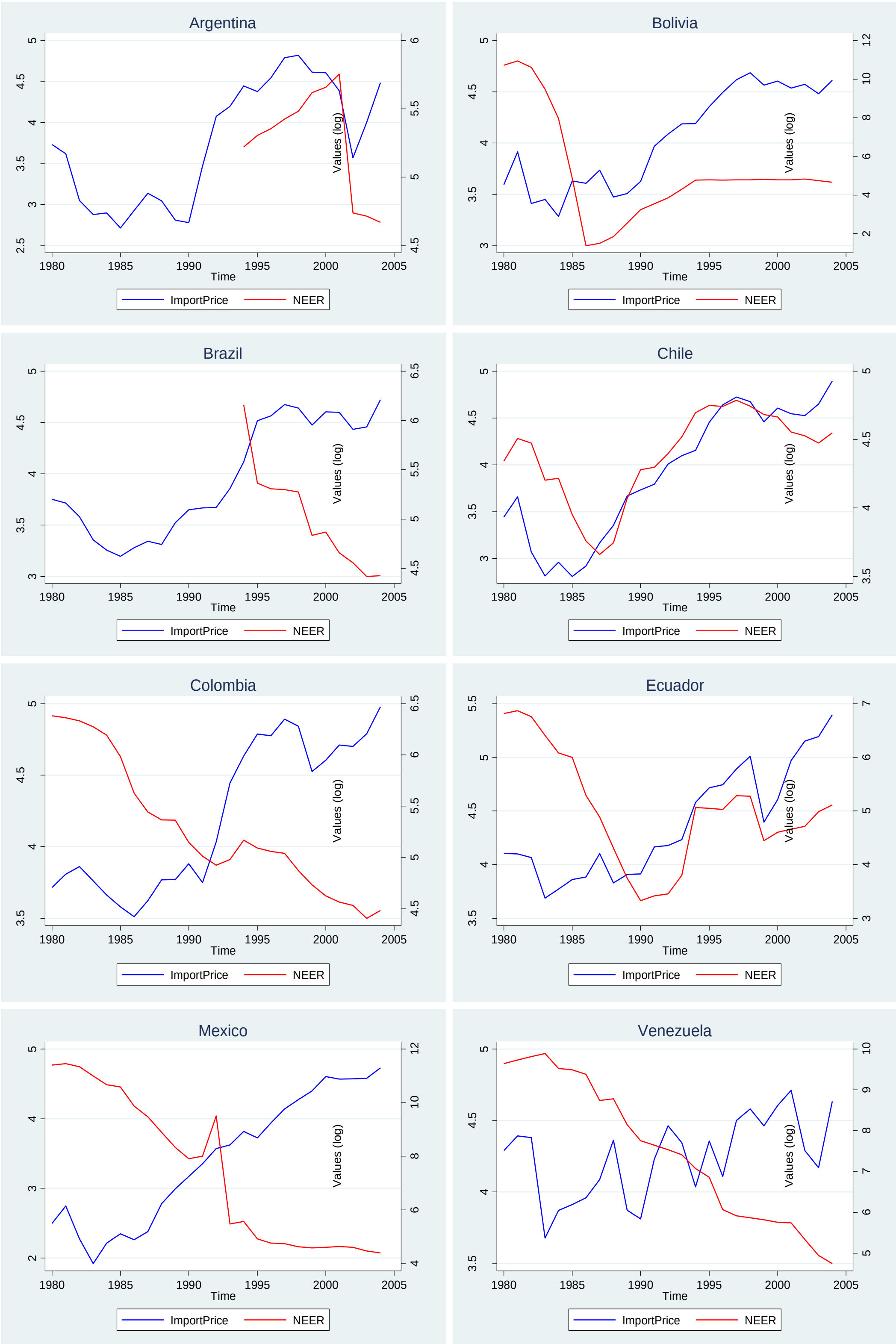
industrial production were employed by Khundrakpam (2007) and Gross Domestic Product in Bahroumi (2005). We considered Gross Domestic Product as proxy to represent domestic demand (E_t) in our study. It was taken from the World Bank *World Development Indicators* database. Figure 4.10 shows the scatter plots with trend-lines for the main variables in this study. Import prices lnP_t^M and Nominal Effective Exchange Rate $ln\,S_t$ are inversely correlated implying depreciation in the S_t will lead to a rise in the domestic currency price of imports. lnP_t^M is positively correlated to foreign marginal costs $ln\,MC_t$, which imply that import prices rise with rising foreign marginal costs. The figure also shows a weak but the expected positive relation between import prices lnP_t^M and domestic demand $ln\,E_t$.

The financial crises that hit both Latin American and Asian economies led to drastic changes to their respective monetary policy and exchange rate targeting measures. Balance of payments crises and chronic inflation were the main problems facing several Latin American economies such as Argentina, Brazil, Bolivia, Colombia, Ecuador, Mexico and Venezuela in our sample. During the 1980s Argentina's economy was characterised by hyperinflation which led to dollarization of its national currency. In 1991, the Argentine peso to dollar convertibility plan reduced inflation and the resulting exchange rate appreciation led to relative price distortions. During the period from 1982 to 1988, a shortage of foreign exchange reserves has been reflected in a series of devaluations of the Chilean currency by nearly 50% of its value. However, since the early 1990s several free trade agreements were signed by Chile which led to increased trade and growth. Colombia has had persistently higher level of import prices during the 1990s due to inflation persistence. Taylor (2000) states that lower and more stable rates of inflation among inflation targeting economies is a crucial factor behind the slowing down of import prices and thereby lower exchange rate pass through. Bolivian trade was characterised by price stability during the 1990s, but import prices rose largely on account of devaluation of Brazilian currency and the Argentinean crisis. External debt, high inflation and stagnating GDP in Ecuador led to depreciation of its domestic currency. Import prices nearly doubled during the two decades 1980-2000. As expected dollarization lowered transaction costs but increasing inflation reduced the price competitiveness of the trade.

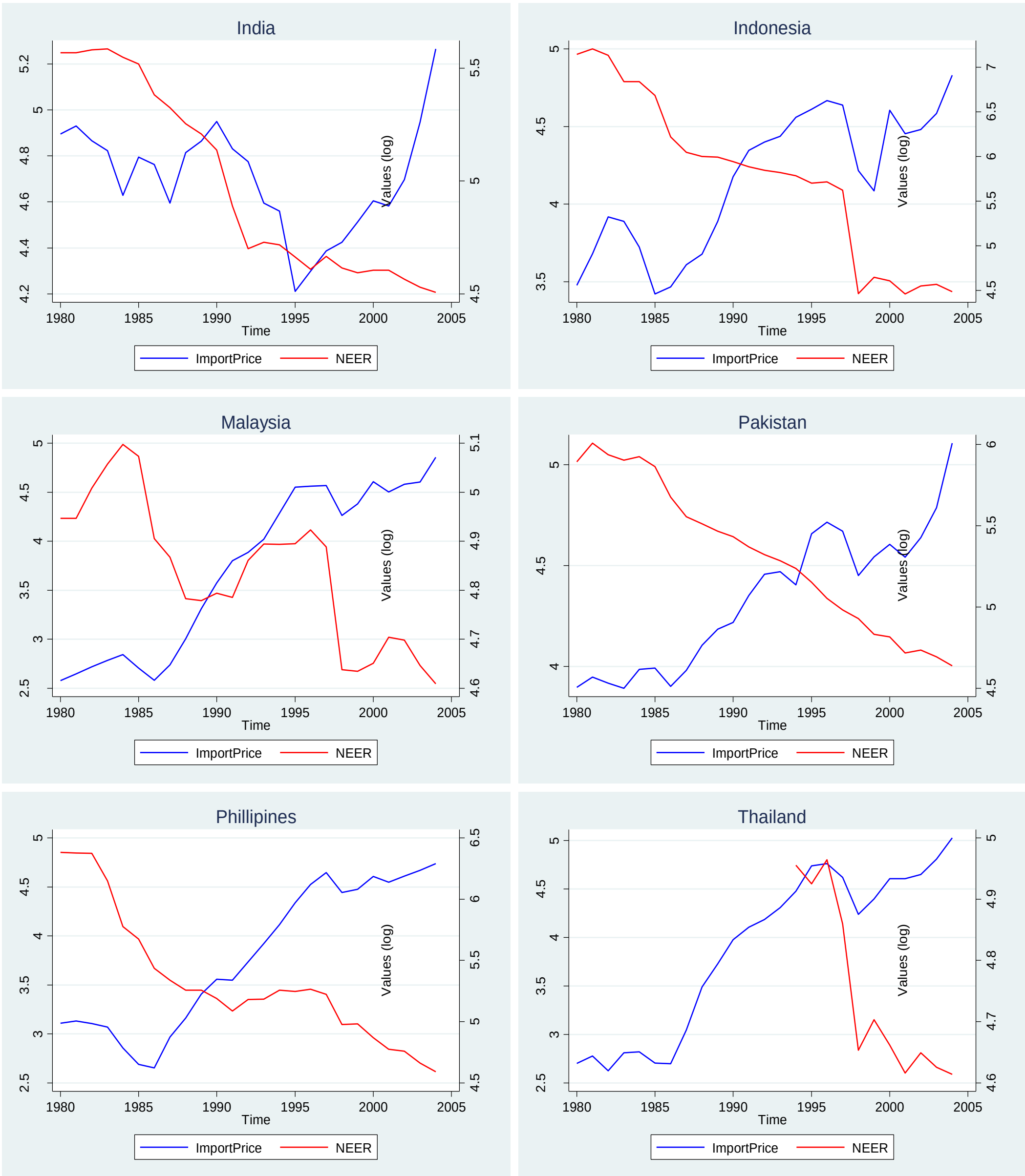
Campa (2002) states that increased exchange rate volatility and speculation about the Mexican peso led to its depreciation which resulted in increased import prices. Economic reforms on several fronts including a shift to the market determined exchange rate system since 1991 and dismantling of import tariffs and quantity restrictions resulted in increased trade openness. Economic crisis during the early 1980s in Venezuela was corrected by resorting to currency devaluation and shifting to a multi-tier exchange rate system, increased agricultural subsidies and import protectionism. But during the late 1980s and early 1990s the drop in the price of oil could not generate enough exports to sustain foreign debts. This led to adopting a floating exchange rate system which brought down the currency value further vis-à-vis the US dollar.[25]

[25] Appendix 4.8 lists out the major external sector reforms in our sample of Latin American and Asian economies for each of the three decades. Active trade liberalisation policies did not bring results in most of the economies until the early to mid 1990s. Several Latin American economies joined trading blocks such as NAFTA and Mercosur, which brought some benefits in terms of boosting manufacturing exports.

Figure 4.1. Import Prices and Nominal Effective Exchange Rates (S_t)



(Continued) Figure 4.1 Import Prices and Nominal Effective Exchange Rates (S_t)



Most of the Asian economies in our study experienced a shift from fixed to flexible exchange rate systems during the 1990s. This is a common reason for increased inflation and exchange rate pass through. As Khundrakpam (2007) reports, the depreciation of India's domestic currency slowed down but there was an increase in the inflation along with import prices since the late 1990s. Indonesian Rupiah depreciated by nearly 50% of its value during 1997. Loss of price competitiveness due to depreciation led to sharp rise in inflation and remained higher than other Asian economies upto 2003. According to

Webber (2000) the Malaysian Ringitt lost about 34% of its value just during 1996-1997 due to the crisis and the import prices registered a growth of about 32% during the same period.

Most of the increases in import prices of petroleum and agricultural products in Pakistan were due to deteriorating terms of trade since the mid 1990s. Chan (2008) has noted that Philippines is characterised by high exchange rate volatility which resulted in high pass through onto its import prices followed by consumer price indices. Thailand had a fixed exchange rate regime prior to 1997 coupled with moderate inflation rates. A sudden shift to a flexible system in 1997 resulted in a 25% depreciation of the Baht. Its maximum effect was on increases in import prices followed by producer prices and consumer prices.

4.5 Econometric Methodology

In this section we review empirical methods utilised in the empirical component of this paper. We firstly consider panel unit root tests as proposed by Im, Pesaran and Shin (2003), we discuss the panel data estimation methods adopted, then present our linear specification for testing pass through. Finally we outline how we account for asymmetric effects.

4.5.1 Panel Unit Root Tests

In this study we use several panel unit root tests from Im, Pesaran and Shin (2003) (IPS), Levin, Lin and Chu (2002) (LLC), Augmented Dickey Fuller (ADF)-Fisher and Phillips Perron (PP) to test for potential non-stationarity in a panel context. Although our subsequent methods are robust to a mixture of stationary and non-stationary regressors, they are not robust to stationary dependent variable and non-stationary regressors. We start with a first order AutoRegressive AR (1) process for the panel time series y_{it} of the form:

$$y_{it} = \rho_i y_{it-1} + X_{it}\delta + u_{it}, \tag{4.4}$$

where i = 1,2,...,N cross section units that are observed over T time periods t = 1,2,...,T. The matrix X_{it}, represents the exogenous variables in the model and include any fixed effects or individual trends. ρ_{it} are the autoregressive coefficients and u_{it} are the error terms that are mutually independent. If $\rho_{it} < 1$, y_{it} is considered to be weakly stationary. But, if $\rho_{it} = 1$, y_{it} contains a unit root. There are other variants of this AR (1) form that combine the individual unit root tests to arrive at a panel specific result. The panel unit root test proposed by Im et al. (2003) typically allows the ρ_{it} to vary across cross sections. The t-statistic (IPS) test is based on a separate Augmented Dickey Fuller (ADF) regression for each cross section.

$$y_{it} = \rho_i y_{it-1} + \sum_{j=1}^{p_i} \varphi_{ij} \Delta y_{it-1} + \mathbf{x}'_{it}\delta + u_{it} \tag{4.5}$$

$$u_{it} = \sum_{j=1}^{p_i} \varphi_{ij} \Delta u_{it-j} + \varepsilon_{it} \tag{4.6}$$

This process tests the null hypothesis $H_0 : \rho_i = 1$ for all i against $H_\alpha : \rho_i < 1$ for at least one i. The t-bar test statistic is the average for the ρ_i from the ADF regressions.

$$\bar{t}_{NT} = \frac{1}{N} \sum_{i=1}^{N} t_{\rho_i} \tag{4.7}$$

In the general case where the lag order in equation (4.4) is non zero for some cross sections, Im, Pesaran and Shin (2003) show that $\bar{t}_{NT}$ asymptotically follows the standard normal distribution as is given as $W_{t_{NT}} \sim N$ (0,1). The Levin, Lin and Chu (LLC) test also follows the same ADF regression as in (4.5) and (4.6), but assumes $u_{it} \sim N(0, \sigma^2)$ and ρ_i = ρ for all i. This implies the coefficient of the lagged dependent variable is homogenous across all cross sections. The null hypothesis for the LLC test is $H_0 : \rho_i = 1$ for all i and the alternative is that all individual series in the panel are stationary, i.e. $H_\alpha : \rho_i < 1$.

4.5.2 Pooled Mean Group Estimation

This section makes use of the available data for each of the countries in our study, and constructs a panel data set. Pesaran et al. (1999) and Schich and Pelgrin (2002) have emphasized the importance of the right choice of econometric methodology in dealing with panels data. Pesaran et al. (1999) proposed the Pooled Mean Group Estimation (PMGE) and this is advantageous since it incorporates both long run and short run effects by adopting an Autoregressive Distributive Lag (ARDL) structure and estimating this as an Error Correction Model. The short run coefficients are estimated by averaging the cross sectional estimates while the long run coefficients are pooled since economic theory typically have stronger implications for long run relationships rather than dynamics of adjustment as is the case in this study. The homogeneity of long run coefficients is tested by a joint Hausman test, which follows a χ^2 distribution.

Pesaran et al. (1999) state that irrespective of the order of integration of the explanatory variables (i.e. whether I(0) or I(1)), by taking sufficient lags in the ARDL structure, we can still trace the effect of the explanatory variables on the dependent variable, and thereby can overcome the problem of spurious regression. Also the error correction mechanism (ECM) integrates the short run dynamics and the long run equilibrium without losing crucial information about the long run.

As the PMGE technique adopts the autoregressive distributed lag model (ARDL) in estimating a dynamic relationship between the dependent variable and the explanatory variables, in our study the ARDL model could be specified as;

$$\Delta y_{it} = \varphi_i y_{it-1} + \beta_i^{'} \mathbf{x}_{it} + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta y_{it-j} + \sum_{j=0}^{q-1} \delta_{ij}^{*'} \Delta \mathbf{x}_{it-j} + \omega_i + \varepsilon_{it} \tag{4.8}$$

Where y_{it}, the dependent variable is the import price and X_{it} is the vector of explanatory variables for group *i*.

4.5.3 Empirical Specification

We now move to an empirical examination of pass through. Following Gil-Pareja (2003), Khundrakpam (2007) and Bahroumi (2005), the empirical long run relationship to be estimated in our study is based upon equation (4.3) and is laid out in logarithmic terms

$$ln P_t^M = \alpha_0 + \alpha_1 ln S_t + \alpha_2 ln MC_t + \alpha_3 ln \mu_t + \varepsilon_t \quad (4.9)$$

From before import prices $ln P_t^M$ are a function of $ln S_t$, the nominal effective exchange rate, $ln MC_t$, marginal costs, and domestic demand, $ln \mu_t$. Additionally in equation (11) we have the error disturbance term, ε_t, and a constant, α_0. We expect the following relationship between the explanatory variables and the dependent variable. A rise in the exchange rate, a domestic currency appreciation, will be associated with an decrease in import prices as foreign goods become less expensive (i.e. $\alpha_1 < 0$). As foreign exporters engage in pricing to market by covering their marginal costs of production in imperfectly competitive markets, an increase in the foreign marginal costs increases the import price (i.e. $\alpha_2 > 0$). Finally, favourable domestic demand conditions should induce the foreign firms to charge higher import prices, therefore the coefficient α_3 is expected to be positive. (i.e. $\alpha_3 > 0$)

4.5.4 Exchange Rate Asymmetry

Our benchmark approach assumes a linear relationship between the exchange rate and import prices. Following several authors including Menon (1996), Wickramasinghe (1999), Webber (2000) and Khundrakpam (2007) we introduced dummy variable for the possible asymmetries in the currency appreciation and depreciation. Interaction of the dummy variable with the exchange rate can be expressed in the following manner:

$$S_t = (\alpha_1 + \alpha_2 DUM_t) S_t$$

$$= \alpha_1 S_t + \alpha_2 DUM_t \times S_t \qquad (4.10)$$

The dummy variable assumes a value of 1 for the periods of appreciation (a rise in S_t) and 0 for periods of depreciation and can be described in the following manner:

$$DUM_t = 1 \text{ if } \Delta S_t > 0 \text{ and } DUM_t = 0 \text{ if } \Delta S_t < 0 \qquad (4.11)$$

Interaction of the dummy variable with the exchange rate in equation (4.10) yields

$$ln\, P_t^M = \alpha_0 + \alpha_1 ln\, S_t + \alpha_2 ln\, S_t \times DUM_t + \alpha_3 ln\, MC_t + \alpha_4\, ln\, \mu_t + \varepsilon_t \qquad (4.12)$$

In the above equation (4.12), the interaction term is expected to capture asymmetry in the exchange rate fluctuations. If its coefficient (i.e. α_2) displays a positive sign, then the effect of appreciation of exchange rates on import prices are greater than deprecations. Conversely, a significant and negative coefficient on the interaction variable implies greater effect of depreciations on the import prices. Consistent with studies such as Khundrakpam (2007) and Pollard and Coughlin (2004), in our study higher pass-through for appreciation than depreciation could be expected for emerging economies as much of the goods were domestically produced. Thus, immediately after liberalisation, when foreign exporters entering into domestic markets would have faced some degree of competition from the locally produced substitutes. Therefore, the objective of foreign firms would likely be to hold or increase their market share.

Further, studies such as Knetter (1994), Pollard and Coughlin (2004) assume that the extent of pass-through is independent of the direction of the change in the exchange rate. There may be circumstances under which firms may vary pass-through depending on how the importer's currency is behaving (i.e, appreciating or depreciating). Three major explanations for asymmetric pass-through are summarized here.

Firstly, binding quantity constraints, foreign firms that face capacity constraints in their distribution network have limited ability to raise sales in the importing country. An appreciation of the importing country's currency would normally induce a foreign firm to lower import price, but capacity constraints limit such expansion of sales through the lower price. Therefore, foreign firms raise their mark-ups to keep import prices in the importing country's currency fixed to keep the volume of sales intact while raising the profit margin. In the case of depreciation, the capacity constraints are not binding and it does not affect the increasing of import prices that depreciation would normally induce. Even when firms may reduce their mark-ups to absorb part of the impact of depreciation, import prices in home currency could still rise. Thus, the pass-through is higher for depreciation than appreciation. Besides the situation that capacity constraints limiting the ability to expand output can also arise when there are trade restrictions.

Secondly, when firms are motivated in building their market share, appreciation in the currency of the importing country allows the firms to lower import prices to increase their market share while maintaining their mark-up. But during periods of depreciation, the exporting firms may offset the potential increase in price to maintain their market shares by reducing mark-ups. Therefore, pass-through would be higher for appreciation than depreciation which would result in asymmetric exchange rate pass through.

Thirdly, Webber (2000), Khundrakpam (2004) highlighted the production switching mechanism in which foreign firms switch between imported and domestically produced inputs depending upon the price. When the importing country's currency appreciates, foreign firms use only the inputs produced in their own country, and the extent of pass-through depends on the elasticity of the mark-up. In the case of depreciation, they use inputs from the currency depreciating country, and no pass through occurs.

4.6 Results

4.6.1 Panel Unit Root Results

Before we proceed with our panel regressions for pass through we firstly identify whether our series are stationary. Our panel unit root test results based upon Im et al.

(2003) are set out in Table 4.1, for both levels and first differences and with different deterministic components. The results show that P_t^M was stationary for both levels and

Table 4.1 Panel Unit Root Results[25]

Test	Levin, Lin and Chu (2002)				Im, Pesaran and Shin (2003)			
Specification	Level		First Difference		Level		First Difference	
Variable	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
$ln P_t^M$	-1.40 [0.08]	-0.42 [0.33]	**-7.32* [0.00]**	**-5.69* [0.00]**	1.86 [0.96]	-1.40 [0.08]	**-7.52* [0.00]**	-5.73 [0.00]
$ln S_t$	-1.60 [0.05]	**-2.07* [0.01]**	**-10.39* [0.00]**	**-8.95* [0.00]**	0.57 [0.71]	**-1.83* [0.03]**	**-9.27* [0.00]**	-5.58 [0.00]
$ln MC_t$	-7.99 [0.89]	-8.09 [1.00]	**-6.62* [0.00]**	**-9.09* [0.00]**	-0.99 [0.16]	-0.39 [0.34]	**-8.83* [0.00]**	-8.65 [0.00]
$ln E_t$	**-5.08* [0.05]**	**-1.32* [0.09]**	**-5.35* [0.05]**	**-6.68* [0.06]**	**-1.53* [0.06]**	**-4.72* [0.05]**	**-3.57* [0.07]**	**3.30* [0.06]**

Note: (a) This table contains panel unit root results from the Levin et al. (2002) and the Im et al. (2003) W-stat. (b) Specification [1] indicates intercept only and [2] indicates trend and intercept. (c) Time period is 1980-2004 for 14 countries. (d) Probability values are in square brackets, we reject at the 5% significance level the null of non-stationarity when the p-value is less than 0.05, and mark this with an asterisk (*). (e) $ln P_t^M$ is Import Prices, $ln S_t$ is the Nominal Effective Exchange Rate, $ln MC_t$ is Foreign Marginal Cost and $ln E_t$ denotes the domestic demand.

first differences. Exchange rate denoted by S_t was found to be stationary under both specifications; therefore we reject the null hypothesis of unit root in Table 4.1. Also for MC_t we do not accept the null of unit root. The mark-up variable E_t, turned out to be consistently stationary throughout the first difference specifications. Therefore we can be confident that our panel regressions are not unbalanced and do not suffer from a spurious regression problem. We now proceed with the main results of the paper. Additional panel unit root tests of the ADF-Fisher and PP-Fisher type are comparable because they test the same null hypothesis of the presence of individual unit root. Results from these tests show that most of the variables in this study were non-stationary at levels, but were stationary at first differences. Domestic demand denoted by $ln E_t$ was also stationary at levels under the ADF-Fisher test.

[25] Results from additional panel unit root tests are presented in the Appendix.

4.6.2 Combined Panel PMGE Results

To assess the degree of pass through in a panel of 14 emerging economies, we use Pesaran et al. (1999) Pooled Mean Group Estimation (PMGE). This allows us to differentiate long and short run effects and also panel heterogeneity. In Table 4.2, we present basic PMGE regression results for exchange rate pass through to import prices. Pesaran et al. (1999) emphasizes that we should account for the common factors across countries, therefore we present raw and cross sectionally demeaned our data. PMGE uses an ARDL model and the lag length was determined by Schwarz Bayesian Information Criteria (SBC).

We firstly consider the impact of the exchange rate on the import prices in a linear model in the first two columns of results in Table 4.2. In the long run, barring the raw data specification in column three, most of the raw and demeaned results indicate that the exchange rate S_t has a negative and significant effect on import prices. This clearly indicates that a depreciation of the domestic currency would result in a higher import price for the importing country in the long run. As the coefficients on the exchange rate variable are all less than unity, though significant, pass through is far from complete in the long run.[26] With a Hausman Test statistic value of 0.52, the null hypothesis of poolability could not be rejected.

[26] However, using demeaned data is considered more appropriate because it accounts for periods of common shocks across countries. (see, Pesaran et al. 1999)

Table 4.2 PMGE Regression Results

	Raw Data	Demeaned	Raw Data	Demeaned
Long Run Coefficients				
$ln\, S_t$	**-0.102*** **(-3.528)**	**-0.170*** **(-8.474)**	**0.305*** **(2.958)**	**-0.175*** **(-3.386)**
$ln\, MC_t$	**0.069*** **(2.539)**	**1.060*** **(9.082)**	-0.101 (-0.231)	0.021 (0.664)
$ln\, E_t$	**1.548*** **(12.176)**	1.051 (1.814)	**1.796*** **(7.706)**	**1.049*** **(4.637)**
$ln\, S_t \times DUM_t$			**0.038*** **(4.116)**	**0.014*** **(2.384)**
Short Run Coefficients				
Error Correction	**-0.399*** **(-3.617)**	**-0.374*** **(-3.033)**	**-0.348*** **(-3.942)**	**-0.276*** **(-5.551)**
$\Delta\, ln\, S_t$	0.048 (1.251)	0.046 (2.046)	-0.271 (-1.087)	**0.055*** **(2.544)**
$\Delta\, ln\, MC_t$	-0.042 (-0.230)	-1.200 (-1.262)	-0.004 (-0.705)	-0.065 (-1.236)
$\Delta\, ln\, E_t$	4.959 (1.802)	**10.073*** **(2.368)**	0.808 (0.059)	1.826 (0.946)
$\Delta ln\, S_t \times DUM_t$			**-0.013*** **(-3.700)**	**0.003*** **(3.127)**
Hausman Test	2.28 [pval = 0.52]	**8.53*** **[pval = 0.04]**	**20.09*** **[pval = 0.00]**	7.92 [pval = 0.09]
Number of Observations	279	279	279	279

Notes: (a) This table presents Pooled Mean Group Estimates for a panel of the total manufacturing sector. (b) t-values are in parentheses. (c) Time period is 1980-2004. (d) The panel consists of fourteen emerging economies. (e) Asterisk indicates significance at the 5% level. (f) Specifications include raw data and cross section demeaned data and SBC determined lag length. (g) Hausman test examines the long run homogeneity of the panel, probability values less than 0.05 reject the null hypothesis. (h) Dependent variable is logged import price.

This suggests that we can pool our long run results and there is not significant difference in a linear specification in our panel of 14 countries. The short run coefficient on S_t is negative but insignificant for an average of short run coefficients. This emphasizes that pass through operates in the long run to a greater extent. Additionally it is worthwhile discussing the impact of costs and our mark up proxy on import prices. While the latter, in the form of domestic demand, is significant and the appropriate sign, marginal costs do not play an important role in the long run. All the error correction terms are negative and significant which indicate partial adjustment of the model to the long run equilibrium.

These results suggest that we can pool our 14 countries based upon a linear specification. However, a linear specification may not be appropriate given evidence from Marston (1990) and Webber (2000) of important non-linearities from S_t to P_t^M. Consequently we asses asymmetric pass through effects from depreciations and appreciations. To do so, we use $S_t \times DUM_t$ an interaction variable. This intends to capture asymmetry in the pass through of exchange rates to import prices. The results for this panel are given in Table 4.2 in columns three and four, for raw and demeaned data, respectively. We find evidence of significant pass through effects in the long run. And an important asymmetric effect, since the coefficient of $ln\, S_t \times DUM_t$ is significantly positive in both the extended models. This result coincides with other works such as Webber (2000), Pollard and Coughlin (2004) and Khundrakpam (2007). Unfortunately the Hausman test statistic for the cross sectionally demeaned results in the benchmark model rejected the long run null hypothesis of common pass through effects (i.e. Hausman test statistic = 8.53 [p = 0.04]. The Hausman test statistic is not rejected for poolability in the extended model under demeaned data with a p-value = 0.79, but, we reject the null hypothesis of poolability of long run coefficients under the raw data specification for the extended model. Given that the effect of exchange rate pass through to import prices in the long run is not uniform across our models as evidenced by the rejection of the Hausman test statistic, we believe there is ample reason to test for the effect of exchange rates on import prices within each region, i.e., Latin America and Asia respectively. Therefore, we further examine the different responses between regions by splitting the panel into Latin America and Asia respectively.

4.6.3 Results for Latin America

Panel regression results for the extent of pass through for eight Latin American countries are presented in Table 4.3. Under a simple linear specification, which does not differentiate between appreciations and depreciation, we find that pass through was positive, significant and incomplete in column two, with cross sectionally demeaned data. There were also important roles for marginal costs and demand. The Hausman test indicates that Latin American is consistently homogeneous. The asymmetric exchange rate effect is positive (in column four) but the linear exchange rate effect is only significant at the 10% level. This highlights an important asymmetric exchange rate effect in the long run for Latin American economies. Hence we extend single country studies to a panel context (see Webber, 2000, Khundrakpam 2007). Asymmetry could be due to: marketing structure, production technology switching and market share (see, Foster and Baldwin, 1986, Ware and Winter, 1988 and Marston, 1990).

Table 4.3 PMGE Regression Results for Latin America

	Raw Data	Demeaned	Raw Data	Demeaned
Long Run Coefficients				
$ln\, S_t$	0.544 (1.408)	**-0.036*** **(3.678)**	**0.049*** **(3.075)**	-0.025 (1.726)
$ln\, MC_t$	**0.396*** **(9.889)**	**0.027*** **(-3.292)**	**0.120*** **(3.423)**	**0.026*** **(-2.553)**
$ln\, E_t$	**6.633*** **(11.016)**	**0.599*** **(1.964)**	**2.557*** **(11.650)**	**0.916*** **(3.863)**
$ln\, S_t \times DUM_t$			**0.028*** **(3.651)**	**0.020*** **(2.475)**
Short Run Coefficients				
Error Correction	**-0.741*** **(-5.456)**	**-0.635*** **(-4.083)**	**-0.582*** **(-5.141)**	**-0.401*** **(-3.283)**
$\Delta\, ln\, S_t$	0.161 (1.000)	**-0.187*** **(-2.182)**	**-0.375*** **(-3.687)**	-0.088 (-1.879)
$\Delta\, ln\, MC_t$	0.199 (0.778)	-0.357 (-1.477)	**-0.070*** **(-5.104)**	**-0.010*** **(-3.280)**
$\Delta\, ln\, E_t$	6.772 (1.427)	2.708 (0.706)	23.076 (1.859)	**2.210*** **(5.007)**
$\Delta ln\, S_t \times DUM_t$			**0.017*** **(2.810)**	**0.008*** **(3.238)**
Hausman Test	**26.47*** **[pval = 0.00]**	6.41 [pval = 0.09]	9.00 [pval = 0.06]	7.43 [pval = 0.11]
Number of Observations	164	164	164	164

Notes: (a) This table presents Pooled Mean Group Estimates for a panel of the total manufacturing sector. (b) t-values are in parentheses. (c) Time period is 1980-2004. (d) The panel consists of six Latin American countries: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico and Venezuela. (e) Asterisk indicates significance at the 5% level. (f) Specifications include raw data and cross section demeaned data and SBC determined lag length. (g) Hausman test examines the long run homogeneity of the panel, probability values less than 0.05 reject the null hypothesis. (h) Dependent variable is logged import price.

4.6.4. Results for Asia

Table 4.4 presents the split panel results for Asia under the linear and the asymmetric models. In the long run, the estimates for S_t were positive and significant under all the models. This implies the estimates for the variable MC_t in the long run were positive although not statistically significant throughout the specifications. In the short run, the co-efficient of MC_t displayed statistical significance in both the extended model specifications. However, its estimates under demeaned specification of the extended model which shows negative sign could indicate some asymmetric interaction with the exchange rates in the short run.

Table 4.4. PMGE Regression Results for Asia

Model Specification	Raw Data	Demeaned	Raw Data	Demeaned
Long Run Coefficients				
$ln\,S_t$	**-0.675* (t=9.360)**	**-0.308* (7.115)**	**-0.637* (5.980)**	**-0.877* (4.480)**
$ln\,MC_t$	0.093 (0.273)	0.184 (1.108)	0.476 (1.320)	**1.314* (3.210)**
$ln\,E_t$	**2.286* (8.351)**	**0.915* (2.523)**	**1.902* (6.740)**	**1.090* (2.477)**
$ln\left(S_t\right)\times DUM_t$			0.018 (1.690)	**0.080* (2.592)**
Short Run Coefficients				
Error Correction	**-0.504* (-3.919)**	**-0.563* (-2.854)**	**-0.373* (-4.604)**	**-0.208* (-4.773)**
$\Delta\,ln\,S_t$	-0.436 (-1.523)	-0.139 (-1.000)	**-0.827* (-3.200)**	-0.021 (-0.116)
$\Delta\,ln\,MC_t$	0.802 (1.268)	**0.106* (1.978)**	**0.177* (3.434)**	**-0.274* (2.004)**
$\Delta\,ln\,E_t$	7.035 (1.397)	5.172 (1.185)	1.004 (0.164)	**0.227* (4.325)**
$\Delta ln\,S_t \times DUM_t$			**-0.007* (-3.205)**	**-0.012* (3.142)**
Hausman Test	7.66 [pval = 0.05]	1.68 [pval = 0.64]	**N.A.**	**N.A.**
Number of Obs.	130	130	130	130

Notes: (a) This table presents Pooled Mean Group Estimates for a panel of the total manufacturing sector. (b) t-values are in parentheses. (c) Time period is 1980-2004. (d) The panel consists of six Asian countries: India, Indonesia, Malaysia, Pakistan, Philippines and Thailand. (e) Asterisk indicates significance at the 5% level. (f) Specifications include raw data and cross section demeaned data and SBC determined lag length. (g) Hausman test examines the long run homogeneity of the panel, probability values less than 0.05 reject the null hypothesis. (h) Dependent variable is logged import price.

A prominent result from Table 4.4 is that the estimates for E_t was positive and significant across all the models and specifications. This indicates the significance of the effect of domestic demand on the import prices in the long run. The interaction variable was included only under the extended model and was consistently positive for the long run. It was also of a greater magnitude than in Latin American countries. This may explain the failure of the Hausman test in Table 4.4 and hence regional differences in response to the exchange rate. Unfortunately we only have evidence of poolability for Asian economies with a linear specification so we can not rule out further heterogeneity in Asian countries in their responses to asymmetry.

Table 4.5. DPD-GMM Results of Aggregate Exchange Rate Pass Through

	Benchmark Model				
	[1]	[2]	[3]	[4]	[5]
$ln\,P^{M}_{t\text{-}1}$	**0.786*** **(20.990)**	**0.765*** **(13.140)**	**0.751*** **(12.550)**	0.381 (0.390)	0.985 (0.980)
$ln\,S_t$	**0.101*** **(2.702)**	**0.102*** **(2.680)**	**-0.128*** **(-3.600)**	-0.395 (-0.160)	-0.501 (-0.150)
$ln\,MC_t$	**-0.376*** **(-2.040)**	**-0.038*** **(-2.360)**	**0.590*** **(3.200)**	-0.505 (-0.045)	0.867 (0.040)
$ln\,E_t$	0.026 (0.224)	0.456 (0.280)	0.181 (0.085)	0.040 (0.400)	0.340 (1.120)
m2[pval]		0.174	0.430	0.170	0.434
Sargan[pval] Hansen[pval]		0.60 1.00	0.09 1.00	0.98 1.00	0.09 1.00
Number of Observations	282	282	282	282	282
Number of Cross Sections	14	14	14	14	14

Notes: (a) Heteroskedasticity consistent t-values are in parenthesis. (b) [1] is within estimates, [2] is one step GMM (t-2) specification, [3] is one step GMM (t-3) specification, [4] is two step GMM (system) specification and [5] is two step GMM (system) specification. (c) Time dummies and cross sectional dummies are included in all the model specifications to control for unobserved effects. (d) m1 and m2 are tests for first-order and second-order serial correlation. (e) Sargan is a test of over identifying restrictions for the GMM estimators, asymptotically follows χ^2. (f) Sample size: 1980-2004.

4.6.5 DPD-Generalized Method of Moments (GMM) Estimation [27]

The issues with endogeneity are dealt with by utilising a wide range of valid instruments. Bond (2002) states that the explanatory variable under question may be correlated with current are earlier period shocks but not with future period shocks or be strictly exogenous and uncorrelated with any shocks at all. If the explanatory variable is assumed to be endogenous, and then lagged values of up to (t-3) periods would turn out to be valid instruments. This view is also supported by Easterly and Serven (2003). In the case that the explanatory variable is predetermined, then additional (t-1) period lag is available as a valid instrument in the levels equation. Blundell and Bond (1998) state that when estimating autoregressive parameters in dynamic panel models, instrumental variable estimators can be plagued with the problem of weak instruments. But, the system GMM

[27] Additional DPD-GMM estimation results for separate panels of Latin America and Asia are presented in the Appendix. Results indicate that for Latin America, the domestic demand and asymmetry factors are significant. But, for Asia the exchange rate asymmetry plays a bigger role in determining import prices. However, the all the models pass the specification tests and from m2 statistics, there is no presence of second order autocorrelation and the models are reasonably well specified.

estimator can ensure higher precision. Sargan tests of orthogonality indicate the validity of the instruments. m1 and m2 statistics test the null hypothesis of no first order and second order serial correlation respectively in the model. If the p-value is less than 0.05 we reject the null and conclude the presence of serial correlation of first and second order. In other words, under the null, the model is not mis-specified with respect to serial correlation. GMM estimation uses different instrument sets at lags and levels.

Following Bond (2002) we carried out the system GMM estimation to account for endogeneity. Table 4.5 presents the benchmark model results of the GMM estimation. Throughout the various specifications, the lagged dependent variable displayed positive coefficients and was statistically significant as expected. The estimates for S_t were positive across all the models but were not significant. This could reflect the imperfect exchange rate pass through to import prices in emerging economies. Although the coefficient on foreign marginal cost, denoted by MC_t, was statistically significant only under specification [5], it still displayed its expected positive sign on most of its coefficients. This indicates that marginal cost pressures are not quickly transferred on to the import prices. The explanatory variable E_t, taken as a proxy for domestic demand also had a positive effect on import prices throughout but was statistically significant only in the within estimation and specification [5]. Sargan test shows that our instrument set is valid with a p-value greater than 0.05 in all the four specifications and all the GMM models pass the Hansen test of identification. However, there is a need to consider better instruments that are strictly exogenous. The statistic m2 indicates no presence of second order autocorrelation among the error terms. Therefore, we do not reject the null hypothesis and conclude that there is no second order autocorrelation and that our model is

Table 4.6. DPD-GMM Extended Results of Aggregate Exchange Rate Pass Through

	Extended Model				
	[1]	[2]	[3]	[4]	[5]
$ln\,P^{M}_{t-1}$	**0.776*** **(20.070)**	**0.761*** **(11.660)**	**0.747*** **(11.140)**	0.387 (0.350)	0.117 (0.140)
$ln\,S_t$	**-0.015*** **(-2.701)**	**0.109*** **(2.780)**	**-0.137*** **(-3.830)**	0.658 (0.024)	1.250 (0.350)
$ln\,MC_t$	**0.036*** **(2.053)**	**0.033*** **(2.070)**	**-0.060*** **(-3.520)**	-0.105 (-0.090)	-1.060 (-0.080)
$ln\,E_t$	0.029 (0.254)	0.046 (0.320)	0.196 (1.030)	0.007 (0.563)	0.170 (0.510)
$ln\left(S_t\right)\times DUM_t$	**0.131*** **(2.366)**	**0.015*** **(3.100)**	**0.014*** **(2.760)**	-0.020 (-0.310)	-0.272 (-0.640)
m2[pval]		0.325	0.420	0.315	0.860
Sargan[pval] Hansen[pval]		0.09 1.00	0.09 1.00	0.23 1.00	0.23 1.00
Number of Observations	266	266	266	266	266
Number of Cross Sections	14	14	14	14	14

Notes: (a) Heteroskedasticity consistent t-values are in parenthesis. (b) [1] is within estimates, [2] is one step GMM (t-2) specification, [3] is one step GMM (t-3) specification, [4] is two step GMM (system) specification and [5] is two step GMM (system) specification. (c) Time dummies and cross sectional dummies are included in all the model specifications to control for unobserved effects. (d) m1 and m2 are tests for first-order and second-order serial correlation. (e) Sargan is a test of over identifying restrictions for the GMM estimators, asymptotically follows χ^2 distribution. (f) Sample size: 1980-2004

not mis-specified. From Table 4.5, the preferred model clearly is the system GMM (*t*-3) in specification [5] as most of the variables are statistically significant and the model also passes all the specification tests.

In Table 4.6 the extended model results from the fixed effects estimation and dynamic panel GMM estimation are presented. The lagged dependent variable $ln\,P^{M}_{t-1}$, is significant in all the models barring one step GMM estimation with (*t*-3) instruments. The variable $ln\,S_t$ which captures the exchange rate pass through effect on import prices displayed the expected positive signs across all the specifications except [1].

However, it is significant only for the specifications using (*t*-2) instruments. $ln\,MC_t$ displayed its expected positive sign on all the coefficients barring specification [4] but was statistically significant only for [3]. This implies that foreign firms do not fully transmit their marginal costs onto the importers. The explanatory variable $ln\,E_t$**,** taken as a proxy for domestic demand was positive signs throughout but was statistically significant only for the within estimation. Finally, the interaction variable $ln\left(S_t\right)\times DUM_t$ which captures the asymmetry in the exchange rate changes displayed positive coefficients throughout barring specification [5]. This implies that import prices respond better to depreciations of the importer currency in the long run across emerging economies. Finally, the model also passes all the specification tests.

Sargan test shows that our instrument set is valid with a p-value greater than 0.05 in all the four specifications and all the models pass the Hansen test of identification. Moreover; m2 statistic indicates a p-value that is consistently greater than 0.05 throughout all the specifications. Therefore, we do not reject the null hypothesis and conclude that there is no second order serial correlation.

4.7. Conclusions

Several studies dealt with the phenomenon of exchange rate pass through and indicate that the presence of complete pass through in the long run and incomplete partial pass through in the short run. Firms react in different ways to the changes in the exchange rates, which results in asymmetric pass through rates across countries. Our paper firstly sets up a simple optimising model of import price determination before examining the long run exchange rate pass through phenomenon to import prices among a panel of 14 emerging economies. The results under the combined panel indicate that the exchange rate pass through effect onto import prices positive although incomplete.

We also note important asymmetric effects. These robustify our results for potential heterogeneous responses by testing poolability across countries. While exchange rate pass through appears to be similar for all countries within a linear framework, this is not the case once we take account of asymmetries. Given that these were significant this encouraged use to investigate different responses across our two regions Latin America and Asia.

Once we investigated our regional grouping, we find strong evidence in favour of a relatively weak but homogeneous asymmetric pass through effect for Latin American in the long run. This suggests that only depreciations of the domestic currency lead foreign firms to increase local currency prices, possibly in an attempt to retain profit margins. For Asian economies we find evidence of a stronger pass through effect compared to Latin America for both appreciation and depreciations. Any evidence of strong asymmetric depreciation effects may affect Asian economies differently. In conclusion, our results extend previous works on emerging economies like Bahroumi (2005) and Khundrakpam (2007) to a panel setting. Furthermore our results suggest an important role for marginal costs and demand as determinants of import prices. We also arrive at one general conclusion that there are important and, to some extent, homogeneity in the long run exchange rate pass through phenomenon in emerging market economies.

Appendix 4.1 Model

This appendix derives our stylised model of the determinants of import prices, based upon foreign firm profits, Π_t^f . Our model starts with the expression for firm profits based upon revenue from imports to the domestic economy, minus costs of production. Hence foreign firm profits are:[28]

$$\Pi_t^f = S_t^{-1} P_t^M Q_t - C_t\left(Q_t, W_t\right) \tag{4.13}$$

Taking the partial derivative of equation (4.13) with respect to import prices P_t^M , and by using the chain rule we get the first order condition as in equation (A2):

$$0 = \frac{\partial \Pi_t^f}{\partial P_t^M} :\ S_t^{-1} Q_t + S_t^{-1} P_t^M \left(\frac{\partial Q_t}{\partial P_t^M}\right) - \left(\frac{\partial C_t\left(Q_t, W_t\right)}{\partial Q_t}\right)\left(\frac{\partial Q_t}{\partial P_t^M}\right) \tag{4.14}$$

where, $\frac{\partial C_t\left(Q_t, W_t\right)}{\partial Q_t}$ indicates marginal cost.

Multiplying and dividing the first term in equation (4.14) with $\left(\frac{\partial Q_t}{\partial P_t^M}\right) P_t^M$ gives us

$$0 = \frac{S_t^{-1} Q_t P_t^M}{P_t^M} \left(\frac{\partial Q_t}{\partial P_t^M}\right)\left(\frac{\partial P_t^M}{\partial Q_t}\right) + S_t^{-1} P_t^M \left(\frac{\partial Q_t}{\partial P_t^M}\right) - \left(\frac{\partial C_t\left(Q_t, W_t\right)}{\partial Q_t}\right)\left(\frac{\partial Q_t}{\partial P_t^M}\right) \tag{4.15}$$

Factoring out the common term $\left(\frac{\partial Q_t}{\partial P_t^M}\right)$ from equation (4.15) gives us the following expression

$$0 = \left(\frac{\partial Q_t}{\partial P_t^M}\right)\left[\left\{S_t^{-1}\left(\frac{Q_t}{P_t^M}\left(\frac{\partial P_t^M}{\partial Q_t}\right)\right)P_t^M + S_t^{-1} P_t^M - \left(\frac{\partial C_t\left(Q_t, W_t\right)}{\partial Q_t}\right)\right\}\right] \tag{4.16}$$

The term $\left(\frac{Q_t}{P_t^M}\left(\frac{\partial P_t^M}{\partial Q_t}\right)\right)$ in the equation (4.16) is the inverse of the elasticity of Q_t with respect to P_t^M . Therefore $\left(\frac{Q_t}{P_t^M}\left(\frac{\partial P_t^M}{\partial Q_t}\right)\right)$ can be written as $\left(\frac{1}{\eta_t}\right)$.

[28] The variables are defined in the main text.

Where, $\eta_t = -\left(\frac{P_t^M}{Q_t}\left(\frac{\partial Q_t}{\partial P_t^M}\right)\right)$

Equation (4.16) can be rewritten as

$$0 = \left(\frac{\partial Q_t}{\partial P_t^M}\right)\left[\left\{-\left(\frac{S_t^{-1}P_t^M}{\eta_t}\right) + S_t^{-1}P_t^M - \left(\frac{\partial C_t\left(Q_t, W_t\right)}{\partial Q_t}\right)\right\}\right] \tag{4.17}$$

Again factoring out $S_t^{-1}P_t^M$ from equation (4.17), we get

$$0 = \left(\frac{\partial Q_t}{\partial P_t^M}\right)\left[S_t^{-1}P_t^M\left\{1\text{-}\frac{1}{\eta_t}\right\} - \left(\frac{\partial C_t\left(Q_t, W_t\right)}{\partial Q_t}\right)\right] \tag{4.18}$$

$$0 = \left(\frac{\partial Q_t}{\partial P_t^M}\right)\left[\frac{S_t^{-1}P_t^M}{\mu_t} - \left(\frac{\partial C_t\left(Q_t, W_t\right)}{\partial Q_t}\right)\right] \tag{4.19}$$

$$\left[\frac{S_t^{-1}P_t^M}{\mu_t}\right] = \left(\frac{\partial C_t\left(Q_t, W_t\right)}{\partial Q_t}\right) \tag{4.20}$$

Where, $\mu_t = \left(1 \big/ 1\text{-}\frac{1}{\eta_t}\right)$ refers to the mark-up factor over marginal cost.

$$P_t^M = S_t\mu_t\left[\left(\frac{\partial C_t\left(Q_t, W_t\right)}{\partial Q_t}\right)\right] \tag{4.21}$$

Where, $\left(\frac{\partial C_t\left(Q_t, W_t\right)}{\partial Q_t}\right)$ is the marginal cost (MC_t).

Finally, equation (4.21) can be rewritten as $P_t^M = S_t MC_t \mu_t$ which is the equation (4.3) in the text.

Appendix 4.2 Data Description

Variable	Definition	Source
Import Prices $\left(P_t^M\right)$	Unit value index.	United Nations Industrial Development Organisation (UNIDO)
Nominal Effective Exchange Rate $\left(S_t\right)$	Foreign currency per unit of domestic currency.	Bank for International Settlements (BIS)
Marginal Cost $\left(MC_t\right)$	WPI*(NEER/REER)	WPI from World Development Indicators (WDI); NEER and REER from BIS.
Domestic Demand $\left(E_t\right)$	De-trended GDP using Hodrick Prescott filter.	United Nations Industrial Development Organisation (UNIDO)

Appendix 4.3 Cross Correlations of main variables at levels.

Variable	lnP_t^M	$ln\ S_{it}$	$ln\ MC_t$	$ln\ E_t$	$ln\left(S_t\right)\times D_t$
lnP_t^M	1.00				
$ln\ S_{it}$	-0.13	1.00			
$ln\ MC_t$	0.44	-0.23	1.00		
$ln\ E_t$	0.36	-0.23	0.36	1.00	
$ln\left(S_t\right)\times D_t$	0.09	-0.28	-0.01	-0.13	1.00

Notes: (a) lnP_t^M is Import Prices. (b) $ln\ S_{it}$ is the Nominal Effective Exchange Rate (NEER). (c) $ln\ MC_t$ is Foreign Marginal Cost. (d) $ln\ E_t$ denotes the domestic demand and $ln\left(S_t\right)\times D_t$ is the term for exchange rate asymmetry. (e) Time period is 1980-2004.

Appendix 4.4 Cross Correlations of main variables at first differences.

Variable	lnP_t^M	$ln\ S_{it}$	$ln\ MC_t$	$ln\ E_t$	$ln\left(S_t\right)\times D_t$
lnP_t^M	1.00				
$ln\ S_{it}$	0.23	1.00			
$ln\ MC_t$	0.04	0.23	1.00		
$ln\ E_t$	0.12	0.23	-0.03	1.00	
$ln\left(S_t\right)\times D_t$	0.15	0.02	-0.01	-0.00	1.00

Notes: (a) lnP_t^M is Import Prices. (b) $ln\ S_{it}$ is the Nominal Effective Exchange Rate (NEER). (c) $ln\ MC_t$ is Foreign Marginal Cost. (d) $ln\ E_t$ denotes the domestic demand and $ln\left(S_t\right)\times D_t$ is the term for exchange rate asymmetry. (e) Time period is 1980-2004.

Appendix 4.5 Panel Unit Root Test Results

	ADF – Fisher				Phillips – Perron (PP)			
Variable/Test	Level		First Difference		Level		First Difference	
	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
$ln\,P_t^M$	19.23 [0.89]	33.45 [0.21]	**108.36*** **[0.00]**	**81.97*** **[0.00]**	17.24 [0.94]	17.45 [0.93]	**118.64*** **[0.00]**	**90.09*** **[0.00]**
$ln\,S_t$	28.04 [0.46]	47.69 [0.11]	**136.56*** **[0.00]**	**104.14*** **[0.00]**	17.15* [0.94]	40.74 [0.05]	**156.84*** **[0.00]**	**129.50*** **[0.00]**
$ln\,MC_t$	50.40 [0.06]	26.03 [0.25]	**110.98*** **[0.00]**	**101.03*** **[0.00]**	18.93 [0.64]	7.76 [0.01]	**134.15*** **[0.00]**	**123.10*** **[0.00]**
$ln\,E_t$	**34.89*** **[0.00]**	**57.74*** **[0.00]**	**51.71*** **[0.00]**	**46.48*** **[0.00]**	20.66 [0.19]	17.40 [0.36]	**22.10*** **[0.02]**	**15.81*** **[0.03]**

Note: (a) This table contains panel unit root results from the ADF-Fisher – χ^2 and the PP-Fisher – χ^2. (b) Specification [1] indicates intercept only and [2] indicates trend and intercept. (c) Time period is 1980-2004 for 14 countries. (d) Probability values are in square brackets, we reject at the 5% significance level the null of non-stationarity when the p-value is less than 0.05, and mark this with an asterisk (*). (e) lnP_t^M is Import Prices. (f) $ln\,S_t$ is the Nominal Effective Exchange Rate. (g) $ln\,MC_t$ is Foreign Marginal Cost. (h) $ln\,E_t$ denotes the domestic demand.

Appendix 4.6 DPD-GMM Results of Aggregate Exchange Rate Pass Through

Model Specification/ Variables	Latin America					
	B.M	E.M.	B.M	E.M.	B.M.	E.M.
	[1]		[2]		[3]	
$lnP_{t\text{-}1}^M$	**0.57*** **(8.42)**	**0.46*** **(6.73)**	**0.38*** **(4.73)**	**0.39*** **(4.64)**	**0.41*** **(4.72)**	**0.40*** **(4.56)**
lnS_t	0.01 (0.78)	**-0.04*** **(2.05)**	0.05 (0.50)	0.07 (0.56)	0.05 (0.60)	-0.04 (0.62)
$ln\,MC_t$	0.04 (0.18)	0.05 (0.31)	-0.06 (-0.61)	-0.05 (-0.57)	-0.05 (-0.60)	-0.03 (-0.54)
$ln\,E_t$	**0.50*** **(2.57)**	**0.60*** **(3.22)**	5.09 (1.64)	5.33 (1.62)	**3.74*** **(2.15)**	**4.13*** **(2.58)**
$ln\left(S_t\right)\times DUM_t$		**0.03*** **(3.13)**		**0.01*** **(2.11)**		**0.07*** **(2.14)**
m2[pval]			0.200	0.030	0.190	0.240
Sargan[pval] Hansen[pval]			**0.000*** 1.000	**0.000*** 1.000	**0.000*** 1.000	**0.000*** 1.000
Number of Observations	152	152	152	152	152	152
Number of Cross Sections	8	8	8	8	8	8

Notes: (a) Heteroskedasticity consistent t-values are in parenthesis. (b) [1] is within estimates, [2] is one step GMM (t-2) specification and [3] is one step GMM (t-3) specification. (c) m1 and m2 are tests for first-order and second-order serial correlation. (d) Sargan is a test of over identifying restrictions for the GMM estimators, asymptotically follows χ^2 (e) Sample size: 1980-2004. (f) Countries included are Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico and Venezuela. (g) B.M. is Benchmark Model and E.M. is Extended Model. (h) Time dummies and Country dummies are included in all the models to account for unobserved effects.

Appendix 4.7 DPD-GMM Results of Aggregate Exchange Rate Pass Through

Model Specification	Asia					
	B.M	E.M.	B.M	E.M.	B.M.	E.M.
	[1]		[2]		[3]	
lnP_{t-1}^{M}	**0.889*** **(23.870)**	**0.889*** **(23.690)**	**0.877*** **(41.794)**	**0.876*** **(42.759)**	**0.875*** **(46.685)**	**0.875*** **(48.285)**
lnS_t	**-0.456*** **(-3.951)**	**-0.439*** **(-3.560)**	**0.473*** **(8.037)**	**-0. 458*** **(-7.746)**	**0.464*** **(5.411)**	**-0.446*** **(-5.401)**
$ln\, MC_t$	**0.260*** **(3.022)**	**0.244*** **(2.561)**	**0.265*** **(6.599)**	**0.247** **(4.687)**	**0.264*** **(5.665)**	**-0.246*** **(-4.314)**
$ln\, E_t$	0.211 (1.180)	0.194 (0.101)	0.238 (1.900)	0.216 (1.484)	**0.295*** **(2.231)**	0.271 (1.721)
$ln\left(S_t\right)\times DUM_t$		0.002 (0.543)		-0.004 (-0.731)		0.003 (0.632)
m2[pval]			0.189	0.087	0.174	0.079
Sargan[pval] Hansen[pval]			**0.000*** 1.000	**0.000*** 1.000	**0.000*** 1.000	**0.000*** 1.000
Number of Observations	125	125	125	125	125	125
Number of Cross Sections	6	6	6	6	6	6

Notes: (a) Heteroskedasticity consistent t-values are in parenthesis. (b) [1] is within estimates, [2] is one step GMM (t-2) specification and [3] is one step GMM (t-3) specification. (c) m1 and m2 are tests for first-order and second-order serial correlation. (d) Sargan is a test of over identifying restrictions for the GMM estimators, asymptotically follows χ^2 (e) Sample size: 1980-2004. (f) Countries included are India, Indonesia, Malaysia, Pakistan, Philippines and Thailand. (g) B.M. is Benchmark Model and E.M. is Extended Model. (h) Time dummies and Country dummies are included in all the models to account for unobserved effects.

Appendix 4.8 Summary Statistics of Main Variables

	lnP_t^M			$ln\,S_t$			$ln\,MC_t$			$ln\,E_t$			$ln(S_t)\times D_t$		
Panel/Country	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max
Combined Panel	4.03	1.92	5.39	-5.49	-11.45	-1.38	3.98	-2.47	8.01	25.15	22.39	27.27	-5.49	-11.45	-1.38
Latin America	3.99	3.09	4.86	-5.63	-7.77	-3.87	3.79	2.30	4.80	25.11	24.81	25.42	-5.63	-7.77	-3.87
Asia	4.07	3.22	4.97	-5.16	-5.87	-4.56	4.14	3.63	4.55	25.20	24.53	25.75	-5.16	-5.87	-4.56
Argentina	3.75	2.71	4.82	-5.26	-5.75	-4.67	4.31	3.97	4.57	26.16	26.00	26.35	-5.26	-5.75	-4.67
Bolivia	4.04	3.28	4.68	-5.17	-10.9	-1.38	2.18	-2.47	4.78	22.60	22.39	22.95	-5.17	-10.9	-1.38
Brazil	3.95	3.19	4.72	-5.01	-6.16	-4.41	4.18	3.85	4.58	27.00	26.72	27.27	-5.01	-6.16	-4.41
Chile	3.91	2.80	4.89	-4.38	-4.78	-3.66	3.25	0.96	4.63	24.58	23.91	25.18	-4.38	-4.78	-3.66
Colombia	4.21	3.51	4.97	-5.27	-6.38	-4.40	3.46	1.92	4.52	25.04	24.62	25.37	-5.27	-6.38	-4.40
Ecuador	4.37	3.68	5.39	-5.01	-6.87	-3.32	4.63	3.23	5.93	23.36	23.09	23.64	-5.01	-6.87	-3.32
India	4.59	4.21	5.26	-4.98	-5.58	-4.50	4.03	3.41	4.46	26.41	25.75	27.06	-4.98	-5.58	-4.50
Indonesia	4.15	3.42	4.83	-5.76	-7.20	-4.46	3.82	3.34	4.22	25.48	24.72	25.97	-5.76	-7.20	-4.46
Malaysia	3.71	2.57	4.85	-4.83	-5.09	-4.60	4.35	3.91	4.77	24.73	23.93	25.42	-4.83	-5.09	-4.60
Mexico	3.41	1.92	4.72	-7.43	-11.4	-4.39	4.27	3.98	4.45	26.82	26.58	27.15	-7.43	-11.4	-4.39
Pakistan	4.33	3.89	5.10	-5.31	-6.00	-4.63	4.09	3.29	4.65	24.68	24.01	25.16	-5.31	-6.00	-4.63
Philippines	3.78	2.65	4.73	-5.33	-6.38	-4.59	4.19	3.61	4.67	24.81	24.58	25.19	-5.33	-6.38	-4.59
Thailand	3.87	2.62	5.02	-4.74	-4.96	-4.61	4.38	4.25	4.54	25.12	24.20	25.69	-4.74	-4.96	-4.61
Venezuela	4.24	3.67	4.71	-7.50	-9.88	-4.74	4.06	2.95	4.93	25.34	25.14	25.47	-7.50	-9.88	-4.74

Note: (a) lnP_t^M is Import Prices. (b) $ln\,S_t$ is the Nominal Effective Exchange Rate (NEER). (c) $ln\,MC_t$ is Foreign Marginal Cost. (d) $ln\,E_t$ denotes the domestic demand and $ln(S_t)\times D_t$ is the term for exchange rate asymmetry. (e) Time period is 1980-2004.

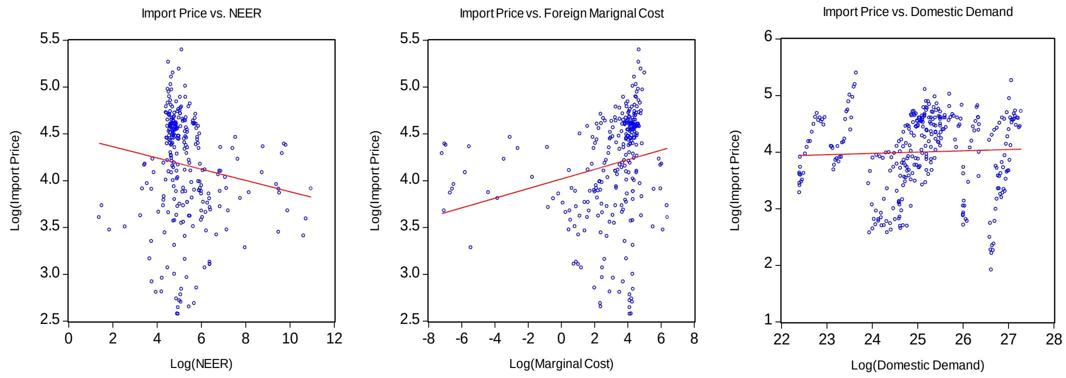
Appendix 4.9 Major External Sector Reforms in Latin America and Asia

Country	1980s	1990s	2000s
Argentina	Increased protection due to 1982 crisis; trade liberalisation since 1987 and tariffs down to 40 percent in 1989.	Membership of Mercosur Regional Trade Agreement led to booming manufacturing exports; debt restructuring plans in 1993 revived access to foreign loans.	IMF stop gap restructuring loan in 2003.
Bolivia	Uniform tariff system in effect at 10 percent since 1985.	Mercosur trade agreement led to increased trade in 1997; World Bank debt relief deal in 1998.	Private participation allowed in Bolivian manufacturing sector since mid 2000s
Brazil	Rationalised tariff structure and reduced tariffs in 1988 but import licences prevail.	Successive government pursued trade liberalisation from 1990 to 1998; massive IMF bail out package following the 1999 Real devaluation.	Further IMF loans in 2002 to assist markets and boost exports.
Chile	Rise in tariffs to 35 percent due to 1982 crisis and gradually down to 15 percent.	Mercosur trade agreements in 1996 to ease tariffs over a decade.	Free trade agreement with USA to ease out all tariffs in 2002.
Colombia	Reluctant import liberalisation; increasing protection during 1980-84.	Discoveries of oil and coal in 1990 replaced coffee as major exports; further import tariff reductions in the early 1990s.	Effective tariff rates reduced from 86% to 26% in manufacturing; simultaneously sectoral barriers to trade were lowered.
Ecuador	Discovery of oil replaced traditional exports such as bananas and coffee; further import substitution efforts.	Equalization of import tariffs in 1990-91; a graduated tariff system in place with tariffs varying from 5-20%; import controls on specific goods ended in 1993; World Bank restructuring loan in 1994.	IMF loans in 2003 to aid foreign investment.
India	Specific import restrictions initially relaxed; free entry for foreign investors in any sector except strategic ones.	In 1991, tariff and quota reductions; further relaxing of controls on foreign companies; standardised investment approvals.	Approvals in 2000 to set up Free Trade Zones (FTZ) across the country.
Indonesia	Tariff reduction and foreign firms' entry in 1983.	Rise in controls in foreign borrowing by private firms in 1991.	Import relief introduced in 2000 in the wake of banking collapse after

			1997 crisis.
Malaysia	Recession of mid 1980s led to easing of monetary controls to stimulate foreign investment in 1986; reforms to facilitate greater ownership for foreign companies.	Large capital flows into private sector and rising loans for non-traded investments in 1991; currency banned from trading externally in 1997; limits set to internal usage of foreign currency.	Easing of controls since 2000
Mexico	After the 1982 crisis imports suppressed, trade surplus generated to pay off the debt; General Agreement on Tariffs and Trade (GATT) member since 1986 and free trade negotiations.	North American Free Trade Agreement (NAFTA) signed in 1994; average tariff fell to 5 percent; elimination of all tariffs in 15 years transition to free trade.	Reduction of level of tariffs; replacement of quantitative restrictions; removal of domestic price controls
Philippines	Effective Rate of Protection (ERP) in place for manufacturing sector.	Tariff reforms reduced protection levels in manufacturing.	Import quotas reduced; two tier tariff system in place for intermediate goods and finished products.
Pakistan	IMF structural reforms in place; Special Export Processing Zones (EPZs) established;	Import duties reduced to 90 percent in 1994.	Foreign investor ownership up to 100 percent in existing industries.
Thailand	Foreign exchange controls relaxed and transfer of capital for foreign loans permitted since 1989.	More exchange rate controls relaxed to promote exporters; entry of foreign banks to hold liquid assets in 1996;	Overall manufacturing tariff protection reduced to about 8%; investment promoted in export oriented SMEs.
Venezuela	Rapid import liberalisation in 1989; abolished import restrictions; reduced tariffs to 80 percent.	Removal of quantity restrictions and tariffs simplified; further tariff reductions in 1993 to 10-20 percent;	Tariff rates were applied at different levels; tariff concessions and preferences to Andean trade partners.

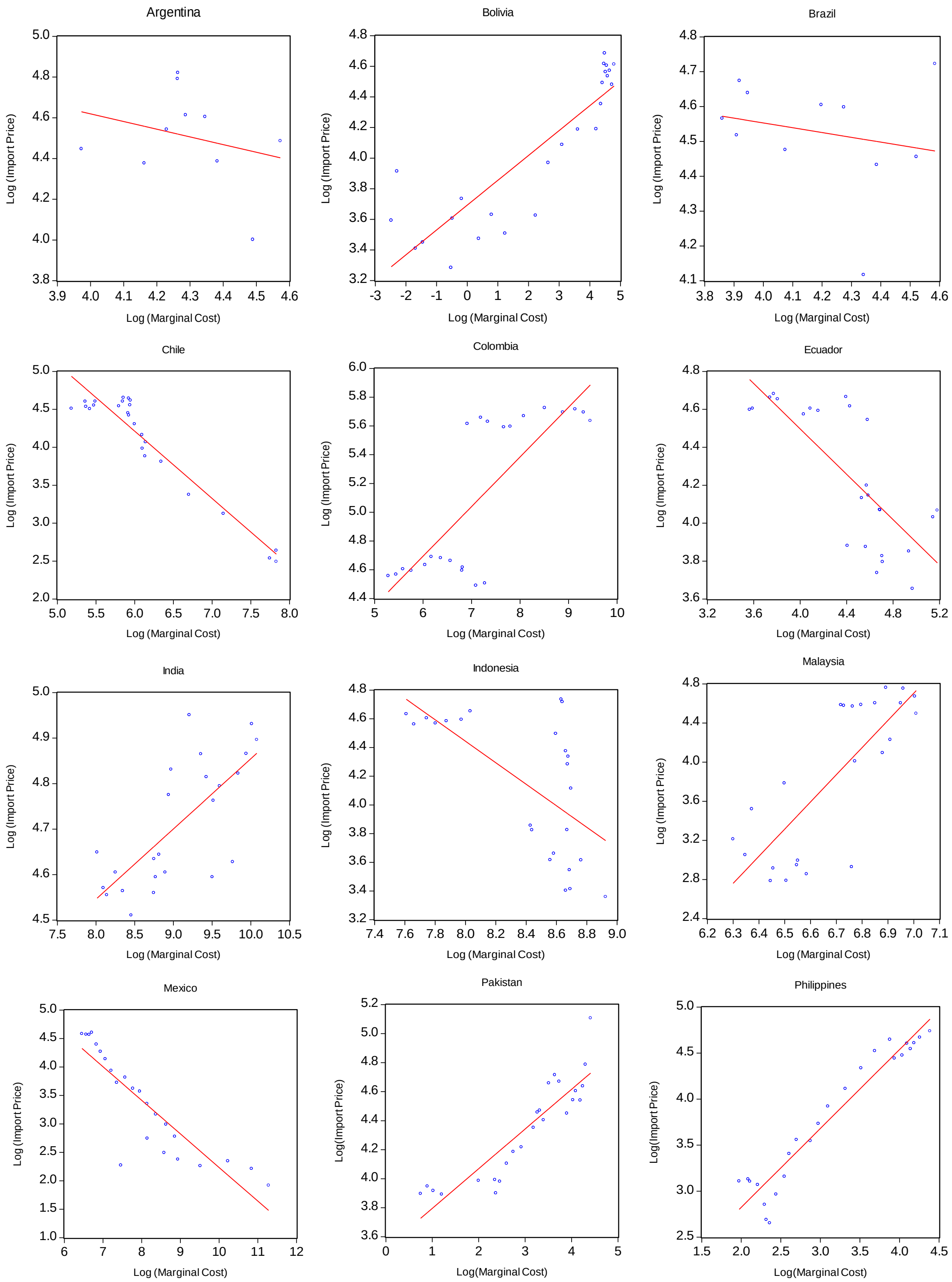
Source: (a) Ariff and Khalid (2005 and Green (2004).

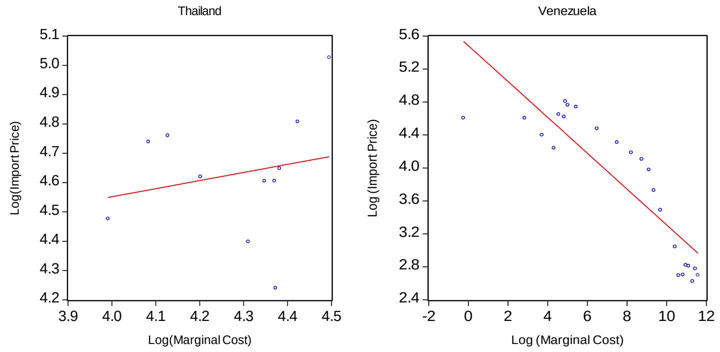
Appendix 4.10 Scatter Plots of main variables



Appendix 4.10 depicts the scatter plots of the main variables included in the study of exchange rate pass through to import prices in this chapter. The first graph indicates a negative relationship between import prices and NEER (S_t) that is also supported by the correlation value of -0.13 from Appendix 4.6. This result implies a domestic currency appreciation (rise in (S_t)) is associated with a fall in the import prices across the entire sample. This result coincides with other works such as Bahroumi (2005). The second panel in the above Appendix 4.10 supports the general conclusion that import prices rise with rising foreign marginal costs in emerging economies. A positive correlation coefficient of 0.23 from Appendix 4.6 confirms this result for our study. Finally, the third panel in the above Appendix 4.10 shows a weak, yet a positive relationship between domestic demand conditions which are a proxy for the domestic mark-up factor and import prices. A positive correlation coefficient of 0.36 from Appendix 4.6 between import prices and mark-up factor affirms this result.

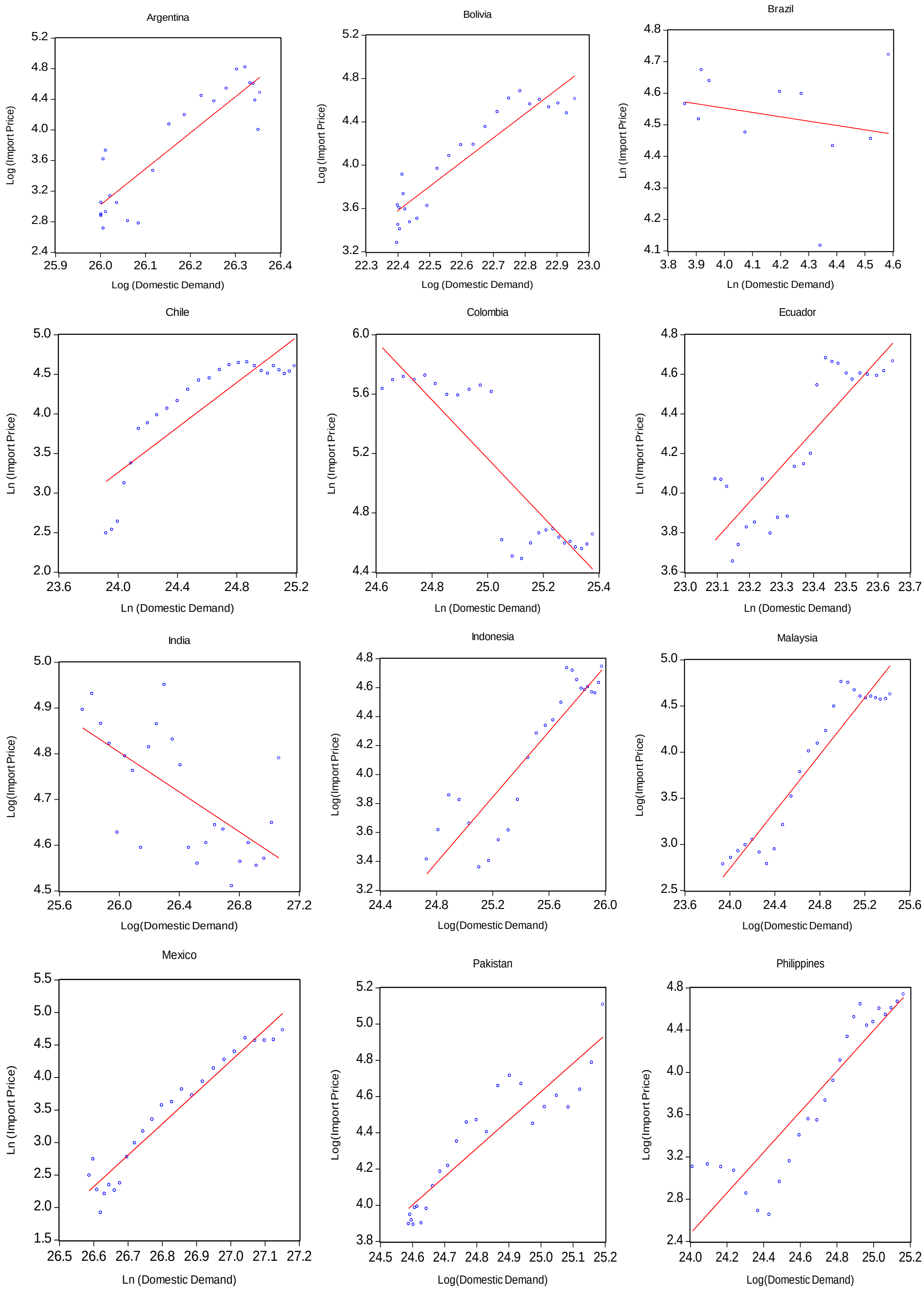
Appendix 4.11 Scatter Plots of Import Prices and Foreign Marginal Cost

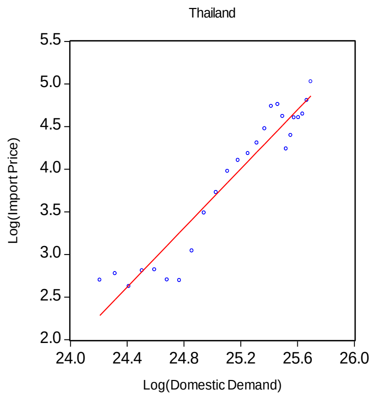


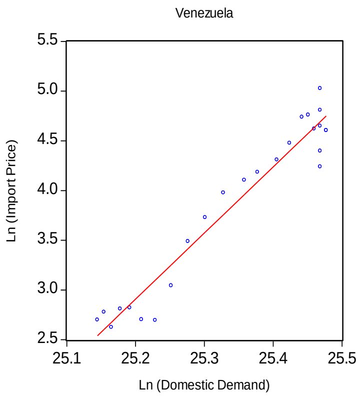


Appendix 4.11 depicts the relationship between import prices and foreign marginal costs. Foreign marginal costs as a determinant of import prices are positive related thereby implying rise in marginal costs would lead to rise in import prices for the importers. However, some of the countries show the opposite relationship. This could be attributed to the presence of asymmetries, wherein producers do not mark-down their prices in order to maintain market shares. Appendix 4.12 shows that except for Brazil and Colombia, the rise in domestic demand is positive related to import prices across other economies. The opposite relation could arise if there is a general economic downtrend in the manufacturing.

Appendix 4.12 Scatter Plots of Import Prices and Domestic Demand




Thailand
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
Log(Import Price)
24.0
24.4
24.8
25.2
25.6
26.0
Log(Domestic Demand)


Venezuela
5.5
5.0
4.5
4.0
3.5
3.0
2.5
Ln (Import Price)
25.1
25.2
25.3
25.4
25.5
Ln (Domestic Demand)

Chapter 5

Relative Producer Prices and Openness: A panel study of the Indian Manufacturing Sector

Chapter Abstract

This paper investigates whether increased trade openness dampens relative producer prices in India. This empirical study employs a panel data approach for 15 manufacturing sectors in India. We purport that the import share, average labour productivity and the mark-up are the key determinants of sectoral wholesale relative producer prices. We distinguish between fixed effects and random effects estimates based on the Hausman test and also carry out the pooled mean group estimation testing for poolability of sectors. There is some evidence of poolability when the private sector credit variable was introduced. Furthermore, dynamic panel GMM estimation was used to account for the potential endogeneity in the model. Our main result is that, there is some evidence that a rise in import share decreases the relative producer prices across the sectors in India, but this effect is not prominent.

5.1 Introduction

In international economics there is an ongoing debate on the relationship between trade openness and relative prices of domestic goods.[29] Some researchers such as BIS (2005) and Greenspan (2005) argue that low and stable rates of domestic price levels reflect intense market competition and this put downward pressure on wages. With openness, the low cost producers in emerging economies quickly integrate with the world markets. The phenomenon that increased import penetration through globalisation has contributed to lower producer prices was examined by Glatzer et al. (2006) across different industrial sectors for a single country Austria. However, Taylor (2006) has alternative views on international markets and competition. He claims that credible monetary policy and improved productivity contributes to lower price pressures in emerging economies.

The issue of globalisation is not a new concept but the rate at which emerging market economies are opening up to international markets over the last decade makes an interesting study. Similar studies on relative producer prices and openness were done by IMF (2006) and Gnan and Valderrama (2006). IMF (2006) examined a broader panel of OECD countries considering three sectors and concludes that both openness and productivity has significantly contributed to declines in relative prices over the 1990s.

There are several themes along which increased openness reduces inflationary pressures within the domestic industry. Rogoff (2003) concludes that there is evidence of a reduction in the overall price levels in industrialised economies due to cheaper imports is true to a large extent. He also argued that increased competition has resulted in greater price flexibility and a consequent decline in average inflation levels across the industrialised economies since the 1990s. Calani (2008) states that increased trade openness reduce sectoral wages due to higher foreign competition, which further reduces domestic price levels. Openness reduces bottlenecks and capacity constraints which lead to

[29] See, Ball (2006) who stated that globalisation has influenced relative prices more than it has overall price levels and he opposed the idea expressed by Rogoff (2003) that cheaper imports have largely resulted in decline of overall price levels.

decreased sensitivity to domestic supply problems. Competition also brings about a selection process in the markets where less efficient firms are automatically driven out of business. This mechanism ensures a rise in productivity and lower price levels. A study by Ito and Sato (2007) relating to emerging economies shows that the degree of influence of exchange rates to domestic prices through openness is higher in Latin American economies than in East Asia with the exception of Indonesia due to a rise in base money which was not present in other countries.

Ball (2006) clarified that trade openness affects the relative prices of domestic goods due to the presence of specific components that in turn affect each good's price differently, which is more complex rather than just the effect on the general price level. Therefore, a rise in trade openness leads to a decline in the price of a traded good relative to the price of other traded goods within the economy. In this context, opening up of the Indian economy to the international market since the early 1990s comprised several developments such as the reduction of tariff and non-tariff barriers and elimination of quantitative restrictions (see, Mallick and Marques, 2008) that have resulted in higher imports [30] and altered prices of traded goods relative to other prices in the manufacturing sector. Therefore, such a development in the context of increased trade openness presents an interesting case and motivates us to examine the effect of increased trade openness on relative producer prices.

This paper seeks to make two contributions to the literature. Firstly, this study extends the existing literature by examining the issue of trade openness and relative producer prices in Indian manufacturing sector using a dynamic panel framework, which, to the best of our knowledge is the first study of its kind for India.[31] Secondly, this study also considers the impact of financial stability on the relative producer prices. In this regard, several studies such as Cestone and White (2003), Levine (2001), Beck and Levine

[30] Ahluwalia, (2002) reports the highest tariff rate was brought down from 150% in 1991–92 to 30.8% in 2002–03, whilst the average import-weighted tariff was reduced from 72.5% in 1991–92 to 29% in 2002–03.
[31] Relative producer prices are defined as the ratio of sector specific wholesale price index to the aggregate wholesale price index.

(2000), Gozzi et.al, (2008) showed that financial stability is important for reducing transaction costs and information costs, which in turn reduces costs of production for firms across emerging economies. This tends to have a depressive effect on the relative price rise. Some works such as IMF (2006), Gnan and Valderrama (2006) and Glatzer et al. (2006) have examined the relationship between trade openness and relative producer prices either for aggregate country level data in industrialised economies (see, IMF 2006) or have conducted a single country aggregate level study like Glatzer et al. (2006) who look at Austria.

The rest of the paper is organized as follows. Section 5.2 describes the empirical literature. Section 5.3 describes the data and discusses recent trends. Section 5.4 outlines the empirical methodology. Section 5.5 explains the results and in Section 5.6 the conclusions are laid out.

5.2 Literature Review

There are two main explanations for the low global prices in recent years. One is international in origin and the other is domestic. Increased globalisation through rising import shares has resulted in declining price levels since the early 1990s through out the world is a generally accepted conclusion. On the other hand, studies such as Romer (1993) have expressed the importance of central bank’s policy to contain rapid rise in inflation rates across the industrialised economies. In this section we review the various channels through which globalisation influences domestic price levels. Firstly, increased share of low cost imports from low income economies have significantly dampened domestic prices in industrialised economies. (Chen et al., 2004; IMF, 2006). Chen et al. (2004) claim that in the short run falling mark-up factors and rising productivity contribute to the decline in domestic price levels, but in the long run the effect of productivity on domestic prices becomes more important.

The second channel is known as the global competition effect. Glatzer et al. (2006) state that dismantling of trade barriers intensifies competition levels in the traded goods sector. This reduces individual firms' market pricing power. Increased trade competition results in declining profit margins and subsequently lower price levels. Glatzer et al. (2006) also claim that increase in competition leads to specialization which has strong incentives for innovation. In such a scenario, temporary monopoly pricing will make way for newer production technologies. This leads to increase in productivity and simultaneous decline in costs of production which subsequently lowers price levels. Rogers (2007) in his study on European economies claims that the relative prices of non-tradables have risen faster in countries with higher productivity growth rates.

The premise that increased globalisation reduces mark-ups by firms and brings about price flexibility is examined by several researchers such as Chen et al. (2004) and Calani (2008). Calani (2008) examined the long run inflation process and results are inconclusive regarding reduced mark-ups and price flexibility. His work concludes that declining mark-ups do not have a large effect on inflation dynamics. Increased price flexibility affects inflation dynamics to some extent but is not large enough to explain worldwide disinflation. Also the fact that financial integration has had a considerable effect on reducing inflation outweighs other domestic factors. Chen et al. (2004) studied the effect of increased competition and openness on price levels within the EU during the 1990s. Their results conclude that in the short run, falling mark-ups and rising productivity levels contribute to declining prices but in the long run, rising productivity is relatively more important in determining price levels.

A third channel influencing relative prices operates through the labour markets potentially raising availability of labour supply puts downward pressure on wages and hence downward pressure on relative prices in industrialised economies. In addition to that, increasing competition forces production costs downward. Therefore, lower wages coupled with lower cost of production result in lower prices of goods and services (Glatzer et al. 2006).

Liberalisation of capital markets and integration of financial institutions both within a country and worldwide eases capital and credit flows and thereby stabilise domestic prices. Crespo Cuaresma et al. (2005) conclude that as emerging market economies integrate with financial markets globally they gain greater access to credit along with lower borrowing costs. In this regard, Levine et al. (2000) have highlighted the importance of private sector credit provided by financial intermediaries. They state that this measure distinguishes the credit issued to the private sector against other types of credit like central bank issued credit and it facilitates growth by reducing the costs of production and that in turn helps in ensuring competitive prices at sector level.

Change in policy measures due to globalisation also influences domestic price levels which accounts for the fifth channel. In this regard Romer, (1993) Rogoff, (2003) and Taylor, (2006) state that factors such as global capacity constraints and debt accumulation influence the effectiveness of the policy within an economy. These can reduce the ability of monetary policy to stabilise prices and stimulate output, which also affects the central bank's credibility. Therefore, there arises a need for independent policy decision making among central banks. In this regard, Gnan and Valderrama (2006) examined the channels through which globalisation dampened domestic price inflation in the Euro area. Their results suggest that globalisation induces flexible wages and prices. But it may result in unexpected price rises. This makes the price stability as the primary goal for the central bank.

BIS (2007) concluded that global factors are gaining importance in determining domestic price changes across economies. Finally, globalisation can also affect the balance of demand and supply across countries. As long as vigorous output expansion comes at low cost by emerging economies, inflation would be potentially lower worldwide.

However, Gamber and Hung (2001) provide evidence that as emerging economies demand catches up with supply globalisation could also increase inflation overtime.

In a similar study on European countries, Mody and Ohnsorge (2007) concluded that globalisation acts through increased trade and thus reduces the scope of domestic price inflation also suggested that domestic business cycles largely determined country specific components of inflation. Overall relation between increases in domestic price levels and globalisation weakened over time because the domestic component of inflation is small. They also concluded that with increased trading possibilities, globalisation may create a gap between domestic demand conditions and price setting by decreasing market power across domestic firms.

Ito and Shiratsuka (2007) examined the responses of consumer prices to shocks in import prices and producer prices across several Latin American and East Asian economies using structural vector auto-regression techniques. Their results showed that firstly, the degree of pass through of exchange rates to domestic prices is higher in Latin American economies than in East Asia with the exception of Indonesia. Secondly, the impulse response functions showed that base money was crucial in determining domestic inflation in Indonesia, which was not observed in other countries. Finally, responses of CPI to shocks in import prices and producer prices are large particularly in Indonesia, Mexico and Turkey. It is important to note that all the above channels are interlinked as many of these influence only the relative prices. But the central banks monitory policies orchestrate the overall price level. In the next section we examine the data issues and sectoral import share compositions over the last two decades in India.

5.3 Data

Our study examines the relationship between relative producer prices and trade openness of 15 manufacturing sectors under the International Standard Industrial

Classification (ISIC) for India at the three digit level.[32] We have an annual frequency and the sample period is 1994-2008. Poor availability of disaggregate data among emerging economies is well known and our study suffers from the same issue. However, we have sought to deal with limited data availability using linear interpolation method to fill the gaps or have constructed proxy variables following the previous literature. We consider import share of production, labour productivity, mark-ups and sectoral credit as potential determinants of relative producer prices following IMF (2006), Chen et al. (2004) and Glatzer et al. (2006). Data on the total number of employees per sector was available only up to 2002 for each of our 15 sectors. We used the data on labour force in each manufacturing industry from the WDI database and linearly interpolated the missing data on sector level employees.

Several studies have highlighted various ways in which trade openness has been captured over the years for both developed economies and emerging economies. Claudio and Guergil (1999) have considered the ratio of trade to GDP in their extensive study of openness and trade reforms in Latin American economies. Similarly, according to a study by Aizenman (1983), a crude measure of openness defined as the GNP share of (exports + import)/2 was used. However, he acknowledges a more appropriate measure should depend on elasticities of substitution in production and consumption between various classes of goods. Distinction between traded and non-traded goods has been another popular way to model trade openness. But, our study considers only the ratio of imports to sector level output as the exports at the disaggregate level were not available.

Given the data paucity a true measure of mark-up is difficult to obtain, especially at sectoral level for India. In this regard authors such as Campa and Goldberg (1999), (2005) have shown that proxies can be constructed.[33] One of their mark-up variable was defined as (Value added – wage costs – material costs)/Total value of production. We followed this

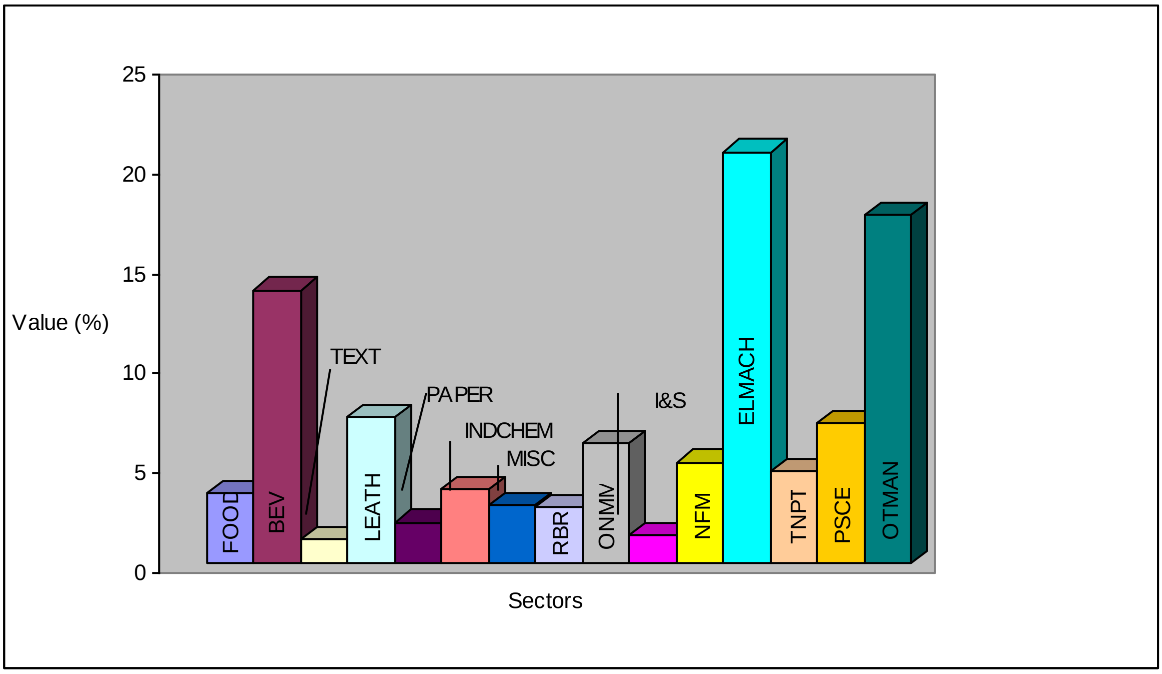
[32] ISIC classification is given in the appendix.
[33] See (Campa and Goldberg, 1999) for different variations of mark-up measures. Morrison (1990) used a measure defined as the ratio of prices to marginal costs (Py/MC), these common measures of market power are Lerner-type indexes which reflect markup behaviour as (Py-MC)/Py or, alternatively, (Py-MC)/MC.

method in our study broadly, as our data availability was limited regarding material costs for our sample of emerging economies, the mark-up variable in our study was constructed using value added, wage costs and total value of production. Some studies have constructed the domestic mark-up factors using measures of elasticity of demand (see Chen et al. 2004 and Glatzer et al. 2006, Morrison 1990).

A positive aspect of our data is the availability of sector specific indices of unit values for imports and producer prices which capture the changes in sectoral composition and thereby avoid the issue of aggregation bias to some extent as highlighted by Wickramasinghe and Silvapulle (1999). We have included an additional variable in our study that can measure the extent of financial stability. Levine (1992) considered measures of financial stability such as the ratio of M3 to GDP for the overall financial depth of the financial system. A second indicator in his study is the size of the banking sector relative to the central bank, which attempts to identify the financial intermediaries involved in the financial system. A third indicator measures the provision of credit to private enterprises relative to the state enterprises. In our study, the additional variable that is incorporated to capture the financial stability effect (credit availability) is defined as the private sector credit provided by the scheduled commercial banks to the manufacturing sector in India. We obtained this measure from the Handbook of Statistics on Indian Economy, provided by the apex bank in the country, Reserve Bank of India (RBI).

Appendix 5.3 shows the correlations of the main variables in our study both at levels and in growth rates. Most of the correlation figures are identical for levels and growth rates barring the mark-up variable. Import share is negatively correlated with the dependent variable, relative prices at levels (-0.16) and in growth rates (0.05). Labour productivity is positively correlated with values of 0.20 for the levels and 0.21 for the growth rates. Similarly, sectoral credit showed positive correlation with the dependent variable with values of 0.10 and 0.11 for levels and in growth rates respectively.

Figure 5.1 India's Sectoral Imports (1994-2008)



Note: (a) This table gives India's sectoral composition of imports as a percentage of total manufacturing imports in Indian Manufacturing Sector. (b) Source: Ministry of Statistics and Programme Implementation (MOSPI), India and based on author calculations. (c) FOOD = Food Products, BEV = Beverages, TEXT = Textiles, LEATH = Leather Products, PAPER = Paper products, INDCHEM = Industrial Chemicals, MISC = Miscellaneous Petroleum & Coal Products, RBR = Rubber Products, ONMM = Other Non Metallic Minerals, I&S = Iron & Steel, NFM = Non-Ferrous Metals, ELMACH = Electrical Machinery, TNPT = Transport Equipment, PSCE = Professional & Scientific Equipment, and OTMAN = Other Manufacturing.

Figure 5.1 lays out the sectoral import composition as a percentage of total manufacturing imports in India. It is the ratio of the total imports in each sector over the entire sample period 1994-2008 to the total manufacturing imports in percentage terms. The major sectors in the international market in terms of imports are Electrical Machinery with 20% of total manufacturing imports, Other Manufacturing with 17% of imports, Beverages with 13% and Leather with 7% respectively. The vibrant automobile sector accounts for most of the electrical machinery imports to be further used in manufacturing and re exported to destinations like South East Asia. During the industrial reforms in 1993-94, import duties on capital goods were reduced to 15% to promote export oriented capital goods. Food Products sector accounts for only 3.5% of the import share of total manufacturing imports given the fact that this sector has a larger weight attached in the total industry. This indicates the presence of several non-tradable products. However, growth in the Textiles sector has not been much and it reflects only a meagre 1.18% of the import share of total manufacturing.

Paper, Industrial Chemicals, Miscellaneous coal and petroleum and Rubber all have marginal import share values of 2%, 4%, 3% and 3% respectively. Similarly, the metals sector recorded relatively low import shares. While Other Manufacturing sector accounted for only 6% and Non-ferrous metals was 5%. The central budget for Iron and Steel reduced the import duties from 75% to 50% during the early nineties up to 1994-95. However, due to reduced demand and higher competition this sector accounted for only 1% of the total manufacturing. The rest of the four sectors accounted for thirty percent of the import share of total manufacturing wherein Transport accounted for 5%, Professional and scientific equipment at 7%. From Figure 5.1 we understand that the core manufacturing sectors such as non-metallic minerals, electrical machinery, non-ferrous metals, transport and other manufacturing accounted for the majority of the import composition.[34] We now move over to dealing with the data specific issues concerning unit roots and stationarity in the methodology section.

5.4 Econometric Methodology

We have taken advantage of the available data for each of the sectors in our study, and constructed a panel data set. In this section we review empirical methods such as the panel unit root tests, Fixed Effects – Random Effects (FE/RE), Pooled Mean Group (PMG) estimation and the Generalised Method of Moments (GMM) estimation. We firstly consider panel data models and then proceed to the panel unit root tests as proposed by Im, Pesaran and Shin (2003).

[34] However, Mallick and Marques (2008) state that there has been a shift in the composition of import structure in Indian manufacturing since the 1991 reforms.

5.4.1 Fixed Effects and Random Effects

Linear panel data models look at both the individual units called cross sections and data over time. This approach is preferred to pure time series or single cross section methods because it allows us to look at dynamic relationships. Panel data models also allow us to control for both unobserved cross section effects and time effects. We now briefly present a panel data model.

Consider the model;

$$y_{it} = \alpha + \beta' x_{it} + u_{it}, \qquad (5.1)$$

where i = 1,2,...,N cross section units that are observed over T time periods t = 1,2,...,T. y_{it} is a scalar dependent variable. The matrix x_{it} represents the exogenous variables in the model and α is a scalar and β' is the vector of coefficients with dimension $(k \times 1)$. The two way error component model can be expressed as;

$$u_{it} = \alpha_i + \lambda_t + \varepsilon_{it}; \; \varepsilon_{it} \sim IN\left(0, \sigma^2\right) \qquad (5.2)$$

where α_i represents the unobservable individual effect, λ_t represents the unobservable time effect and ε_{it} is the error disturbance term. Hsiao (1986) states that if the number of periods is relatively small, a two way FE model can be fitted using a set of time indicator variables. The fixed effects model implemented with such indicators can be tested jointly that all the coefficients on indicator variables will be zero using a joint F test. We have utilised the Hausman test in our study to determine the effectiveness of fixed effects over the random effects. The Hausman test (henceforth Hausman Test [A]), is distributed asymptotically as chi-square (χ^2) with k degrees of freedom. It tests the null hypothesis that the extra orthogonality conditions imposed by the RE estimator are valid. In other words, there is no difference between random effects and fixed effects. Its alternative hypothesis is that the fixed effects estimator is appropriate.

5.4.2 Pooled Mean Group Estimation

If there exists a cointegrated long run equilibrium relationship among nonstationary variables, the short-run and long-run relationships of the variables are estimated by an error correction model (ECM). Pesaran et al. (1999) and Schich and Pelgrin (2002) have stressed the importance of the right choice of econometric methodology in dealing with panel data heterogeneity. Pesaran et al. (1999) proposed the Pooled Mean Group Estimation technique and this is advantageous since it incorporates both long run and short run effects by adopting an Autoregressive Distributive Lag structure and estimating this as an Error Correction Model. The short run coefficients are estimated by averaging the cross sectional estimates while the long run coefficients are pooled since economic theory typically have stronger implications for long run relationships rather than dynamics of adjustment as is the case in this study. The null hypothesis of homogeneity of long run coefficients is tested by a joint Hausman test (henceforth Hausman test [B]), which is distributed as χ^2. The alternative hypothesis is no homogeneity of long run coefficients.

Pesaran et al. (1999) state that irrespective of the order of integration of the explanatory variables (i.e. whether I(0) or I(1)), by taking sufficient lags in the ARDL structure, we can still trace the effect of the explanatory variables on the dependent variable, and thereby can overcome the problem of spurious regression. Also the error correction mechanism integrates the short run dynamics and the long run equilibrium without losing crucial information about the long run. It explains the speed of adjustment of the model to the long run equilibrium. If the error correction coefficient is zero, then there is no long run relationship between the variables in the model. Values between -1 and 0 imply a partial adjustment; a coefficient of -1 indicates full adjustment of the model and coefficients smaller than -1 implies adjustment in the present time period.

5.4.3 DPD - Generalised Method of Moments (GMM)

In estimating long run equilibrium relationships in economics, there is a possibility that the variables could be simultaneously determined. Therefore, since our study deals with simultaneously determined variables, there is a definite endogeneity bias. Endogeneity could be dealt with by making use of valid instruments. Bond (2002) states that the explanatory variable under question may be correlated with current are earlier period shocks but not with future period shocks or be strictly exogenous and uncorrelated with any shocks at all. If the explanatory variable is assumed to be endogenous, then lagged values of up to (t-3) periods would turn out to be valid instruments. This view is also supported by Easterly and Serven (2003). In the case that the explanatory variable is predetermined, then additional (t-1) period lag is available as a valid instrument in the levels equation. Blundell and Bond (1998) state that when estimating autoregressive parameters in dynamic panel models, instrumental variable estimators can be plagued with the problem of weak instruments. But, the system GMM estimator can ensure higher precision. GMM also scores over the fixed effects and random effects estimators in terms of efficiency. Sargan tests of orthogonality indicate the validity of the instruments. Similarly, m2 statistic tests the null of no second order autocorrelation in residuals and is normally distributed with N (0,1). If the p-value is greater than 0.05 we do not reject the null and conclude no presence of serial correlation of first and second order respectively. In other words, under the null, the model is not misspecified with respect to serial correlation. Arrelano and Bond (1991) state that for the validity of the GMM instruments to hold, the second order serial correlation (m2 test) is necessary and the residuals must not be serially correlated.

5.4.4 Panel Unit Root Tests

During the recent past panel unit root tests have gained importance in the light of econometric techniques using non-stationary panels with stationary dependant variable but non-stationary regressors. Panel unit root tests have been employed to increase the number of observations which solves the problem of low power for unit root tests to some extent. Harris and Tzavalis (1999) state that panel unit root tests allow for both parametric and dynamic heterogeneity across groups and therefore are more powerful than conventional tests.

In this regard several commonly used panel unit root tests to test for stationarity are the Levin, Lin and Chu (LLC) test, Im, Pesaran and Shin (IPS) test and the Maddala and Wu (MW) test. In this study we use Fisher's panel Augmented Dickey Fuller (ADF) test and the Phillips-Perron (PP) tests to check for non-stationarity in our panel. Additionally, we also present the estimates of the IPS and the LLC tests which test for potential non-stationarity in a panel context. The fact that all these tests test for the same null hypothesis of the presence of unit root makes it easy to compare and also solves the problem of low power of unit root tests (Maddala and Wu, 1999). An alternative approach to panel unit root tests is the ADF test that uses Fisher's (1932) results to derive tests that combine the p-values from individual unit root tests. This idea has been proposed by Maddala and Wu, and by Choi. If we define π_i as the p-value from any individual unit root test for cross-section *i*, then under the null hypothesis of unit root for all *N* cross-sections, we have the asymptotic result that

$$-2\sum_{t=1}^{N} log\left(\pi_i\right) \sim \chi^2_{2N} \qquad (5.3)$$

5.4.5 Empirical Specification

We now move to an empirical examination of the phenomenon of the effect of increased trade openness on relative producer prices. We follow a variant version of IMF (2006) and Chen et al. (2004) in expressing the empirical relationship. IMF (2006) examined import share of output, average labour productivity, exchange rates, sector and country specific characteristics (dummies) as the determinants of relative producer prices.

Whereas, Chen et al. (2004) considered import share of output, labour productivity, mark-up, sector and country specific characteristics. We start by incorporating similar determinants such as import shares, labour productivity, mark-up, sector and country specific characteristics, but extend the empirical framework beyond both the papers by including the availability of sectoral credit as an additional explanatory variable. Therefore, the empirical relationship to be estimated in our study is laid out in logarithmic terms as;

$$ln\left(P_{it}/P_t\right) = \alpha_0 + \alpha_1\, ln\left(IM_{it}/Y_{it}\right) + \alpha_2\, ln\left(Y_{it}/L_{it}\right) + \alpha_3 ln\left(\mu_{it}\right) + \alpha_4\, ln\left(Credit_{it}/Y_{it}\right) + \varepsilon_{it} \qquad (5.4)$$

Where, $\left(P_{it}/P_t\right)$ denotes the sector level wholesale price scaled by the aggregate wholesale price. Sector specific price levels are scaled by the overall price level in order to account for the influence of monetary policy along with the fact that long run price levels are invariably determined by monetary policy (IMF, 2006). α_0 is the constant term. The import share of output is denoted by $\left(IM_{it}/Y_{it}\right)$. We expect this variable to be negatively associated with relative producer prices (i.e. $\alpha_1 < 0$). This is because rise in import share due to greater openness increases competition which results in a slower price rise (see, Chen et al. 2004). The output per unit of labour, which reflects the average labour productivity, is denoted by $\left(Y_{it}/L_{it}\right)$. This variable is expected to exert a negative influence on relative producer prices (i.e. $\alpha_2 < 0$). This is due to the fact that increased competition forces firms to raise their average productivity levels thus lowering production costs and thereby prices. The mark-up variable is represented by $\left(\mu_{it}\right)$. In the presence of foreign competition, domestic firms revise their mark-ups downwards in order to remain competitive and hold their market share, thereby inducing a declining effect on the prices. This indicates mark-up factors and relative prices move in the same direction and therefore, its coefficient is expected to be positive (i.e. $\alpha_3 > 0$). The credit available to each sector as a ratio of their output is represented by $\left(Credit_{it}/Y_{it}\right)$. This variable is expected to capture the effect of the integrated financial markets channel on the relative prices. It reflects to some extent the financial position of each sector to gain access to industrial credit. Levine (1992) opines that as financial intermediaries collect information about producers from different firms in an industry, they reduce the costs per producer by spreading the cost over several producers.[35] This indirectly reduces the costs of production, and therefore has a depressive effect on relative prices. We expect this variable to have a negative influence on the relative producer prices (i.e. $\alpha_4 < 0$). Finally, ε_{it} is the error disturbance term.

5.5 Results

We now present the results from the panel unit root tests for stationarity. Then we present and analyse the panel data results from the Fixed Effects and Random Effects estimation. We also present and discuss the dynamic panel data results from the Pooled Mean Group Estimates and the Generalised Method of Moments estimation.

5.5.1 Panel Unit Root Tests

We carried out several panel unit root tests on the variables in this study as mentioned in the methodology. The results indicate $ln\left(P_{it}/P_t\right)$ is stationary at both levels and first differences under the ADF and PP tests.

We do not accept the null of unit root under both the specifications for the import share variable $ln\left(IM_{it}/Y_{it}\right)$**.** Also for $ln\left(Y_{it}/L_{it}\right)$ turned out to be consistently stationary throughout all the different specifications. $ln\left(\mu_{it}\right)$ was weakly stationary under the log specifications with a low t value, but under the first difference specification it was stationary for both [1] and [2] and therefore we reject the null hypothesis of unit root. The.

[35] See Levine (1992), Asli-Demigurc-Kunt et al (2001) for additional measures.

Table 5.1 Panel Unit Root Test Results

	ADF – Fisher				Phillips Perron (PP)			
Variable/Test	Levels		First Differences		Levels		First Differences	
	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
$ln(P_{it}/P_t)$	25.63 [0.69]	**45.32* [0.03]**	**85.85* [0.00]**	**74.76* [0.00]**	23.04 [0.81]	24.68 [0.74]	**77.48* [0.00]**	**97.81* [0.00]**
$ln(IM_{it}/Y_{it})$	50.95 [0.09]	**77.72* [0.00]**	**110.83* [0.00]**	**88.61* [0.00]**	44.02 [0.05]	**46.37* [0.03]**	**134.20* [0.00]**	**113.45* [0.00]**
$ln(Y_{it}/L_{it})$	21.21 [0.88]	19.90 [0.91]	37.41 [0.16]	**22.03* [0.00]**	14.32 [0.99]	9.22 [0.99]	31.06 [0.41]	**45.06* [0.03]**
$ln(\mu_{it})$	6.83 [0.63]	34.36 [0.26]	**82.94* [0.00]**	**114.46* [0.00]**	34.63 [0.25]	**44.09* [0.04]**	**134.45* [0.00]**	**160.98* [0.00]**
$ln(Credit_{it}/Y_{it})$	22.75 [0.82]	33.07 [0.23]	**138.91* [0.00]**	**109.91* [0.00]**	22.94 [0.81]	37.37 [0.16]	**146.23* [0.00]**	**163.53* [0.00]**

Note: (a) Specification [1] indicates intercept only and [2] indicates trend and intercept. (b) Null Hypothesis is unit root (H_0: I (1)) and Alternate Hypothesis is no unit root (H_1: I (0)). (c) Robust t-statistic with a probability value in square brackets of more than 0.05 indicates acceptance of the null at 5% level. (d) Bold and asterisk (*) when reject null. (e) (P_{it}/P_t) stands for Import price. (f) (IM_{it}/Y_{it}) is the sectoral import to production ratio. (g) (Y_{it}/L_{it}) denotes the sectoral labour productivity. (h) (μ_{it}) is the term representing the mark-up variable. (i) $(Credit_{it}/Y_{it})$ denotes the extent of credit availability.

measure of financial stability denoted by $ln(Credit_{it}/Y_{it})$ was stationary only at first differences

5.5.2 Panel Estimation – PMGE Results

In Table 5.2, we present the pooled mean group estimates for two types of models; benchmark model and the extended model. We firstly consider the impact of the import share $ln(IM_{it}/Y_{it})$ on the relative producer prices.

Import share consistently had the expected negative signs in all the four models and were also significant throughout. However, in the short run, though insignificant throughout, it carried the expected negative coefficients in two of the models. However, there is some evidence which indicates that higher shares of import to production across sectors within the economy reduce relative producer price levels. The coefficient of $ln(Y_{it}/L_{it})$ is

Table 5.2 Determinants of Relative Producer Prices in Indian Manufacturing

Variable/Model	Benchmark Model		Extended Model	
	[1]	[2]	[1]	[2]
Long Run Coefficients				
$ln(IM_{it}/Y_{it})$	**-0.063*** **(t= -9.840)**	**-0.088*** **(-3.941)**	**-0.062*** **(-13.681)**	**-0.112*** **(-17.610)**
$ln(Y_{it}/L_{it})$	**0.034*** **(2.069)**	**-0.071*** **(-3.131)**	**-0.036*** **(-3.265)**	**0.021*** **(2.403)**
$ln(\mu_{it})$	-0.010 (-0.545)	-0.184 (-1.356)	**0.078*** **(4.192)**	0.010 (0.405)
$ln(Credit_{it}/Y_{it})$			**-0.076*** **(-4.882)**	**-0.061*** **(2.832)**
Short Run Coefficients				
Error Correction	**-0.200*** **(-2.321)**	**-0.183*** **(-3.953)**	**-0.373*** **(-4.604)**	**-0.330*** **(-2.890)**
$\Delta ln(IM_{it}/Y_{it})$	-0.021 (-0.944)	0.022 (0.875)	-0.019 (-1.811)	0.027 (1.901)
$\Delta ln(Y_{it}/L_{it})$	**0.049*** **(2.545)**	0.027 (1.488)	0.012 (0.492)	**-0.274*** **(2.040)**
$\Delta ln(\mu_{it})$	-0.011 (-0.373)	0.010 (0.511)	-0.021 (-0.709)	**0.227*** **(2.520)**
$\Delta ln(Credit_{it}/Y_{it})$			**-0.076*** **(-4.882)**	**-0.010*** **(-2.933)**
Joint-Hausman Test	7.66 [pval = 0.05]	**9.84** **[pval = 0.04]**	7.66 [pval = 0.05]	1.68 [pval = 0.09]
Number of Observations	197	197	197	197
Number of Cross Sections	15	15	15	15

Notes: (a) Heteroskedasticity corrected t-values in parenthesis. (b) [1] indicates raw data specification and [2] indicates cross sectionally demeaned specification. (c) Sample size: 1994-2008. (d) * indicates significance at 5% level. (e) Dependent variable is the log of relative producer prices measured as the difference of between sectoral producer prices and overall producer prices. (f) Time dummies and sector dummies are included in the estimation of all the models. (g) Sector dummies are interacted with the nominal effective exchange rate to account for the effect of cost of imported intermediaries. (h) Joint Hausman test tests the null hypothesis of poolability of long run coefficients in all the models.

negative and significant in two models, but is positive and significant in the other two models in the table. This expected negative relationship coincides with the conclusions of several authors such as Chen et al. (2004) and Glatzer et al. (2006) who conclude that rising productivity levels are inversely related to domestic relative producer prices through a fall in production costs.

The pooled mean group estimate indicates a significant but positive effect on the dependent variable. We reckon that productivity might have a bigger impact on relative prices over time through the accumulated effect of openness.[36] The variable $ln(\mu_{it})$, which intends to capture the effect of mark-up factors on relative prices, was employed following Chen et al. (2004) and Glatzer et al. (2006). The effect of this variable is positive and significant as expected only in the pooled mean group estimation. Across other models, its effect is not significant. Following others such as, Levine et al. (1999) and Levine et al. (2000) we consider the effect of private sector credit issued by the banks on the sectoral relative prices. Greater access to sector level credit by firms negatively impacts upon relative prices by reducing their cost of production. The effect of this credit variable $ln(Credit_{it}/Y_{it})$ included in the estimation was negative as expected across both the models and also in the short run. This indicates that in a highly unorganized manufacturing sector in India, availability and access to credit by the firms still plays a very significant role in their business operations. All the error correction coefficients are statistically significant, thereby indicating partial adjustment of the model to the long run equilibrium. The joint Hausman statistic tests for the null hypothesis of homogeneity of long run coefficients by comparing PMGE and MG estimates. A high probability value of 0.09 indicates we accept the long run homogeneity and therefore can pool the sectors within our study on Indian manufacturing. We then present additional results from the fixed effects and random estimation.

5.5.3 Dynamic Panel Data – Fixed Effects and Random Effects Estimation

Table 5.3 presents the results from the fixed effects and random effects estimation. We believe that the sectors chosen for this study are a sample that represents the Indian manufacturing industry. Therefore, we have reason to believe that there are random factors associated in examining sector level dynamics like relative prices, sector level import share

[36] Chen et al. (2004) state that only those firms with high productivity import more. This implies that changes in productivity in the long run are crucial to firms pricing strategies to remain competitive, which in turn can determine their survival or exit from the industry. Also, firms with higher productivity experiencing increasing returns to scale (operating on declining cost curves), may increase their prices in a bid to generate quicker profits.

of output, labour productivity, mark-up factors and sector specific credit. The results categorised into two, the benchmark model that considers the lagged dependent variable

Table 5.3 Fixed Effects and Random Effects Estimates

Variable/Model	Benchmark Model		Extended Model	
	[1]	[2]	[1]	[2]
Long Run Coefficients				
$ln(P_{it-1}/P_{t-1})$	**0.706*** **(t=8.467)**	**0.883*** **(17.674)**	**0.866*** **(16.562)**	**1.053*** **(23.979)**
$ln(IM_{it}/Y_{it})$	0.008 (0.531)	-0.006 (-0.061)	0.124 (1.802)	**-0.877*** **(-2.646)**
$ln(Y_{it}/L_{it})$	-0.002 (-0.532)	0.008 (1.280)	0.027 (0.872)	0.008 (0.215)
$ln(\mu_{it})$	0.013 (1.122)	0.032 (1.750)	0.031 (1.421)	0.003 (0.332)
$ln(Credit_{it}/Y_{it})$			**-0.025*** **(-2.613)**	**-0.015*** **(-2.542)**
Hausman Test	24.16 [pval = 0.76]		11.48 [pval = 0.87]	
Number of Observations	197	197	197	197
Number of Cross Sections	15	15	15	15

Note: (a) Heteroskedasticity corrected t-values in parenthesis. (b) [1] indicates Fixed Effects estimation and [2] indicates Random Effects estimation. (c) Sample size: 1994-2008. (d) * indicates significance at 5% level. (e) Dependent variable is the log of relative producer prices measured as the difference of between sectoral producer prices and overall producer prices. (f) Time dummies and sector dummies are included in the estimation of all the models. (g) Sector dummies are interacted with the nominal effective exchange rate to account for the effect of cost of imported intermediaries. (h) Hausman specification test presented to determine the difference between fixed effects and random effects in the models.

$ln(P_{it-1}/P_{t-1})$, import share of output $ln(IM_{it}/Y_{it})$, average labour productivity $ln(Y_{it}/L_{it})$, and the mark-up factor $ln(\mu_{it})$. The extended model incorporates the sector specific credit as a share of output given by $ln(Credit_{it}/Y_{it})$ as an additional determinant of the relative prices.

Throughout the Table 5.3, the coefficient on the lagged dependent variable is positive and statistically significant. However, none of the other variables bear any significance in the benchmark model. The Hausman specification test with a high value does not reject the null hypothesis and therefore we conclude that there are no significant differences between fixed and random effects models. Hence, our preferred model is the random effects estimation. Whereas, under the extended model, import share of output denoted by $ln(IM_{it}/Y_{it})$ and the sector level credit denoted by $ln(Credit_{it}/Y_{it})$ were significant with the expected signs on their coefficients. Also, we can confirm from the Hausman test that we do not reject the null hypothesis and therefore conclude that with no systematic difference between fixed effects and random effects estimators, we prefer the random effects estimator.

5.5.4 Dynamic Panel Data – Generalised Method of Moments (GMM) Estimation

Additional results from the GMM estimation are presented below in Table 5.4 However, Arellano and Bond (1991) state that in a dynamic panel context, more efficient estimates that exploit all the available information must be considered. Following Bond (2002) we carried out the GMM estimation to account for endogeneity in the model. GMM estimation uses different instrument sets at lags and levels. We report GMM with (*t*-2) differences and also system GMM with (*t*-3) estimation. The system GMM estimation combines both levels equation and first difference equations. Table 5.4 presents the results of the GMM estimation. Throughout the various specifications, the lagged dependent variable $ln(P_{it-1}/P_{t-1})$ was positive and statistically significant as expected.

The estimates for $ln(IM_{it}/Y_{it})$ displayed negative coefficients across all specifications as expected but none of them turned out to be significant. This might imply that the effect of openness on prices occurs over time and is not uniform. The average labour productivity variable $ln(Y_{it}/L_{it})$ displayed expected negative signs on the coefficients only on the PMGE and MG specifications. The estimates for the mark-up variable $ln(\mu_{it})$, were positive but with no significance in all the specifications barring PMGE. The financial variable $ln(Credit_{it}/Y_{it})$, included in the extended model showed a significant negative effect on relative producer prices as expected. In comparison, our estimates differ in size and significance from previous works by Chen et al. (2004), Glatzer et al. (2006) and IMF (2006) due to different methods adopted. For example, the

Table 5.4 DPD – Generalised Method of Moments (GMM) Estimates

Variable/Model	[1]	[2]	[3]	[4]
$ln\left(P_{it\text{-}1}/P_{t\text{-}1}\right)$	**0.861*** **(t=19.144)**	**1.060*** **(23.750)**	**0.866*** **(16.562)**	**1.053*** **(23.979)**
$ln\left(IM_{it}/Y_{it}\right)$	-0.030 (-1.690)	-0.040 (-1.331)	0.124 (0.802)	-0.056 (-0.372)
$ln\left(Y_{it}/L_{it}\right)$	-0.012 (-1.442)	0.028 (0.025)	0.027 (0.872)	**0.494*** **(2.315)**
$ln\left(\mu_{it}\right)$	-0.040 (-1.623)	0.027 (0.051)	**0.031*** **(2.421)**	0.086 (0.594)
$ln\left(Credit_{it}/Y_{it}\right)$			**-0.025*** **(-2.613)**	**-0.056*** **(-2.216)**
m2[pval]	0.232	0.148	0.689	0.255
Sargan[pval]	0.331	**0.028***	0.331	0.064
Hansen[pval]	1.000	1.000	1.000	1.000
Number of Observations	182	182	182	182
Number of Cross Sections	15	15	15	15

Notes: (a) Heteroskedasticity consistent t-values are in parentheses. (b) [1] is one step GMM (t-2) specification, [2] is one step GMM (t-3) specification, [3] is extended model and one step GMM (t-2) specification, [4] is extended model and one step GMM (t-3) specification. (c) m2 is a test for the second-order serial correlation. (d) Sargan is a test of over identifying restrictions for the GMM estimators. (e) Sample size: 1994-2008. (f) * indicates significance at 5% level. (g) Dependent variable is the log of relative producer prices measured as the difference of between sectoral producer prices and overall producer prices. (h) Control variables include time dummies and sector dummies are included in the estimation of all the models. (i) Sector dummies are interacted with the nominal effective exchange rate to account for the effect of cost of imported intermediaries.

estimates for import share calculated by Chen et al. (2004) vary from -0.010 to -0.068 and the import share estimates by Glatzer et al. (2006) range from -0.043 to 0.094. Whereas, our coefficients on the import share of output range from -0.013 to -0.357. This indicates a slightly higher range of import share in Indian manufacturing. The coefficients for productivity from IMF (2006) are quite similar across countries and sectors at -0.09 and -0.10 but are higher in Glatzer et al. (2006) and range between -0.056 and –0.187. However, the coefficients for productivity in India range from -0.013 to -0.106 but are not significant. Finally, the mark-up coefficients in our study ranging between 0.007 and 0.054 are smaller in comparison to Glatzer et al. (2006).

According to Arellano and Bond (1991), for the validity of the GMM instruments to hold, the second order serial correlation (m2 test) should not be identified in the model and the residuals should not be serially correlated. In other words, one should not reject the null hypothesis of no second order serial correlation (m2 test) among the residuals. Our model shows that we do not reject the null hypothesis under the m2 test in all models barring [1]. However, additional tests for validity of instruments are looked at (Hansen test). Baum (2006) states that this is the most commonly used test to check for the suitability of the model, i.e. validity of instruments. In our study, we do not reject the null hypothesis of correct model specification with p values of 1.000. Sargan test shows that our instrument set is valid with p values of 0.05 or higher in all the four specifications. But, there might still be a need to consider better instruments that are strictly exogenous because measurement errors in the model could still persist at higher lags.

5.6 Conclusions

Several studies dealt with the phenomenon of increasing openness and its effects on domestic price levels both producer and consumer prices. Our paper examines the phenomenon of the effect of increasing trade openness on relative producer prices at the sector level for a leading emerging economy India. The initial panel results indicate that the effect of globalisation occurs mainly through two channels; directly via the increases in the import share and the productivity levels. But as Chen et al. (2004) and Ito and Shiratsuka (2007) suggest, some of the subdued effect could be due to the delay in response of firms to external changes.

Other important determinant, the mark-up factor in the importing country was not predominantly significant in explaining the changes in the relative sectoral prices. Among the different sets of results, from Table 5.1, our preferred model is the pooled mean group estimation in terms of statistical significance and the expected signs on the coefficients. However, we believe the random effects estimation is a better representation of the impact of globalisation on relative prices as it passed the Hausman test. From Table 5.3, the extended model with sector specific credit as an additional determinant of relative prices is the preferred one with relatively better significance and having passed the auto correlation and identification tests. We also arrive at one general conclusion that the increase in globalisation through rising import shares reduces relative producer prices in India but this effect is not prominent. In general, possible policy implications could be to strengthen the domestic sector by reducing production costs in order to withstand the negative effects of rising trade openness and import penetration. Diversifying the product base also reduces the unfavourable impact of trade openness for small open economies.

Appendix 5.1 Data Description

Variable	Definition	Source
Sectoral Wholesale Prices (P_{it})	(Base Period: 1993-94 = 100)	Ministry of Planning and Statistics of India (MOSPI).
Aggregate Wholesale Prices (P_t)	(Base Period: 1993-94 = 100)	Handbook of Statistics on Indian Economy, RBI.
Sectoral Imports (IM_{it})	Sector specific import unit values with base period 1993 = 100.	Handbook of Statistics on Indian Economy, RBI
Sectoral Output (Y_{it})	Sector specific total production. (Nominal)	United Nations Industrial Development Organisation (UNIDO) Database.
Sectoral Labour (L_{it})	Total number of employees per sector.	United Nations Industrial Development Organisation (UNIDO) Database.
Nominal Effective Exchange Rate $ln(S_{0t})$	Trade weighted index. Number of units of foreign currency per unit of domestic currency. (Base Period: 2000=100)	Bank for International Settlements (BIS)
Private Sector Credit $(Credit_{it})$	Sector specific scheduled commercial banks credit	Handbook of Statistics on Indian Economy, RBI
Relative Wholesale Prices $ln(P_{it}/P_t)$	Difference between Sectoral Wholesale Prices and Overall Wholesale Prices in log terms.	Based on author's calculations.
Import Share $ln(IM_{it}/Y_{it})$	Ratio of imports to total output per sector in log terms	Based on author's calculations.
Labour Productivity $ln(Y_{it}/L_{it})$	Output produced divided by total employment in log terms	Based on author's calculations.
Mark-up ratio $ln(\mu_{it})$	(Value added – wage costs) /Total value of production in log terms.	Based on author's calculations.
Financial index $ln(Credit_{it}/Y_{it})$	Ratio of Private Sector Credit to Output in log terms.	Handbook of Statistics on Indian Economy, RBI and based on author's calculations.
Sectoral Value Added	Value Added per sector	United Nations Industrial Development Organisation (UNIDO) Database.
Sectoral Wages	Sector specific wages	United Nations Industrial Development Organisation (UNIDO) Database.
Sector size	Ratio of total number of employees per sector and number of establishments per sector.	United Nations Industrial Development Organisation (UNIDO) Database and based on author's calculations.
Data Span 1994 - 2008	Yearly frequency	

Appendix 5.2 ISIC 3 Digit Classification of Indian Manufacturing Sector.

311 Food Products (FOOD)

313 Beverages (BEV)

321 Textiles (TEXT)

323 Leather products (LEATH)

341 Paper and products (PAPER)

351 Industrial chemicals (INDCHEM)

354 Miscellaneous petroleum and coal products (MISC)

355 Rubber products (RBR)

369 Other Non-metallic Mineral products (ONMM)

371 Iron and Steel (I&S)

372 Non-Ferrous Metals (NFM)

383 Machinery, electric (ELMACH)

384 Transport equipment (TNPT)

385 Professional and scientific equipment (PSCE)

390 Other manufactured products (OTMAN)

Appendix 5.3 Cross Correlations of the main variables at levels.

Variable	$ln(P_{it}/P_t)$	$ln(IM_{it}/Y_{it})$	$ln(Y_{it}/L_{it})$	$ln(\mu_{it})$	$ln(Credit_{it}/Y_{it})$
$ln(P_{it}/P_t)$	1.00				
$ln(IM_{it}/Y_{it})$	-0.16	1.00			
$ln(Y_{it}/L_{it})$	0.20	0.11	1.00		
$ln(\mu_{it})$	0.04	-0.16	0.18	1.00	
$ln(Credit_{it}/Y_{it})$	0.10	0.28	0.06	-0.10	1.00

Source: (a) Based on author calculations.

Appendix 5.4 Cross Correlations of the main variables in growth rates.

Variable	$ln(P_{it}/P_t)$	$ln(IM_{it}/Y_{it})$	$ln(Y_{it}/L_{it})$	$ln(\mu_{it})$	$ln(Credit_{it}/Y_{it})$
$ln(P_{it}/P_t)$	1.00				
$ln(IM_{it}/Y_{it})$	0.05	1.00			
$ln(Y_{it}/L_{it})$	0.21	0.45	1.00		
$ln(\mu_{it})$	-0.11	0.01	0.08	1.00	
$ln(Credit_{it}/Y_{it})$	0.11	-0.11	-0.14	-0.05	1.00

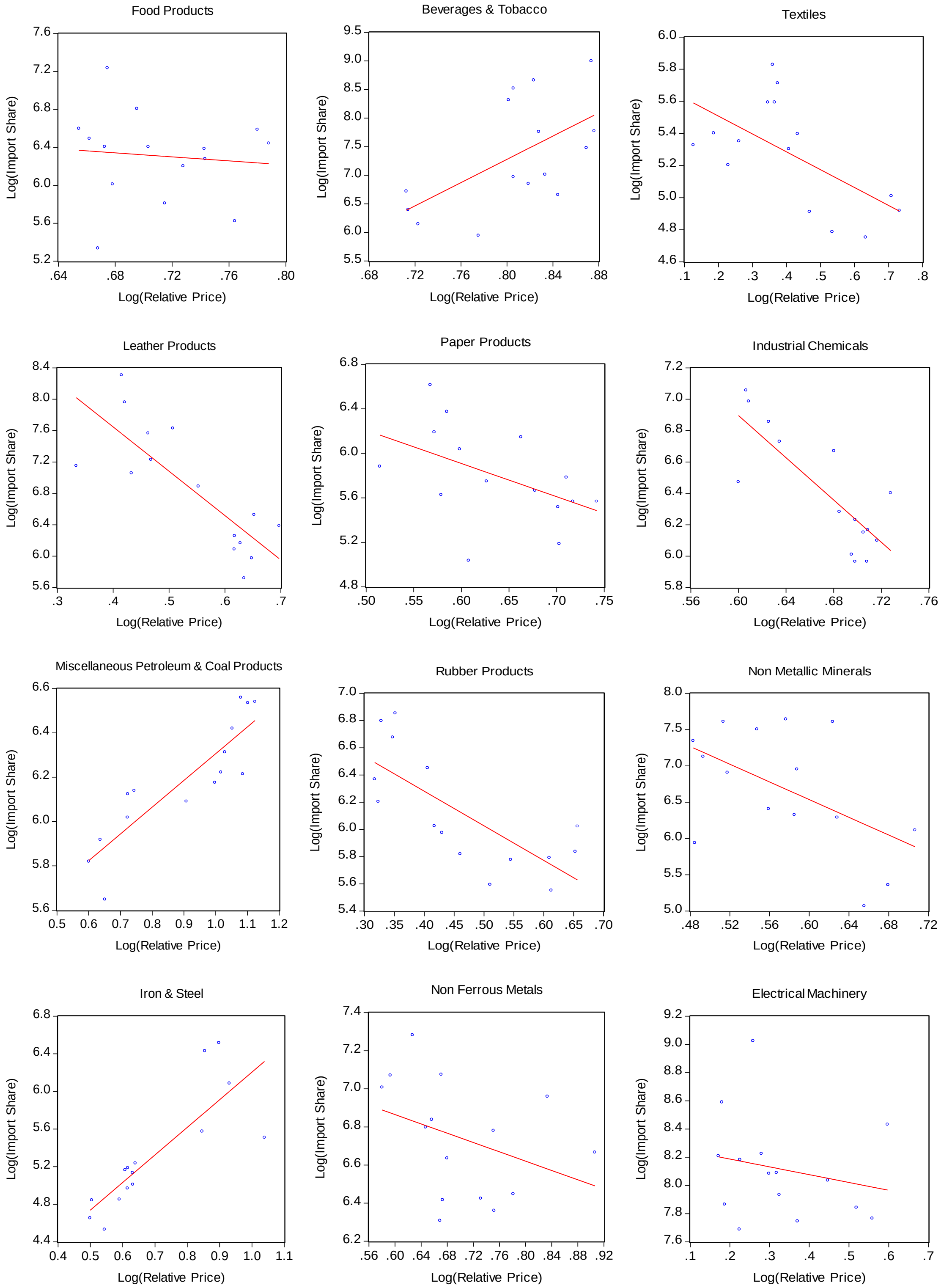
Source: (a) Based on author calculations.

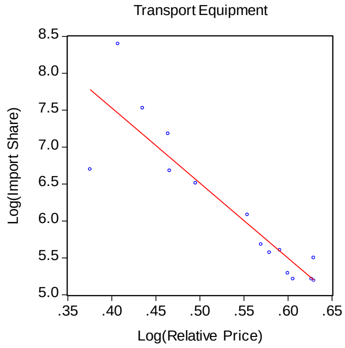
Appendix 5.5 Panel Unit Root Test Results

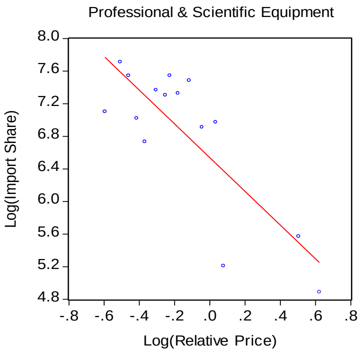
	IPS-W stat				LLC t-stat			
Variable/Test	Levels		First Differences		Levels		First Differences	
	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
$ln(P_{it}/P_t)$	25.63 [0.69]	**45.32* [0.03]**	**85.85* [0.00]**	**74.76* [0.00]**	23.04 [0.81]	24.68 [0.74]	**77.48* [0.00]**	**97.81* [0.00]**
$ln(IM_{it}/Y_{it})$	50.95 [0.09]	**77.72* [0.00]**	**110.83* [0.00]**	**88.61* [0.00]**	44.02 [0.05]	**46.37* [0.03]**	**134.20* [0.00]**	**113.45* [0.00]**
$ln(Y_{it}/L_{it})$	21.21 [0.88]	19.90 [0.91]	37.41 [0.16]	**22.03* [0.00]**	14.32 [0.99]	9.22 [0.99]	31.06 [0.41]	**45.06* [0.03]**
$ln(\mu_{it})$	6.83 [0.63]	34.36 [0.26]	**82.94* [0.00]**	**114.46* [0.00]**	34.63 [0.25]	**44.09* [0.04]**	**134.45* [0.00]**	**160.98* [0.00]**
$ln(Credit_{it}/Y_{it})$	22.75 [0.82]	33.07 [0.23]	**138.91* [0.00]**	**109.91* [0.00]**	22.94 [0.81]	37.37 [0.16]	**146.23* [0.00]**	**163.53* [0.00]**

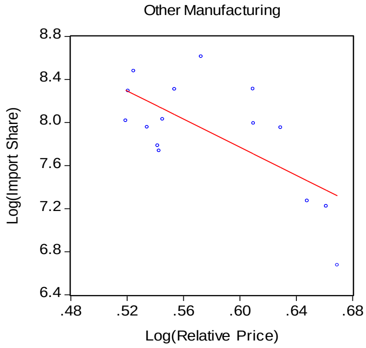
Note: (a) Specification [1] indicates intercept only and [2] indicates trend and intercept. (b) Null Hypothesis is unit root (H_0: I (1)) and Alternate Hypothesis is no unit root (H_1: I (0)). (c) Robust t-statistic with a probability value in square brackets of more than 0.05 indicates acceptance of the null at 5% level. (d) Bold and asterisk (*) when reject null. (e) (P_{it}/P_t) stands for Import price. (f) (IM_{it}/Y_{it}) is the sectoral import to production ratio. (g) (Y_{it}/L_{it}) denotes the sectoral labour productivity. (h) (μ_{it}) is the term representing the mark-up variable. (i) $(Credit_{it}/Y_{it})$ denotes the extent of credit availability.

Appendix 5.6 Scatter Plots of Import Share and Relative Price Level



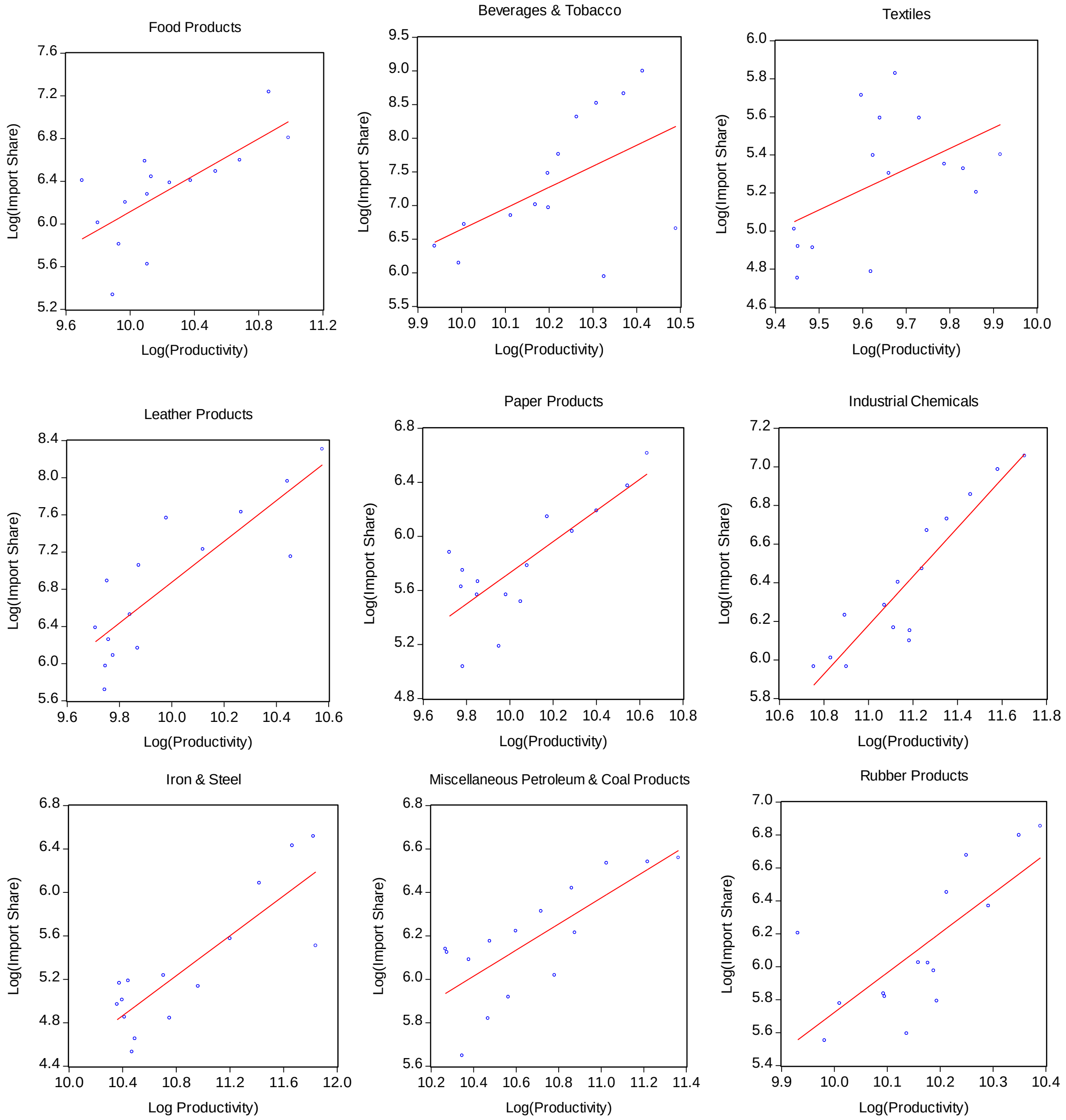


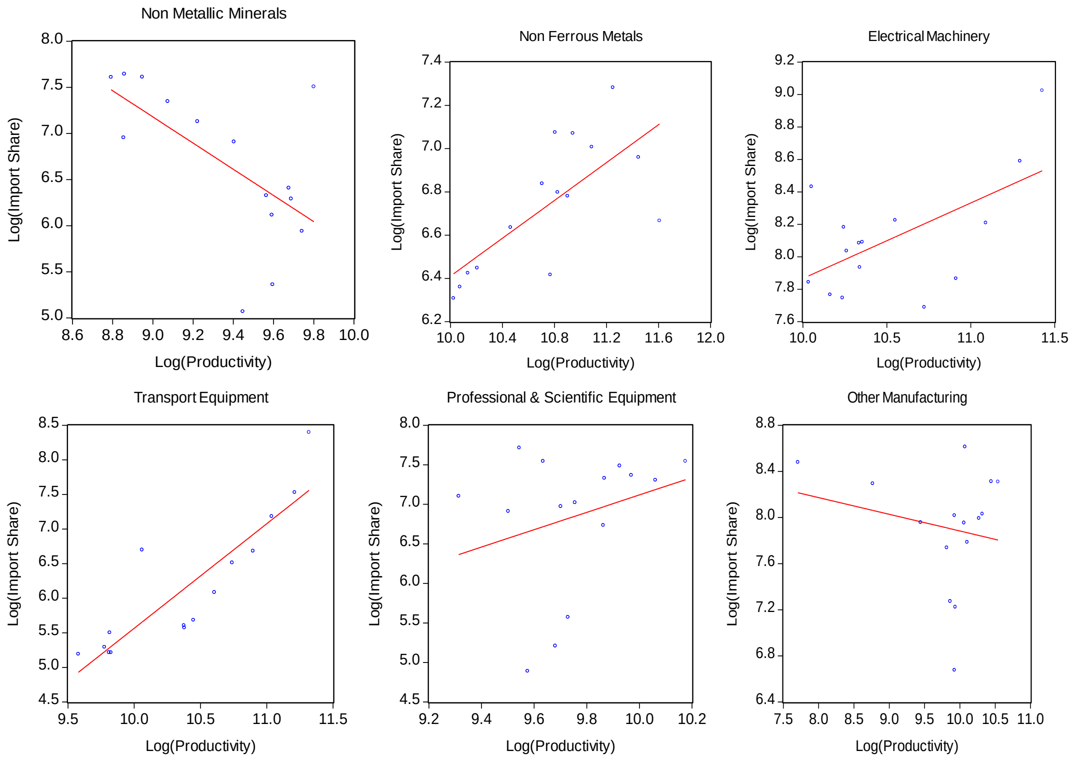




Appendix 5.6 depicts the sector wise scatter-plots with regression for the dependent variable relative prices $ln\left(P_{it}/P_t\right)$ and independent variable import share $ln\left(IM_{it}/Y_{it}\right)$. The fact that the slopes and intercepts are not identical indicates significant sectoral differences. We take advantage of this heterogeneity and conduct a dynamic panel estimation which confirms the appropriateness of the random effects estimation.

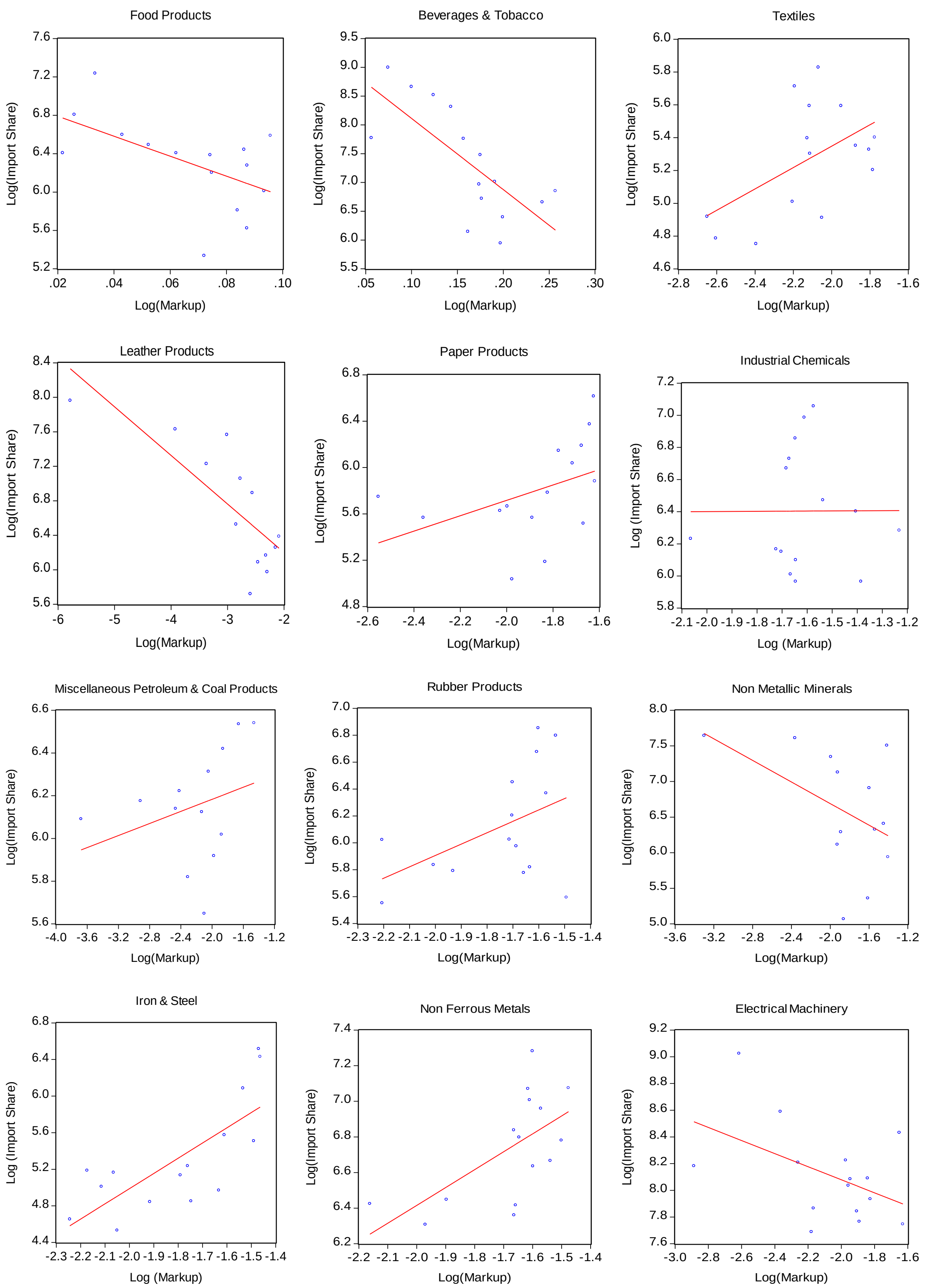
Appendix 5.7 Scatter Plots of Import Share and Productivity

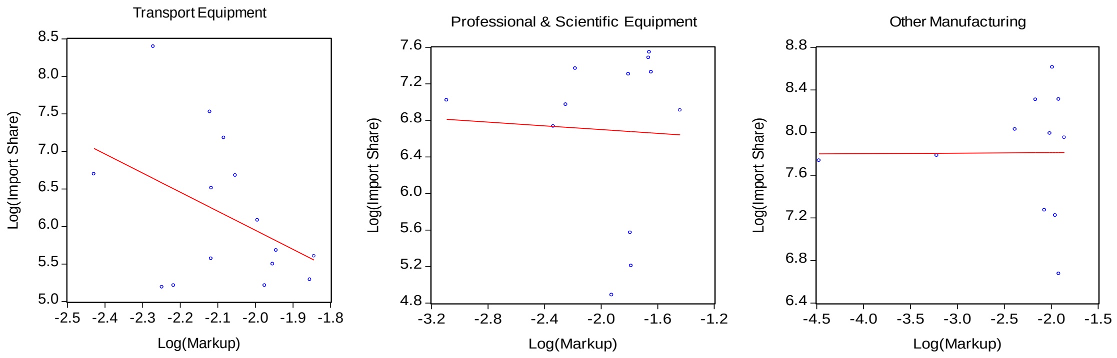




From Appendix 5.7 we can see that except for two sectors; non metallic minerals and other manufacturing, import share of production is positively related to the average labour productivity. This could imply that sectors that are open to international trade and foreign competition are more productive.

Appendix 5.8 Scatter Plots of Import Share and Mark-up





Appendix 5.8 depicts panels of scatter plots between import shares and mark-up for each of the manufacturing sectors in India. As trade openness increases and import share of production rise, in general, there should be a drop in mark-up rates in order to stay price competitive in the domestic markets. However, from the above panels we observe that six out of fifteen sectors show a rise in mark-ups for rising import shares. Such industries might be experiencing imperfect market structures and hence be forced to erect entry barriers in a bid to remain competitive as import penetration intensifies. Such sectors might either be strategic market players or relatively small sectors.

Appendix 5.9 Summary Statistics of Main Variables

	Relative Prices			Import Share (%)			Productivity		
Country/Sector	Average	Min	Max	Average	Min	Max	Average	Min	Max
Food products	2.03	1.92	2.19	78.47	38.75	124.70	29775.11	16328.12	58970.82
Beverages	2.24	2.03	2.40	139.95	61.25	227.87	25802.61	150.59	35943.87
Textiles	1.53	1.13	2.07	24.77	8.22	42.92	15712.04	12618.52	20252.85
Leather products	1.72	1.39	2.00	161.62	94.10	266.65	22894.04	16452.94	39160.29
Paper products	1.89	1.67	2.10	38.60	30.31	54.37	23230.74	107.57	41499.71
Industrial chemicals	1.96	1.82	2.07	69.78	40.87	98.96	74034.50	46825.60	120745.60
Miscellaneous coal & petroleum products	2.49	1.82	3.07	70.69	31.85	93.86	46031.18	28778.25	86101.98
Rubber products	1.60	1.37	1.92	71.60	48.94	99.88	24818.86	626.28	32518.65
Non metallic minerals	1.78	1.62	2.02	86.17	38.47	186.36	11710.79	4.12	18040.89
Iron & Steel	2.03	1.64	2.82	34.77	19.62	54.37	62647.38	31558.23	138606.80
Non ferrous metals	2.02	1.78	2.47	145.89	47.58	238.61	52081.82	22562.02	109931.60
Electrical machinery	1.40	1.18	1.81	483.13	198.59	1615.53	39840.74	360.39	91582.80
Transport equipment	1.71	1.45	1.87	49.06	25.04	129.46	36309.11	159.66	82298.35
Prof. & scientific equipment	0.91	0.55	1.86	157.97	39.80	327.93	16890.69	15.17	26244.48
Other manufacturing	1.78	1.68	1.95	340.38	146.48	831.70	20172.78	0.17	37809.30

Notes: (a) Import share is ratio of imports to output per sector as a percentage of total manufacturing import shares. The above table presents the summary statistics of key variables studied in this chapter. Sectors with higher average import shares and higher productivity averages are associated with lower relative prices. Such a relationship is often the case with capital intensive sectors like Electrical Machinery, non-ferrous metals and other manufacturing equipment. On the other hand, sectors such as food and beverages show higher prices and lower productivity levels. This is often the case with an emerging economy like India.

(Continued) Appendix 5.9 Summary Statistics of Main Variables

	Mark-up			Credit (%)			Size		
Country/Sector	Average	Min	Max	Average	Min	Max	Average	Min	Max
Food products	0.06	0.02	0.09	3.50	1.98	5.73	89.14	52.70	436.41
Beverages	0.16	0.05	0.25	0.58	0.25	0.83	89.75	62.78	130.06
Textiles	0.12	0.07	0.16	5.74	4.46	6.99	93.05	72.40	114.20
Leather products	0.05	-0.01	0.12	1.23	0.66	1.82	41.10	33.96	50.03
Paper products	0.15	0.07	0.19	1.75	1.55	2.15	56.83	48.42	62.97
Industrial chemicals	0.20	0.12	0.29	10.63	7.20	13.16	83.41	48.93	107.35
Miscellaneous coal & petroleum products	-0.81	-7.07	0.23	3.54	0.28	5.28	58.79	39.10	89.36
Rubber products	0.17	0.11	0.22	1.20	0.82	1.57	54.48	40.21	73.82
Non metallic minerals	0.13	-0.14	0.24	1.62	1.34	2.17	55.07	32.62	116.11
Iron & Steel	0.17	0.10	0.23	8.57	5.62	10.21	100.86	79.77	137.46
Non ferrous metals	0.18	0.11	0.22	3.09	2.60	3.97	60.47	24.50	154.89
Electrical machinery	0.13	0.05	0.19	5.06	1.77	12.27	70.71	61.43	80.57
Transport equipment	0.12	0.08	0.15	2.47	1.69	4.07	111.33	74.68	178.12
Prof. & scientific equipment	0.08	-0.28	0.23	0.57	0.27	0.96	75.03	55.73	100.15
Other manufacturing	-1.26	-19.06	0.15	18.97	11.55	24.32	76.26	44.52	123.45

Note: (a) Credit is ratio of private sector credit to output as a percentage of total manufacturing credit. (b) Sector size is total number of employees per sector.

Chapter 6

Conclusions

6.1 General Conclusions and Future Research Work

This research thesis facilitates a better understanding of the relationship between disaggregate investment and exchange rates in emerging market economies from two distinct regions, Latin America and Asia. This study conducts a detailed research into the mentioned relationship in a dynamic panel framework while testing for long run equilibrium relationships. In doing so, this research enriches the existing literature in the following manner.

Firstly, this thesis has highlighted the renewed interests in new open economy macroeconomics, both theoretically and empirically in the following dimensions: a) we have clarified the role of adjustment costs and exchange rates in the micro founded investment models in studying emerging economies; b) this work has brought forward the effect of exchange rate fluctuations on investment in a dynamic panel context that examines both short run and long run effects; c) we have also attempted to account for the potential endogeneity in the estimation of determinants of sectoral investment by employing instruments; d) in addition, we have also looked at region wise panels, viz., Latin America and Asia separately to examine the nature of impact of exchange rate changes on sectoral investment.

Secondly, the sample period in this study spans 25 years from 1980 to 2004, which captures the changes in exchange rates and crisis that affect investment across economies in our sample. Similar patterns emerge when examining determinants of disaggregate investment for Latin American and Asian economies and hence are comparable to some extent. Our findings reflect most of the existing studies on how the exchange rates and other micro founded determinants such as wages and output influence investment. This study also highlights the importance of exchange rate volatility since the onset of currency crises. Our study also puts into perspective the phenomenon of globalisation through trade openness and relative prices in key manufacturing sectors that are export oriented.

Thirdly, several empirical methodologies have been applied and analysed in this research, spanning both time series and panel data estimation. They include both the time series unit root tests such as the Augmented Dickey Fuller (ADF) and Phillips Perron (PP), and panel unit root tests such as the Levin, Lin and Chu (LLC), Im Pesaran and Shin (IPS), ADF-Fisher and PP type tests to check for the stationarity of the variables. Given that our sample is an unbalanced panel, it is essential to avoid non-stationarity in the variables, which if ignored, could lead to spurious regression issues. Some of the applied econometric estimation methodologies used are Pooled Mean Group Estimation (PMGE) to capture the long run equilibrium relationships. Persistence in exchange rates are best captured by robust methods such as the Generalised Autoregressive Conditional Heteroskedasticity (GARCH), and Component GARCH (CGARCH) models. In addition to them, we take account of heterogeneity in our panel data by employing the Fixed Effects (FE), Random Effects (RE) and Generalised Method of Moments (GMM). This study conducts these estimation procedures across different sample sizes; combined sample of all the economies, only Latin American economies and also only Asian economies sample. Therefore, in this manner this thesis enables us to closer understand the effects of exchange rates on the sectors during the various crisis periods. However, the methodologies employed in this study can easily be applied to other regional economic blocks or individual countries' disaggregate studies. The next section explains the key findings and policy implications from this research. It also lays out the potential areas for future research work.

6.2 Key findings and policy implications

In Chapter 2, by employing a dynamic panel methodology, our paper has attempted to model the determinants of investment for different sectors in key emerging market economies from both Latin America and Asia. Confirming with previous works, the main conclusions are: firstly, the effect of a depreciation of the domestic currency in real terms on investment is negative but not significant in the long run. However, some of the positive effect could be attributed to a greater demand for exports following bouts of depreciation that outweigh the negative effects of increased imported goods or other input costs. Secondly, the negative effect of real wages on investment in the long run is consistent with the fact that increased input costs reduce firm profitability and thus reduce investment. Thirdly, we accept the null hypothesis of poolability of cross sections in examining the combined effect of exchange rates and other determinants of investment in emerging economies. This chapter accounts for the endogeneity in the model estimation by conducting dynamic panel GMM estimation. However, there is greater need to consider better instruments to tackle the issue of endogeneity.

The next chapter has attempted to model the exchange rate volatility along with the other determinants of investment for different sectors in key emerging market economies from both Latin America and Asia. As Serven (2003) highlighted the positive effect of permanent component of volatility on investment arises due to the fact that most of the emerging economies are small open economies with low trade openness. As the firms in small open economies are not much dependent upon exchange rates, they might view volatility as a signal to invest more in the domestic markets. Moreover, any exchange rate shocks arising in that part of the world are believed to affect all emerging economies in that region in our sample.

Chapter 4 dealt with the phenomenon of exchange rate pass through and indicate that the presence of complete pass through in the long run and incomplete partial pass through in the short run. Firms react in different ways to the changes in the exchange rates, which results in asymmetric pass through rates across countries. While exchange rate pass through appears to be similar for all countries within a linear framework, this is not the case once we take account of asymmetries. Given that these were significant this encouraged us to investigate different responses across our two regions Latin America and Asia. It finds that, unlike that which has been observed for several other countries, there is no clear-cut evidence of a decline in exchange rate pass-through to domestic prices in emerging economies during the chose time period. Further, it observes that there is asymmetry in pass-through between appreciation and depreciation, and between large and small exchange rate changes. It is rather surprising to note the incomplete pass through in emerging economies despite the liberalisation efforts, reductions in tariffs and removal of quantitative restrictions on trade and the changing composition of imports.

This chapter has examined the proposition that globalization has been an important factor behind low and steady inflation in recent years. The impact of globalisation captured through import share of production on relative prices will be temporary over the medium run, unless the overarching objectives of monetary policy are affected. In emerging market and developing countries, however, greater openness appears to have been and is likely to remain an important factor behind the sustained improvement in inflation. Sectors that have become more exposed to foreign competition have seen the largest relative price declines in recent years. Nevertheless, globalization is not the only factor driving relative price changes. While openness has been important, particularly in low-tech and low-skill sectors, productivity growth has also contributed significantly to relative price changes, particularly manufacturing and sectors.

6.3 Policy Implications

In this section we present the possible policy implications arising from our research findings in the thesis. These policy suggestions are by no means exhaustive, but intend to form general guidelines.

Firstly, from the policy point of view, our initial results might actually suggest that real currency depreciation could be beneficial to export oriented firms in emerging economies over a short run, but they need to switch to lower cost of production techniques to maintain their competitiveness in the international market. Secondly, since the general nature of exchange rate volatility seems to affect investment climate in emerging economies, we believe that firms should hedge against unanticipated exchange rate shocks and other external shocks by diversifying their investment portfolio. Along with this, we also acknowledge the fact that there must be adequate presence of regulatory framework in order keep a constant vigil on the external borrowing to finance domestic operations and to tackle the negative balance sheet effects on investment opportunities in emerging economies. Thirdly, while we acknowledge the fact that exchange rate pass through is also dependent upon the inherent structural factors that influence the industrial set up in each of the economies in our study. We also believe that firms in emerging economies are always prone to sudden exchange rate fluctuations, thereby resulting in depreciated domestic currencies. Hence, these firms should initially develop a strong domestic presence and simultaneously diversify their product base to overcome any adverse impact from unanticipated pass through of exchange rates during periods of depreciation of domestic currency.

Finally, we observe that particularly firms in emerging markets open to international trade should not only watch out for unanticipated exchange rate fluctuations, but should also strengthen the domestic sector and by reducing production costs and increasing labour productivity in order to withstand the negative effects of rising trade openness and import penetration by foreign competitors.

6.4 Future Research Work

This research thesis does not touch upon several issues throughout the empirical chapters. Such issues are worth investigating in the future.

Chapter 2 examines the determinants of sectoral investment in emerging economies in a dynamic panel framework and also distinguishes between periods of investment and disinvestment. However, there is a need to use better data sets that reflect specific sector level or even firm level characteristics which invariably influence investment at that level. Another possibility of extension could be to segregate the sector sample size based upon size of establishments. This would give us a clearer picture of the effect of exchange rates and other determinants relative importance at disaggregate levels in emerging economies.

Chapter 3 examined the effect of exchange rate volatility on sectoral investment along with other determinants such as output, wages, exchange rates and external debt. Our results are reasonably in accordance to the existing literature that exchange rate volatility depresses investment in the long run. But, there is scope for improvement in the way we dealt with external debt in this study. If there is data on external debt at sector or firm level, we would be able to precisely quantify the effect of the Balance Sheet Effect on investment. In addition to this, as in the earlier chapter, firm level characteristics would clarify the picture on investment in emerging economies better.

Chapter 4 investigated the effect of the exchange rate pass through on import prices in fourteen emerging market economies across two economic blocks, Latin America and Asia. Nevertheless, one aspect of further improvement would be the measurement of mark-up in this chapter. Due to lack of data on the components that are needed to construct the mark-up variable, a general measure was incorporated. But, a refined measure is definitely required to aid the assessment of the impact of the exchange rate pass through on the import prices.

Chapter 5 deals with the impact of increased trade openness on the relative producer prices in Indian manufacturing sector. Clearly, this study could be extended to study other regional economies at disaggregate levels provided the availability of relevant data. Apart from the data issues, one significant direction of future research could be to measure the impact of import penetration or trade openness on welfare.

References

Abel, A.B. (1983) 'Optimal investment under uncertainty', *American Economic Review,* Vol. 73, pp. 228-233.

Abel, A. B. and Eberly, J.C. (1996) 'Optimal Investment with Costly Reversibility', *Review of Economic Studies,* Vol.63, pp. 581-593.

Agarwal, P. (2004) 'Interest rates and investment in East Asia: An empirical evaluation of financial liberalisation measures', *Journal of Development Studies,* Vol. 40, pp. 142-173.

Aghion, P., Burgess, R., Redding, S. and Zilibotti, F. (2003) "The Unequal Effects of Liberalization: Theory and Evidence from India", mimeo London School of Economics, London.

Aguiar, M. (2005) 'Investment, devaluation and foreign currency exposure: The case of Mexico', *Journal of Development Economics,* Vol. 78. pp 95-113.

Ahluwalia, M. S. (2002) 'Economic Reforms in India since 1991: Has gradualism worked?' *Journal of Economic Perspectives,* Vol. 16, pp. 67–88.

Alesina, A., Ardagna, S., Perotti, R. and Schiantarelli, F. (2002) 'Fiscal Policy, Profits, and Investment', *American Economic Review* Vol. 92, pp. 571-89.

Arellano, M. and Bond, S.R. (1991) Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations.' *Review of Economic Studies,* Vol. 58, pp. 277-297.

Ariff, M. and Khalid, A., (2005) 'Liberalisation and Growth in Asia: 21st Century Challenges' Edward Elgar, UK.

Astorga, P., Berges. A.R. and Fitzgerald. V. (2003) Productivity growth in Latin America during the twentieth century. University of Oxford Discussion Papers in Economic and Social History, No. 52. December.

Aswicahyono, H. and Feridhanusetyawan, T. (2004) 'The Evolution and Upgrading of Indonesia's Industry.' CSIS Working Papers, No. 073

Atella, V. Atzeni, G.E. and Belvisi, P.L. (2003) 'Investment and exchange rate uncertainty', *Journal of Policy Modelling*, Vol. 25, pp. 811-824.

Athukorala, P. (1991) Exchange rate pass through: The case of Korean exports of manufactures. *Economics Letters*, Vol. 35, pp. 79-84.

Bach, I.W. (2002) Empirical modelling of Norwegian import prices. Norges Bank Working Papers. ANO. 2002/1.

Bahroumi, K. (2005) Exchange rate pass-through into import prices in developing countries: An empirical investigation. *Economics Bulletin*, Vol. 3, pp. 1−14.

Bailliu, J. and Fujii, E. (2004) Exchange rate pass-through and the inflation environment in industrialized countries: An empirical investigation. Bank of Canada Working Paper, No. 2004–21.

Ball, L. (2006) 'Has Globalisation changed inflation?' NBER Working Paper No. 12687.

Bank for International Settlements (BIS), (2005), Annual Report, Basel.

Barnett, S. and Sakellaris, P. (1999) 'A New Look at Firm Market Value, Investment and Adjustment Costs', *Review of Economics and Statistics*, Vol. 81, pp. 250-260.

Barro, J.R. (2001) Economic growth in East Asia before and after the financial crisis. *NBER Working Paper*, No. 8330.

Baum, F. C. (2006) An Introduction to Modern Econometrics Using Stata, Texas: Stata Press.

Beckerman, P. (2001) Dollarization and semi-dollarization in Ecuador. World Bank Policy Research Working Paper, No. 2643.

Bernanke, B. and Gertler, M. (1989) 'Agency costs, net worth and business fluctuations', *American Economic Review*, Vol. 79, pp. 14-31.

Betts, C. and Devereux, M.B. (2000) Exchange rate dynamics in a model of pricing-to-market. *Journal of International Economics*, Vol. 50, pp. 215-244.

Blonigen, B.A. and Haynes, S.E. (2002) Antidumping investigations and the pass through of antidumping duties and exchange rates. *American Economic Review,* Vol. 92, pp. 1044-61.

Blundell, R.W. and Bond, S.R. (1998) 'Initial Conditions and Moment Restrictions in Dynamic Panel Data Models.' *Journal of Econometrics,* Vol. 87, pp. 115-143.

Bollerslev, T. (1986) 'Generalized autoregressive conditional heteroskedasticity', *Journal of Econometrics*, Vol. 31, pp. 307-327.

Bond, S.R. (2002) Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice, Cemmap Working Paper Series No. CWP09/02, Institute for Fiscal Studies, London.

Bond, E. and Estache, A. (1994) Which foreign investors worry about foreign exchange risk and why? World Bank Policy Research Working Paper No. 1344.

Bosworth, B. and S.M. Collins (2008) 'Accounting for growth: Comparing China and India', *Journal of Economic Perspectives,* Vol. 22, pp. 45-66.

Branson, W. (1986) 'Stabilization, Stagflation and Investment Incentives: The Case of Kenya', in Economic Adjustment and Exchange Rates in Developing Countries, S. Edwards and L. Ahmed, eds. The University of Chicago Press.

Buffie, E. (1986) 'Devaluation, Investment and Growth in LDCs'. Journal of Development Economics, Vol.16.

Byrne, J.P. and Davis, E.P. (2005) 'The Impact of Short- and Long-run Exchange Rate Uncertainty on Investment: A Panel Study of Industrial Countries', *Oxford Bulletin of Economics and Statistics*, Vol. 67, pp. 307-329.

Caballero, J.R. (1991) 'On the Sign of the Investment-Uncertainty Relationship', *American Economic Review,* Vol. 81, pp. 279-288.

Calani, M. (2008). 'Testing Globalization-Disinflation Hypothesis.' MPRA Paper No. 4787, November.

Calvo, G.A. and Reinhart, C.M. (2002) 'Fear of floating', Quarterly Journal of Economics, Vol. CXVII, No. 2, May.

Campa, J.M. and Goldberg, L.S. (1995) ‘Investment in Manufacturing, Exchange Rates and External Exposure’, *Journal of International Economics,* Vol. 38, pp. 297-320.

Campa, J.M. and Goldberg, L.S. (1998) Employment versus wage adjustment and the U.S. Dollar, NBER Working Paper No. 6749.

Campa, J.M. and Goldberg, L.S. (1999) ‘Investment, Pass-Through, and Exchange Rates: A Cross-Country Comparison’, *International Economic Review,* Vol. 40, pp. 287-314.

Campa, J.M. (2002) Exchange rate crises and bilateral trade flows in Latin America. CIIF Research Paper, No. 470.

Campa, J.M. and Goldberg, L.S. (2004) Exchange rate pass-through into import prices. CEPR Discussion Paper Series, No. 4391.

Campa, J.M., Goldberg, L.S. and Minguez, J.M. (2005) Exchange rate pass-through into import prices in the Euro Area. Bank of Spain Working Paper Series, No. 0538.

Campa, J. and Goldberg, L. (2005) ‘Investment, Pass-Through and Exchange Rates: A Cross-Country Comparison.’NBER Working Paper No. 5139, 1995b.

Carruth, A., Dickerson, A. and Henley, A. (2000) ‘What do we know about investment under uncertainty?’, *Journal of Economic Surveys,* Vol. 14, pp. 19-153.

CEPAL (1988) ‘A note on the evolution of Argentina’s economy in 1988’, The Economic Commission for Latin America and Caribbean, Working Paper 31, Buenos Aires.

Chen, N., J. Imbs and A. Scott. (2004). ‘Competition, Globalization and the Decline of Inflation’. CEPR Discussion Paper 6495. October.

Clarida, R. (1997) ‘The Real Exchange Rate and US Manufacturing Profits: A Theoretical Framework with some Empirical Support’, *International Journal of Finance and Economics,* Vol. 2, pp. 177-187.

Claudia, L. and Geurgil, M. (1999) 'Trade and trade reforms in Latin America and Caribbean in the 1990s.' Journal of Applied Economics, Vol II, No. 1, May.

Coe, D.T. and Helpman, E. (1995) ‘International R&D spillovers’, *European Economic Review,* Vol. 39, pp. 859-887.

Crespo Cuaresma, J., E. Gnan and D. Ritzberger-Grünwald. (2005). 'The Natural Rate of Interest – Concepts and Appraisal for the Euro Area'. Monetary Policy and the Economy Q4/05. Vienna: Oesterreichische National Bank. pp. 29–47.

Darby, J., Hughes Hallet, A., Ireland, J. and Piscatelli, L. (1999) 'The Impact of Exchange Rate Uncertainty on the Level of Investment', *Economic Journal,* Vol. 109, pp. C55-C67.

Diallo, A. I. (2008) Exchange rate volatility and investment: A panel data cointegration approach. MPRA Paper No. 5364.

Dixit, A. and Pindyck, R.S. (1994) *Investment under Uncertainty*, Princeton University Press. Princeton, New Jersey.

Doyle, E. (2004) Exchange rate pass through in a small open economy: The Anglo-Irish case. *Applied Economics,* Vol. 36, pp. 443-455.

Easterly, W. and Serven, L. (2003) The limits of stabilization: Infrastructure, Public deficits, and growth in Latin America. Stanford University Press.

Eaton, J. and Kortum, S. (1996) 'Trade in ideas: patenting and productivity in the OECD', *Journal of International Economics*, Vol. 40, pp. 251-278.

Engle, R.F. (1982) 'Autoregressive conditional heteroskedasticity with estimates of the variance of UK inflation', *Econometrica,* Vol. 50, pp. 987-1008.

Engle, R.F. and Bollerslev, T. (1986) 'Modelling the persistence of conditional variances', *Econometric Reviews,* Vol. 5, pp. 1-50.

Engle, R.F. and Lee, G.J. (1999). 'A long run and short run component model of stock return volatility', in Engle R.F. and White H. (eds), *Cointegration, Causality and Forecasting: A Festschrift in Honour of Clive W. J. Granger,* Oxford University Press, Oxford, pp. 475-497.

FAO (1996) A system of economic accounts for food and agriculture. *FAO Statistical Development Series.* W0010/E. http://www.fao.org/docrep/w0010e/W0010E00.HTM

Ferderer, P.J. (1993) 'The impact of uncertainty on aggregate investment spending: An empirical analysis', *Journal of Money, Credit and Banking,* Vol. 25, pp. 30-48.

Ferrari, A. and Dhingra, I.S. (2008) ' India's investment climate: Voices of Indian Business.' World Bank Publications, November.

Forbes, K.J. (2002) ‘Cheap labour meets costly capital: The impact of devaluations on commodity firms’, *Journal of Development Economics,* Vol. 69, pp. 335-365.

Forbes, K.J. (2007) ‘One Cost of the Chilean Capital Controls: Increased Financial Constraints for Smaller Traded Firms’, *Journal of International Economics,* Vol. 71, pp. 294-323.

Froot, K. A. and Klemperer, P. D. (1989) ‘Exchange Rate Pass-Through When Market Share Matters’, *American Economic Review,* Vol. 79, No.4. pp. 637-654.

Fujii, E. (2004) Exchange rate pass-through in the deflationary Japan: How effective is the yen’s depreciation for fighting deflation? CESIFO Working Paper, No. 1134.

Gamber, E. N. and J. H. Hung. (2001). ‘Has the Rise in Globalization Reduced U.S. Inflation in the 1990s?’ *Economic Enquiry*, Vol. 39(1). January, pp. 58–73.

Gagnon, E. and Khan, H. (2001) New Phillips Curve with alternative marginal cost measures for Canada, the United States, and the Euro Area. Bank of Canada Working Papers, No. 25.

Gali, J., Gertler, M. and Lopez-Salido, J.D. (2001) European inflation dynamics. *European Economic Review,* Vol. 45, pp. 1237-70.

Galindo, A., Panizza U. and Schiantarelli, F. (2003) ‘Debt composition and balance sheet effects of currency depreciation: a summary of the micro evidence’, *Emerging Markets Review,* Vol. 4. pp. 330-339.

Gilchrist, S. and Himmelberg, C. (1995). ‘Evidence on the role of cash flow investment’, Journal *of Monetary Economics*, Vol. 36, pp. 541-572.

Gil-Pareja, S. (2003) Pricing to Market Behaviour in European Car Markets. *European Economic Review,* Vol. 47, pp. 945-962.

Giovanni, P.O. (2002) Exchange rates and prices of manufactured products imported into the United States. *New England Economic Review,* No. 4.

Glatzer, E, Gnan, E and Valderrama, M.T. (2006) ‘Globalisation, Import Prices and Producer Prices in Austria.’ *Monetary Policy and The Economy*, Q3/06.

Gnan, E and Valderrama. M. T (2006). ‘Globalization, Inflation and Monetary Policy’ Monetary Policy & the Economy Q3/06. Vienna: Oesterreichische National Bank. pp. 24–43.

Goldberg, L. (1993) ‘Exchange Rates and Investment in United States Industry’, *Review of Economics and Statistics*, Vol. 75, pp. 575-589.

Goldberg, K.P. and Knetter, M. (1997) Goods prices and exchange rates: What have we learnt? *Journal of Economic Literature*, Vol. 35, pp. 1243-1292.

Green, D. (2004) Silent Revolution: The Rise and Crisis of Market Economies in Latin America. Monthly Review Press, New York.

Greenspan, A. (2005). ‘Economic Outlook.’ Testimony before the Joint Economic Committee, U.S. Congress, November 3.

Guiso, L. and Parigi, G. (1999) ‘Investment and demand uncertainty’, *Quarterly Journal of Economics*, pp. 185-227.

Harris, R. and Tzavalis, E. (1999) ‘Inference for unit roots in dynamic panels where the time dimension is fixed.’ *Journal of Econometrics*, Vol. 91, pp.201-226.

Hartman, R. (1972) ‘The Effects of Price and Cost Uncertainty on Investment’, *Journal of Economic Theory*, Vol. 5, pp. 258-266.

Hayashi, F. (1982). ‘Tobin’s marginal Q and average Q: A neoclassical interpretation’, Econometrica, Vol. 50, pp. 215-224.

Heijdra, B. J. and van der Ploeg, F. (2003) Foundations of Modern Macroeconomics. Oxford University Press, New York.

Hofman, B., Rodrick-Jones, E. and Thee, K.W. (2004), Indonesia: Rapid growth, weak institutions. A case study from: Scaling up poverty reduction. A global learning process and conference, Shanghai, May 25-27, 2004. The International Bank for Reconstruction and Development, World Bank.

Huizinga, J. (1993) ‘Inflation uncertainty, relative price uncertainty and investment in US manufacturing’, *Journal of Money, Credit and Banking*, Vol. 25, pp.521-54.

Im, K. S. Pesaran, M. H. and Shin, Y. (2003). ‘Testing for unit roots in heterogeneous panels.’ *Journal of Econometrics*, Vol. 115, pp. 53−74.

IMF. (2006).Chapter III: ‘How Has Globalization Affected Inflation?’ World Economic Outlook Spring, Washington, D.C.

Isard, P. (1977) How far can we push the Law of One Price? *American Economic Review*, Vol. 67, pp. 942-948.

Ito, T and Sato, K, (2007) ‘Exchange Rate Pass-Through and Domestic Inflation: A Comparison between East Asia and Latin American Countries.’ RIETI Discussion Paper Series, No. 07-E-040.

Khan, S. T. (2006) Productivity Growth, Technological Convergence, R & D, Trade and Labour Markets: Evidence from the French Manufacturing Sector. *IMF Working Papers, No.* 6.

Khundrakpam, J.K. (2007) Economic reforms and exchange rate pass through to domestic prices in India. BIS Working Papers, No. 225.

Krugman, P. (1987) Pricing to Market when the Exchange Rate Changes. NBER Working Paper No. 1926.

Krugman, P. (1999). Balance Sheets, the Transfer Problem, and Financial Crises, In: Isard, P., Razin, A., Rose, A., (Eds.), *International Tax and Financial Crises, Essays in honour of Robert P. Flood*, Kluwer Academic, Boston, pp. 459–472.

Kun, S.S. and Zhanna, K. (2008) Exchange rate pass-through and volatility: Impacts on domestic prices in four Asian countries. MPRA Paper, No. 11130.

Kuwayama, M. Mattos, J.C. and Contador, J. (2000) ‘Trade and investment promotion between Asia-Pacific and Latin America: Present position and future prospects’. CEPAL Series, No.9, Chile, September.

Landon, S. and Smith, E.C. (2007) ‘Investment and the exchange rate: Short Run and Long Run aggregate and sector level estimates’, MPRA Paper, No. 9958, Munich, Germany.

Levine, R. Loayza, N. Beck, T, (2000) ‘Financial Intermediation and growth: Causality and Causes’, *Journal of Monetary Economics,* Vol. 46, pp. 31-77.

Levine, R. and Renelt, D., (1992) ‘A Sensitivity Analysis of Cross Country Growth Regressions.’ *American Economic Review,* Vol. 82, No. 4, pp. 942-63.

Levine, R. Loayza, N. and Beck, T. (1999) “Financial Intermediation and Growth: Causality and Causes”, World Bank Policy Research Working Paper, No. 2059.

Love, I. (2003) ‘Financial development and financing constraints: international evidence from the structural investment model’, Review *of Financial Studies*, Vol.16, 765–791.

Maddala, G.S. and Wu, S. (1999) ‘A comparative study of unit root tests with panel data and a new simple test.’ *Oxford Bulletin of Economics and Statistics.* Special Issue, November, Vol. 61, pp. 631–652.

Mairesse, J., Hall, B.H. and Mulkay, B. (1999) Firm level Investment in France and the United States: An exploration of what we have learnt in twenty years, NBER Working Paper, No. 7437.

Mallick, S and Marques, H. (2008) ‘Pass-through of Exchange Rate and Tariffs into Import Prices of India: Currency depreciation versus Import Liberalisation.’ *Review of International Economics,* Vol. 16, No. 4, pp. 765-782.

Mankiw, G.N. (2006) Macroeconomics, Worth Publishers, New York. 6th Edition.

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

Menon, J. (1996) The degree and determinants of exchange rate pass through: market structure, non-tariff barriers and multinational corporations. *Economic Journal*, Vol. 106, pp. 434-444.

Mody, A and Ohnsorge, F, (2007) ‘Can Domestic Policies Influence Inflation?’ IMF Working Paper, No. 257. November.

Naryan, K. (2008) ‘An econometric model of the determinants of private investment and a CGE model of the impact of democracy on investment and economic growth in Fiji’, *International Journal of Social Sciences,* Vol. 35, No. 12, pp. 1017-1035.

Narayanan, B.G. and Vashisht, P. (2008) Determinants of Competitiveness of the Indian Auto Industry, ICRIER Working Paper, No. 201.November.

Naug, B. and Nymoen, R. (1996) 'Pricing to market in a small open economy', *Scandinavian Journal of Economics*, Vol. 98, pp. 329-350.

Nucci, F. and Pozzolo, A.F. (2001) 'Investment and the Exchange Rate: An Analysis with Firm-Level Panel Data', *European Economic Review*, Vol. 45, pp. 259-83.

OECD (2003) Economic Surveys, Chile, Vol. 17, November.

OECD. (2006). **'**Economic Outlook', Vol. 79. Box I.5.

OECD (2007) Glossary of Statistical Terms. ESA. [3.102-3.106.]: http://stats.oecd.org/glossary/detail.asp?ID=1173

Ohno, K. (1989) Export pricing behaviour of manufacturing: A US-Japan comparison. IMF Working Paper WP-88-78**.**

Peltzman, S. (2000), 'Prices Rise Faster than They Fall', *Journal of Political Economy* Vol. 108, No. 3, pp. 466-502.

Pesaran, M.H., Shin, Y. and Smith, R. (1999) 'Pooled mean group estimation of dynamic heterogeneous panels', *Journal of the American Statistical Association*, Vol. 94, pp. 621-634.

Pindyck, R.S. (1982) 'Adjustment costs, uncertainty, and the behaviour of the firm', *American Economic Review*, Vol. 72, pp. 415-427.

Pollard, P.S. and Coughlin, C.C. (2003) Size matters: Asymmetric exchange rate pass through at the industry level, *Federal Reserve Bank of St. Louis Working Paper* 2003-029C, July.

Pradhan, G., Schuster, Z. and Upadhyaya, K.P. (2004) 'Exchange rate uncertainty and the level of investment in selected South East Asian countries', *Applied Economics*, Vol. 36, pp. 2161-2165.

Pratap, S., Lobato, I. and Somuano, A. (2003) 'Debt composition and balance sheet effects of exchange rate volatility in Mexico: a firm level analysis', *Emerging Markets Review*, No. 4. Vol. 4, pp. 450-471.

Price, S. (1996) ‘Aggregate uncertainty, capacity utilization and manufacturing investment’, Applied *Economics,* Vol. 28, pp. 1369-1379.

Rogers, H. (2007) ‘Monetary union, price level convergence and inflation: How close is the Europe to the USA?’ *Journal of Monetary Economics,* Vol. 54, pp.785-796.

Rogoff, K. (2003). ‘Globalisation and Global Disinflation’. Paper prepared for the Federal Reserve Bank of Kansas City conference on “Monetary Policy and Uncertainty: Adapting to a Changing Economy.” Jackson Hole, Wyoming.

Romer, D. (1993). ‘Openness and Inflation: Theory and Evidence.’ *The Quarterly Journal of Economics,* Vol. 107(4). pp. 869–903.

Schich, S and Pelgrin, F. (2002) ‘Financial development and investment: Panel data evidence for OECD countries from 1970-1997’, *Applied Economics Letters*, Vol. 9, pp. 1-7.

Serven, L. (1990) Anticipated real exchange rate changes and the dynamics of investment. World Bank Policy Research Working Paper. No. 562.

Serven, L. (1998) Uncertainty, Instability and Irreversible investment. Theory, evidence and lessons for Africa. World Bank Policy Research Working Paper. No. 1722.

Serven, L. (2003) ‘Real Exchange Rate Uncertainty and Private Investment in Developing Countries’, *Review of Economics and Statistics,* Vol. 85, pp. 492-492.

Shafaeddin, M. (2007) ‘Does trade openness helps or hinders industrialisation?’, MPRA Paper, No. 4371, November.

Srinivasan, T. and Bhagawati, J. (1999) ‘Trade Orientation, Trade Liberalization, and Economic Growth,’ in Development, Duality, and the International Economic Regime: Essays in Honor of Gustav Ranis, Ann Arbor, University of Michigan.

Taylor, J.B. (2000) Low inflation, pass-through, and the pricing power of firms. *European Economic Review,* Vol. 44, pp. 1389–1408.

Taylor, A. M. (2006). ‘Globalization. A Historical Perspective.’ Globalization – Opportunities and Challenges for the World, Europe and Austria. Proceedings of the 34th Economics Conference of the Oesterreichische National Bank, pp. 64–81.

Tobin, J. (1969). ‘A general equilibrium approach to monetary theory’, Journal of Money, Credit and Banking, Vol. 1, pp. 15–29.

Webber, A. (2000) Newton’s Gravity Law and import prices in the Asia Pacific. *Japan and the World Economy*, Vol. 12, pp. 71-87.

Wei, S.J. (2000) ‘How taxing is corruption on international investors’, *Review of Economics and Statistics*, Vol. 82, pp. 1-11.

Wezel, T. (2003) ‘ Determinants of German foreign direct investment in Latin American and Asian emerging markets in the 1990s’, Discussion paper No. 11/03, Economic Research Centre of the Deutsche Bundesbank, Frankfurt.

Wheeler, M. and Mody, A. (1992) ‘International investment location decisions – the case of US firms’, *Journal of International Economics*, Vol. 33, pp. 57-76.

Wickremasinghe, G. and Silvapulle, P. (2001) Exchange Rate Pass Through to Manufactured Import Prices: The case of Japan, Monash University Working Paper, International Trade 0406006.

World Bank Development Report (2006) ‘Equality and Development’.