2.0 Literature Review

A number of early studies focused on experience in the 19th century and in the interwar period. These are summarized in Yeager (1976), who found little evidence of the adverse impact of exchange rate variability on trade. Of course, the sample used was backdated hence results are not irrefutable.

Clark and Haulk (1972) investigated the experience of Canada during the period 1952-70, of which the Canadian dollar is floated in the early part of the period and pegged again in 1962. The indicator of variability is defined as the standard deviation of daily rates from the average in every quarter. The daily rates used are both the spot and the 90-day forward quotation. However, they recognised that variability over longer periods would be required to match the planning horizon of the firms.

In Clark and Haulk's paper, they found that exchange rate variability was significantly greater in the flexible than in the fixed rate period, and that the determinants of Canadian exports and imports seemed to shift somewhat between the two periods. The inclusion of exchange rate variability in the trade equations did not add to their explanatory power. They concluded that nominal exchange rate variability did not adversely affect Canadian trade during this period, though they admitted that a different formulation of their model could perhaps lead to a different result.

Makin (1976) also attempted a preliminary assessment of the effects of floating on trade, using data up to the end of 1973. Makin fitted import equations for the Federal Republic of Germany, Japan, the United Kingdom and Canada. Makin's measurement of variability is the moving standard deviation calculated from 6-month blocks of data. Like Clark and Haulk, he is unable to detect any systematic relationship between exchange rate variability and trade volume.

These early studies suffered from a number of shortcomings, many of which the authors have conceded. Firstly, the exchange rate variability they measured was either limited in time as in the case studies that have included only 2 or 3 quarterly observations from the flexible period. Secondly, they did not take into account the possibility of exchange rate movements offsetting the movements of relative prices. Lastly, they used the variability in the exchange rate vis-à-vis the US dollar as a proxy for exchange rate uncertainty effects on all trade flows.

A paper by Hooper and Kohlhagen (1978) addresses some of these difficulties by covering an additional 2 years and desegregating the trade of individual countries into separate bilateral flows. In their theoretical analysis, Hooper and Kohlhagen show that the effect of exchange rate uncertainty on price depends on the currency in which international contracts are denominated. In this study, Hooper and Kohlhagen were unable to detect any significant effect of exchange rate uncertainties on volume of trade (at the 0.95 confidence level). Similar results were obtained when alternative proxies and functional forms of the quantity equation were tested.

Hooper and Kohlhagen's failure to discover such a relationship could not be blamed on the peculiarities of data for a particular time series of bilateral trade flows. They tested their model for all combinations of bilateral flows among 6 of the largest industrial countries namely the United States, the United Kingdom, Japan, the Federal Republic of Germany, France and Canada. However, their data covered only the first 2 ½ years of the floating period, and it could be argued that their tests were unable to capture possible lagged adverse effects of the greater volatility that has characterised exchange rate behaviour since 1973. Although Hooper and Kohlhagen used numerous alternative proxies for exchange rate volatility, they bear short-term characteristics which cover not more than 3 months. Their short-term orientation of their variability measure was obvious when they used only nominal exchange rate variability, and did not attempt to estimate "real" exchange rate movements through the use of deflating techniques.

Coes (1981), in his paper investigated the impact of exchange rate uncertainty on trade flows in Brazil using real exchange rates, and covering quite long periods of both the stable and variable exchange rates. Brazil has adopted a crawling peg system in August 1968 and, in Coes paper he separates a period of extreme volatility in the real US dollar/Brazilian cruzeiro rate from the period of relative stability. He proposes a measure of monthly variability in exchange rates as a proxy for real exchange rate uncertainty (including price and income variables) in an equation explaining exports by sector.

Coes' equations are based on annual data, and cover exports of 22 sectors, both manufacturing and primary products. The great majority of his equations show that uncertainty has a highly significant impact on export volumes. While this evidence is suggestive, Coes acknowledged that it should be interpreted with caution. This is because the changes in the economic environment coincided with the adoption of the crawling peg. Therefore, the restoration of domestic economic and financial stability, and the resumption of economic growth, may have been more important factors than the reduction of exchange rate instability – although the latter factor cannot really be separated from the measures that were undertaken to restore domestic economic stability.

It should be noted that the degree of real exchange rate instability in Brazil prior to 1968 was unusually large, and this was mainly due to the economic and political uncertainties. Therefore, it would not be appropriate to assume that proportional effects on trade would flow from reductions in exchange rate variability when the initial degree of variability was smaller and resulted from different causes. Nonetheless, Coes' paper suggests that, when uncertainty reaches a critical level, it can have a marked adverse effect on trade flows.

Cushman (1983) uses real exchange rate variability in his study of uncertainty effects on trade flows among industrial countries. Cushman's model resembles Hooper and Kohlhagen's (1978) model with the main differences being:

i. The use of more recent data

ii. The use of real exchange rate instead nominal exchange rates. The uncertainty measure used in each bilateral trade flow equation is quarterly variability in the bilateral exchange rates, in real terms. The price index used to deflate nominal exchange rates is relative movements in wholesale prices.

Cushman's results can be interpreted as providing some, though not overpowering support to the proposition that exchange rate variability adversely affects trade flows. Of the 14 sets of bilateral trade flows, real exchange rate variability is significantly and negatively correlated with the trade flows of 6 countries. Only 2 cases show significant and positive correlation between the bilateral trade flows and real exchange rate variability. The remaining 6 countries produce insignificant correlation at 95% confidence level. Of the 6 insignificant results, only 2 produce negative signs while the other 4 produce positive signs.

The studies reviewed are based on data of the early part of the floating exchange rate period. With the exception of the papers by Coes (1981) and Cushman (1983), the evidence they evaluate refers to the variability of nominal exchange rates. As argued earlier studies have shown that the real exchange rates have more relevance to international trade flows.

Caballero and Corbo (1989) examined the relationship between real exchange rate uncertainty and exports. Their paper does not only examine the relationship between these 2 variables but also factor in the sources of uncertainty namely risk aversion. Therefore, they have improvised Able and Hartman's simple risk-aversion model where export equations allow for uncertainty. By maximising

operating profit function which includes real exchange rate uncertainty, quantity of exports can be estimated. Since Able and Hartman's model is presented as having a marginal operating profit function that is convex in the real exchange rate, results show that exports will be higher for every real exchange rate realisation. This is because, when capital is predetermined and agents are risk-neutral, investment is an increasing function of uncertainty. This can be explained by the fact that the firm losses less (with respect to frictionless allocation) when the change in the real exchange rate is unfavourable than it does when it is favourable. When the change in the real exchange is unfavourable, the firm wishes to reduce production and has too much capital compared with its optimal value. On the contrary, when the changes in the real exchange rate is favourable, the firm has a capital stock that is too low. Given the convexity of the profit function, the potential profits forgone due to an insufficient capital stock when the rise in the real exchange rate is higher than losses due to an underutilised capital stock when the real exchange rate falls. Consequently, a profit-maximising firm would invest more, and thereby raise exports in the face of uncertainty.

The positive relationship established by Hartman and Abel can be reversed by assuming that firms can adjust their capital stock in the second period (at a higher cost), or those firms are risk averse. The first approach is as shown by Caballero and Carbo where firms pay a higher premium in order to reduce the investment lag (1988). This is similar to the model of irreversible investment. When the capital stock is irreversible but not predetermined, it is always possible to invest in the second period. This is a move to limit the losses of having invested too little in the

previous period, balancing it with higher costs incurred for "rushing" into capital installation in the second period. On the other hand, losses are incurred when caught with too much capital. Given this ability to adjust (to a higher cost), for a broad set of parameters uncertainty reduces rather than increases exports.

The second approach is the risk aversion approach where it produces a negative effect of uncertainty on exports. If the concavity of the utility function is large enough to offset the convexity of the profit function (with respect to prices) as real exchange uncertainty rises, investment, and therefore exports will decline. Caballero and Carbo (1989) modifies their previous model to illustrate this mechanism.

In Caballero and Carbo's study, the export volume is a function of prices, world demand, uncertainty, lagged exports and time. The equation is as follows:

$$x(t) = c_0 + c_1[p(t) + wd(t)] + c_2\alpha(t) + c_3x(t-1) + c_4a(t) + \in(t)$$

where x denote the logarithm of export volume, p for real exchange rate, wd for world demand, α for uncertainty, x(t-1) for lagged export volume and a for the function of time.

The ordinary least squares (OLS) and instrumental variables (IV) are used to estimate the above equation. The instruments chosen for the IV estimates are: the constant, the log of industrial countries' CPI divided by the developed countries' domestic CPI, the log of world demand, the standard deviation of the log of the real exchange, the log of lagged exports and the log of time. However in both the

simple OLS and IV approaches, the lagged exports and time variables were rejected, as they were insignificant.

When the IV procedure is used, the estimates of the effects of real exchange rate uncertainty on exports are always negative, although it can be validated statistically for only half the countries under examination (Peru, Thailand and Turkey). The probability that the coefficient of uncertainty yields negative signs for every country as a result of sampling error is considerably less than the significance level of each individual test. Thus there is clear evidence of the depressing effect of real exchange rate uncertainty on export levels.

The results show that not only does real exchange rate uncertainty depress exports of the 6 countries (Chile, Colombia, Peru, Philippines, Thailand and Turkey), but it does so by a significant amount. This occurs even in the short run. For example, Caballero and Corbo's estimates show that a 5.0% increase in real exchange rate variability in Chilean economy leads to a total decline in exports of about 10.0%. And this is a very conservative example where the swings in Chilean exchange rate regimes suggests changes that far exceed the 5.0% change used in the example. The example is far more dramatic in the case of Thailand and Turkey, where similar increase in variability would lead to a 30.0% decline in exports. With the exception of Turkey, where adjustment seems to be very fast, all the effects previously described are magnified in the long run. A 5.0% increase in real exchange rate uncertainty would lead to a long-run decline in exports of 25.0% in the case of Chile, and it would eliminate Thailand's exports.

However, one weakness in Caballero and Corbo's is that the impact of the expected and realised exchange rate on the exports should be treated separately. In the empirical section of their study, they have disregarded the difference and proceeded with just the usage of the realised exchange rate, p(t). If all the information on which production decisions depend were available in the first period, the unanticipated change would not be relevant. They have also conceded that if all the instruments in their model belong to the information set at (t-1), the estimation procedure would be unable to distinguish between the realised and the expected exchange rates.

The empirical evidence in Caballero and Corbo's article show that there is apparently clear and strong negative effect of real exchange rate uncertainty on exports. In the empirical investigation, simultaneity was carefully treated and shown to have a substantial effect on the estimates of the price-elasticity of exports. Also, the results were tested for robustness to various specification errors. The estimates obtained show that increases of 5.0% in the annual standard deviation of the real exchange rate leads to a short run decline of 2.5% in exports for Colombia and 30.0% for Thailand and Turkey. These effects appear to be magnified in the long run.

Consequently, Caballero and Corbo's results suggest an option for governments that want to increase export supply without exacerbating the recessionary effect of sectoral reallocation due to exchange rate depreciation and restrictions on aggregate demand. The article therefore, suggests that such reallocation policies could be

accompanied by a program to stabilise the real exchange rate and to make its policy-induced changes more predictable. Consequently, the decline in real exchange uncertainty would expect to increase exports thus minimising the length and costs of the adjustment period.

Dell'Ariccia (1998) analysed the effects of exchange rate volatility on bilateral trade flows using data from Western European countries. The trade issue was the main topic of debate on the European Monetary System (EMS) and the European Monetary Union (EMU). The EMS was established with the purpose of controlling exchange rate volatility and avoiding misalignments among European currencies. The argument is by reducing exchange rate volatility intra-EU trade and investments can be enhanced. Dell'Ariccia narrowed the scope of research to Western European countries. The reason for limiting the scope of study is Dell'Ariccia's theoretical model assumes identical and homothetic preferences across countries. In this case, Western European countries are assumed to be relatively homogeneous in terms of technology, factors of endowments and per capita income. Therefore, by restricting the sample, he is minimising problems due to country-specific factors.

Dell'Ariccia paid attention to the simultaneous causality problem that may arise from his study. If the central banks make an effort to stabilise the exchange rate with their main trading partners, a negative correlation between exchange rate volatility and trade would appear from the data. However, Dell'Ariccia says this should not be misconstrue as trade reacting negatively to exchange rate instability.

Therefore, the panel data takes care of this problem as it explicitly takes into account the behaviour of the central bank. The standard deviation which measures uncertainty is defined as the first differences of the logarithmic exchange rate.

Giovanni's gravity model is as follows:

$$\text{Log}\,(TRADE_{ijt}) = \gamma_t + \beta_1 \log (GDP_{it}\, GDP_{jt}) + \beta \log (DIST_{ij}) + \beta_3 \log (pop_{it}\, pop_{jt}) + \beta_4 BORD_{ij} + \beta_5 Eu_{ijt} + \beta_6 LANG_{ij} + \beta_7 v_{ijt} + \varepsilon_{ijt}$$

where:

TRADE = (Export + Import) between countries i and j at time t

EU = represents membership in the European Union (1 when both countries i and j at time t, 0 otherwise)

BORDER = common border

LANG = language

v = uncertainty

The model allows the intercept to change over time. Any change in world aggregate GDP would be captured by the intercept[5]. The results the instrumental variable (IV) method, random and fixed effects estimations show that exchange rate volatility has a negative impact on trade flows. The IV method of estimation the exchange rate volatility decreases trade by an estimated 21-23%. However, the in random and fixed effects estimations, the impact of exchange volatility is lower, estimated to be between 3-4%.

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[5] See Dell' Ariccia, Giovannu (1998) Exchange Rate Fluctuations and Trade Flows: Evidence from the European Union

Nonetheless, the results are consistent with the idea that a negative correlation between exchange rate volatility and trade exists and that at least a part of it is not spurious correlation cause by central bank stabilisation policies.

Dell'Ariccia conclusion is firms react negatively to volatility on foreign currencies market and hence the volume of international trade decreases when the exchange rate becomes more volatile. Sectors where export activity requires large investments, trade should prove more sensitive to exchange rate volatility then in sectors characterised by "short-term" export.

2.1 Hypothesis

In this study it is expected that:

1. The real exchange rate plus world demand, [p(t) + wd(t)] will be positively correlated with exports, therefore yielding a positive sign
2. Standard deviation (uncertainty), σ will be negatively correlated with exports, therefore yielding a negative sign
3. The lagged exports x(t-1) will be positively correlated with exports, therefore yielding a positive sign