The Macroeconomic Effects of Exchange Rate Shocks

Thesis Proposal

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May 2015

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Abstract

In recent years the impact of exchange rate shocks on the macroeconomy has received significant attention. However, much of the research still focuses on the impact on the exchange rate from macroeconomic shocks and not the impact of the macroeconomy from the exchange rate shocks. Although the existing literature on the impact of exchange rate shocks is growing, assessing macroeconomic effects of exchange rate shocks is still in its infancy. This is particularly because the frequency in which the data are available. Exchange rate shocks are visible in high frequency financial data where are macroeconomic data are usually published in quarterly, and seldomly monthly time series. This research proposes to use monthly macroeconomic data series generated via employing a Kalman filter to demonstrate what are (i) the macroeconomic effects of a carry-trade collapse, especially on the commodity market, (ii) the impact of exchange rate shocks on inward workers' remittances in South Asia, and (iii) the impact of exchange rate shocks on emerging capital markets. This research aims to fill the gaps in the existing literature by identifying the macroeconomic impacts for these exchange rate shocks which will be beneficial for policy makers in the future to employ appropriate policies at the outbreak of an exchange rate shock to safeguard the macroeconomy.

Contents

1 Introduction

In recent years the impact of exchange rate shocks on the macroeconomy has received significant attention. This research is intended to be part of a vigorous debate currently going on in the international community of the macroeconomic effects of exchange rate shocks. From different angles and aspects, this research aims to contribute to the related literature, and provides fresh theoretical arguments and comprehensive study on selected macroeconomic effects that arise from exchange rate shocks. The research thus will carry out empirical investigation on several sets of countries exploring into various macroeconomic effects pertaining to that set of countries.

1.1 Research questions

To this effect, the following questions will be addressed in this dissertation. What are (i) the macroeconomic effects of a carry-trade collapse, (ii) the impact of exchange rate shocks on inward workers' remittances in South Asia, and (iii) the impact of exchange rate shocks on emerging capital markets.

1.2 Significance of the research

The way a country is exposed to the movements in the exchange rate can affect its volume of trade, capital flows and income. With the increased economic growth in developing economies, many countries now have integrated foreign exchange markets. This level of integration brings in an exposure of an economy to exchange rate movements and shocks. Among a number of perennial macroeconomic policy debates, much of the existing literature focuses on how the exchange rate reacts to macroeconomic shocks. There is scarce literature that focuses on the impact on the macroeconomy from exchange rate shocks. This is primarily because exchange rate shocks are observed in higher data frequencies whilst much of the macroeconomic data are published in much lower frequencies.

Given this backdrop, Chapter 2 will employ a threshold vector autoregression (TVAR) approach to look at the macroeconomic effects of a carry-trade collapse. Given that high frequency data is needed to identify of carry-trade and its collapse, the TVAR is proposed to run on monthly macroeconomic data series. However, macroeconomic data tend to be obtained in much lower frequencies. Therefore, the research proposes the use of a Kalman filter to generate, where applicable, a monthly macroeconomic data series using the publicly available quarterly data.

To investigate the impact of exchange rate shocks on workers' remittances in the South Asian region, Chapter 3 proposes the use of panel estimations employing monthly macroeconomics data. Here too the research proposes the use of Kalman filter to interpolate quarterly macroeconomic series to a monthly series. The research

aims to carry out both fixed-effects and random-effects to identify both the relationships between explanatory variables within the region and specific to a country.

Chapter 4 explores the impact of exchange rate shocks on emerging capital markets. The research, although at a conceptual state, proposes to incorporate several countries with emerging capital markets covering various geographies.

The Chapter 5 will present the expected time taken for this research, including specific milestones and Chapter 6 will summarize the research that is proposed to be undertaken while highlighting some policy areas the research would focus on.

2 What are the macroeconomic effects of a carry-trade collapse?

2.1 Motivation

The currency market is an ideal marketplace for speculative trading. Interest rate differentials have been a driving force behind exchange rate movements in recent years. This has focused market attention on the role of currency carry trade positions, and on the possibility that a sudden unwinding might adversely affect financial stability as explained by Galati et al. (2007). Engel (1996) state that periods of low exchange rate volatility are particularly conducive for carry trade activity, as investors prefer appreciating high-yielding currencies to lower-yielding currencies, the opposite of what is predicted by the uncovered interest rate parity (UIP) which were later observed by Clarida et al. (2009) and Anzuini and Fornari (2012). Low exchange rate volatility and persistent interest rate differentials have enabled unprecedented growth in carry-trade in recent years.

Baillie and Chang (2011) and Anzuini and Fornari (2012) add to this that carry trade positions are typically rolled over as long as the two currency groups maintain a wide interest rate differential and/or exchange rate risk, as measured by the implied volatility of the nominal bilateral exchange rate, remains low. Accordingly, Habib and Stracca (2012) argue that the nominal interest rate may be high or low depending on domestic macroeconomic conditions and the monetary policy regime prevailing in individual countries. In an open economy, however, as Brunnermeier et al. (2013) observed, the nominal interest rate is also an endogenous variable which responds to prevailing conditions in global financial markets. Galati et al. (2007) highlight that since 2000, official interest rates have been lowest in Japan and Switzerland, and the Japanese yen and the Swiss franc have been the most commonly cited funding currencies. Galati et al. (2007) and Liu et al. (2012) state that the Australian dollar, New Zealand dollar, Brazilian real and the South African rand have appreciated steadily and have been cited as popular target currencies.

Although it is difficult to measure precisely the amount of Yen-carry trade positions, there are indications that the growth in Yen-carry trade was rapid over the past decade or so. Galati et al. (2007) argue that the rapid increase in foreign exchange turnover was probably a result of a rise in Yen-carry trade activities. The increase was especially for Australian dollar and New Zealand dollar. Liu et al. (2012) explain that the demand for dollar tends to drive up the value of the currencies and the unwinding of the carry trades tends to cause the currencies to crash. Dramatic movements in exchange rates occur sometimes without fundamental news announcements. Liu et al. (2012) and Galati et al. (2007) explain that an increase in interest rates in turn attract the inflow of foreign capital, the reverse would happen if the interest rates were to decrease but the outflow would be sudden and at times larger than the inflows. The sharp swing of the currency can have significant adverse impacts on growth and economic stability.

There are times when so many commodity prices move so much together that it becomes difficult to ignore the influence of macroeconomic phenomena. For example, the price increases of oil and almost all mineral and agricultural commodities during 2001 to 2007, peaking in mid-2008 prior to plummeting together in 2009 and attaining a second peak in 2011, is argued by Frankel (2014) stating that these movements cannot be a coincidence. Literature provides three theories which compete to explain increases in commodity prices in recent years. First, is the global growth explanation. Kilian and Hicks (2013) argue that the unusually widespread growth in economic activity after 2000 and emerging economies' rapid recovery from the 2008-09 global recession together with the future growth prospects of those economies have raised the demand for, and hence the price of, commodities. Second is speculation. One explanation as presented by Wolf (2008) and Frankel (2014) argue speculation as the purchases of the commodities, whether in physical form or via contracts traded on an exchange, in anticipation of financial gain at the time of resale. The other presented by Kilian and Lee (2014) and Kilian and Murphy (2014) argue that speculation is driven for example by geopolitical fears of disruption to the supply of commodities. Third is that easy monetary policy has contributed to increases in commodity prices, via either high demand or low supply as argued by Barsky and Kilian (2004).

The past decade has witnessed a large increase in the prices of many commodities, despite significant falls during the global financial crisis, consistent with the physical supply and demand fundamentals that underpin these markets. The past decade has witnessed a large increase in the prices of many commodities, despite significant falls during the global financial crisis. Australia, New Zealand and Canada are unique amongst the Organisation for Economic Cooperation and Development (OECD) countries in that they are heavily dependent on commodity markets and are major suppliers of some of the world's key commodities. The recent increase in the level of commodity prices has been accompanied by a significant rise in the volatility of commodity prices. Dwyer et al. (2011) observe while price signals play an important role in boosting future supply and allocating existing supply, volatility in prices can hinder this process by generating uncertainty about future price levels. Empirical evidence indicates that nominal exchange rate changes are not fully passed through to goods prices. In fact, it appears that consumer prices are very unresponsive to nominal exchange rate changes as observed by Devereux and Engel (2002). An implication of this finding is that the change in the nominal exchange rate might not lead to a reduction in demand for domestically produced goods because the relative prices of those goods do not change much for final users. Devereux and Engel (2002) further argue that if the exchange rate change has little effect on the behaviour of final purchasers of goods, then it may take large changes in exchange rates to achieve equilibrium after some shock to fundamentals. That is, low pass-through of exchange rates might imply high exchange rate volatility in equilibrium as first expressed by Krugman (1989), and explored by Devereux and Engel (2002). Devereux and Engel (2002) and, Obstfeld and Rogoff (1995) emphasise that fully articulated equilibrium open-economy macroeconomic models with sticky nominal prices have found that exchange rate volatility is difficult to generate even when there is little exchange rate pass-through.

A set of theories exists that discusses affect of exchange rate fluctuation on trade and trade of different product groups. According to Broda and Romalis (2011), effects of exchange rate volatility on trade of product differ by the degree of differentiation of those products. More precisely, trade of commodities is less influenced by exchange rate changes than trade of highly differentiated product. It is widely agreed that although daily and monthly financial asset returns are approximately unpredictable, return volatility is highly predictable, a phenomenon with important implications financial economics and risk management as observed by Solnik et al. (1996) and Fong (2010). Kenen and Rodrik (1986) suggest the use of variance of exchange rate around its predicted trend as an effective measure of volatility. Using high-frequency data on yen returns against the dollar, Andersen et al. (2001) construct model-free estimates of daily exchange rate volatility and correlation that cover an entire decade, and conclude that termed realized volatilities and correlations, are not only model-free, but also approximately free of measurement error under general conditions.

By impeding the linkage of goods prices across countries, Devereux and Engel (2002) argue that local currency pricing leads to deviations from purchasing power parity (PPP), and therefore, in principal, may be able to explain high exchange rate volatility. First, if international financial markets allow for full risk-sharing across countries, then exchange rates will be determined by a risk sharing condition, despite the fact that local currency prices are independent of exchange rates. Second, even if risk sharing is limited, the linkage of assets prices through bond markets will impose a tight limit on the degree to which exchange rates can move. Third, even without any international asset trade at all, local currency pricing does not guarantee high exchange rate volatility because wealth effects of exchange rate changes through firms' profits will limit the degree to which the exchange rate can change.

Despite the existence of numerous papers on historical carry trading and returns from carry trading, the empirical evidence of macroeconomic effects of carry trade collapse is relatively scarce. Empirical findings of Baxter (1989) and Flood, R P; Rose (1995) show that high exchange rate volatility under floating exchange rates is not obviously tied to or reflected in high volatility of other macroeconomic variables. Little has been written on the macroeconomic effects of the carry trade collapse and there is no consensus on the overall macroeconomic effects or even if indeed the effects are positive or negative. Habib and Stracca (2012) and Galati et al. (2007) summarize that studies of carry trades have mainly been concerned about the size of the carry trade positions, profitability and its implications for currency market stability. The current literature focus on either the effects of large devaluations as observed by Fong (2010) and Brunnermeier et al. (2013), dynamics of currency crisis as observed by Eichengreen et al. (1996) and Hartmann et al. (2004), or examines the macroeconomic recovery of crisis countries as observed by Borio (2014) and McKinnon (2012). Engel and West (2010) decomposes real exchange rates into real long run interest rate and risk premium components to explain the movements in the US dollar. They find that most of the movements arise from the risk premium component under an assumption of 'no bubbles forward'. As such, the correlation between the real interest rate differential and the real

value of the dollar is strongest when the long-run real interest rate differential is highly positively correlated with the risk premium. Clarida et al. (2009) also find that carry trade returns tend to unwind dramatically as exchange rate volatility increases. They find the relationship between exchange rate movements and interest rate differentials change depending on volatility in the currency market, which too suggests a threshold.

This research therefore, has the main purpose to merge the two strands of literature of high-frequency macroeconomic data and impact of carry trade collapse in a single empirical framework. In particular, the main contribution of this research to the existing literature is to employ a threshold vector autoregression model (TVAR) to investigate three questions, (i) do carry trade collapses have different effects under the influence of low and high nominal exchange rate volatility regimes? (ii) do carry trade collapses of different magnitudes have asymmetric output effect on the real economy? and (iii) do shocks to the interest rate differential increase the probability of regime switching between low and high nominal exchange rate volatility regimes?

2.2 Empirical specifications

2.2.1 Model

A threshold vector autoregression (TVAR) approach is proposed in this research to examine the impact of carry trade collapse on the macroeconomy, using the Australian economy as an example. In the TVAR model estimated in this paper, there are two regimes, the low exchange rate volatility and high exchange rate volatility regimes, defined by a boundary which is equal to certain value of the threshold variable. The TVAR model allows regime switching to take place. The coefficients of the TVAR system are specific to each regime, where the process within each regime can be described by a linear model. The TVAR model can be described as follows in equation 1,

$$Y_t = B_1 + \gamma_1(L)Y_t + (B_2 + \gamma_2(L)Y_t)I(y^*_{t-d} > \theta) + \varepsilon_t \tag{1}$$

where Y_t is a vector containing data for composite price index of metals, Australian Gross National Expenditure, Australia's real GDP, inflation differential and interest rate differential between Australia and Japan, and JPY-AUD nominal exchange rate volatility. The GNE, real GDP and composite price index of metals are in percentage log-deviations from a deterministic trend. I is an indicator function that equals one if the threshold variable y^*_t at lag order d (the delay parameter) is greater than the threshold θ, and zero otherwise. The delay parameter d implies that if the threshold variable y^*_t crosses the threshold value of θ at time $t-d$, the dynamics actually change at time t. The lag polynomials $\gamma_1(L)$ and $\gamma_2(L)$ describe the dynamics of the TVAR system. With the threshold variable y^*_{t-d} as a function of composite price index of metals, which is an element in Y_t, the TVAR describes both the evolution of Y_t and that of the low exchange rate volatility and high exchange rate volatility regimes. This implies that shocks to the interest rate can determine whether the economy moves to a low or high exchange rate volatility regime. By construction, the TVAR model implies

that heretoskedasticity can be assumed across the two regimes as the process within each regime can be described by a linear model as in equation 2

$$Y_t = B_1 + \gamma_1(L)Y_t + \varepsilon_{1,t} + (B_2 + \gamma_2(L)Y_t + \varepsilon_{2,t})I(y^*_{t-d} > \theta) \tag{2}$$

However, the use of regime-dependent impulse response functions may not be sufficient to analyse the overall impact of a shock to the economy, particularly when a shock to the interest rate differential can result a change in the nominal exchange rate volatility, resulting in a switch in the regime. Therefore, a second set of impulse response functions is needed which relaxes the assumption that the economy remains in the same regime prevailing at the time of the shock. The nonlinear impulse response of a variable y at horizon n can be defined as the differences in two conditional expectations due to a shock at time t, dependent on the economy being in a particular regime. This nonlinear impulse response is denoted in equation 3

$$IRF_y(n, u_t, \Omega_{t-1}) = E[y_{t+n}|\Omega_{t-1}, u_t] - E[y_{t+n}|\Omega_{t-1}], \tag{3}$$

where $\Omega_{t-1}$is the information set at time $t-1$. The size and sign of the shock and the initial conditions of the regime that the economy is starting in, Ω_{t-1}, are required to calculate the impulse responses. The conditional expectations $E[y_{t+n}|\Omega_{t-1}, u_t]$ and $E[y_{t+n}|\Omega_{t-1}]$ are computed by simulating the model. The nonlinear impulse responses can be simulated through the following steps as proposes by Zheng (2013). First, shocks for periods 0 to 300 are simulated using the cholesky decomposition of the variance-covariance matrix for the TVAR model. For given initial values of the variables, these shocks are fed through the estimated model to produce a set of simulated data series. The result from this step is a forecast of the variables conditional on initial values and a particular sequence of shocks, denoted as the baseline forecast. Second, the same procedure is repeated with the same set of initial values and shocks, with the shock to the federal funds rate in period 0 fixed at 1 standard deviation. The shocks are fed through the model to obtain a forecast of the variables. The impulse response function for a set of initial values and particular sequence of shocks is then the difference between this forecast and the baseline forecast. This simulation is repeated for 500 draws of the shocks to allow the shocks to average out. Subsequently, these impulse response functions are averaged over the respective regime history to produce an impulse response function conditional only on initial values.

Furthermore, the probability of transiting between the low and high nominal exchange rate volatility regimes given an interest rate differential shock needs to be examined. The probability of the economy being in the low nominal exchange rate volatility regime, given the information set, Ω_{t-1}, at time $t-1$, and a particular realisation of an exogenous shock $u_t$at time t, is denoted as:

$$P(\text{low nominal exchange rage volatility regime}) = P[I(y^*_{t-d} \leq \theta)|\Omega_{t-1}, u_t] \tag{4}$$

Similarly, the probability of the economy being in the high nominal exchange rate volatility regime is denoted as:

$$P(\text{high nominal exchange rage volatility regime}) = P[I(y^*_{t-d} > \theta)|\Omega_{t-1}, u_t] \quad (5)$$

The impulse response functions of the threshold variable are calculated for each observation in the initial regime. The probability of regime switching is estimated by calculating the number of times the switching variable crossed the threshold value. Accordingly, the probabilities of regime switching for the economy starting in the low and high nominal exchange rate volatility regimes can be computed as described in equation 6 and 7, respectively.

$$P(\text{low nominal exchange rage volatility regime}) = \frac{1}{n}\sum_{i=1}^{n}[I(y^*_{t-d} \leq \theta)|\Omega_{t-1}, u_t] \quad (6)$$

and

$$P(\text{high nominal exchange rage volatility regime}) = \frac{1}{n}\sum_{i=1}^{n}[I(y^*_{t-d} > \theta)|\Omega_{t-1}, u_t] \quad (7)$$

2.2.2 Non-linearity tests

The TVAR model is estimated by ordinary leased squares (OLS). Prior to estimating the TVAR model, the threshold of the switching variable is either arbitrarily fixed or estimated from the model. In this analysis, the threshold is determined endogenously by a grid search over possible values of the threshold variable. The grid is constructed such that 20 percent of the upper and lower bound values are trimmed to ensure there are at least a minimum of 48 observations in each regime.[1] Based on the constructed grid, the estimated threshold value corresponds to the estimated model with the smallest determinant of the variance-covariance matrix of the estimated residuals:

$$\theta^* = \text{argminlog}_\theta \ |\Omega_\epsilon| \quad (8)$$

It is also important to test if the chosen threshold value is meaningful by employing non-linearity tests to each equation of the TVAR system. The null hypothesis is that the coefficients of B_2 and $\gamma_2(L)$ equal zero is expressed in equation 9 as follows:

$$H_o = B_2 \text{ and } \gamma_2(L) = 0 \quad (9)$$

In the event the threshold is known, a Wald test can be used to test the null hypothesis. However, in this instance the threshold is not identified under the null. Accordingly, standard inference cannot be applied and asymptotic p-values need to be

[1] The level of trimming of the grid is chosen arbitrarily. The standard level of trimming often used in the existing literature is between 15 and 20 percent.

derived (Hansen 1996). Let W^* be the sup-Wald statistics of all possible statistics over the grid:

$$W^* = \sup_{\theta} W(\theta) \tag{10}$$

As θ is not identified under the null hypothesis, the distribution of this sup-Wald statistic does not follow a χ^2 distribution. Asymptotic p-values are derived from the empirical distribution for the sup-Wald statistic using the bootstrap procedure of Hansen (1996; 1997). Non-linearity is tested for each equation of the TVAR system.

2.2.3 Data and specification issues

To establish the nature of the relationship between carry trade collapse and its macroeconomic impact, both high-frequency data as low-frequency macroeconomic data are needed. To this effect, the research employs Australian and Japanese daily, monthly and quarterly data drawn from the International Financial Statistics database released by the International Monetary Fund, and the data published by the Reserve Bank of Australia. The sample ranges from the first quarter or month of 1984 to the last quarter or month of 2013. The choice of the data sample is motivated by the inclination to study a relatively consistent time period as far as both exchange rates and monetary policies are concerned. The quarterly data consist of Australian consumer price index and the real GDP of Australia. Monthly data consist of Australian and Japanese markets' interbank overnight cash rate, commodity price index, Australian import and export values and Japan's consumer price index. The daily JPY-AUD exchange rate data were downloaded from the web site of the Reserve Bank of Australia. The data are mid-points of buying and selling rates quoted around 4:00 p.m. Sydney time on each trading day. Table 1 provides more information on the source of data used in this research.

The TVAR model proposed to study the macroeconomic impact of carry trade collapses will require a monthly macroeconomic data series. Mariano and Murasawa (2010) and Kizin et al. (2011) propose the use of the Kalman filter to interpolate low-frequency variables to a higher sampling frequency according to their stock-flow nature. Using the daily JPY-AUD exchange rate, the research proposes to compute the 4-week moving average variance as measured by $sigma^2$ of the nominal exchange rate on a daily basis and obtain a monthly average. All variables are made stationary prior to the estimation of the TVAR. Hence, real GDP, commodity price index, interest rate differential, inflation differential are defined in percentage log-deviations from the deterministic linear trend. The chosen lag length of the TVAR model is one lag, determined by the Schwartz information (SC) and Hannan-Quinn (HQ) information criteria.

In the presence of financial market imperfections, the interbank overnight cash rate is supposed to capture the premium for external finance and may be possibly linked to restrictions in the supply of credit in the market as observed by Engel and West

Table 1: Data sources used for carry-trade collapse analysis

Variable	Data used	Source
Composite index of metals	"Metals Price Index, 2005 = 100, includes Copper, Aluminum, Iron Ore, Tin, Nickel, Zinc, Lead, and Uranium Price Indices	IMF Primary Commodity Prices
Real GDP	Australia's real GDP in Australian dollars	IMF International Financial Statistics
Australian imports	Balance of Payments imports of goods and services at current prices	Reserve Bank of Australia
Australian exports	Balance of Payments export of goods and services at current prices	Reserve Bank of Australia
Japan's inflation	Percent change over corresponding period of previous year	IMF International Financial Statistics
Australian inflation	Index, 2010=100	IMF International Financial Statistics
Japan's interest rates	Money market lending rate	IMF International Financial Statistics
Australian interest rates	90 days bank accepted bills rate	Reserve Bank of Australia
Exchange rate	Mid-points of JPY-AUD buying and selling rates quoted around 4:00 p.m. Sydney time on each trading day	Reserve Bank of Australia

(2010). The research proposes the use of the interbank overnight cash rate to other market interest rates as carry trade investments are usually made in liquid, short-terms assets. Moreover, as the low default rates on interbank overnight borrowings makes it a close substitute for treasury bills. A possible problem could arise if the variations of the interbank overnight cash rate closely track business cycles. In this case, our threshold variable will not be able to capture different exchange rate regimes as it would only be a proxy of output fluctuations as previously carried out by Bodart et al. (2012). The correlation between the first difference of GDP and interest rate differential is computed to test this hypothesis which is only 0.43.

3 Impact of exchange rate shocks on inward workers' remittances in South Asia

3.1 Motivation

International financial transfers from migrant workers to family members in their home countries are known as remittances. Singer (2010) identifies that workers' remittances flows are the international financial consequence of immigration and have increased rapidly over the past two decades. The World Bank's 2015 Migration and Development Brief produced by Ratha et al. (2015), estimated that global remittance flows to developing economies would reach US$ 436 billion in 2014 and this is expected to further grow to US$ 440 billion in 2015. The magnitude and growth rate of these inflows has been nearly three times the amount given in official development assistance and almost on par with foreign direct investment flows to developing countries as highlighted by Acosta et al. (2009). Singer (2010) identifies that although migration has been increasing steadily, it is not a new phenomenon, and it alone cannot explain the steady increase in the flow of remittances. An understanding of the motivation of remitters is needed to understand the consequences of remittances. Rapoport and Docquier (2006) identify altruism within the context of family relationships is perhaps the most obvious motivation. The migrants' want to support family members who remain behind to ensure that the transfers of funds do not lead to promises of future compensation as emphasized by Singer (2010). Migrants send more money home when their families experience economic difficulties (World Bank 2012). Moreover, Ratha et al. (2011) state from their finding that adverse circumstances often trigger more migration, which results in greater remittance inflows. As such these flows pose a challenge in understanding the influence of global finance on domestic economic policy, especially in developing economies.

Singer (2010) argued that remittances are an important influence on exchange rate policy making in the developing world. Several studies have investigated standard theory for the effects of worker remittance flows on the recipient economy's real effective exchange rate (REER). The REER is the value of a currency against a weighted average of several foreign currencies divided by a price deflator or index of costs. Lartey (2008) explain that the rapid appreciation of the REER in the Netherlands following the development of natural gas on a large scale and ensuing difficulties faced by the industry sector gave rise to the term 'Dutch disease'. Although Dutch disease has been mainly attributed to foreign revenue from primary exports, Lopez et al. (2007), Acosta et al. (2009) and Lartey (2008) emphasizing that any upward pressure on the REER resulting from financial capital inflows as a Dutch disease and it can be applied to assess the impact of remittances inflows. While the literature on the macroeconomic consequences of remittances is growing, the research focuses on developing economies in Latin America, Africa, the Middle East and Central Asia as observed in Acosta et al. (2009), Acosta et al. (2009), Lartey et al. (2012) and Adams (2009).

Although historical data patterns of remittances flows observed by Frankel (2010),

show that these remittances tend to flow counter-cyclically relative to the recipient country's economic activity and pro-cyclically with respect to remittance originating country. However, the literature on the impact of exchange rate movements on remittances flows is scarce. This research aims to bridge the gap in existing literature in identifying the impact of exchange rate movements on the remittances flows to recipient countries.

3.2 Empirical specifications

3.2.1 Model

The objective of this research is to verify empirically using a reduced form model the impact of exchange rate shocks on the remittances inflows of South Asian economies. Based on the literature, a model for this study to analyse panel data estimation techniques could be described as:

$$\begin{aligned} lrem\_pc_{it} &= \beta_0 + \beta_1 lreer_{it} + \beta_2 lex\_pc_{it} + \beta_3 lim\_pc_{it} + \beta_4 lgdp_{it} \\ &\quad + \beta_5 lgov\_ex\_gdp_{it} + \beta_6 m2\_gr_{it} + \eta_i + \lambda_t + \varepsilon_{it} \end{aligned} \tag{11}$$

where $lrem\_pc$ is the change in remittance flows per capita, $lreer$ is the change in the real effective exchange rate (REER) index, lex_pc represents growth in exports per capita, lim_pc represents growth in imports per capita, $lgdp$ represents growth rate of real GDP, $lgov\_ex\_gdp$ is the growth in government expenditure as a percentage of GDP, $m2\_gr$ is the growth in broad money, η is an unobserved country-specific effect, λ is a time-specific effect, and ε is the error term.

Variations in the external terms of trade can also alter domestic macroeconomic conditions. To address the impact of trade liberalization on remittances flows, following previous research by Acosta et al. (2009), this study used two variables, namely, growth rate of exports per capita and growth rate of imports per capita. Following Acosta et al. (2009) and Adams (2009), an explanatory variable is included to capture the growth in broad money. Excess money growth can put upward pressure on the prices of non-tradable goods, which may produce inflationary tendencies in the economy and independently create an environment which attracts remittances. Due to sufficient data not being available on technological progress in South Asian economies or on total aid flows, those determinants were omitted from the proposed equation. Acosta et al. (2009) and Fajnzylber and López (2008) identify that higher GDP per capita is expected to incomes and hence increase demand for non-tradable goods. Furthermore, Fajnzylber and López (2008) show that demand for tradable goods may increase imports in periods of large portfolio and capital inflows that is associated with consumption boom and GDP growth.

Drawing from previous literature, the expected signs for the dependent variables are given in Table 2.

Table 2: Determinants of remittances infolws

Variable	Definition	Expected sign
$lreer$	Change in REER	$(-)$
lex_pc	Growth rate of exports per capita	$(+)$
lim_pc	Growth rate of imports per capita	$(-)$
$lgdp$	Growth rate of the GDP	$(-)$
$lgov\_ex\_gdp$	Annual growth of government consumption expenditure relative to GDP	$(+)$
$m2\_gr$	Growth rate of broad money	$(+)$

3.2.2 Data and specification issues

The research employs a balanced panel data set comprising five South Asian countries for the period 2000-2014. The countries, Bangladesh, India, Nepal, Pakistan and Sri Lanka were selected on the basis of data availability. Workers' remittances, export and import value, are expressed in US dollars per capita. The remittance series is derived from the balance of payment statements released by the national governments, reported in International Financial Statistics and compiled in the World Development Indicators. Data for Nepal were obtained from the Nepal Rastra Bank. Official population series are used to convert total remittances to a per capita series to more appropriately compare remittance receipts given different country sizes as described by Alemu and Schalkwyk (2008).

As in Lopez et al. (2007) and Lartey (2008), the study used a REER index as a measure of the REER. There are a variety of definitions of REER; the main choice being between the purchasing power parity (PPP) and trade theory definitions. Following Lopez et al. (2007) and Lartey (2008), the research used the REER index based on PPP as a measure of REER. A REER index represents a nominal effective exchange rate (NEER) index adjusted for relative changes in consumer prices, a proxy of cost indicators of the home country as described by Lartey (2008). Since REER is defined as the relative price of domestic to foreign goods, an increase in REER implies a real exchange rate appreciation. A current vintage REER data series was obtained from Bruegel, a European think tank. This index used wholesale price index for traded goods and the consumer price index for non-traded goods. The REER is defined such that an increase (decrease) in the value represents appreciation (depreciation). By also assuming that the base year reflects a period where we believe that the exchange rate was in equilibrium, a value larger (lower) than the base value represents an overvaluation (undervaluation).

Darvas (2009) who computes the REER from the nominal effective exchange rate (NEER) and consumer prices (CPI) as a measure of the relative price between the country and its trading partners. The research uses a consistent methodology using a CPI-based REER. The REER series is calculated as:

$$REER_t = \frac{NEER_t \times CPI_t}{CPI_t^{(foreign)}} \tag{12}$$

where $REER_t$ is the real effective exchange rate of the country under study against a basket of currencies of trading partners, CPI_t is the consumer price index of the country under study, $NEER_t = \Pi_{i=1}^{n} S(i)_t^{w^{(i)}}$ is the nominal effective exchange rate of the country under study, which is in turn the geometrically weighted average of $S(i)_t$, the nominal bilateral exchange rate between the country under study and its trading partner i measured as the foreign currency price of one unit of domestic currency, $CPI_t^{(foreign)} = \Pi_{i=1}^{N} CPI(i)_t^{w^{(i)}}$, is the geometrically weighted average of CPI indices of trading partners, $CPI(i)_t$ is the consumer price index of trading partner i, $w^{(i)}$ is the weight of trading partner i, and N is the number of trading partners considered according to Darvas (2009). This REER index uses time-invariant weights and is measured against a basket of countries representative of foreign trade in 1998-2003. The base year for this index series is set as 2007.

4 Impact of exchange rate shocks on emerging capital markets

4.1 Motivation

As a result of the increased economic growth globally over the last two decades, many poor countries transformed into emerging market economies with low- to middle- per capita income. The World Bank (2015) classifies those low- to middle- income economies are those with a GNI per capita of more than US$1,045 but less than US$12,746. Many of the economies who elevate to this category face a significant challenge in having access to international funding sources enabling them to continue to grow. Kharas and Kohli (2011) emphasize that without international funding to bridge the savings-investment gap, many economies tend to get drawn into the middle-income trap. This is particularly challenging for emerging economies because as they become emerging market economies, they do not have access to the level of concessional funding they used to have and their capital markets are not developed enough to attract foreign funding at competitive rates. Kharas and Kohli (2011) argue that in order for these emerging economies to have access to international capital markets, they should first develop their own. In doing so, Chue and Cook (2008) and Dominguez and Tesar (2006) argue that without having sufficient foreign reserves, many emerging capital markets are susceptible to exchange rate movements. The final research in this dissertation aims to look at the impact of exchange rate shocks on these emerging capital markets. Based on the findings, the research aims to provide policy recommendations to economies with emerging capital markets to safeguard themselves from exchange rate shocks.

5 Time line of the dissertation

Table 3: Timeframe of the PhD research

Date	**Milestone**
2013 December	Complete academic coursework requirements
2014 March	Complete a preliminary literature review for the first paper
2014 April	Obtain and construct data sets for first paper
2014 June	Commence estimation for the first paper
2015 February	Complete a preliminary literature review for the second paper
2015 May	Obtain and construct data sets for second paper
2015 June	Complete estimation for first paper
2015 July	Write-up first paper
2015 August	Complete estimation for second paper
	Finalize first paper
2015 September	Complete a preliminary literature review for the third paper
	Write-up second paper
2015 October	Obtain and construct data sets for third paper
	Finalize second paper
2015 November	Complete estimation for third paper
2016 January	Write-up third paper
2016 February	Prepare first draft of the dissertation
	Finalize third paper
2016 March	Prepare final draft of dissertation
	Dissertation submission

6 Conclusion

Assessing macroeconomic effects of exchange rate shocks is still in its infancy. This is particularly because the frequency in which the data are available. Exchange rate shocks are visible in high frequency financial data where are macroeconomic data are usually published in quarterly, and seldomly monthly time series. The objective of this dissertation is to examine several macroeconomic effects of exchange rate shocks. To aid this, all the research undertaken for this dissertation will employ the Kalman filter to construct higher frequency (monthly) macroeconomic data series. The first component of the research will look at the macroeconomic effects of carry-trade collapse, taking Australia and Japan as an example. The second part of this research will look at the impact of exchange rate shocks on inward workers remittances on the South Asian region. In the past, the unavailability of data has resulted in scarce research being carried out on remittances of South Asia although in many counties, the remittances flows are as large as 10% of their respective GDP. The final segment of this dissertation will look at the impact of exchange rate shocks on emerging capital markets. With much of Asia being categorized as emerging market economies, the findings of this research would be crucial for these economies to prevent or limit exposure to an event such as the 1997 Asian Financial Crisis.

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