Erasmus University Rotterdam

MSc in Maritime Economics and Logistics

2014/2015

An analysis of how chosen exchange rates regimes and exchange rate volatility affect bilateral maritime trade

By

Deep Maity

Acknowledgements

The three biggest challenges faced so far, during my life, have been joining a pre graduation college far away from home, working in an environment unimaginable to many and then a challenging era through the curriculum of MEL.

Rotterdam is a city that has been a home to me before I arrived at MEL. My frequent visits, while working on-board ships, gave me the opportunity to know about it more closely than in any other form of media. The passion to be a part of the sea has been ever garnering but the port city really attracted me to start a new chapter in my life not only as a seasoned officer but also as a student, inclined to learn more about the business and logistics of maritime sector. Thus, this decision led me to land up at MEL. It has been a tough but fulfilled journey with lots of ups and downs in life. I came across friends, both young and matured, novice and intellectuals, best of the lot. Through out the year, I ran into several natures of challenges and during this period, I came across the challenge to write my first thesis.

Choosing a suitable topic was not easy and getting along with the chosen topic was not suitable either until I came across a very good book, introduced by a very good friend of mine about exchange rate stability and the importance of adhering to gold standard. Pages were flipped, knowledge was gained and at each step, a new revelation came across. At the end of the book, it was decided to pursue my thesis by combining maritime industry with international economics.

This thesis has been a professional and personal challenge to me because of it being unique in nature. I took up this thesis in order to analyse the claims made in the book that inspired me to write the thesis and conduct parallel research through qualitative and quantitative methodologies. The journey was not easy but these challenges helped me to evolve and find out solutions that would foster in completing it. But in the end, it could not be completed without the support of many. And I wish to pay my gratitude to them for it.

First, I would like to thank my supervisor, professor Dr. Koen Berden who has time and again proved to be my moral ‘Guru’ in moulding me from a mere student into an active professional, ready for combat, to fight against odds in order to achieve my goals. There has never been a day when I have not been inspired to run that extra mile and each new challenge thrown at me has turned to be a blessing in terms of knowledge and expertise gain. Also, I would like to thank my dear friend Deepak Sekar, who has taken the very initiative to guide me through my thesis by introducing me to new ideas and scope of improvements by taking cue from his own life experience as a thesis student. In short, he has pushed me harder every time to achieve a bit further from where I decided to end.

Second, I would like to thank my parents whose untiring and unbroken trust and confidence in me has brought upon a huge incentive to me to keep working harder and their constant support and encouragement has helped me thrive my success and withstand my failures. Lastly, I would like to thank MEL staff in providing me countless opportunities to learn about work life balance through constant push for working hard and partying harder.

After all, ‘*An Effort Not Taken Is An Opportunity Wasted*.’

Abstract

In the year 1971, the link between the dollar and gold and the other currencies to the dollar was suspended – the end of the Bretton Woods System – and it was decided that the dollar would be delinked from gold and be allowed to float freely. Many nations followed suit with their own currencies. A whole literature followed on the economic impact of exchange rate regimes and exchange rate volatility. The Monetary Policy Trilemma was discovered and also that changing from one exchange rate regime to another could cause several damaging factors such as trade fluctuations and uncertainties. These conditions are also applicable to maritime industry, which on an average governs about 90% of the world trade. It is important to know, as a part of the shipping sector, which one of the exchange rate regimes shall be beneficial as a whole and how important exchange rate volatility is for maritime trade. The focus of this research, therefore, is to understand and analyze the impact of such exchange rates regimes and subsequent exchange rate volatility on bilateral maritime trade flows. Not many papers have been found that clearly mention that a particular exchange rate regime and subsequent volatility has an impact on maritime international trade.

We first carry out a qualitative analysis on the post-Bretton Woods era until the present where the exchange rate regime and the shifts and trends in inter and intra-industry trade and subsequent elements in the maritime trade sector are analysed. Then a gravity regression approach us used on a panel dataset of 27 bilaterally trading nations over the tenure of 22 years from 1992 until 2013 to try to quantify the effect of exchange rate regimes and exchange rate volatility on bilateral maritime trade flows.

Upon analysis, we find that individual chosen exchange rate regimes do have a significant impact on bilateral maritime trade. The fixed exchange rate regime has a sizeable (+0.40) and significant (at 1% level) positive effect on maritime trade flows. The managed and free floats, however, are both found to have a significantly negative effect (-0.17 and 0.08 respectively). Clearly for maritime trade, the element of the policy Trilemma that becomes visible, as an important determinant is the stability in exchange rates – which fixed exchange rates, exhibit most. We also find that the effect of exchange rate volatility on bilateral maritime trade flows is insignificant, even though we have looked at six different definitions of exchange rate volatility. That implies that from this research, we find that stability in exchange rates – through a fixed rate is the main driver for bilateral maritime trade flows.

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1 Introduction

If you are a global conglomerate company operating in global trade, shipping and energy with over 50,000 employees, it is very likely that the exchange rate regime is a variable to be watched closely for the performance of your company for two reasons. First, changes in earnings vary with changes in exchange rates. And second, there could be an effect on Maritime Trade of exchange rate changes and systems

The first factor can be addressed by currency hedging of exchange rate regimes. Hence, the main focus of the thesis is on the second medium: how do exchange rate regimes and exchange rate volatility affect maritime trade?

In general, there are many firms, engaging in international trade facing commercial and economic risks determined by the exchange rate regimes and their volatility and certain risk management tools and techniques, although complex, are available but do not cover many financial and commercial operations and the same techniques might not be available due to its significant cost (Korinek, 2011). On the other hand, exchange rate fluctuations develop contractual effects in shipping industries due to the lack of hedging instruments against exchange rate exposure (Wang, n.d.).

Steve Forbes (2014), in his book, *"Money: How Destruction of Dollar Threatens the Global Economy- And What Can We Do About It?"* has mentioned that nations would benefit preferably by free trade and in order to bring stability in the trade flows, monetary policy needs to be stable in order to perform, which can be brought forward by stable exchange rates in order to provide stability to exchange rate volatility, although lack of quantitative evidence finds it hard to support the idea. Empirical studies have shown so far that exchange rate volatility and volume trade are related to each other in multiple manners, that is, positive, negative and neutral and this discrepancy has led to the development of other theories explaining a possible effect that exchange rate volatility have on trade flows (Altvater, 2012).

Ninety per cent of merchandise trade by volume is transported to market by ship while operation of merchant ships now generates an estimated annual income approaching US$380 billion, equivalent to about five per cent of total world trade (Sourdin, 2009). We note, however, that the 90 per cent is an average. Naturally, if we disaggregate this average into bilateral trade flows, trade between Germany and Denmark or Germany and The Netherlands will show a much lower percentage of maritime trade than 90 per cent. For other nations – e.g. island economies like the UK, Australia or New Zealand, this percentage is found to be higher. For the section of the shipping industry, which relies mostly on greater domestic demand than foreign demand, exchange rate fluctuations are positively correlated to its unexpected operating profits and as such results in exchange rate loss due to import contracts leading to less profits when, as an example, when the Taiwan dollars depreciated (Wang, n.d.). Whether this is also the case on average for aggregate maritime trade flows is what we will analyse further down below.

1.1 Research Objectives

Historically, the cost of conversion from one currency to another and the risk associated with potential changes in exchange rates have dampening effects on trade flows (Korinek, 2011). For example, export oriented textile and glass industries depended upon imported petrochemical raw materials via American markets, which, being small, led to increase in raw material costs as the New Taiwan Dollars depreciated against US dollars thus leading to a reduction of operating revenues of the MNC's in Taiwan (Wang, n.d.). However none of the papers addresses the question of whether the impact of complete monetary union on macroeconomic integration is different from that of adoption of a hard peg, which is of a potential policy importance because certain countries find it prohibitively difficult to join a monetary union due to the administrative or political costs (Shields, 2007).

Hence, the main research question is the following: ***"What is the impact of a chosen exchange rate regime and exchange rate volatility on bilateral maritime trade flows?"*** The objective of this research is to find out whether chosen exchange rate regimes as such have any effect on trade values within the maritime sector.

In order to satisfy the main research question, a set of sub-research questions needs to be answered:

- *"What research has been carried out in order to observe the link between exchange rate systems and maritime trade?" (Covered in Chapter 2);*
- *"What different types of exchange rate regimes are currently present and how can we classify them?" (Covered in Chapter 2);*
- *"What methodological approach can be best chosen in order to answer the research question?" (Covered in Chapter 3);*
- *"How can we measure or quantify bilateral maritime trade flows, exchange rate regimes and exchange rate volatility?" (Covered in Chapter 3).*

1.2 Research Design and Methodology

This thesis shall employ qualitative methods and a quantitative analysis in order to deal with the research question about the effect of the chosen exchange rate regime and related exchange rate volatility on bilateral maritime trade.

Qualitative approach
The qualitative approach will focus on the nature of exchange rate regimes and the impact of exchange rate volatility on trade that have been incorporated by different countries, exchange rate regime switches and policy measures that were adopted in 1970-2013 duration. For example, certain countries such as Sweden, after 1992, have been *'forced'* to switch from a fixed exchange rate regime to a flexible exchange rate regime by de-pegging of its Krona from the European Currency Unit (ECU) at the time and let the Krona float freely (Altvater, 2012). Further research has been carried out in order to understand the trends and the shifts that have been observed in the maritime sector due to changes in market structure, government and company policies that can have an impact on the bilateral maritime trade flows such as certain organizations chose to go for proximity to the market rather than export goods by sea.

Quantitative analysis
For the quantitative analysis, we chose to employ a gravity model approach as the method to research the effect of the chosen exchange rate regime and exchange rate volatility on international maritime trade. The qualitative approach of this thesis mainly focuses upon the events that have occurred after the year 1971 but due to significant data constraints, especially in bilateral maritime trade flows, probably due to inconsistent reporting, the gravity model regressions and results have been based on the period from 1992 onwards. We use panel data for the 1992 – 2013 period for 27 bilateral country pairs, which depending on the type of regression run (OLS or PPML) involve 15216 or 15372 data points respectively for total international trade and 15212 and 15374 respectively for international maritime trade.

1.3 Thesis Structure

Chapter 2 starts with a short description of the history of exchange rates describing shortly the pre 1971-era then the post-1971 era. We then describe the different exchange rate regimes and the degrees of freedom in monetary policy goals during that regime currently present within countries. Chapter 2 concludes with a description of trends, quantities and patterns in total as well as maritime international trade. Chapter 3 covers the methodological approach (i.e. the explanation of the gravity model) followed an explanation of the gravity regression variables that have been chosen. In Chapter 4 we present the results and analysis of those results. Chapter 5 concludes, points out areas for further research and makes policy recommendations.

2 Exchange rates regimes and maritime trade

In this chapter we summarize the historical occurrences and the anecdotes that have defined exchange rate regimes and exchange rate volatility.

2.1 History of exchange rates

This section shall focus on the historical accuracies and the significance behind the implication of the exchange rate regimes before and after 1971. It shall also signify the reason behind the choice of the year 1971 as a benchmark for segregation.

2.1.1 Pre 1971 Exchange Rate Regimes

The Gold Standard, over a period, had been a commitment by participating countries to fix the prices of their domestic currencies into specified amounts of gold through its sale and purchase, as for example, the USA between 1834 and 1933 maintained the price of gold at $20.67 per ounce except during the greenback era from 1861 until 1878. Economic performance in the USA and UK had been superior under the classical gold standard when compared to the subsequent period in which, both price level and real economic activity have been more stable during the pre- World War I gold standard era than in the years afterwards (Bordo, 1981).

Yet questions have often been raised why gold has been chosen as a mode of exchange over the centuries. The main reason was that gold, unlike other metals, is durable, easily recognizable, storable, portable, divisible, standardized and its stock being limited due to high costs of production. This makes it difficult and costly for governments to manipulate it (Bordo, 1981). For example, a metallic standard had been in circulation after the great coinage at the end of the 17th century, yet, at the turn into the next century, Sir Isaac Newton, the master of Mint established the pound sterling weight in gold at 123.274 grains of gold at 22/24 carats (Cecco, 2013). In a simple manner, peripheral countries that adhered to the gold standard rule had better access to capital from the Western European region rather than the rest known as the *'Good Housekeeping Deal*' (Edelstein et al., 1999).

However, the two World Wars, [World War I- (1914-1918)] and [World War II – (1939-1945)] disrupted the economy turning around to unstable economy followed by high inflation (Marrewijk et al., 2012). Several trade barriers, import quotas and tariffs were imposed by the governments, "*leading to sharp contraction in world trade*." during the interwar period, which led to Great Depression in United States of America and hyperinflation in Germany (Eichengreen & Irwin, 2010).

Post Second World War, 44 nations took membership under the agreement of Bretton Woods 1944 (Stephey, 2008). The countries decided to link the dollar to Gold Standard at $35 per ounce followed by the currencies of the remaining nations linked to dollar in order to reduce the frictions in currency. This agreement had been a result of extensive negotiations; the principal drafters, John Maynard Keynes in Britain and Harry Dexter White in the United States established a set of rules to replace the international gold standard, thus avoiding the rigidities of the gold standard system and implicating safeguards against protectionist and deflationary policies of the interwar years (Meitzer, 1991). However after 1971, President

Richard Nixon, removed dollar from the Gold Standard and floated the dollar in order to support US during the Vietnam War, which caused a widening of US balance of payments disequilibrium. Some currencies remained then linked to the US Dollar without the parity on gold as such leaving these nations at the mercy of US monetary policies (Marrewijk et al., 2012; Marrewijk et al., 2012).

2.1.2 Post Bretton Woods Era

The Federal Reserve, after the collapse of the Bretton Woods system, needed access to considerable amounts of money in order to fund not only war efforts in Vietnam but also Great Society social programs. This was carried out by exploiting the short run Phillips curve trade-off between inflation and unemployment, and for that, monetary growth was raised to support employment leading to accelerated growth in inflation until Paul Volcker put a hold on the policy (Bordo & Schwartz, 1997).

European Monetary co-operation was established after the collapse of the Bretton Woods system, giving birth eventually to the European Monetary System (EMS) leading to European Economic and Monetary Union (EMU) which proved to be quite stable due to the failure of Keynesian policies dealing with the first oil crisis, appeal of a monetary theory with the focus against inflation and Germany's considerable success under monetarism (McNamara, 1999).

Eventually, dramatic liberalization trends were observed as capital controls were removed in advanced industrial states thus giving market operations several degrees of freedom such as capital account liberalization and financial globalization, which began with Great Britain by abolishing its forty-year-old capital control on direct and portfolio investment, holding of foreign currency deposits and foreign currency lending by UK residents and banks (Marston, 1993) in 1979 followed, by Japan, Australia, New Zealand and all members of the European Community in the in the mid 80's and the Scandinavian countries in the late 80's (Helleiner, 1994).

Yet, a severe downside was discovered that jostled with the financial market. A high degree of short-term volatility took over in the commodity or equity markets and un-hedged positions in a particular currency resulted in unanticipated gains and losses. This exceeded expectations of those experienced under Bretton Woods system resulting in the development of foreign exchange risk premiums needed to compensate investors for positions in particular currencies leading to high costs imposed by flexible rates (Marston, 1993).

Several developments have been witnessed in the maritime sector during this period. A recurring pattern of cyclical annual behaviour in the shipping sector was seen during the period especially within the years 1975 until 1995. A major downturn in growth in sea trade was observed in the 1970's followed by in the 1980's triggered by the deep recession in the world economy occurring post 1973 oil crisis which paralleled in severity with respect to the great depression in the 1930's which led to a loss in confidence among the investors and traders about the future of transport requirements thus giving way to a more risky role on the 'Spot' market (Stopford & Grammenos, 2010).

Although, a bull market was observed in the year 1980, following years witnessed severe collapse especially in wet and dry bulk maritime industry with one time-charter rate reaching a depth until $4700/day for a 65000 deadweight Panamax bulk carrier which proved to be less than the operating cost under the German flag thus leaving time charters at default, owners penniless and rendering liquidity crisis (Stopford & Grammenos, 2010).

In the wake of the financial crisis in the year 2008, several steps were undertaken to bring the shipping industry into a more sustainable business. Investors and owners commenced with many restructured policies with respect to changing patterns in international trade, changing government-industrial relations, and the importance of being green and transparent (Ng & Liu, 2009). For example, A.P. Moller- Maersk group brought about serious changes in their policy in the maritime sector such as introducing optimization in operations such as slow steaming in their vessels in order to check on bunker fuel costs and tonnage overcapacity, offering reliability in their entire supply chain through on time delivery of their shipments, pioneering in strong industry leadership in sustainability towards health, safety, security, environment protection and anti-corruption and investing in research and development projects such as the bio-fuel ships and 'Triple E' ships (Reinhardt et al., 2015).

In recent times, digital currency has come into several discussions as one of the many ways the present currency exchange system can be replaced with. The concept is relatively new and developing it as such might take a considerable amount of time. Yet there is huge speculation about it being the sole currency of the future for all balances of payments.

Digital currency has its own advantages such as cheap and convenient mobile-to-mobile transactions, easily portable, nil cost of moving the currency from one place to another and not inflationary (Desk, 2014). However several bottlenecks emerge such as there is a fear about government losing the monopoly over the control of the currency (Dorn, 1997) and the fear of being looted by the government electronically in the name of '*Bail-In*' programs leaving the customers cashless (Daniels, 2015). Moreover, digital currency is currently more of an asset rather than a currency thus leading to huge speculation and consecutive volatility such as the value of bit coin, due to huge market speculation on Market share 30 September, 2013 jumped from $118.48/- to $979.45/- on 25 November, 2013 which returned to $638.09/- on 16 December, 2013 (Coin Desk, 2015).

2.2 Monetary policies and related exchange rate policies adopted and affecting exchange rates

After the break-up of the Bretton Woods System, several countries adopted currency exchange rate regimes depending upon the monetary policy goals. The policymakers, due to the macroeconomic '*Trilemma*', faced in the open economies, (Obstfeld et al., 2003) have been able to fulfil, only two out of the three objectives, constituting of:

1) Stabilization of exchange rate;
2) Free international capital mobility;

3) Monetary policy aiming towards domestic goals (Obstfeld et al., 2003).

Stabilization of exchange rate aims at keeping economic volatility at bare minimum thus easing the ability of businesses and households to engage in world economy; *free international capital mobility* allows the citizens of the nation to invest abroad and diversify their holdings thus encouraging the investors to bring foreign direct investment into the country while *monetary policy towards domestic goals* is adopted by the central bank in order to control the money supply and fluctuate interest rates when the economy is depressed or overheated (Mankiw, 2010). For example, European central bank sets interest rates for the whole of Europe and Greece, being a member state of the European Union, since 2002, does not have control over its monetary policy to address its national problems (Mankiw, 2010) while government of India, being an independent entity chose an active intervention in foreign exchange markets while maintaining control over international capital flows (Hutchison et al., 2012).

Certain developing nations tried to counteract the '*Trilemma*' by adopting the combination of all the three objectives. Countries such as Korea, Mexico and Thailand adopted financial liberalization but they also tried to control exchange rate stability and monetary policy thus failing to sail through the Trilemma and their inconsistent policy goals led from one crisis into another such as the Mexican financial crisis in the year 1994-1995 and Asian financial crisis in the year 1997-1998 while China, chose to put a leash upon its free international capital mobility in order to protect its banking system by restricting its capital outflow while pursuing a path towards capital outflow (Glick & Hutchison, 2009).

These degrees of freedom in monetary policy goals led to the birth of three exchange rate regimes: fixed arrangements (Currency unions, Currency boards such as dollarization and truly fixed exchange rates), Intermediate arrangements (Adjustable pegs, Crawling pegs, Basket pegs, Target zone or bands) and Floats (Managed floats, free floats) (Marrewijk, 2012)

There is a thin line that separates fixed arrangements from intermediate arrangements and float arrangements from intermediate arrangements. The policy whether to fix or not is an institutional commitment illustrates the first separation line while the second separation line is determined by whether there is an explicit target zone around which the authority intervenes (Bordo, 2003). It is far easier for the share holders and other players in the money market to understand whether the central bank is following a corner solution: fixed peg will show whether the exchange rate data has been different on a daily basis and a floating peg will allow the investor to monitor the central bank policy on a monthly basis where as under an intermediate basket band, investors need more months of data in order to verify the central bank's announced policy (Frankel et al., 2000).

This thesis has incorporated for careful scrutinization of the intermediate exchange rate regime and the meaning of each of the content in this regime interpreted. It has been found that most of the terms are somehow related to the pegged or fixed exchange rate regime with a narrow margin. For example, a crawl-like arrangement remains at a 2% margin within a peg and is not a float (Marrewijk et al., 2012). Hence, the intermediate regime has been chosen under fixed exchange rate.

Floating exchange rate regimes have been further subdivided into managed float and free float respectively.

2.2.1 Fixed exchange rate regimes

This regime fosters the central bank to set its exchange rate and the interventions in the foreign exchange market would lead to an increase or decrease in foreign reserves (SANDU, 2014). The monetary authority under currency board reserves completely in foreign currency and the money supply expands or contracts according to the balance of payments whereas Dollarization/Eurorization and currency unions eliminate national currencies and adopt a single currencies. For example, Ecuador, in the year 2000, adopted dollar as its national currency after renouncing dual/multiple exchange rate regimes (Suarez, 2003) where as several European nations such as Germany and France entered Eurozone currency union in the year 1999 followed by Greece in the year 2002.

Fixed exchange rate policy considerably allows stable fiscal and structural policies, low inflation and higher degree of certainty for pricing international transactions but the central bank under this currency lacks the credibility to adjust its exchange rates and its interest rates are linked to anchor-currency country (Stone et al., 2008). UK is a special case where the country joined ERM in 1990 so as to increase their credibility of the monetary policy and reduce the high inflation rate with minimum unemployment effects but the reduction in inflation could not help UK achieve enough credibility thus forcing it to withdraw in 1992 (Masson, 1995).

2.2.2 Managed float exchange rate regimes

Also known as '*dirty float*' or '*managed float without a predetermined path*', the central bank has the authority to actively intervene into the financial market through purchase and sale of foreign currency in exchange for local currency (Stone et al., 2008) to counteract the long-term trend of exchange rate without having an exchange rate path or target and the indicators for managing it can be determined through balance of payments, international reserves and parallel market developments (Wang, 2009). 46 countries including India and Singapore have adopted this exchange rate regime. In other words, "*a managed floater responds to a one per cent fluctuation in demand for his currency by accommodating to the extent of varying the supply of the currency by K per cent, and letting the rest show up in the price -- the exchange rate*" (Frankel, 1999).

China, for example, switched to a managed float regime in 2005 after being pegged to US dollar during and after the Asian crisis in 1998 (Qing, 2012). The reason is due to the exchange rate flexibility that helps to create better incentives towards developing foreign exchange market and currency risk management which includes development of hedging instruments and forward markets thus facilitating capital account liberalization by arming the economy to deal with the impact of increased capital flows and possessing this flexibility shall assist China to counteract macroeconomic shocks, both external and internal through exchange rate flexibility and monetary policy (Prasad et al., 2005).

2.2.3 Free float exchange rate regimes

Countries such as United States of America, New Zealand, Sweden and Iceland have maintained their currency, free of any intervention from the central bank. The countries adopting this regime, unlike countries under fixed exchange rate regimes are free to utilize their discretion on monetary policy, especially during frantic times when the economy of the country is in a frequent cyclic motion, such as a shift in world wide demand of goods and services thus rendering the country helpless, the government shall be able to respond unlike its counterparties which have adopted fixed exchange rates (Frankel, 1999).

On the contrary, these countries have to be large and stable enough in order to sustain unparalleled shocks in the foreign exchange and financial markets and that too with the availability of financial instruments needed to hedge against risks caused by fluctuating exchange rates (Stone et al., 2008). In addition to that, exchange rate flexibility can expose financial system vulnerabilities by facilitating outflows from banking system due to the investment opportunities available abroad by domestic economic agents (Prasad et al., 2005).

2.2.4 Exchange Rate Volatility

There is a common discourse that fixed exchange rates or pegs are far more vulnerable to banking and exchange rate crisis especially in emerging markets. On the contrary, countries with advanced economies find flexible exchange rate systems quite durable and higher growth return without higher inflation. A research paper supports the latter statement but it has been revealed that fixed or pegged exchange rate regimes actually deliver low inflation, stability and higher durability for countries with little access to international capital markets (Husain et al., 2004). However, supply shock of foreign goods is experienced which forces the domestic market to depreciate its quantity thus leading to high exchange rate volatility in order to achieve equilibrium although price substitution of goods due to exchange rate volatility is bare minimum because the relative price for domestically produced goods and internationally produced goods is very small for final consumers (Devereux & Engel, 2002).

Several countries, over the years have suffered severe currency and banking crisis leading to precarious economies especially in emerging markets. The cost of restructuring the banking sector undertook a substantial part of 20% of the GDP while output declined to as large as 14% and for that, fixed exchange rate regime is viewed to be blamed and the general viewers appeal allowing their currency to float in favour of emerging markets (Calvo & Reinhart, 2000). For example, Mexico, after the Peso Crisis in 1994 and Thailand after the Asian crisis in 1997 switched to free and managed float respectively. During the Bretton Woods era, a price shock in a country was likely to be wired into other countries unless checked by trade barriers but it was presumed that under flexible exchange rate system, the US inflation might be offset by the depreciating dollar without affecting other countries (Eun & Jeong, 1999).

Another research paper suggests that a change in the fiscal policy of the country shall have an influence over the real exchange rate, which might have little impact on the economy and this step is at times taken in order to boost the demand for

domestic output in order to support the increase labour supply hunting employment (Wren-Lewis, 1997).

Exchange rate volatility is governed by policy intervention depending upon the behaviour of foreign exchange reserves. In principle, pure float carries zero variance of reserves. However, in reality, reserves tend to change with fluctuations in valuation, interest earnings accrual and submerged foreign exchange reserves transactions such as Ireland, which utilized its credit lines during Exchange Rate Mechanism Crisis of 1992-1993 and the probability that Japan's monthly changes in foreign exchange reserve, within the range of 2.5% (+/-) band is 74 per cent while that for Mexico and Korea is 28 per cent and 6 per cent respectively suggests that reserve variability is more for floating arrangements than that for limited flexibility arrangements (Calvo & Reinhart, 2000). Another argument in favour of floating exchange rate claims the possibility of '*rapid resource re-allocation'* following real shocks where short run price rigidity is significant where as countries with fixed exchange rate regimes face more folds of trade shocks and the inability to absorb such shocks leads to lower growth and the need to defend the peg following the shock may result in high real interest rates and low growth (Husain et al., 2004).

An investigation on the interdependence structure of national price levels during the post Bretton Woods's era had been carried out. It was found that exchange rate fluctuations failed to insulate the domestic price level from foreign price shocks due to the country's limited ability to control its domestic price level thus enabling the government to coordinate their monetary and exchange rate policies curtailing national policy autonomy (Eun & Jeong, 1999). After all, the weight of exchange rate volatility under a floating regime is not tied to the volatility of other macroeconomic variables thus making it difficult to analyse the impact on the society (Devereux & Engel, 2002).

2.3 Empirics of international maritime trade flows

This section will observe and integrate the trends and patterns that are observed in trade analysis and compare these features with that in the maritime trade in order to understand the impact of the chosen exchange rate regime on bilateral maritime trade.

2.3.1 Trends, quantities and patterns in trade and multi-national companies

Demand is a major driver or determinant for bilateral trade and in order to boost demand, national per capita income followed by income distribution, politics, climate and historical background hold equal importance (Abrams, 1980).

It is generally noted that consumers with similar per capita incomes consume similar bundles of goods, and firms manufacture those goods according to the demand both in the domestic and international market whereas demand of the goods and products such as commodities depend upon the consumption expenditure and elasticity of demand. For example, USA, having the highest per capita income and high elasticity of demand has a 13 per cent personal consumption expenditure in comparison to India's 60% in the food sector (Markusen, 1986). In short, developed industrialized economies with similar factor endowments and capital labour ratios

interact in intra-industry trade while inter-industry trade is utilized in the case of developing nations through export of labour intensive resource based products and import of manufactured goods (Sawyer et al., 2010).

Research shows that low-income countries specialize in production and consumption of food while high-income countries specialize in production and consumption of manufactures and services (Markusen, 1986). And results in another research paper shows that higher levels of intra-industry trade is observed among developed nations such as Taiwan, Japan, South Korea and Singapore rather than in developing, low income nations such as Bangladesh and Turkmenistan (Sawyer et al., 2010).

However, China begs to differ. China's intra-industry trade with Japan based on electrical and machinery sectors accounted for 52% and 46% respectively and as such, in 2004, there was a boost of 34% of their annual trade, which was a little larger than 10% with respect to US; China-USA usually trading in food and chemical sector and in addition to that, China has been the one of the largest ICT importing and exporting countries with high tech exports doubling to $166 billion (28% of China's exports) plus $180 billion ICT products in 2004 surpassing economically advanced nations such as Japan, European Union and United states (Xing, 2007). And observing at the distance proximity, ocean barrier between China-Japan trade and China-USA trade and the volume of import and exports occurring annually, it can valuably be suggested that maritime sector has played a major role in being a major player in the transportation industry.

The same example on China can be seen from the other side of the mirror. Intra-industry trade can occur due to several reasons such as difference in products, market segmentation and pro-competition but if '*ceteris paribus'* is assumed keeping the size of the country as the only focus, manufacturers would definitely prefer to shift their production units into a bigger country size, where the potential for demand from a larger population will considerably be higher, so that transport costs can be reduced and fixed costs can be optimized thus earning maximum profit (Amiti, 1997). Yet, the above theory is completely undermined when the volume of cross-sea transport of electronic and high tech goods are observed in the 2004 example of cross trade between China-Japan and China-USA citing from the fact that ninety per cent of the world trade is carried out by sea.

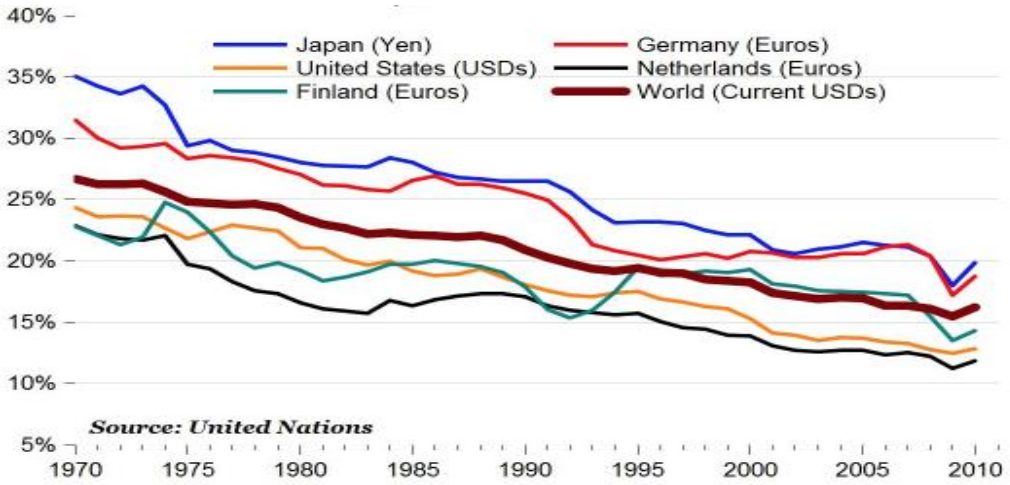

Figure 1: Manufacturing share of GDP current national currency units 1970 to 2010

Source: The Importance of Manufacturing and its Relationship to Tapering (http://viableopposition.blogspot.nl)

Another example to support the argument is the shift of manufacturing plant of Harley Davidson bikes into India. The company had decided to shift its manufacturing base in Haryana, India in order to provide two models – street 750 and street 500 to its local market and into Europe unlike its main manufacturing plant in Kansas, USA which would serve its local market (Patankar, 2013). Similarly, Mercedes Benz, a German car manufacturer, due to the pro-employment policies of the Government of India (GOI), has sought and received permission to install its second manufacturing plant in Pune, India so as to usher further localization of its new C-Class and S-class vehicles in order to exploit local consumerism (Thakkar, 2015). These recent developments can have a substantial impact in the maritime trade flows of pure car carriers and containers.

Multinational companies (MNCs) are separate entities that also govern the trend and pattern of trade across the globe. A simple trade off in the business environment governs multinationals companies: whether to expand into other nations via trade or approach towards foreign direct investments, and this actually distinguishes the trade-off of advantages between proximity to the market and economy of scale (Brianard, 1993). In short, multinational companies are a substitute for a market as method of organizing international exchange (Hymer, 1970).

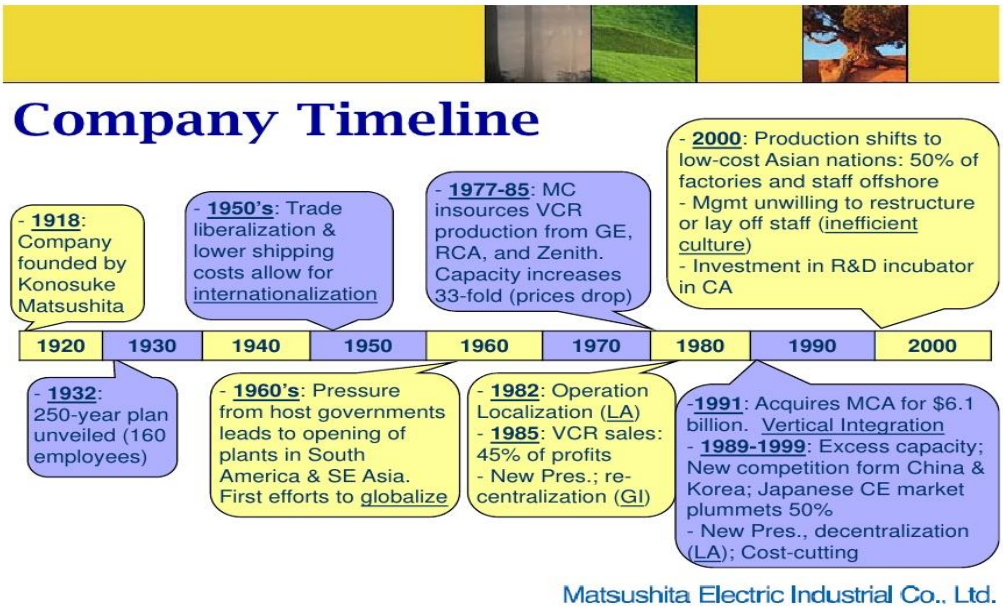

Figure 2: Company timeline 1920 to 2000

Source: Matsushita Electric Industrial Co., Ltd (Kedy, 2008)

The above illustration depicts such as trend, It is quite significant that a company which started almost a 100 years ago took the opportunity of trade liberalization and lower shipping cost leading to internationalization which further took them opening their manufacturing plants into different continents. Further, down the timeline, production shifts to low cost nations are observed in the new millennium followed by decentralization and cost cutting.

Foreign direct investment (FDI) is not a new phenomenon. MNCs and their FDIs' have been prevalent in the nineteenth century with western European firms such as Unilever, Nestle, Siemens, Phillips and imperial chemicals manufacturing their products in foreign nations until the advent of World War II, which broke the pattern, and the main emphasis began on exports of manufactured goods into developed and developing nations which soon lost vigour due to several trade barriers thus compelling the same firms to revert to setting manufacturing units and FDI in other nations (Dymsza, 1984).

Yet, plenty investors might forego long term investments for establishing or expanding foreign markets or exports facilities and establish lines of domestic chains to conduct business among the interstates within the country or among regional based countries in a free trade zone sharing a common currency such the Eurozone due to the following reasons. Exchange rate uncertainty may prove the long-term contracts to be unprofitable both for the exporter and importer, the fluctuations may instil massive speculation due to the fear of altered international price competitiveness and the increased variability in the expected earnings may reduce future investment prospects (Abrams, 1980).

A separate research paper evidences that pegging into a common currency or adopting a hard exchange rate regime with the main trading partner causes

reduction in international transaction costs and exchange rate risks thus promoting more frequent trade and greater business cycle synchronicity and also appears to insulate the partner countries from speculative bubbles that lead to temporary and unnecessary fluctuations in the real exchange rate yet none of the papers address the question of whether the impact of complete monetary union on macroeconomic integration is different from that of adoption of a hard peg, which is of a potential policy importance because certain countries find it prohibitively difficult to join a monetary union due to the administrative or political costs (Shields, 2007).

2.3.2 Unique elements of maritime trade flows vis-à-vis general trade flows

Globalization had opened gates for several cross-country trades among several cultures and borders. Interestingly, the gap to be bridged between the trading countries grew bigger and bigger which could be filled by the maritime sector (Verhetsel & Sel, 2009). Maritime trade flows is an exponential part of the overall international trade flows and patterns in the world. And as discussed earlier regarding international trade flow trends and patterns, the factors that can and have affected it, can have also affected the maritime trade may be in a manner of incentive or repercussion depressing the transport sector.

FDI had a major impact in the reorientation of the maritime and the logistics sector due to the policy change that brought forward new opportunities for MNCs to invest and labour to get employment. Approval of the Shenzhen special economic zone in the year 1980 brought in a wave of investment from Hong Kong into southern China along the Pearl River Delta which integrated Chinese Labour and resources with Hong Kong Investments thus paving an active logistical platform for goods to transhipped out of China to compete the global market and similarly massive foreign investments pour into China from neighbouring Taiwan and this reorientation helped to develop logistical functions along the coastal central China mostly concentrating on Shanghai followed by South Korea within the Yellow Sea Rim thus refurnishing a new port system (Lee & Rodrigue, 2006).

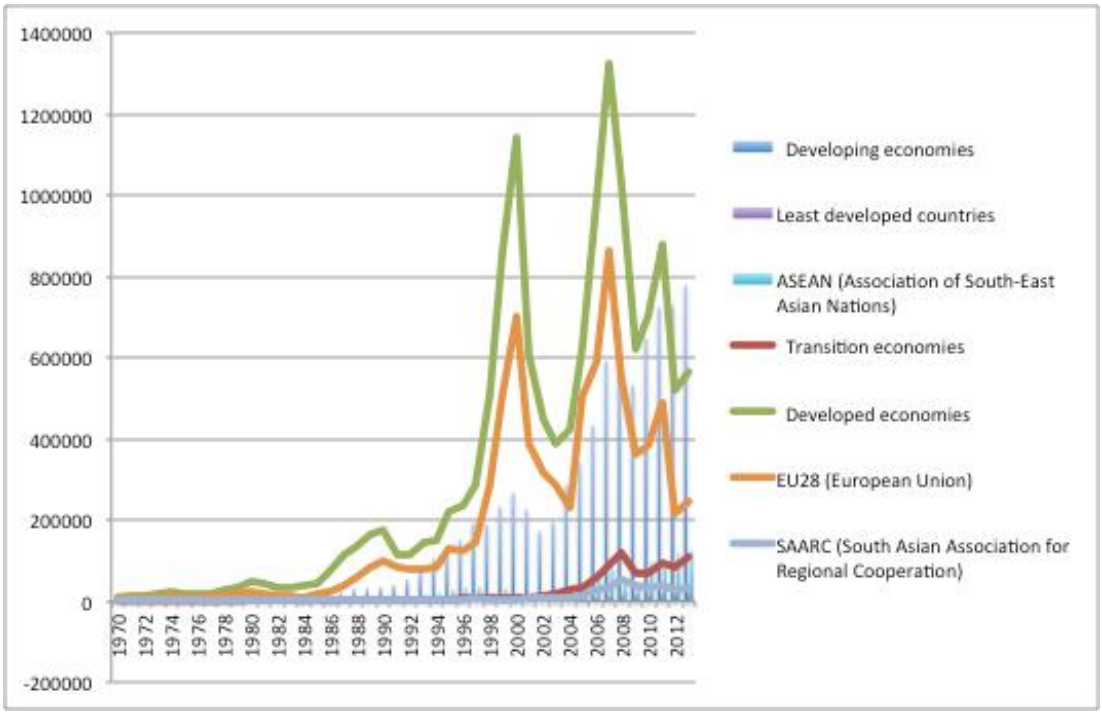

Figure 3: FDI outflows in million US dollars, 1970-2013

Source: Adapted by Author from Source (http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=89)

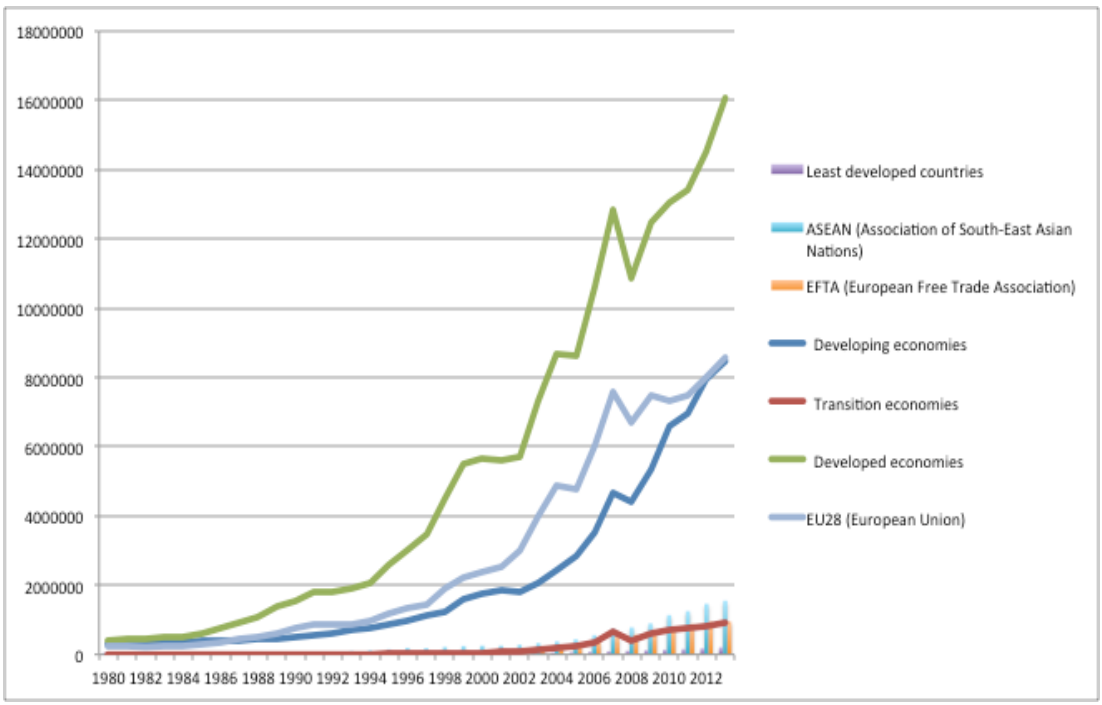

Figure 4: FDI inflows in million US dollars, 1980-2013

Source: Adapted by Author from Source
*(*http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=89*)*

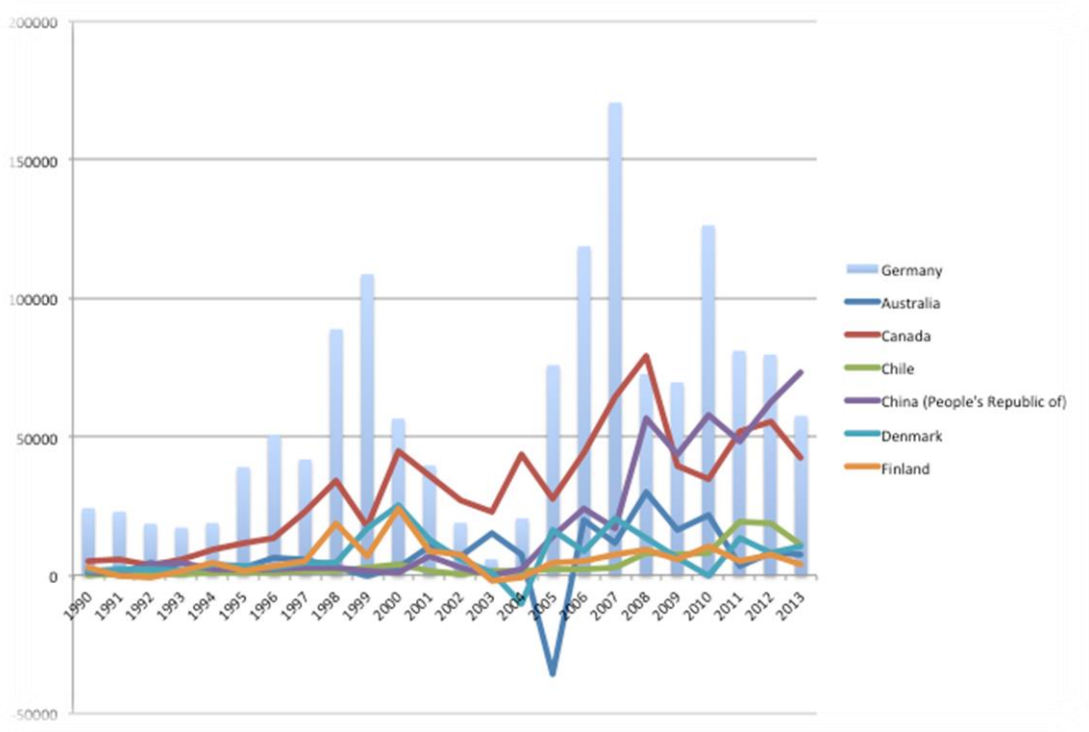

Figure 5: FDI outward flow in million US dollars, adapted by author from source

Source: Author via (https://data.oecd.org/fdi/fdi-flows.htm)

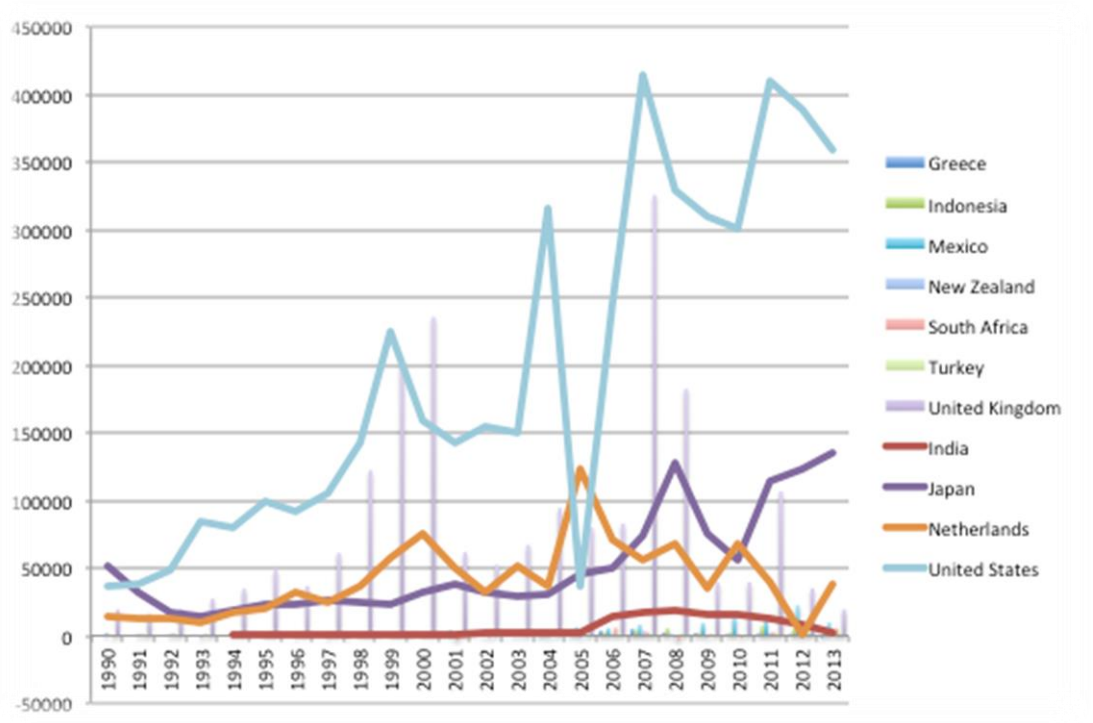

Figure 6: FDI outward flow in million US dollars, adapted by author from source

Source: Author via (https://data.oecd.org/fdi/fdi-flows.htm)

Shanghai has experienced a 10-year growth of 231% ranging from 14.557 million TEU in 2004 to 33.617 million TEU in 2014 where as Rotterdam grew 140% growth from 8.281 million TEU to 11.621 million TEU (International Association of Ports and Harbors, 2014). However, this new strategy of open free market has brought upon a severe logistical problem. According to a report, 60% of containers shipped from Asia to USA in 2005 returned empty at a considerable discounted price up to $400 or $500 per twenty-foot container in comparison to $1400 for a container carrying cargo in the return journey (Behrens & Picard, 2011). This can disrupt the current trade patterns and port throughputs.

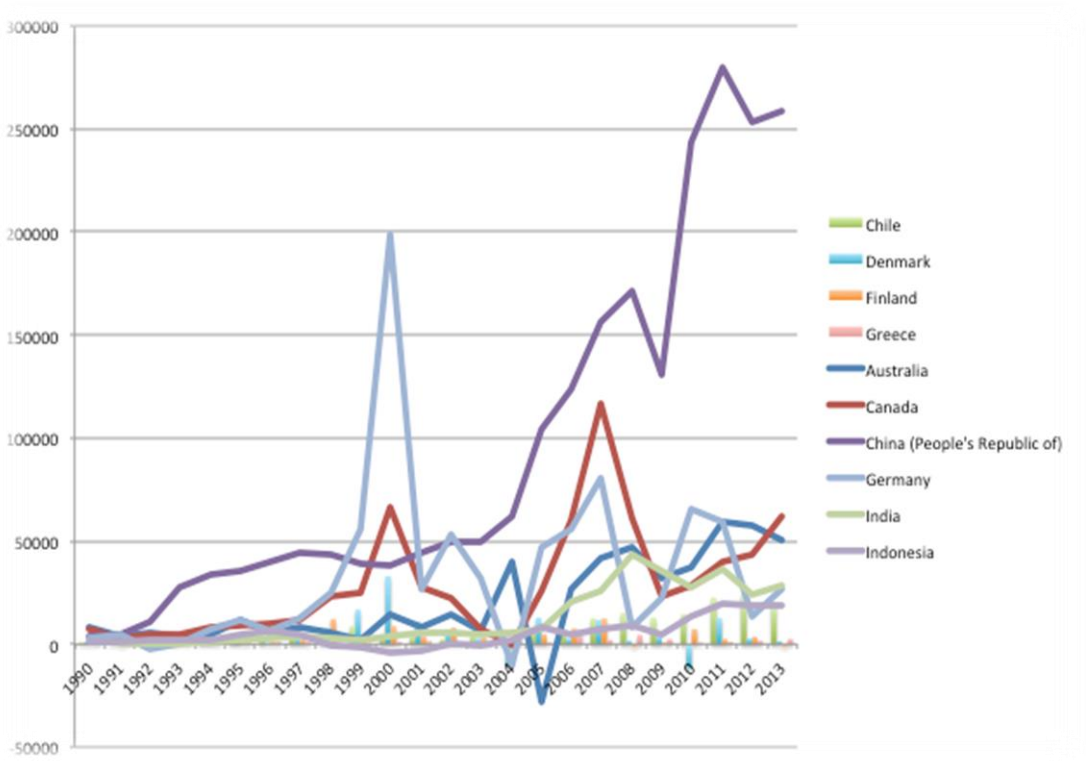

Figure 7: FDI inward flow in million US dollars, adapted by author from source

*Source: Author via source (https://data.oecd.org/fdi/fdi-flo**ws.htm)***

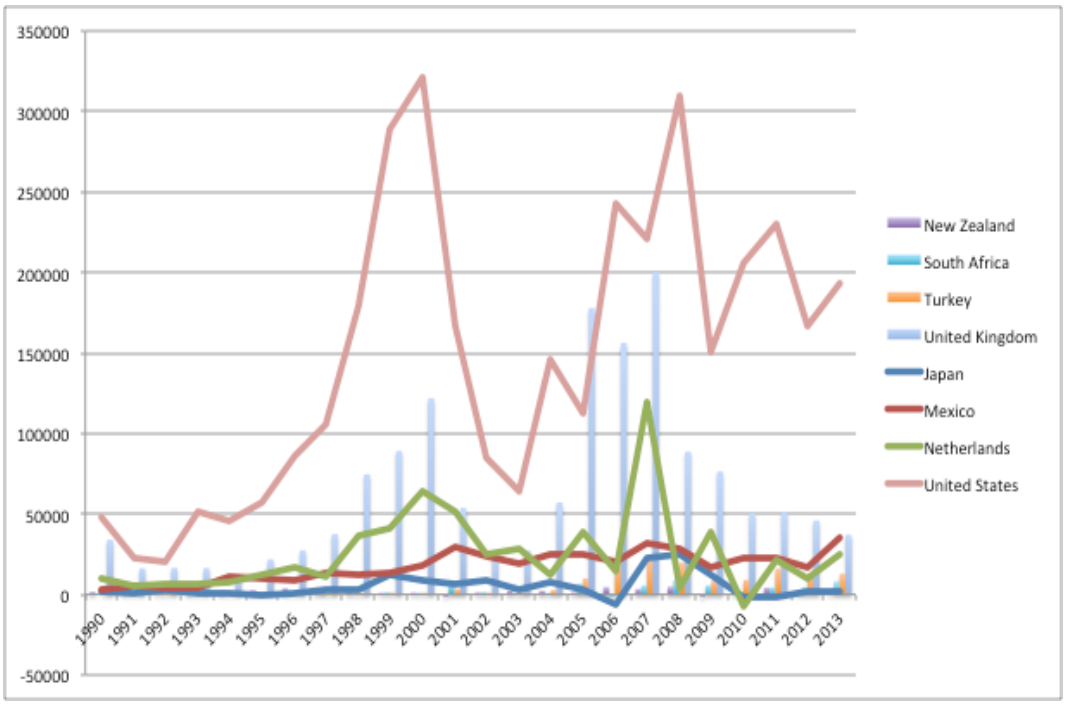

Figure 8: FDI inward flow in million US dollars, adapted by author from source

Source Author via source (https://data.oecd.org/fdi/fdi-flows.htm)

The current Obama administration understands the potential of China's financial and trading power and thus intends to bring forth Trans-Pacific Partnership (TPP) between nations such as Australia, New Zealand and Malaysia on the coast, west to the Pacific Ocean and USA, Chile and Peru on the coast east to the Pacific Ocean in order to accelerate trade and investment thus enhancing job creation, growth and development in all sectors including the maritime industry (US Trade Representative, 2011). The impact on the throughput of Shanghai port is yet unknown, which shall be left for future research.

Exchange rates fluctuations due to the policy measures adopted by the governments of the trading countries might also impact the maritime trade. A report suggests that the long run value of agricultural products is more sensitive to changes in exchange rate levels than in manufacturing in certain cases such as Euro Area's agricultural exports to the United States and US agricultural exports to China because for e.g., a 10% depreciation in the Euro leads to 21.8% increase in European Agricultural exports to US and 9.4% increase in manufacturing exports to US (Korinek, 2011). And, overall maritime transport costs, in the year 2007, represented for 10.3% ad valorem of the imported value of agricultural products (Sourdin, 2009).

3 Research methodology and data

In order to understand the effects of exchange rate regimes and exchange rate volatility on bilateral maritime trade flows, a quantitative analysis is necessary which can be undertaken through an econometric model thus determining the answer to the research carried out in this thesis. Statistical time series data will be used for analysis and gravity model shall assist in connecting such research question with the designated answer. This chapter shall introduce the model, its features and attributes, the reason for its choice, fallacies and rectifications and the variables that shall be applied in the model so as to reach the result.

3.1 Gravity analytical model

3.1.1 Salient Features of The Model

Gravity model, utilizes the concept of Sir Isaac Newton's gravitational force nature between the two attracting bodies separated by a distance to the amount of trade that occurs between two nations with gross domestic product (GDP) and separated by a distance.

Newton's law of gravity is defined as the following:

$$Fij = G\frac{MiMj}{Dij^2} \qquad \text{(Equation 1)}$$

Where: -

Fij is the gravitational attraction

Mi, Mj are the mass of two objects

Dij is the distance

G is the gravitational constant

Jan Tinbergen, a Dutch economist, had applied the gravity model in the year 1962, in which, the trade flow is shown as a dependent variable while GDP and geographical distance as independent variable and the result of the regression analysis has been used to interpret the impact of each independent variable on the dependent variable and this was further refined by Krugman and Obstfeld in 2005 as the following (Binh et al., 2011).

$$Tij = A\frac{YiYj}{Dij^2} \qquad \text{(Equation 2)}$$

Where: -

Tij = the total trade flow from country of origin which to country of destination j

YiYj = Economic size or GDP of two trading countries which and j

Dij = distance between two trading countries

A = constant term

The current thesis will utilize the expanded form of gravity model where trade flow as dependent and several independent variables shall be incorporated including GDP and geographical (nautical) distance. In order to understand the elasticity of each independent variable affecting the dependent variable, a log linearization is formulated. For example, keeping all other parameters constant, the formula below would be interpreted as follows.

$$lnT_{ijt} = = (0.73)GDP_i \quad \text{(Equation 3)}$$

The coefficient represents that for every unit change of GDP of the source country, the bilateral trade T would get affected by 0.73 times or by 73%. It means that if GDP of source country rises by a single unit, there would be 73% increase in bilateral trade.

$$lnT_{ijt} = \beta_0 + \beta_1(lnY_{it}) + \beta_2(lnY_{jt}) + \beta_3(lnD_{ij}) + \beta_4(FF_{ijt}) + \beta_5(MF_{ijt}) + \beta_6(FR_{ijt}) + \beta_7(BORD_{ij}) + \beta_8(CULT_{ij}) + \beta_9(LANG_{ij}) + \beta_{10}(V_{ijt}) + \varepsilon_{ijt}$$
(Equation 4)

$$lnMT_{ijt} = \beta_0 + \beta_1(lnY_{it}) + \beta_2(lnY_{jt}) + \beta_3(lnD_{ij}) + \beta_4(FF_{ijt}) + \beta_5(MF_{ijt}) + \beta_6(FR_{ijt}) + \beta_7(BORD_{ij}) + \beta_8(CULT_{ij}) + \beta_9(LANG_{ij}) + \beta_{10}(V_{ijt}) + \varepsilon_{ijt} \quad \text{(Equation 5)}$$

Where:

which = 1,2,3,…..25, 26,27 (country of origin)

j = 1, 2, 3, 4,.....25, 26, 27 (country of destination)

t = 1992, 1993, 1994,..., 2011, 2012, 2013

lnT_{ijt} : Natural logarithm of trade flow value from country which trade with country j in year t in USD

$lnMT_{ijt}$: Natural logarithm of the maritime trade flow value from country which trade with country j in year t in USD

lnY_{it} : Natural logarithm of Country which nominal GDP in year t

lnY_{jt} : Natural logarithm of country j nominal GDP in year t

LnD_{ij}: Natural logarithm of distance in nautical miles between country which and country j

FF_{ij}: Free float exchange rate regime dummy variable between country which and country j

MF_{ij}: Managed float exchange rate regime dummy variable between country which and country j

FR_{ij}: Fixed exchange rate regime dummy variable between country which and country j

$BORD_{ij}$: Border sharing dummy variable between country which and country j

$CULT_{ij}$: Cultural commonality dummy variable between country which and country j

$LANG_{ij}$: Language sharing dummy variable between country which and country j

V_{ijt} : Exchange rate volatility

ε_{ijt} : Nominally distributed random error term

3.1.2 Reason for choosing the gravity model as the core method

Gravity model will be used for researching the main research question in this thesis.

In order to support the reason for its choice, further research has been carried out. Hausman (2005) describes that bilateral trade has significantly been mentioned by several authors such as McCallum (1995); Helliwell (1998); Frankel, Stein, and Wei (1998); Feenstra, Markusen, and Rose (2001); Limão and Venables (2001); Clark, Dollar, and Micco (2004); Nordås and Piermartini (2004); and de Groot and others (2004) who, in their individuals papers, have researched on various factors such as McCallum (1995) on North Atlantic free trade agreement (NAFTA) and trade arrangements between USA and Canada, and Limão and Venables (2001) and Clark, Dollar, and Micco (2004) on transport costs and distance that affects bilateral trade. In addition to that, Hummels (2001) uses the Gravity model in order to explicitly write about shipping distance and time taken to cover that distance and about de Groot and others (2004) who have made an extensive use of Gravity model, which include dummy variables such as common border, common language, common trade area and common religion.

Radman (2003) used the gravity model to investigate the trade flow between Bangladesh and its major trading partners and found that trade of Bangladesh is determined by the size of economy, distance and willingness to trade while Blomquist (2004) found that gravity model explains the significance of impact on trade flow of Singapore due to attributes such as GDP and distance (Do, 2006).

Giovanni Dell Ariccia (Ariccia, 1998) took up the opportunity to research on the effect on bilateral trade flows that tend to get affected by exchange rate fluctuations. But, this paper has chosen to focus on intra-European trade only where the change of behaviour of the central bank is mentioned as country fixed effect and the goal was to determine the effect on Eurozone converting the individual currencies of European countries under a single wing, Euro.

The goal of this thesis is to determine effect of chosen exchange rate regime and exchange rate volatility affects bilateral maritime trade flows on a global scale. Since, gravity model, has been used in so many research papers, it is intended that the same model be pursued for carrying out this research.

3.1.3 Methodological challenges in the gravity approach

One of the limitations regarding gravity model has been cited as its trade estimation in terms of gross value thus ignoring the import content in its exports, which remain

different for different nations (GUILHOTO et al., 2015). Gravity model also fails to address the problem of substitution between trade flows caused due to economic effects such as economic integration and plausible disintegration. An example is cited where countries such as Estonia, after its integration, into EU should lead to increase in wood import but the model fails to address the trade diversion caused due to the integration such as the potential decline of wood imports into other EU nations (Bikker, 2009). The challenge that has been most concerning in the gravity model is how to deal with the zero-values in the model. The zeroes might have been created due to the absence of trade or other relevant value in the model or due to the limit set in the value below or above which the value, if stays outside the range, would be deemed as zero and logarithm value of zero is undefined which can create a substantial error in the gravity model (Benedictis & Salvatici, 2011).

3.1.4 Model alterations applied to address the above mentioned challenges

Introducing a new dummy variable known as the country and time fixed effects has carried out the trade diversion rectification. This method will bring a binary number (1 or 0) depending upon whether the assigned entity (Country and year) matches the column or not.

The other concerned problem has been widely discussed and a couple of probable solutions have been explored. Certain possibilities such as ignoring the zeroes, replacing them with small positive trade flows, use of Torbit estimator considering that the problem is not due to omission but truncation or censored data or the utilization of the Heckman 2-stages least squared estimation of which the latest method is most preferable due to the reasons such as the first and the second method would lead to inconsistent estimation and the third method would be valid if and only if the truncated value is known (Benedictis & Salvatici, 2011). Heckman 2 stages least squared estimation is a two equation context wherein, the first equation represents the behaviour of interest and the second equation represents whether the observations have a non-zero value or not but yet, it fails to address the problem of logarithm for a zero value thus leading to large biases caused by the heteroscedasticity which leads to an alternative approach to Poisson-Pseudo Maximum Likelihood (PPML) estimator as suggested by Santos Silva and Tenreyo (Martin & Pham, 2008) for solving the problems caused due to the value zero. A further simulation was carried out which confirms the concept that PPML has very little biasness and better behaved even though the proportion of zero values in the sample is large (Silva & Tenreyro, 2011). This thesis has undertaken both OLS and PPML regressions. The OLS regressions are used to understand the parameters in the gravity model and the PPML serves the purpose of making the distinction between ‘zero’ values and no data values. Further regressions were carried out in both OLS and PPML so as to understand the coefficients that will affect bilateral maritime trade as the dependent variable instead of the overall maritime trade.

3.2 Data

3.2.1 Gravity Model Data

Traditionally, gravity model has been used to understand the impact of individual independent variables upon the dependent variables; the dependent variable being

the trade flow between countries and the independent variables being the economic factors between countries such as GDP, exchange rates and geographical factors such as distance. The bilateral trade flow has been revised as the sum of the exports and the imports between the trading nations measured in a year.

Nominal GDP of individual source and destination countries engaged in bilateral trade. This data has been taken from World Bank website for 27 countries over a period from 1992 until 2013. Data for mutual exchange rates between trading countries over the same period has been taken from UNCTAD alone.

The data for nautical distance between the nations engaged in maritime trade has been generated by selecting the port that adds significant value to the economy of the individual country, examples being, Rotterdam for Netherlands, Hamburg for Germany, Ulsan for Republic of Korea and Dubai for UAE. The spread of the country and the geographical location of the ports have been taken into consideration in order to understand, analyse and note down the economical distance a ship would travel. For example, a ship carrying goods, travelling from Republic of Korea to USA would depart from Ulsan and head east into the Pacific Ocean and reach San Francisco, USA west coast but a ship departing from Rotterdam would head for Baltimore, US east coast, after crossing the Atlantic Ocean. Similarly, goods heading for India from China would normally utilise the port of Hong Kong as departure and Port of Chennai as destination for the respective countries but goods travelling from China to Japan would depart from Shanghai to Tokyo.

Dummy variables of free float, managed float and fixed exchange rate regimes in which the bilateral trading countries fall into and analysis of the result found in it as a significance in these variables would determine which country would fall in which category over the time period and how will the chosen exchange rate regime affect the maritime trade between the nations. This, being a dummy variable data, has been generated through extensive studying about each chosen country's preference of exchange rate regime from 1992 until 2013. This generated data shall also help to understand the exchange rate volatility bilateral maritime trading countries would have encountered during the era thus answering the second part of the main research question.

Binary data for country and time fixed effects of each bilateral maritime trading country has been generated depending upon whether the assigned name of country and year matches the column for country source, country destination and year or not.

The dummy variables for culture, border and language the bilateral trading countries share have been generated through extensive research on each individual country in order to understand the attributes, such as culture and language sharing through web browsing, articles, journals and personal interviews while Google maps allowed to understand and the analyse the border sharing between bilateral trading nations.

Exchange rate volatility: Deriving a consistent measure for exchange rate volatility has been widely discussed in many papers. Many techniques have been employed to find out the correct measure of volatility. A research paper employed a couple of methods of calculating this volatility such as absolute values of quarterly percentage

change in exporting nations' effective exchange rates and logarithm of the eight quarter moving standard deviation of real effective exchange rate (Hondroyiannis et al., 2008). Another research paper has used the autoregressive distributed lag model for estimating the impact of volatility (Huchet-Bourdon & Korinek, 2011).

Yet, there is no clear or right or wrong method of calculating exchange rate volatility although standard deviation of moving average of logarithm of exchange rates is used for calculation (Serenis & Tsounis, 2012). Hence, this research paper has employed 6 techniques to estimate the volatility impact on trade. The methods are as follows:

- Volatility of 3-year Moving Average of logarithm of exchange rate – 3 year moving average of logarithmic value of bilateral mutual exchange rates are calculated and the volatility is measured as follows:
  $V_{ijt} = (\ln E_n - \ln E_{n-1})/E_{n-1}$ where;

  V_{ijt} = Exchange rate Volatility
  $\ln E_n$ = Logarithm of 3 year moving average of exchange rates including current year
  $\ln E_{n-1}$= Logarithm of 3 year moving average of exchange rates starting from previous year
- Currency appreciation: It is to observe in which periods does the exchange rate volatility is positive in nature. A positive sign on change in volatility between two 3-year moving average of logarithm of exchange rate would signify currency appreciation.
- Currency Depreciation: A negative sign on change in volatility between two 3-year moving average of logarithm of exchange rate would signify currency depreciation.
- Standard deviation of 3-year moving average of exchange rate: A standard deviation of three year moving of exchange rates is calculated.
- Standard deviation of 3-year moving average of 3-year moving average of logarithmic exchange rate: As the name suggests
- Standard deviation of 3-year moving average of logarithm of exchange rate

3.2.2 Value Addition for Analysis

Trade flows, the dependent variable in the gravity model, were taken from the UNCTAD and OECD data. This provides the best available dataset of cross-country comparable data. We also faced some challenges, however. Certain countries in the OECD and other major and minor groups have bilateral trade values missing in certain ranges or years, which may cause biases in the model, depending on the econometric specification. In order to restrict the model from displaying those results, the bilateral trade flow data has been scaled down into a range of year from 1992 to 2013 with 27 countries, representing same, different or no groups such as OECD, OAPEC, BRICS and other trading nations. This is intentional in order to make the thesis more coherent.

Selection Criteria	Countries
Organization of economic cooperation and development OECD	Australia, Canada, Chile, Denmark, Germany, Greece, Israel, Japan, Mexico, Netherlands, New Zealand, Turkey, United Kingdom (UK), United States of America (USA)
Organization of Arab Petroleum Exporting Countries OAPEC	Egypt, UAE, Iran, Tunisia
BRICS	Brazil, India, China, South Africa
African Community	Congo, Nigeria
Other Nations	Ecuador, Indonesia, Singapore

Table 1: Summary of selection criteria for chosen bilateral trading nations

Source: Author

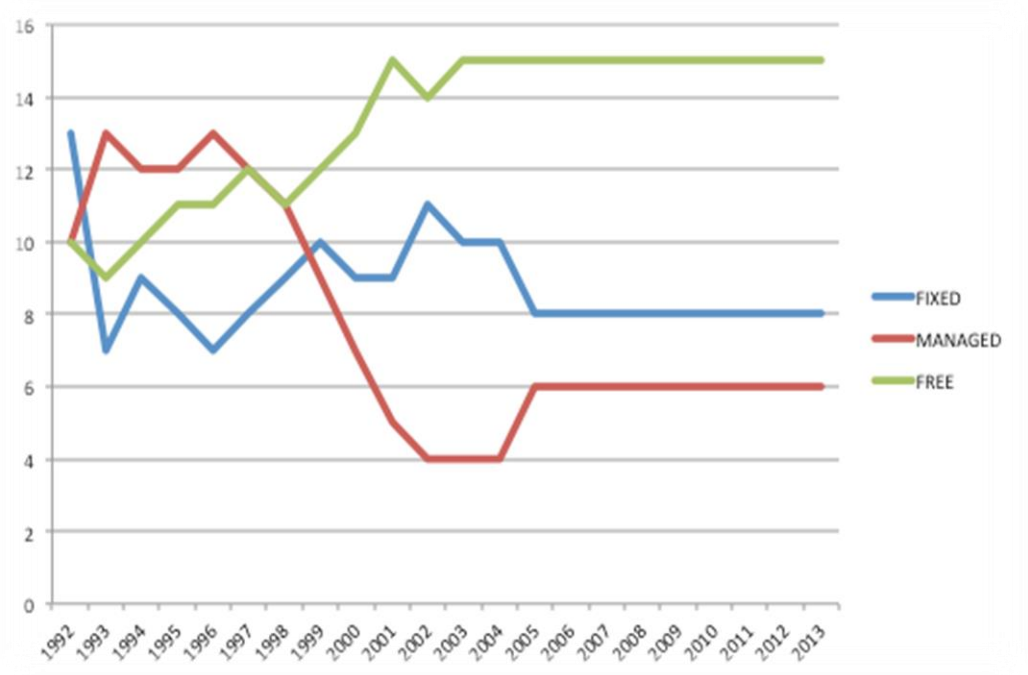

Figure 9: Number of countries and their respective exchange rate regimes

(Refer Table No. 7)

Source: Author

4 Results and data analysis

4.1 Gravity model Results

This thesis focuses on examining the effect of exchange rate regimes and exchange rate volatility on bilateral maritime trade. Gravity regression specification, data collection and compilation and running the regressions have been carried out. In Table 2 and Table 3 below, we present the results.

Variable	1	2	3	4	5	6	7	8	9(a)
GDP Source (i)	0.95*** (0.00)	0.78*** (0.00)	0.74*** (0.00)	0.78*** (0.00)	0.74*** (0.00)	0.73*** (0.00)	0.72*** (0.00)	0.75*** (0.00)	0.75*** (0.00)
GDP Destination (j)	0.95*** (0.00)	0.78*** (0.00)	0.75*** (0.00)	0.78*** (0.00)	0.76*** (0.00)	0.74*** (0.00)	0.73*** (0.00)	0.76*** (0.00)	0.72*** (0.00)
Nautical Distance	-0.81*** (0.00)	-1.05*** (0.00)	-0.63*** (0.00)	-0.99*** (0.00)	-0.62*** (0.00)	-0.60*** (0.00)	-0.63*** (0.00)	-0.61*** (0.00)	-0.61*** (0.00)
Free Float	-0.48*** (0.00)	0.12*** (0.00)	-0.29*** (0.00)	-	-	-0.08*** (0.00)	-	-	-
Managed Float	-	-	-0.33*** (0.00)	-0.12*** (0.00)	-0.07** (0.04)	-	-0.17*** (0.00)	-	-
Fixed Regime	-0.19*** (0.00)	0.09*** (0.00)	-	0.00 (0.83)	-0.39*** (0.00)	-	-	0.43*** (0.00)	-
Border	-0.36*** (0.00)	-0.45*** (0.00)	1.01*** (0.00)	-1.03*** (0.00)	0.46*** (0.00)	0.44*** (0.00)	0.38*** (0.00)	0.48*** (0.00)	0.37*** (0.00)
Culture	-0.09* (0.09)	-0.37*** (0.00)	-0.18*** (0.00)	-0.43*** (0.00)	-0.25*** (0.00)	-0.26*** (0.00)	-0.27*** (0.00)	-0.24*** (0.00)	-0.27*** (0.00)
Language	0.68*** (0.00)	0.17*** (0.00)	-0.018 (0.50)	0.09*** (0.00)	-0.16*** (0.00)	-0.19*** (0.00)	-0.19*** (0.00)	-0.16*** (0.00)	-0.20*** (0.00)
Exchange rate volatility	-	-	-	-	-	-	-	-	0.00 (0.423)
Constant	-29.87 (0.00)	-18.73 (0.00)	-19.72 (0.000)	-19.14 (0.00)	-20.74 (0.00)	-18.82 (0.00)	-18.82 (0.00)	-20.89 (0.00)	-18.31 (0.00)
R-Square	0.76	0.84	0.94	0.83	0.90	0.90	0.90	0.91	0.91
DW Coefficient	1.70	1.98	2.04	1.99	2.09	2.09	2.09	2.09	2.09
N	15216	15216	15372	15212	15342	15374	15374	15374	13259

Table 2: Impact of exchange rate regimes on maritime trade – gravity results

Source: Author

Variable	1	2	3	4	5	6	7	8	9(a)
GDP Source (i)	0.95*** (0.00)	0.78*** (0.00)	0.74*** (0.00)	0.78*** (0.00)	0.74*** (0.00)	0.73*** (0.00)	0.72*** (0.00)	0.75*** (0.00)	0.75*** (0.00)
GDP Destination (j)	0.95*** (0.00)	0.78*** (0.00)	0.75*** (0.00)	0.78*** (0.00)	0.76*** (0.00)	0.74*** (0.00)	0.73*** (0.00)	0.76*** (0.00)	0.72*** (0.00)
Nautical Distance	-0.81*** (0.00)	-1.05*** (0.00)	-0.63*** (0.00)	-0.99*** (0.00)	-0.62*** (0.00)	-0.60*** (0.00)	-0.63*** (0.00)	-0.61*** (0.00)	-0.61*** (0.00)
Free Float	-0.48*** (0.00)	0.12*** (0.00)	-0.29*** (0.00)	-	-	-0.08*** (0.00)	-	-	-
Managed Float	-	-	-0.33*** (0.00)	-0.12*** (0.00)	-0.07** (0.04)	-	-0.17*** (0.00)	-	-
Fixed Regime	-0.19*** (0.00)	0.09*** (0.00)	-	0.00 (0.83)	-0.39*** (0.00)	-	-	0.43*** (0.00)	-
Border	-0.36*** (0.00)	-0.45*** (0.00)	1.01*** (0.00)	-1.03*** (0.00)	0.46*** (0.00)	0.44*** (0.00)	0.38*** (0.00)	0.48*** (0.00)	0.37*** (0.00)
Culture	-0.09* (0.09)	-0.37*** (0.00)	-0.18*** (0.00)	-0.43*** (0.00)	-0.25*** (0.00)	-0.26*** (0.00)	-0.27*** (0.00)	-0.24*** (0.00)	-0.27*** (0.00)
Language	0.68*** (0.00)	0.17*** (0.00)	-0.018 (0.50)	0.09*** (0.00)	-0.16*** (0.00)	-0.19*** (0.00)	-0.19*** (0.00)	-0.16*** (0.00)	-0.20*** (0.00)
Exchange rate volatility	-	-	-	-	-	-	-	-	0.00 (0.423)
Constant	-29.87 (0.00)	-18.73 (0.00)	-19.72 (0.000)	-19.14 (0.00)	-20.74 (0.00)	-18.82 (0.00)	-18.82 (0.00)	-20.89 (0.00)	-18.31 (0.00)
R-Square	0.76	0.84	0.94	0.83	0.90	0.90	0.90	0.91	0.91
DW Coefficient	1.70	1.98	2.04	1.99	2.09	2.09	2.09	2.09	2.09
N	15216	15216	15372	15212	15342	15374	15374	15374	13259

Table 3: Impact of exchange rate volatility on maritime trade – gravity results
Source: Author

Looking at the impact of exchange rate regimes and exchange rate volatility on maritime trade flows – the goal of this thesis – with the use of a gravity model, implies that we have to search for the best regression equation to estimate this impact. The equations (1) until (9f) represent that search.

Exchange rate regimes

We started off by looking at a simple gravity regression in OLS without country fixed effects (CFE) and time fixed effects (TFE). In this regression, we included the traditional gravity variables GDPi, GDPj, Nautical distance, the traditional gravity control variables (common language, common border, and common culture) as well as the three dummy variables we are investigating: free float, managed float and

fixed exchange rates. These independent variables are regressed on the dependent variable 'total trade' (in specifications, (1), (2) and (3)). The results are presented in column (1). We find that both GDP origin and GDP destination affect trade positively with a high significance, that is, for every one per cent increase in GDP of origin and GDP of destination country, bilateral trade increases by 0.95 per cent. Nautical distance has a negative impact on bilateral maritime trade. For every one per cent increase in distance, the estimated fall in bilateral trade is 0.81 per cent.

The regression results report only two out of the three exchange rate regimes, not all three. It is interesting to shortly explain why this is the case. Countries chosen in the regression either are under a fixed regime, a managed float or a free float regime and their interaction leads to only one of the three exchange rate regimes (Refer Table 6). So, when we have two variables in the regression equation, the third one is always automatically determined because the summation of the three regimes is always equal to one (that is: there is no country with two regimes at the same time as shown in Table 4). This leads to the dropping of one of the three exchange rate regimes without losing information.

Source	Destination	Free Float	Managed Float	Fixed Float	Final
AUSTRALIA	GERMANY	1	0	0	1
AUSTRALIA	GREECE	1	0	0	1
AUSTRALIA	INDIA	0	1	0	1
AUSTRALIA	INDONESIA	0	1	0	1
AUSTRALIA	IRAN	1	0	0	1
AUSTRALIA	ISRAEL	1	0	0	1
AUSTRALIA	JAPAN	1	0	0	1
AUSTRALIA	MEXICO	0	0	1	1
AUSTRALIA	NETHERLANDS	1	0	0	1
AUSTRALIA	NEW ZEALAND	1	0	0	1

Table 4: Exchange rate regimes under country interactions

Source: Author

In specification (1), we find a medium relationship between the dependent and independent variables through the medium of coefficient of determination, R-squared that is 76%. We also note that the Durbin Watson (DW) coefficient is rather low. This suggests that there is a degree of serial correlation involved. Hence we need to investigate and improve the regression specification.

The first step to improve upon column (1) is to add country fixed effects (CFE) and time fixed effects (TFE) for each country and year in the dataset. Column (2) reports those results. We see that in table 2 and table 3. When we compare this to column (1), we note that the positive coefficient for the size of the market for origin and destination countries is now 0.78 while the negative impact of nautical distance has increased to -/- 1.05. Interestingly, there is a change in sign for both the exchange rate regimes. The coefficient for free float changes from -48% to 12% while that of fixed regime changes from -19% to 9%. The coefficient of determination goes up to 84% and the Durbin-Watson coefficient moves up to 1.98, which suggests that running the OLS regression including CFE and TFE is a better specification.

Adding CFE and TFE improves the specification because they capture specific factors for individual countries and years (country- and year-specifics) that are in (1) captured in part by the other variables, leading to a misspecification in (1). Hence, (2) is therefore a better specification than (1). This also becomes clear when we look at the DW coefficient – it goes up from 1.70 (borderline value for serial correlation) to 1.98, clearly indicating there is no serial correlation.

In the third column, we address another issue raised with the gravity approach: the zero-value problem. If we use the Ordinary Least Squares (OLS) specification, the regression run automatically drops all zero-values. This is a problem, because there is an important difference between – for example – no maritime trade and a zero maritime trade flow. In the first case the data should be dropped from the regression, but in the second case it should not. There is indeed no maritime trade between – for example – Czech Republic and Slovakia (i.e. the maritime trade flow is zero). This bilateral trade pair should remain in the equation with a zero-trade value. That is different from the fact that we do not know the value of trade between Ecuador and the United Arab Emirates in 1992. That is why specification (3) does not use OLS, but instead PPML as the specification. It is clear immediately that this has an impact because the number of observation in specification (2) is 15216 and now in specification (3) is 15372. Because we can now make a distinction between real 'zero' values and 'no data', specification (3) is considered more accurate than specification (2). When comparing specifications (2) and (3) with other literature on gravity work (e.g. (Bergstrand & Egger, 2007) (Bergstrand et al., 2008) (Bergstrand & Baier, 2006)) we can conclude that the outcomes are consistent.

For total trade, specification (3) is the most accurate. We recall, however, that the goal of this thesis is to look at maritime trade flows, not at total trade flows.

So column (4) uses exactly the same specification as the validated column (2) with one difference: the dependent variable is changed from total trade flows to maritime trade flows. When we compare the outcomes between columns (2) and (4) we see that column (4) run has dropped free exchange rate regime and introduced managed exchange rate regime. The coefficient of determination has increased significantly to 90% from 84%. The DW coefficient remains well within its limits, suggesting that there is no serial correlation. Column (5) uses the exact same specification as column (3) but not with an OLS but a PPML regression. Comparing the results of columns (3) and (5), we find that there is no significant change in GDP origin, destination and nautical distance. But, similar to column (4), column (5), under PPML, has dropped free exchange rate regime keeping managed regime at a value far lower than in column (3) although its significance has changed from 1% to 5%.

In column (5) we look at the effects of the different exchange rate regimes in one regression. As discussed, we split the exchange rate regimes into fixed, managed and free floating regimes because this gives a clear indication of the direct effect of the exchange rate regime on maritime trade flows – one of the two goals of this thesis.

When in specifications (6), (7) and (8), we run the gravity regressions with each of the exchange rate systems separately, we see that the different exchange rate

regimes have – statistically significant – but opposite effects on maritime trade. A fixed exchange rate regime, so we show, has had a positive effect on bilateral maritime trade flows, while the managed and free-floating regimes have had negative effects. In terms of the size of the effect, the coefficient for the fixed exchange rate regime (with a coefficient value of 0.43) is much higher (by a factor 3) than the estimated negative size effects of free float (-0.08) or managed float (-0.17). This implies that relatively speaking the very stable fixed exchange rate regimes are most strongly affecting maritime trade flow volumes – and in a positive way. This is an interesting find.

Exchange rate volatility

Finally, we turn to looking at the impact of exchange rate volatility – i.e. the swings in exchange rates up or down – on maritime trade flows – as is the second part of the research question of this thesis. Exchange rate volatility can be measured in different ways. In order to generate robust results, we have decided to run all six different measures of exchange rate volatility in the gravity specifications:

1. Volatility moving average
2. Currency appreciation
3. Currency depreciation
4. Moving Standard Deviation
5. Standard deviation of moving average
6. Log standard deviation of moving average

For that, we replace the exchange rate systems dummy variables with the measures for exchange rate volatility. We use the PPML estimator and other specifications (including CFE and TFE) as done in columns (5) to (8). The results of these runs are presented in columns (9a) to (9f) in Table 3.

These results show that exchange rate volatility has no significant impact on bilateral maritime trade flows. Each of the runs was carried out for each calculated exchange rate volatility measure as specified in Chapter 3. It is quite interesting to know that none of the calculated exchange rate volatility variables show any significant impact on bilateral maritime trade flows. All the coefficients of determination show an equivocal strength in the range of 90-94% and the valued for the DW test show there is no serial correlation.

The reason for the exchange rate volatility not having any impact on bilateral maritime trade might be because the policy of a country to devaluate their currency in order to boost their exports has a behavioural effect on other nations which either follow the same pursuit or choose a different strategy to counter such measures such as trade barriers thus compensating for the shocks that tend to generate due to the volatility. Also, the calculation has been done in a long run where there might be short run cases of volatility impact on bilateral maritime trade but due to these counter measures, the effect either minimized to an extent that the impact of volatility is not observed.

4.2 Country and time fixed effects

Variable	1	2	3	4	5	6	7	8	9(a)
CFE AUSTRALIA	-	0.00 (0.94)	0.01 (0.89)	-0.01 (0.87)	0.07 (0.37)	0.00 (0.91)	-0.02 (0.84)	0.08 (0.32)	0.12 (0.41)
CFE BRAZIL	-	-0.3*** (0.00)	-0.53*** (0.00)	-0.35*** (0.00)	-0.53*** (0.00)	-0.62*** (0.00)	-0.62*** (0.00)	-0.53*** (0.00)	-0.47*** (0.00)
CFE CANADA	-	-0.53*** (0.00)	-0.05 (0.43)	-0.52*** (0.00)	-0.08 (0.23)	-0.11 (0.13)	0.13* (0.07)	-0.08 (0.26)	0.03 (0.86)
CFE CHILE	-	-0.05 (0.696)	0.17 (0.165)	-0.02 (0.89)	0.17 (0.19)	0.05 (0.68)	0.02 (0.86)	0.17 (0.17)	0.15 (0.21)
CFE CHINA,HK	-	0.71*** (0.00)	0.43*** (0.00)	0.70*** (0.00)	0.49*** (0.00)	0.34*** (0.00)	0.51*** (0.00)	0.45*** (0.00)	0.57*** (0.00)
CFE CONGO	-	-1.12*** (0.00)	-0.18 (0.35)	-1.16*** (0.00)	-0.21 (0.35)	-0.09 (0.64)	-0.15 (0.46)	-0.21 (0.30)	-
CFE DENMARK	-	-0.62*** (0.00)	-1.36 (0.00)	-0.71*** (0.00)	-1.49*** (0.00)	-1.36*** (0.00)	-1.37*** (0.00)	-1.50*** (0.00)	-1.22*** (0.00)
CFE ECUADOR		-1.50*** (0.00)	-0.79*** (0.00)	-1.58*** (0.00)	-0.89*** (0.00)	-0.72*** (0.000)	-0.76*** (0.00)	-0.89*** (0.00)	-0.61*** (0.00)
CFE EGYPT	-	-1.29*** (0.00)	-1.12*** (0.00)	-1.33*** (0.00)	-1.07*** (0.00)	-1.09*** (0.000)	-1.14*** (0.00)	-1.06*** (0.00)	-0.99*** (0.00)
CFE GERMANY		0.35*** (0.00)	-0.24*** (0.00)	0.24*** (0.00)	-0.35*** (0.00)	-0.14** (0.01)	-0.14*** (0.00)	-0.35*** (0.00)	0.08*** (0.67)
CFE GREECE	-	-1.25*** (0.00)	-1.35*** (0.00)	-1.23*** (0.00)	-1.35*** (0.00)	-1.23*** (0.00)	-1.23*** (0.000)	-1.35*** (0.00)	-1.11*** (0.00)
CFE INDIA		-0.03 (0.77)	-0.478*** (0.00)	0.02 (0.85)	-0.19** (0.04)	-0.33*** (0.00)	-0.20** (0.03)	-0.2** (0.01)	-0.12 (0.45)
CFE INDONESIA	-	-0.06 (0.54)	0.02 (0.82)	0.06 (0.56)	0.08 (0.41)	0.00 (0.93)	-0.02 (0.76)	0.09 (0.38)	0.10 (0.49)
CFE IRAN	**-**	**-0.87*** (0.00)**	**-0.33*** (0.00)**	**-0.90*** (0.00)**	**-0.33*** (0.00)**	**-0.41*** (0.00)**	**-0.44*** (0.00)**	**-0.35*** (0.00)**	**-0.30** (0.02)**
CFE ISRAEL	-	-0.88*** (0.00)	-0.05 (0.62)	-0.94*** (0.00)	0.00 (1.0)	-0.14 (0.25)	-0.16 (0.21)	-0.01 (0.93)	-0.05 (0.69)
CFE JAPAN	-	0.11*** (0.00)	-0.16*** (0.00)	0.06 (0.29)	-0.18*** (0.00)	-0.23*** (0.00)	-0.25*** (0.00)	-0.17*** (0.00)	-0.07 (0.74)
CFE MEXICO	-	-1.11*** (0.00)	-0.31*** (0.00)	-1.13*** (0.00)	-0.15* (0.05)	-0.21*** (0.00)	-0.23*** (0.00)	-0.14*** (0.00)	-0.04 (0.79)
CFE NETHERLANDS	-	-0.47*** (0.00)	-0.27*** (0.001)	0.40*** (0.00)	-0.39*** (0.00)	-0.19** (0.03)	-0.20** (0.03)	-0.40*** (0.00)	0.00 (0.95)
CFE NEW ZEALAND	-	-0.14 (0.33)	-1.04*** (0.00)	-0.14 (0.33)	0.00 (0.98)	-0.11 (0.41)	-0.16 (0.24)	0.00 (0.94)	-0.05 (0.67)
CFE NIGERIA	-	-0.74*** (0.00)	-0.001 (0.99)	-0.73*** (0.00)	0.00 (0.99)	0.00 (1.00)	-0.05 (0.74)	0.11 (0.4)	0.07 (0.56)

CFE SINGAPORE		-	1.07*** (0.00)	1.25*** (0.00)	1.07*** (0.00)	1.4*** (0.00)	1.22*** (0.00)	1.33*** (0.00)	1.37*** (0.00)	1.35*** (0.00)
CFE SOUTH AFRICA		-	-0.16 (0.18)	0.09 (0.39)	-0.16 (0.18)	0.21* (0.08)	0.02 (0.88)	0.13 (0.25)	0.17 (0.13)	0.19 (0.14)
CFE TUNISIA		-	-1.62*** (0.00)	-1.06*** (0.00)	-1.64*** (0.00)	-1.12*** (0.00)	-1.26*** (0.00)	-1.19*** (0.00)	-1.14*** (0.00)	-1.18*** (0.00)
CFE TURKEY		-	-0.60*** (0.00)	-0.5*** (0.00)	-0.59*** (0.00)	-0.46*** (0.00)	-0.57*** (0.00)	-0.58*** (0.00)	-0.46*** (0.00)	-0.44*** (0.00)
CFE UAE		-	0.12 (0.38)	0.39*** (0.00)	0.07 (0.58)	0.31** (0.01)	0.50** (0.00)	0.46*** (0.00)	0.31** (0.01)	0.64*** (0.00)
CFE UK		-	-0.09 (0.18)	-0.26*** (0.00)	-0.06 (0.35)	-0.18*** (0.00)	-0.20*** (0.00)	-0.23*** (0.00)	-0.17*** (0.00)	-0.05 (0.76)
CFE USA	-	-	-	-	-	-	-	-	0.20 (0.367)	
TFE 1992	-	0.26** (0.01)	0.17** (0.02)	-	-	-	-	-	-	
TFE 1993	-	0.38*** (0.00)	0.26*** (0.00)	0.12* (0.05)	0.15** (0.02)	0.00 (0.98)	0.03 (0.61)	0.14** (0.03)	-	
TFE 1994	-	0.34*** (0.00)	0.26*** (0.00)	0.08 (0.17)	0.30*** (0.00)	0.16** (0.10)	0.19* (0.07)	0.29*** (0.00)	-	
TFE 1995	-	0.38*** (0.00)	0.27*** (0.00)	0.12* (0.05)	0.13* (0.05)	0.00 (0.95)	0.00 (0.87)	0.13*** (0.05)	-	
TFE 1996	-	0.34*** (0.00)	0.27*** (0.00)	0.08 (0.23)	0.12* (0.08)	0.00*** (0.92)	0.00 (0.97)	0.12* (0.08)	0.00 (0.91)	
TFE 1997	-	0.39*** (0.00)	0.30*** (0.00)	0.14** (0.03)	0.14** (0.04)	0.03 (0.58)	0.03 (0.61)	0.14** (0.03)	0.30 (0.61)	
TFE 1998	-	0.43*** (0.00)	0.26*** (0.00)	0.17*** (0.00)	0.07 (0.27)	0.02 (0.71)	0.03 (0.64)	0.07 (0.27)	0.03 (0.59)	
TFE 1999	-	0.39*** (0.00)	0.26*** (0.00)	0.1** (0.04)	0.06 (0.35)	0.01 (0.75)	0.02 (0.8)	0.06 (0.34)	0.03 (0.65)	
TFE 2000	-	0.46*** (0.00)	0.31*** (0.00)	0.19*** (0.00)	0.12* (0.07)	0.06 (0.28)	0.07 (0.24)	0.12* (0.06)	0.09 (0.13)	
TFE 2001	-	0.50*** (0.00)	0.28*** (0.00)	0.24*** (0.00)	0.09*** (0.12)	0.06 (0.28)	0.05 (0.40)	0.10 (0.10)	0.07 (0.22)	
TFE 2002	-	0.43*** (0.00)	0.24*** (0.00)	0.17** (0.01)	0.06 (0.29)	0.03 (0.59)	0.02 (0.77)	0.07 (0.26)	0.03 (0.48)	
TFE 2003	-	0.35*** (0.00)	0.21*** (0.00)	0.10 (0.16)	0.04 (0.53)	0.00 (0.89)	0.00 (0.95)	0.05 (0.48)	0.02 (0.69)	

TFE 2004	-	0.31*** (0.00)	0.22*** (0.00)	0.04 (0.55)	0.05 (0.44)	0.02 (0.69)	0.01 (0.82)	0.06*** (0.41)	0.04 (0.45)
TFE 2005	-	0.35*** (0.00)	0.22*** (0.00)	0.09 (0.24)	0.05 (0.40)	0.03 (0.61)	0.02 (0.71)	0.06 (0.38)	0.06 (0.35)
TFE 2006	-	0.32*** (0.00)	0.24*** (0.00)	0.06 (0.47)	0.08 (0.28)	0.03 (0.61)	0.05 (0.47)	0.08 (0.25)	0.08 (0.18)
TFE 2007	-	0.29*** (0.00)	0.19*** (0.00)	0.02 (0.82)	0.02 (0.76)	0.00 (0.94)	0.00 (0.99)	0.02 (0.73)	0.04 (0.56)
TFE 2008	-	0.35*** (0.00)	0.19*** (0.00)	0.08 (0.39)	0.02 (0.77)	0.00 (0.89)	0.00 (0.95)	0.03 (0.74)	0.05 (0.49)
TFE 2009	-	0.26*** (0.00)	0.01 (0.77)	0.00 (0.94)	-0.15* (0.05)	-0.17** (0.02)	-0.17** (0.02)	-0.15* (0.06)	-0.13* (0.06)
TFE 2010	-	-0.18*** (0.002)	0.06 (0.19)	-0.08 (0.36)	-0.11 (0.19)	-0.12 (0.12)	-0.12 (0.12)	-0.11 (0.21)	-0.07 (0.28)
TFE 2011	-	0.17*** (0.004)	0.07 (0.15)	-0.10 (0.32)	-0.03 (0.73)	-0.04 (0.66)	-0.04 (0.66)	-0.03 (0.74)	0.00 (0.97)
TFE 2012	-	0.14** (0.02)	0.04 (0.42)	-0.13 (0.19)	-0.14 (0.10)	-0.14* (0.08)	-0.15* (0.08)	-0.14 (0.11)	-0.1 (0.21)
TFE 2013	-	-	-	-0.27*** (0.00)	-0.19** (0.03)	-0.18** (0.02)	-0.19*** (0.00)	-0.18** (0.03)	-0.14* (0.08)

Table 5: Country and time fixed effects, Regression 1 to 9(a)

Source: Author

Variable	9(a)	9(b)	9(c)	9(d)	9(e)	9(f)
CFE AUSTRALIA	-0.11 (0.22)	0.13 (0.41)	0.13 (0.41)	0.10 (0.48)	0.11 (0.26)	0.10 (0.49)
CFE BRAZIL	-0.64*** (0.00)	-0.47*** (0.00)	-0.47*** (0.00)	-0.50*** (0.00)	-0.69*** (0.00)	-0.49*** (0.00)
CFE CANADA	0.00 (0.94)	0.03 (0.86)	0.03 (0.86)	0.00 (0.95)	-0.20 (0.01)	0.00 (0.96)
CFE CHILE	0.01 (0.96)	0.15 (0.21)	0.15 (0.21)	0.12 (0.26)	-0.09 (0.51)	0.13 (0.26)
CFE CHINA,HK	0.35*** (0.00)	0.58*** (0.00)	0.58*** (0.00)	0.53*** (0.00)	0.37*** (0.00)	0.53*** (0.00)
CFE CONGO	-0.18 (0.42)	-	-	-	-0.28 (0.23)	-
CFE DENMARK	-1.33*** (0.00)	-1.22*** (0.00)	-1.22*** (0.00)	-1.23*** (0.00)	-1.15*** (0.00)	-1.24*** (0.00)
CFE ECUADOR	-0.73*** (0.00)	-0.60*** (0.00)	-0.60*** (0.00)	-0.61*** (0.00)	-0.56*** (0.00)	-0.62*** (0.00)
CFE EGYPT	-1.22*** (0.00)	-0.99*** (0.00)	-0.99*** (0.00)	-1.01*** (0.00)	-1.24*** (0.00)	-1.02*** (0.00)

CFE GERMANY	-0.09* (0.09)	0.08* (0.66)	0.08* (0.66)	-0.04 (0.82)	-0.13** (0.03)	-0.04 (0.83)
CFE GREECE	-1.33*** (0.00)	-1.11*** (0.00)	-1.11*** (0.00)	-1.12*** (0.00)	-1.35*** (0.00)	-1.12*** (0.00)
CFE INDIA	-0.56*** (0.00)	-0.12 (0.46)	-0.12 (0.46)	-0.15 (0.29)	-0.35** (0.02)	-0.16*** (0.00)
CFE INDONESIA	-0.12 (0.28)	0.09 (0.49)	0.09 (0.49)	0.08 (0.56)	0.14 (0.21)	0.07 (0.57)
Variable	9(a)	9(b)	9(c)	9(d)	9(e)	9(f)
CFE IRAN	-0.44*** (0.00)	-0.31** (0.03)	-0.31** (0.03)	-0.32*** (0.00)	-0.53*** (0.00)	-0.31** (0.02)
CFE ISRAEL	-0.23* (0.07)	-0.05 (0.70)	-0.05 (0.70)	-0.06 (0.62)	-0.29** (0.03)	-0.06 (0.62)
CFE JAPAN	-0.24*** (0.00)	-0.06 (0.75)	-0.06 (0.75)	-0.10 (0.59)	-0.28*** (0.00)	-0.10 (0.59)
CFE MEXICO	-0.38*** (0.00)	-0.04 (0.79)	-0.04 (0.79)	-0.08 (0.57)	-0.26*** (0.00)	-0.08 (0.57)
CFE NETHERLANDS	-0.15* (0.07)	0.00 (0.97)	0.00 (0.97)	-0.03 (0.80)	-0.24** (0.02)	-0.03 (0.80)
CFE NEW ZEALAND	-0.29** (0.04)	-0.05 (0.67)	-0.05 (0.67)	-0.06 (0.62)	-0.31 (0.04)	-0.06** (0.62)
CFE NIGERIA	-0.17 (0.19)	-0.08 (0.55)	-0.08 (0.55)	0.06 (0.62)	-0.17 (0.23)	0.07 (0.59)
CFE SINGAPORE	1.06*** (0.00)	1.35*** (0.00)	1.35*** (0.00)	1.34*** (0.00)	1.09*** (0.00)	1.33*** (0.00)
CFE SOUTH AFRICA	-0.05 (0.69)	0.19 (0.14)	0.19 (0.14)	0.16 (0.20)	-0.05 (0.28)	0.16 (0.20)
CFE TUNISIA	-1.25*** (0.00)	-1.18*** (0.00)	-1.18*** (0.00)	-1.18 (0.00)	-1.44*** (0.00)	-1.18*** (0.00)
CFE TURKEY	-0.63*** (0.00)	-0.44*** (0.00)	-0.44*** (0.00)	-0.46 (0.00)	-0.67*** (0.00)	-0.46*** (0.00)
CFE UAE	0.49*** (0.00)	0.65*** (0.00)	0.65*** (0.00)	0.62*** (0.00)	0.41*** (0.00)	0.63*** (0.00)
CFE UK	-0.32*** (0.00)	-0.05*** (0.766)	-0.05*** (0.766)	-0.08*** (0.62)	-0.28*** (0.00)	-0.08*** (0.61)
Variable	9(a)	9(b)	9(c)	9(d)	9(e)	9(f)
CFE USA	-	0.21 (0.35)	0.21 (0.35)	0.16 (0.47)	-	0.16 (0.47)
TFE 1992	-	-	-	-	-	-
TFE 1993	-	-	-	-	-	-
TFE 1994	-	-	-	-	-	0.28** (0.02)
TFE 1995	0.16** (0.04)	-	-	-0.16* (0.09)	-	0.12 (0.13)
TFE 1996	0.15** (0.04)	0.00 (0.89)	0.00 (0.89)	-0.17* (0.08)	0.11 (0.16)	0.11 (0.17)
TFE 1997	0.20** (0.01)	0.03 (0.62)	0.03 (0.62)	-0.13 (0.17)	0.15* (0.06)	0.14* (0.06)
TFE 1998	0.20** (0.01)	0.03 (0.61)	0.03 (0.61)	-0.13 (0.18)	0.15* (0.06)	0.14* (0.06)
TFE 1999	0.10** (0.01)	0.03 (0.66)	0.03 (0.66)	-0.14 (0.17)	0.15* (0.06)	0.14* (0.07)
TFE 2000	0.26*** (0.00)	0.08 (0.23)	0.08 (0.23)	-0.08 (0.44)	0.21*** (0.00)	0.19*** (0.00)
TFE 2001	0.22*** (0.00)	0.07 (0.23)	0.07 (0.23)	-0.09 (0.31)	0.19** (0.01)	0.18** (0.01)
TFE 2002	0.19***	0.04	0.04	-0.13	0.16**	0.15**

	(0.00)	(0.49)	(0.49)	(0.17)	(0.03)	(0.03)
TFE 2003	0.16***	0.02	0.02	-0.15	0.14**	0.13
	(0.00)	(0.70)	(0.70)	(0.13)	(0.03)	(0.04)
Variable	9(a)	9(b)	9(c)	9(d)	9(e)	9(f)
TFE 2004	0.18***	0.04	0.04	-0.13	0.17***	0.15**
	(0.00)	(0.45)	(0.45)	(0.20)	(0.00)	(0.01)
TFE 2005	0.19***	0.05	0.05	-0.11	0.18***	0.16***
	(0.00)	(0.35)	(0.35)	(0.25)	(0.00)	(0.00)
TFE 2006	0.21***	0.08	0.08	-0.08	0.21***	0.18***
	(0.00)	(0.17)	(0.17)	(0.38)	(0.00)	(0.00)
TFE 2007	0.16***	0.04	0.04	-0.13	0.17***	0.14***
	(0.00)	(0.56)	(0.56)	(0.19)	(0.00)	(0.00)
TFE 2008	0.17***				0.17***	0.15***
	(0.00)	0.05	0.05	-0.13	(0.00)	(0.00)
		(0.50)	(0.50)	(0.22)		
TFE 2009	0.05	-0.13*	-0.13*	-0.31***	0.00	-0.03
	(0.86)	(0.05)	(0.05)	(0.00)	(0.98)	(0.57)
TFE 2010	0.05	-0.08	-0.08	-0.25**	0.05	0.02
	(0.30)	(0.28)	(0.28)	(0.02)	(0.26)	(0.66)
TFE 2011	0.06	0.00	0.00	-0.17	0.14**	0.10*
	(0.18)	(0.97)	(0.97)	(0.16)	(0.02)	(0.09)
TFE 2012	0.03	-0.1	-0.1	-0.28**	0.04	-
	(0.46)	(0.20)	(0.20)	(0.02)	(0.47)	
TFE 2013	-	-0.14*	-0.14*	-0.31***	-	-0.04
		(0.08)	(0.08)	(0.00)		(0.40)

Table 6: Country and time fixed effects, Regression 9(a) to 9(f)

Source: Author

Table 5 and table 6 show the results of the country and time fixed effects that have an impact on bilateral maritime trade.

From the above table, a thorough analysis has led to certain results. China and Singapore appear to have the highest positive and significant impact on bilateral maritime trade with a value at an average of 0.40 and 1.20 respectively for all calculated exchange rate volatility. On the other hand, Brazil (-0.50), Denmark, (-.1.23), Ecuador (-0.6), Egypt (-1.0), Greece (-1.11) and UK (-0.8) while the rest of the countries seem to show minimum to no significant impact on the bilateral maritime trade. None of the time fixed effects, under volatility regression table 6 show any significance of impacting on bilateral maritime trade except TFE 2008 shows a major impact for specification 9(a), 9(e) and 9(f) at par with TFE 2004 to TFE 2007, which probably gives certain tell tale signs that under these volatility calculations, bilateral trade has been severely affected, in a positive manner, during these years than in any preceding or following years. The results signify the growth in trade during these years following the global financial crisis that dropped trade significantly and hence, the following years show least significance for most calculated volatility.

Similar results are observed in the regression Table 5 where China and Singapore have a very significant and positive impact on bilateral maritime trade for all the exchange rate regimes while Brazil, Denmark, Ecuador, Egypt and Greece and Iran have significantly very high negative impact on bilateral maritime trade while rest of the countries show significance only in certain exchange rate regimes. The result for the time fixed effects show very little impact on bilateral maritime trade flows except for specifications (2) and (3) which can analysed as that the PPML regression has

identified the zero values and no data values and accordingly removed the time fixed effects from gaining any significance unlike in the OLS regression.

4.3 Summary

4.3.1 Exchange rate system effects on bilateral maritime trade

The thesis commenced with the research question about how exchange rate regime affects bilateral maritime trade. 8 gravity regressions were carried on a 22-year timeline with 27 nations in the model with international trade and international maritime trade as dependent variables. After thorough analysis through qualitative approach and gravity model, it has been found that exchange rate regime has a significant impact on bilateral maritime trade.

Countries engaging under fixed exchange rate regime tend to benefit the most with a growth in trade of 0.43, which is significant enough to show to show that each new country trading in this regime would cause a growth in trade by 43%. Countries engaging in free float regimes and managed float regimes tend to face drop in trade by 0.08 and 0.17 respectively which signifies that every new country engaging in either of these exchange rate regimes shall witness a negative growth in trade by 8% and 17% respectively.

In the end, through this research, it can be concluded that exchange rate regime does have an impact on bilateral maritime trade and the choice of the regime would determine whether the country would benefit by trading with the corresponding country bilaterally or would there be a significant loss in doing so.

*4.3.2 **E**xchange rate volatility effects on bilateral maritime trade*

This thesis also generated gravity regression results in order to understand and analyse the impact of exchange rate volatility on bilateral maritime trade. Six new volatility calculations were introduced and it was found that none of the volatility specifications have shown any significant impact on bilateral maritime trade. A thorough qualitative analysis was also carried out in order to understand the impact on international trade and bilateral maritime trade due to exchange rate volatility but the research papers found show mixed results from very negative impact to no impact at all. Also, it has been found that volatility in trade is mainly due to supply and demand shocks and the effect of exchange rate volatility has insignificant impact.

Thus it can be concluded that exchange rate volatility has no significant impact on bilateral maritime trade flow in a long run.

5 Conclusions

This final chapter will summarize the entire thesis and the research that has been conducted and try to indicate the key findings followed by policy recommendations. We end with suggestions for further research.

5.1 Key Findings

This thesis set out to answer what would be the impact of chosen exchange rate regimes and exchange rate volatility on bilateral maritime trade.

Qualitative analysis provided us with a clear picture about the meaning of the terms, of the different exchange rate regimes and their characteristics, followed by their existential reasons and their subsequent impact causing trade fluctuations. We also carried out a short statistical analysis was carried out in order to visualize the trends that the maritime sector has gone through regarding shifts in trade and subsequent trade imbalances. The qualitative analysis has shown a significant level of volatility in maritime trade flows and some of the (qualitative0 causes.

Then, in order to answer the research question also in a quantitative sense, we employed the gravity model to run various gravity regressions in an attempt to measure quantitatively the effect of a specific exchange rate regime on bilateral maritime trade, and of exchange rate volatility on bilateral maritime trade.

Starting from the traditional specification with total bilateral trade as the dependent variable, we took a step-by-step approach to improve the econometric specification. We added country and time fixed effects, and we replaced the OLS specification by a PPML one – in order to solve for the 'zero' problem in gravity regression literature. The explanatory power of the regression was high, and the Durbin-Watson coefficient showed there was no serial correlation. Equation (3) was compared to the literature and our results were confirmed.

From that validated basis onwards, we moved to looking at specific bilateral *maritime* trade flows and the different exchange rate systems and exchange rate volatility. From running various specifications, we found specific impact of exchange rate regimes on bilateral maritime trade. The free float and managed float exchange rate regimes appear to have a statistically significant negative impact on bilateral maritime trade (with the managed float having a stronger negative impact than the free float). We also find that fixed exchange rate regimes are shown to have a statistically significant positive impact on maritime trade. These results reflect the fact that trade flourishes in a more certain environment. What is not included in the shock-effect of a change in exchange rate regimes (e.g. abandoning a peg). The fact that the managed float is performing slightly worse than a free float could again be a reflection of uncertainty: when will central banks or governments intervene and when will they not. At least the free float is left to the (also uncertain) markets. We then turned to look at exchange rate volatility and its effect on bilateral maritime trade flows. This thesis introduced 6 new techniques of calculating exchange rate volatility and the model was run keeping bilateral maritime trade as dependent variable and the different definitions of exchange rate volatility as one of the many independent variables We found no statistically significant effect of exchange rate volatility on bilateral maritime trade flows.

The research proposal has been initiated in response to the claims by Steve Forbes that in order to bring stability in trade flows, the world would need to return to the gold standard or some kind of fixed exchange rate regime. The reason specified was that exchange rate volatility causes a significant impact on international trade. The findings from this thesis provide mixed evidence for Forbes' suggestion: he may actually be right when we look at the positive effects of a fixed exchange rate regime (which the gold standard is in essence) for bilateral maritime trade. On the other hand, we do not find that exchange rate volatility in general has a negative effect on maritime trade flows.

5.2 Implications and policy recommendations

The implications of this research should provide useful insights not only for companies in the maritime industry but also for other sectors involved in transportation, trade economics and finance. The same qualitative and quantitative analysis can be carried out for other sectors that have the possibility of an impact from the exchange rate regimes.

But the biggest impact would be that policymakers of the respective bilateral trading nations have the freedom to make decisions on their exchange rate regimes. Their decisions have to keep in mind the finding of this thesis that fixed exchange rates do seem to have a positive effect on bilateral maritime trade flows. So the result of the decisions on exchange rages shall have a significant impact on the maritime sector, which governs almost 90% of the bilateral trade between nations.

5.3 Limitations of the research and suggestions for further research

Although the results in the paper describe a lot about the research question, and the employed quantitative methodology is state-of-the-art, we have come across some limitations.

The focus of this research has been on the impact on bilateral maritime trade due to the exchange rate regimes. However, the gravity model fails to understand the behaviour of the trading countries that is generated in a particular trade. It fails to understand the change in trade due to factors such as change in preference from one type of commodity to another although the shift in trade of one commodity into another can level the change in trade thus showing that the overall quantity traded between nations have remained the same. It does not provide with a clear picture whether the oil industry is getting affected from the exchange rate regimes or is it the food and beverage industry, which is necessary for survival in the short and long run. The CFE and FTE solve for some of these problems, but structural relations are still not included. Further research can be done by introducing dummy variables for preference of commodities between bilateral trading nations. Future research can be carried out to understand the impact of volatility on a shorter run of a few months. The number of countries taken as a sample in this thesis is few due to reasons mentioned earlier. However, further research can be carried out on individual trade and collective trade blocs or comparison of the trade blocs in terms of trade and investment due to the regimes these follow or inter bloc trade that can get affected

due to the regimes. Also, a separate research can be allocated for understanding the impact of exchange rate regimes between bilateral trading countries due to the economic and political factors that allows or restricts the entry of the third country eligible to trade with the bilateral trading nations.

The other limitation found was that the calculation of exchange rate volatility was carried out on an annual or moving average basis. However, a year-to-year exchange rate is considered quite a long time when trading companies rely mostly upon weekly, daily or sometimes minute-to-minute change in exchange rate thus failing to provide a clear picture about the changes that occur frequently and whether these frequent changes have any impact on bilateral maritime trade in the short run. On the other hand for trade analysis, exchange rate volatility is often looked at over multi-year periods. This leads to a mismatch between company questions and macro-economic analysis.

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Appendices

YEAR	FIXED	MANAGED	FREE
1992	13	10	10
1993	7	13	9
1994	9	12	10
1995	8	12	11
1996	7	13	11
1997	8	12	12
1998	9	11	11
1999	10	9	12
2000	9	7	13
2001	9	5	15
2002	11	4	14
2003	10	4	15
2004	10	4	15
2005	8	6	15
2006	8	6	15
2007	8	6	15
2008	8	6	15
2009	8	6	15
2010	8	6	15
2011	8	6	15
2012	8	6	15
2013	8	6	15

Table 7: Number of countries in each exchange rate regime per year

Source Author

SOURCE	DESTINATION		FINAL
FREE	FREE	=	FREE
FREE	MANAGED	=	MANAGED
MANAGED	FREE	=	MANAGED
FIXED	FREE	=	FIXED
FIXED	MANAGED	=	FIXED
MANAGED	FIXED	=	FIXED
FREE	FIXED	=	FIXED
MANAGED	MANAGED	=	MANAGED
FIXED	FIXED	=	FIXED

Table 8: Logic gate for final exchange rate regime

Source: Author