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Department of Mathematics, Faculty of Engineering.

Masters of Finance Mathematics

An Evaluation of United States' trade balance with selected two countries including a demographic variable.

By Ms. Ugika Navaratnarajah.

13th May 2022.

DECLARATION STATEMENT

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in text.

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ACKNOWLEDGEMENTS

I would like to express my special thanks of gratitude to my main supervisor Ms. Kumuthini Sivathas, PhD candidate, Economics/ Econometrics with University of Adelaide, Australia and my Co – Supervisor Dr. Rohana Dissanayake, Department of mathematics, faculty of engineering, University of Moratuwa for their consecutive comments and continual support throughout this research work. Without my supervisors, successful completion of this research work would never become reality.

Finally, I would like to express my sincere gratitude to my parents, husband and friends for their support and motivation to complete this dissertation.

ABSTRACT

The purpose of this research study is to estimate the determinants of USA's trade balance with Australia and Germany including a demographic variable (youth dependency ratio) and testing their relationships in the long run.

The research data included over the period of 39 years (1980 – 2018). We run linear regression with these set of variables that are GDP ratio, real exchange rate, nominal exchange rate, price deflator ratio, lending rate ratio, money supply ratio and youth dependency ratio for both the pair of countries.

For both pair of countries namely USA vs Australia and USA vs Germany, all the variables are I (1) which means non stationary. Also, cointegration tests shows that there is a relationship between selected variables. Since these variables (non-stationary) are cointegrated then run the multiple linear regression model to estimate the determinants of USA's trade balance.

For the pair of USA and Australia, we run Engle – Granger test where Australia's import share and GDP ratio are cointegrated at 10% and showed a weaker relationship between those significant variables. There is a positive long run relationship between net exports (NE) and exchange rate (ER) at 5% level of significance.

For the pair of USA and Germany, based on Engle – Granger test there is no strong correlation between Germany's import share and GDP. But there is a positive long run relationship between net exports (NE) and exchange rate (ER) at 10% level of significance.

For the pair of USA and Australia, regression results showed the most important determinant of net export is GDP ratio followed by price deflator ratio, money supply ratio, lending rate ratio and the real exchange rate which explains 89.7% of the variation in net exports. We run F – Test which showed that net exports respond to rising and falling exchange rate regimes symmetrically.

For the pair of USA and Germany, regression results showed that the most important determinant of net export is real exchange rate followed by GDP ratio and youth dependency ratio which explains 76.9% of the variation in net exports. We run F – Test which showed that net exports depend on rising and falling exchange rate regimes.

Results based on error correction model (ECM) suggests that there exists a positive long run relationship between expected exchange rate (ER) and USA's net export (NE) at 5% level of significance, for both pair of countries.

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LIST OF ABBREVIATIONS

NE	– USA's net exports
ADF	– Augmented Dickey Fuller
PP	– Phillip perron
ECM	– Error Correction Model
ECT	- Error Correction Term
U. S	– United states of America
GDP	– Gross domestic product
NEER	– Nominal effective exchange rate
CEIC	– Census and economic information center
BEA	– Bureau of economic analysis
OEC	– The observatory of economic complexity
OECD	- Organisation for Economic Cooperation and Development
CV	– Coefficient of variation

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CHAPTER 01
INTRODUCTION

1.1. Introduction.

This study is looking into the determinants of the United States of America's trade balance with Australia and Germany. Shedding some light on the determinants and the level of influence they have on USA's trade balance is essential as it helps these countries to develop their better relationship in terms of their international trade and financial affairs. Accordingly, the economic effects of the USA's trade deficit have been a topic of long-standing congressional interest of USA and the rest of the world, because USA's economic policies have impact on all other countries to the extent of small or big. However, in this thesis we are analysing such effects on two countries especially Australia and Germany.

Over the certain time interval, monetary value of a nation's exports and also imports difference is called as trade balance. If a nation's export value is greater than the import value, then it's called a trade surplus, positive, or favourable balance and conversely, if a nation's import value is greater than the export value, then it's called as trade deficit, negative, or unfavourable balance. Factors such as political and economic can affect the growth of international trade, further Gross domestic product rate, nominal exchange rate, money supply, lending rate, real exchange rate, price deflator ratio and youth dependency ratio and many other factors affect the international trade (Factors Influencing International Trade, 2021). Industrial countries benefit from trading deals with developing countries which are growing rapidly (Arora and Vamvakidis, 2004).

United States of America's gains in many ways such as, expanding this production of USA's most powerful competitive industries and products, shifting production to attractive areas. Australia's economy helps USA to increase the productivity of an average United States employees, and also through that these income USA earn with this ability to serve a well global market, investment is encouraged in Australia's enlarging the export sectors and the expanding scale of volume helps to reduce the mean of production costs. Such kind of reactions help to build up the America's economic growth rate. Moreover, the nation's imports level rises the purchasing power of consumers, and increase consumer choices, and also helping to keep in low prices. As a result of Australia's help, imports provide premium quality inputs for USA businesses helping companies, USA employees remain highly competitive or turn in both foreign and domestic markets.

Industrial nations bent on their sustained economic development for the production of necessarily wanted goods and the services should be worldwide huge competitive market. This growing economic could be done along with the increased level of the production sector at very lower cost for export, expanded level of investment and savings in output of human capital development and the capital goods, policies of exchange rate which can steer a particular currency with regard to its equilibrium rate, fiscal policies which can promotes saving and the investments and the number of young people at an age when they are known as generally and economically active compared with the number of people of age between 15 – 64 are working age, leading to better economic outcomes. Larger investment needs to be made in schooling and other necessities for children to indicate the result of high youth dependency ratio.

USA and Australia are highly developed mixed economy. Between United States and Australia have the benefit of a long period of cooperation between their two respective governments and people. The relationship between United States and the Australia is not static but rather dynamic. USA is the leading global trader and the world's biggest national economy. Australia is an export country which achieved a positive trade balance of around $8 billion.

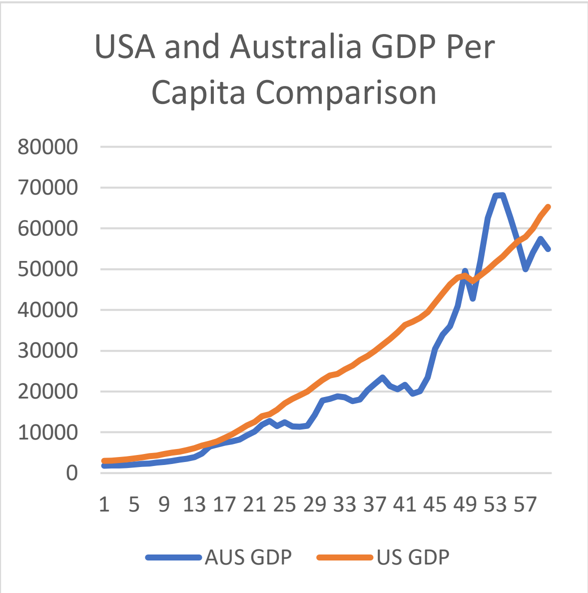
Germany runs trade surplus due to stronger export of vehicles and other machineries since 1952. Germany's trade surplus amounted to 209.21 billion U.S. dollars. After China and USA, Germany is the world largest exporter. In 2019, United States exports valued as 96.7 billion U.S. dollars and also United States Imports 162.9 billion U.S. dollars (U.S. Relations with Germany - United States Department of State, 2021).

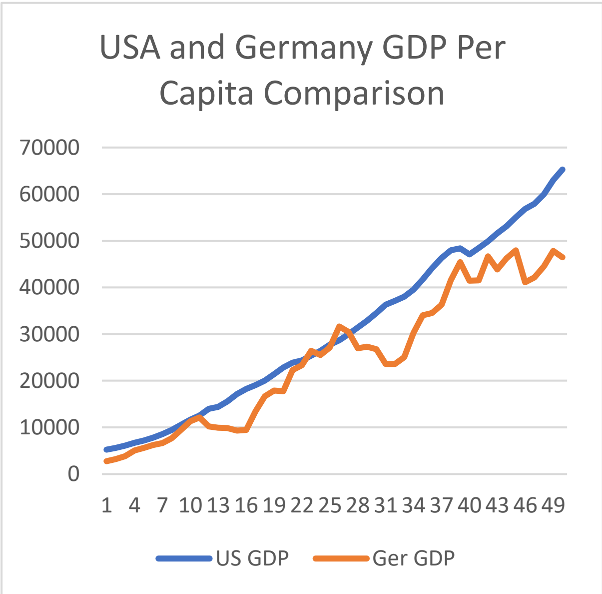
Gross Domestic Product Per Capita (GDP Per Capita)

According to Diane (2014), Gross Domestic Product is the recognized method of measuring the value added to the goods and production within a country in a certain time zone. GDP Per Capita is calculated by country's GDP compared with its Total Population. This reflects the standard of living of that nation. USA also has highest GDP Per Capita. This calculates the value of money earned per person in a country. According to world bank data, GDP Per Capita fell by an average of 4.5% in 2020, globally. Highest GDP countries may not have highest GDP Per Capita. (What Is Per Capita GDP, 2021).

GDP Per Capita, which is gross domestic product per mid-year population. U.S. GDP Per Capita for 2019 was 3.51% increase from 2018, and 2020 was 2.66% decline from 2019 (GDP (current US$) - United States | Data, 2021). Australia's GDP Per Capita for 2018 was 6.16% increase from 2017, 2019 was 4.01% decline from 2018 and 2020 was 5.89% incline from 2019 (Australia GDP Per Capita 1962-2021, 2021). Germany's GDP Per Capita for 2018 was 7.31% increase from 2017, 2019 was 2.81% decline from 2018 and 2020 was 1.6% decline from 2019 (Germany GDP Per Capita 1970-2021, 2021).

Figure 1.1: USA's GDP Comparison with Australia and Germany.





Exchange rate (Nominal and Real)

Nominal exchange rate, which is the value of the domestic currency necessary to purchase the amount of particular foreign currency. These nominal exchange rate helps to point out which currency value more effectively. Nominal exchange rate coefficient value more than one means, our home currency is worthier than a particular imported currency, similarly lower coefficient refers as import currency is worthier than our home currency. Moreover, Real exchange rate adjusted for the inflation rate of our home country relative to the inflation rate of particular import country (Inside the Nominal Effective Exchange Rate (NEER), 2021).

The financial crisis of 2007-2009, also known as global financial crisis. Which begun with cheap credit and tax lending standards that fuelled a housing bubble. Millions of household owners and institution owners owing their mortgages more than the worth value (The 2007-2008 Financial Crisis in Review, 2021)

Figure 1.2: Real broad effective rates for United States.

Figure 1.3: Real broad effective exchange rate for Australia.

Figure 1.4: Real broad effective exchange rate for Germany.

The currency exchange rate, which is one of the most important determinants of a nation's economic level. A higher value of currency makes more expensive of exports and less expensive of imports in foreign markets.

Figure 1.5: US Dollar to Australia Dollar spot exchange rate.

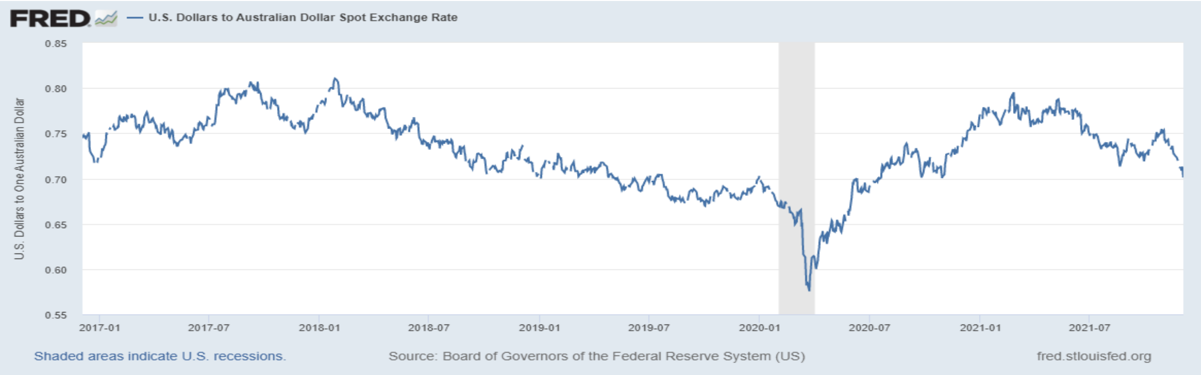
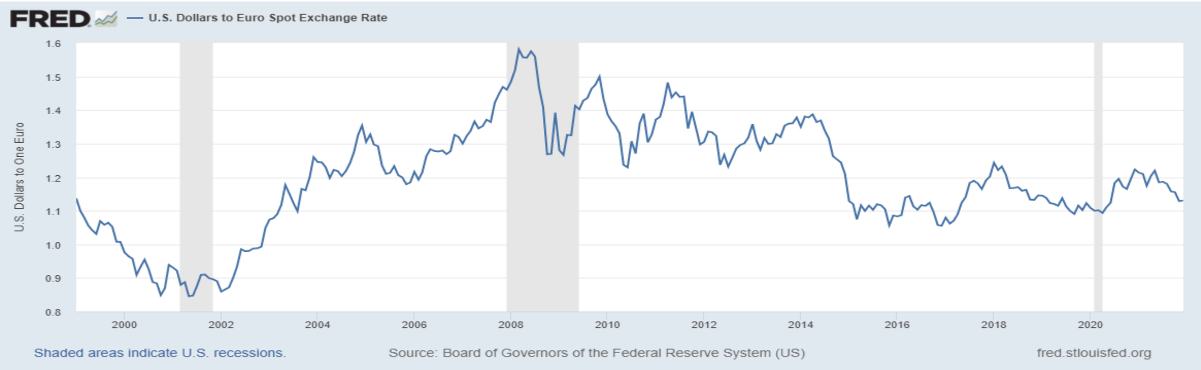


Figure 1.6: US Dollar to Euro spot exchange rate.



Money Supply

In this study we considered M2, broad money. Money supply M2 includes current, saving deposits and cash. This is broad measure than M1. Broad money supply M2 closely observes as an indicator of money supply, inflation and target of central bank money supply (What Is M2, 2021).

Figure 1.7: USA's Money Supply.

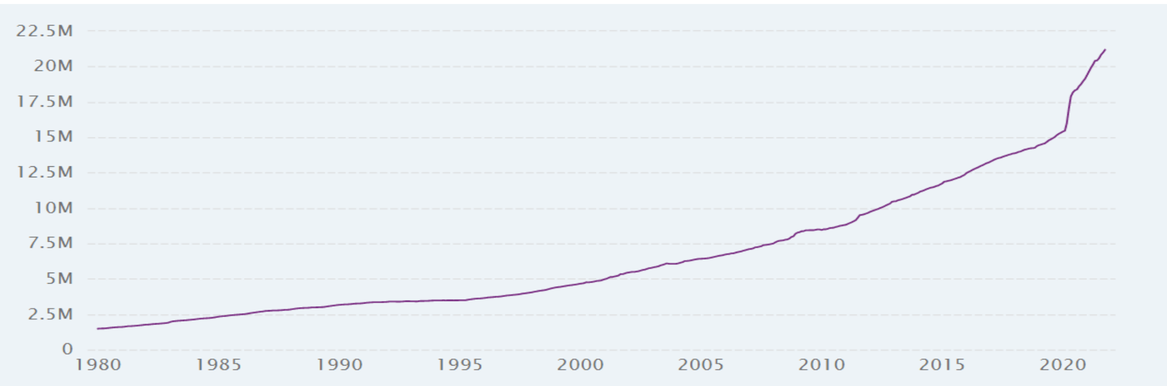
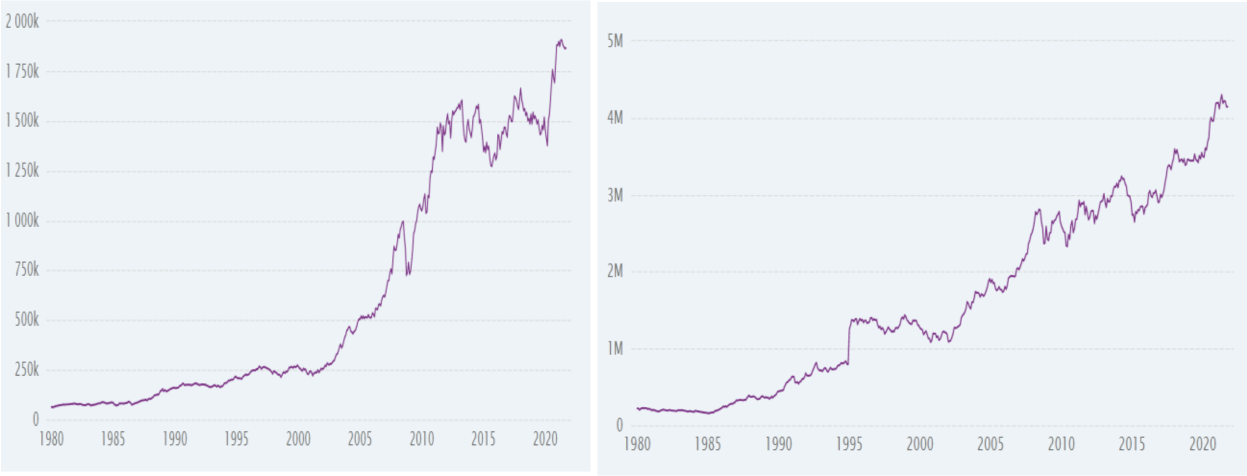


Figure 1.8: Australia and Germany's Money Supply.



Youth dependency ratio

The youth dependency ratio (DE), which is described as a number of persons between 0 – 14 years old compared with the number of working age population (15 – 64 years old) as a percentage was taken form World Development Indicators 2000 and Penn World Table. This ratio is more important in the developed and the developing countries. The number of working age people who are economically active compared to the number of youth people. We paid more attention to youth dependency ratio because, youth population composition of any economy is expected to reduce in the future as the global population increasing rate is reducing.

Figure 1.9: USA and Australia's Youth dependency ratio.

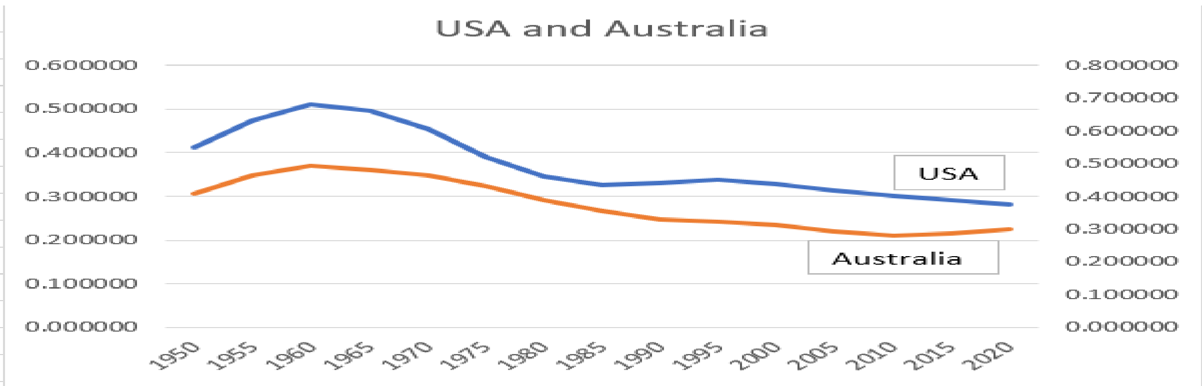
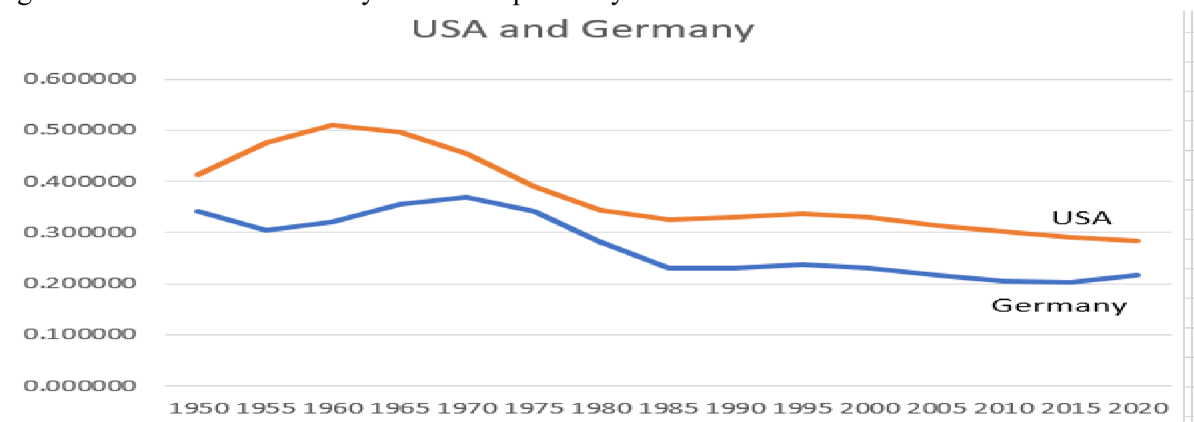


Figure 1.10: USA and Germany's Youth dependency ratio.



Lending rate

The interest rate which is charged by the lenders within a time period as the percentage of the amount deposited or lent out is known as lending rate. United States of America's lending rate details updated daily, averaging 7.25% from 1980 to 2021. 3.25% per annum for 2021 (US Bank Lending Rate, 1980 – 2021 | CEIC Data, 2021). Australia's lending rate for the year 2011 was 7.738% and reducing afterwards, 2018 was 5.261% and 2019 was 5.101% (Lending interest rate (%) - Australia | Data, 2021). Germany lending rate (LR) details were updated monthly, which is averaging percentage of 3.21% from 2003 to 2021, also 1.83% per annum for 2021 (Germany's Bank Lending Rate, 2003 – 2021 | CEIC Data, 2021).

Figure 1.11: USA's Lending interest rates.

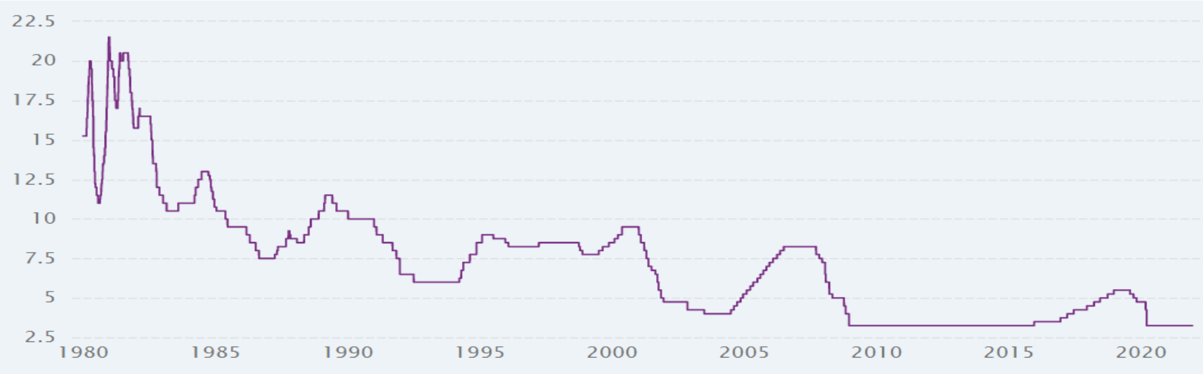


Figure 1.12: Australia's Lending interest rates.

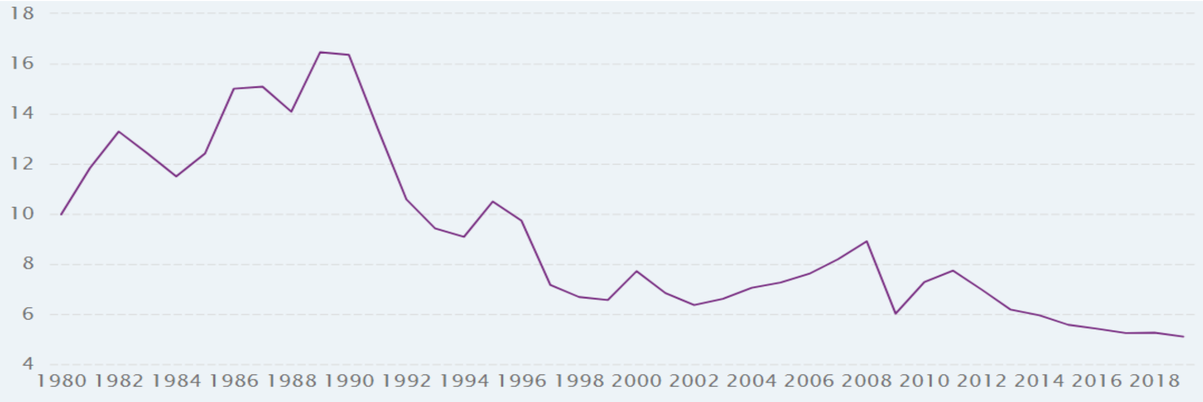


Figure 1.13: Germany's Lending interest rates.

GDP Price deflator ratio.

The GDP price deflator (PR) is calculated using nominal GDP and real GDP data. GDP price deflator ratio is defined as, dividing nominal GDP by real GDP and multiplying by hundred. This measures the price inflation of the country. (GDP Price Deflator | U.S. Bureau of Economic Analysis (BEA), 2021).

Figure 1.14: USA’s GDP Price Deflator.

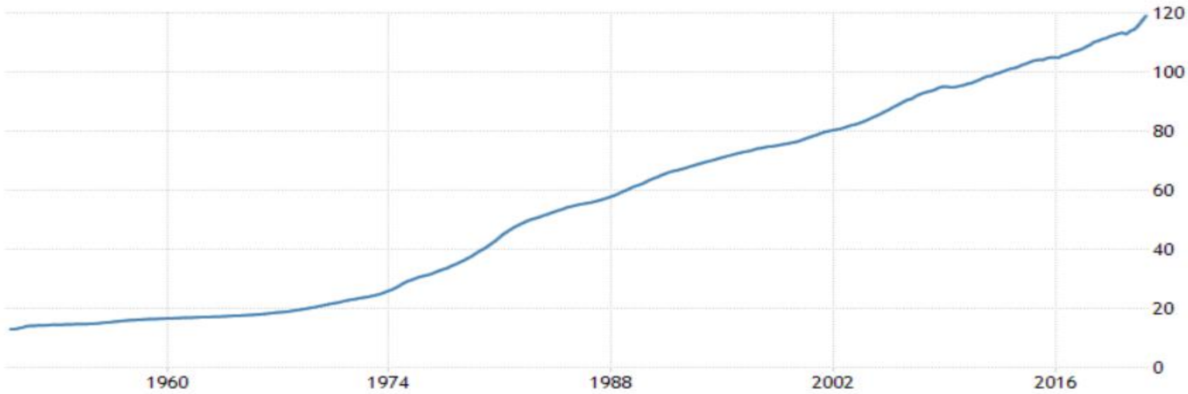


Figure 1.15: Australia’s GDP Price Deflator.

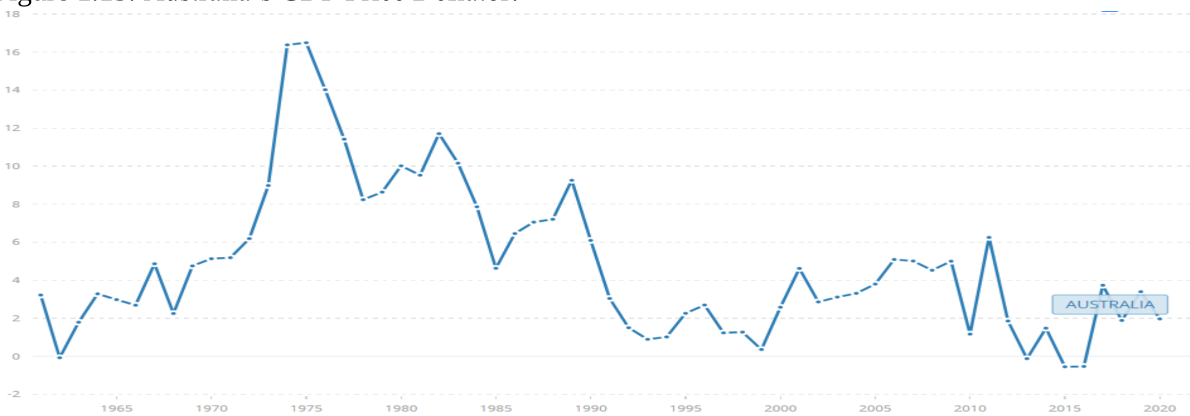
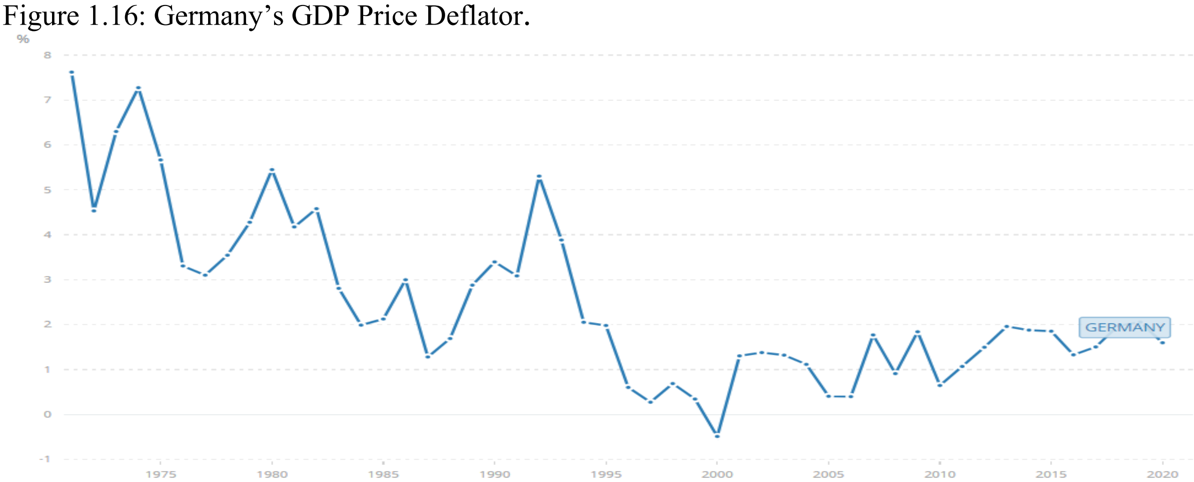


Figure 1.16: Germany’s GDP Price Deflator.



In 2019, US exported products worth $24.9 billion to Australia. The main products are cars ($1.65 billion), blood, antisera, vaccines, toxins, and cultures ($951 million), and medical instruments ($927 million). During the last 24 years it has increased at an annualized rate 3.33%. In 2017, US exported services to Australia worth $17.4 billion, with travel, royalties and license fees, and other business services. In 2019, Australia exported $10.3 billion to US. The main products are toxins and cultures, blood, vaccines, antisera, sheep and goat meat and frozen bovine meat. During the last 24 years it has increased at an annualized rate 4.69%. Australia exported services to USA in 2018, it's worth $6.1 billion, with travel, financial services and other business services. (Australia (AUS) and United States (USA) Trade | OEC, 2021).

USA exports of goods and services to Australia in 2019 were 26 billion and 22 billion respectively, which were 32.6% and 59% up respectively since 2009. US goods items where trade surplus with Australia were 15.1 billion in the year 2019, also 7% reduction compared to the year 2018. The main leading exports in services sector from USA to Australia were in the financial services, intellectual property sectors and travel. The United States of America considered as Australia's second most powerful important market for goods items of exports, behind Japan, and most important source of goods items imports. Service sector wise, Australia has had a well trade in goods and services of deficit with the USA (Australia (AUS) and United States (USA) Trade | OEC, 2021).

In 2019, United States exported products worth $59.8 billion U.S dollar to Germany. The main products are vaccines, toxins and cultures and gas turbines, cars, blood, and antisera. In USA, during the last 24 years, export has annually increased at an annualized rate of 3.79%. United States exported services to Germany in 2011, which worth $18.7 billion, with transportation and license fees, travel and royalties. In 2019, Germany exported products worth $131 billion U.S dollar to United states. The main products are vehicle parts, packages medicaments and cars. During the last 24 years, export has annually increased at an annualized rate of 5.3%. In 2018, Germany exported to United states products worth $47.6 billion U.S dollar, with transportation, other business services, and computer and information services. (United States (USA) and Germany (DEU) Trade | OEC, 2021).

1.2. Research Problem and justification.

As our research problem was "What key factors affect the evaluation of United states trade balance with Australia and Germany including a demographic variable.

The main rationale behind the research problem is that due to substantial trading affairs between USA with Australia and USA with Germany the fluctuations and the changes that takes place adversely and favourably on USA trade balance including terms of trade.

1.3. Research Objectives.

As our objective was,

- To determine these factors which influence the trade balance between USA and Australia.
- To determine these factors which influence the trade balance between USA and Germany.
- To analyse the symmetry on the effects of rising and falling US dollar rate with respect to Australian dollar.
- To analyse this symmetry on the effects of rising and falling US dollar rate with respect to the use of EURO by Germany.
- To tests for the long and also the short run relationships among Australia's import and Australia's export shares.
- To tests for the long and also the short run relationships among Germany's import and Germany's export shares.
- To analyse the long and short run relationship between the exchange rate and the country's trade balance.

1.4. Research Questions.

We asked the following type of research study questions in our study:

- Does rising and falling US dollar against Australian dollar affect the trade balance?
- Does falling and rising US dollar against Germany Euro affect the trade balance?
- Do export/import shares between US and Australia has long run relationship?
- Do export/import shares between US and Germany has long run relationship?
- Does exchange rate affect the long run relationship of trade balance?

Answer to the above questions will help analyse the determinants of USA vs Australia and USA vs Germany trade balance analysis in the long and short run periods.

After conducting a detailed critical review of the significant part of the literature review, we developed four hypotheses to evaluate the research questions.

Hypothesis 1: Significantly linear relationship between the determinants of net export is price ratio (PR), GDP ratio (GR), money supply ratio (MR), lending rate ratio (LR), and real exchange rate (RER). (All the ratio variables are in natural logs)

(Establishing a relationship between USA's net export and microeconomic variables such as money supply, lending rate, GDP, GDP deflator ratio, exchange rates and a demographic variable youth dependency for Australia and Germany)

Hypothesis 2: Net export has significant impact on exchange rate.

(Identify the behaviour of USA's net export for rising and falling exchange rates)

Hypothesis 3: Significant long run adequate relationship analysis between country's net exports and its chosen determinants.

(Also, in the long run net exports are influenced by microeconomic variables such as money supply, lending rate, GDP, GDP deflator ratio, exchange rate and a demographic variable youth dependency variable for both pair of countries)

Hypothesis 4: Significant relationship between import/export shares and output growth/ GDP ratio, also significant relationship between net export and exchange rate.

(Identify the relationship between Australia/ Germany import/export shares and output growth, also, relationship between USA's net exports and Australia/ Germany exchange rate)

Hypothesis 5: Significant long and short run necessary relationship analysis between net exports and exchange rate.

1.5. Organisation of the study.

This dissertation shows an evaluation of United states of America's trade balance with Australia and Germany including a demographic variable. Dissertation has been divided in to five main chapters which are Introduction, Literature Review, Methodology, Empirical results and Findings and Conclusions.

First chapter: Introduction which gives the basic idea of USA's trade balance and objectives of this research study.

Second Chapter: Literature Review, which focused on previous research studies related to this research topic and help to find out and fill the gap.

Third Chapter: Methodology, which focus on theoretical background of the study. Statistical theory used for this research study described under this chapter.

Fourth Chapter: Empirical Results and Findings, which shows the results and findings of the objectives of this research study.

Fifth Chapter: Conclusion, which concludes the conclusions and will help for the new research studies.

CHAPTER 02
LITERATURE REVIEW

2.1. Introduction.

One of the most important chapters in this study is this literature review. This purpose of this study is to emphasize this various research results findings of numerous scholars related to this research study. Most of the literatures conducted to identify the relationship between net exports and microeconomic economic variables and also some literatures related to demographic variables and microeconomic economic variables. This literature section consist is to undertake a comprehensive study on national and international literature available concerning key areas that are necessary to have a better understanding of the research study.

2.2. Related researches.

These empirical studies also have more powerful verification that international trade on this economic development which has a positive effect by facilitating this capital accumulation, modernization of industrial structure, institutional and also technological progress. Particularly, growing imports of capital and intermediate products, which are not obtainable on the domestic market may growing the strength of country's production (Sun and Heshmati 2010). Wagner (2007) described about promotion of the export fosters expanded intense competition and improved the growing of productivity. There were many case studies that evaluated the effect of the nation's trade balance on the country's growing economic development. Further, several types of empirical studies were conducted on list of countries, also panel or individual country cases. Most of the empirical studies analyse the casual relationship among the trade and the growing economic development on individual nation's level, mostly on developing nations.

In the export segment, spread of knowledge and technology facilitated using training activities. In addition to that, these trade benefits are widely generated by these external environmental factors, the structure of trade, and the proper trade policy. Large number of various empirical studies have been conducted on the effect of the trade on growing economic development. Before 1960s, when trades of impact these studies were conducted here only in a very few selected specific nations. The econometrics development is based on this research mathematical analysis model, which has been introduced by researcher to analyse this result of interactive results of trade and the growing economic. The main focus of this study is on the examination of the causal link among nation's trade as well as the growth of economic, whether particular growth of economic is driven by trade or vice versa.

Sun and Heshmati (2010) studies mentioned that international trading which exerts a positively impact shown on China's growing economic. However, China facing with lower level of domestic absorptive capacity, worsening the trading conditions, the negative result influence on the environment, and also trading friction with particular partners and an uneven outcome of this regional progress.

These research study done by Altaee et al. (2016) used particularly ARDL model as well as ECM model to investigate the particular short-run term as well as the long-run results of trade on the level of growing economic. The outcome of this study result given that; outcome of export has positively influenced on the level of economic growth. Moreover, it shows that the import influenced the growth of real GDP value negatively in the country of Kingdom of Saudi Arabia.

K. Navaneetham (2002) fitted on Ordinary Least Squares (OLS) model in order to find the relationship between the economic well-known growth and age structural transition. Data obtained from United nations and Penn World tables from 1950 to 1992 annual data. Variables selected for this study were, investment share of GDP, age structure, share of public consumption expenditure, net foreign balance, inflation rate, tropical conditions and institutional quality. This study covers Indonesia, Malaysia, Thailand, Singapore and Sri Lanka. This study concluded the results that the demographic variable had a positive impact on required economic well-known growth.

This is a key factor to evaluate the impact of desired level of growing economic on trade balance, when evaluating the importance of economic and effectiveness of international trading for a nation or the trade policies has to improve in the future. Some particular industrialized countries, which are known as USA, Greece, Portugal, United Kingdom, Spain and Australia show very large as well as uncompromising particular trade deficits. Large level of trade deficits can also be observed in the other various nations such as, Eastern and Central European countries. Moreover, on the other hand there are some Western European known countries such as Germany, Finland also Austria, Switzerland, Netherlands, Sweden as well as Ireland have accumulated outcome of sustainable trade surpluses measured output as a fraction of GDP. On other hand, the trade balance differences across the countries and also the time, it’s very important to analyse the influencing factors especially trade balance and also there are any other differences in the impact of across the nations. Many of these empirical analyses have variously looked into the trade balance determinants. Also, some various looked into the bilateral trade balance also while rest of the focus on the aggregate trade balance.

According to United Nations report (2011), the level of demographic change and level of growth, various countries have been affected various ways. Most developed countries have hit older age systems and are witnessing reducing proportions of youth and working age adults, also with adverse effects on labour supply and support ratios for their ages. Many developing countries are facing rising numbers and percentage of youths and working age populations, which can contribute to a short-term demographic benefit under the right conditions, but same time creating problems in terms of educations and job opportunities (united nations, 2011).

Mason (1987, 1988) studies identified that there was an opposite reaction on aggregate savings because of the youth dependency ratio part and also the growing population rate. Bloom and Williamson (1997) and also Williamson (1998) as well as Higgins and Williamson (1997) especially looked into the country East Asia for the implications of especially growing youth dependency. Researchers discussed that the investment and also savings has an important role on youth dependency, and also foreign capital dependence. This idea was discussed by the author Coale as well as Hoover (1958). Various types of empirical studies before 1980s, identified that there was a negative macroeconomic link among dependency ratios and also saving rates. Bloom and also Sevilla (2001) as well as Bosworth, Bryant, Canning, also Burtless (2004) also survey some of these researches.

Elena Bobeica et al (2017) analysed about the relationship between demography and inflation rate using VAR model. Data collected from 1975 to 2016 for this study. Variables selected for this study were, share of working age population, real interest rate as well as inflation rate. The results indicated that there is a positive long run relationship analysis between the inflation and the working age population growth rate. Also, this long run relationship can be reduced by monetary policy.

Atif Ali Jaffri et al (2016) analysed and studied on the given impact of demographic changes on inflation in Pakistan. These Autoregressive Distributed Lag (ARDL) model used for this analysis. Population growth, middle age working population proportion, consumer price index, inflation, real GDP, change in terms of trade and money supply growth were used in this study. Results concluded as the population growth has positive impact on inflation and middle age working population portion has negative effect on inflation. Also, negative coefficients of Error correction model (ECM) show that, there exists a long run relationship analysis between variables.

Yugang He (2017) studied on the trade balance between China and USA based on cointegration analysis. Cointegration test used for the analysis. The outputs show that the amount of export, this nominal exchange rate and USA's disposable income have positive effect on trade balance. And also, China's disposable income and import have negative effect on that. To maintain a better trade balance China's government should open more domestic market to the world.

Yee et al (2016) analysed the relationship of exports with inflation, imports, exchange rate and foreign direct investment. Data collected from 1975 to 2013. Ordinary least square method used for this analysis. Results revealed that the amount of country's import has positive relationship with the amount of country's exports, which explained that electric and electrical equipment are the major export components. Foreign exchange rate has positive relationship with export. This study pointing out some effective policies and activities which can be used to increase the export.

Stephen S. Kyereme (2002) analysed the determine factors of USA and Australia's trade balance and also tests done for the existence of long run period relationships. Data collected from 1965 to 2002. In this study, multiple linear regression test used to identify the determine the factors of USA and Australia trade balance. Also, relevant cointegration tests used to find the short or long run relationships. Asymmetric of exchange rate shifts in the parameter identified using the F – test. This research study estimated the regression model to clearly monitor as well as to forecast the USA and Australia's trade balance.

Arize (2017) studied the USA's trade balance and real effective exchange rate relation. ARDL method used for this analysis. This study investigated that not only long run relationship but also the short run dynamics between USA's trade balance as well as the given real effective exchange rate.

Kumar (2020) has studied the results of India's trading on the analysis of growing economic of neighbour country Sri Lanka, Bhutan, Bangladesh and also Nepal. The negative effects of imports, and also positive effects of exports were found in pair of countries. This research study focusing the particular importance of given exports to provide positively economic performance as well.

Fetahi-Vehapi et al. (2015) analysis has investigated results in ten particular South East especially European countries for the reaction results of the trade on growing economic development indicated the positive results. Also used the growing economic development, which is conditioned by other explanatory variables such as, human capital as well as gross fix capital information and also the initial income per capita. Empirical various evidence can be also very sensitive to the particular research periods and also the considered data sources which are selected, also the trade measurement. In their research studies, the majority of these authors have done analysis for the changes in the selected GDP as a dependent variable. However, there is no any other different consensus especially on the selection of various independent variables. These empirical research studies also analysed, described and also distinguished where there are three independent different factors such as exports and trade balance as well as imports.

Another various group of these studies which examines this relationship among various trade as well as the economic growth by applying various panel data or else the across country. Michelis as well as Zestos (2004) applied Granger and causality cointegration test especially for export as well as the growth of imports to the analysis on growth of GDP, which pointing out the different policies also had orientated these only to different export promotion, can be very inefficient. Awokuse (2007) also easily mentioned that various trade stimulates the growing economic development emphasising various role on exports and also on imports. Moreover, these research study by Awokuse (2008) had analysed the major three countries especially in Europe region confirmed that the trade impact on the economic rapid growth as well.

This author had used the different specific variables for the analysis and determine the factors of trade balance. Trade volume considered especially as a major share of the variable GDP (Fetahi-Vehapi et al. 2015) and also it was trade deficit (Abbas and Raza 2013). The important factor import was analysed by the specific authors (Awokuse 2007, 2008; Altaee et al. 2016) and also some other authors (Cetintas and Barisik 2008; Sun and Heshmati 2010), who had especially analysed using especially the variable export.

This can be concluded as, there is no any clear consensus on the specific inclusion of selected independent variables in the analysed statistical model of the trade balance impacts especially on growing economic sectors. As it depends specifically on the subjective specific purpose of the empirical research study and the theoretical analysis selected approach chosen. Moreover, it can be clearly seen that, there is lack of research studies analysing determine factor of trade balance impact on various economic fast growth in selected European countries. Also, to reveal particular country’s trade balance, is important to include not only export or else import separately.

CHAPTER 03
DATA AND METHODOLOGY

This chapter described the data collection for an evaluation of United States' trade balance with selected two countries, namely Australia and Germany including a demographic variable. Subsection 3.1 described the source of variables and defines the construction of variables. Subsection 3.2 and all subsequent ones described the methodology used for this research study.

3.1. Source of Variables.

Annual data from January 1980 to December 2018 was collected for an evaluation of United States' trade balance with Australia and Germany including a demographic variable.

A country's net export is defined as the amount of its total of export minus the amount of its total of import. While nation's positive net exports have a benefit of a trade surplus and negative net export means trade deficit. USA's net exports, Australia's net exports and Germany's net exports were collected from Macro Trend website. Macro Trend website is known as a fundamental needs analysis website, is managed, maintained and also which operated by the savviest financial analysts and this website is engaged with the market traders too. Data was measured in billion US dollars. The net export ratio of USA to Australia and USA to Germany were collected.

The country's gross domestic product divide by its total population is defined as "gross domestic product per capita", GDP and total population obtained from USA federal reserves by United States' central bank. The money supply is a broad measure which includes cash and checking deposits and lending rate. The rate of interest processes payable when repaying the loans. Annual Money supply, annual lending rate of Australia and annual lending rate of Germany obtained from the Organisation for Economic Cooperation and Development (OECD). Money supply ratio (MR) and also lending rate ratio (LR) for both pair (USA vs Australia and USA vs Germany) also calculated using the collected data.

The nominal exchange rate, which is defined as the value of domestic currency or home currency necessary to purchase the amount of particular foreign currency. Nominal exchange rate obtained from USA federal reserves by United States' central bank. US/AUS real exchange rate and US/EUR real exchange rate obtained from investing website.

The ratio of GDP price deflator between USA to Australia and USA to Germany were calculated. The value of nominal GDP divide by the value of real GDP and multiplying by 100 is defined as GDP price deflator ratio, measures price inflation in an economy.

The youth dependency ratio between USA to Australia and USA to Germany were obtained. The youth dependency ratio (DE) is calculated as a number of persons between 0 – 14 years compared to the number of working age population 15 – 64 years as a percentage, was taken form World Development Indicators 2000 and Penn World Table. Youth dependency ratio obtained from Penn world population prospects 2019.

3.2. Methodology.

Our interest is in learning about United States' trade balance with selected two countries especially Australia and Germany including a demographic variable. We intend to estimate the factors affecting United states' trade balance with selected two countries Australia and Germany also the long and short run relationship between the selected variables.

Further, non-stationary variables should not be used in regression models, to avoid the problem of spurious regression. However, there is an exception to this rule. (Hill, Griffiths and Lim, n.d.).

If Y_t and X_t are non-stationary I (1) variables, then we expect their difference, or any linear combination of them, such as $e_t = Y_t - \beta_1 - \beta_2 X_t$ to be I (1) as well. Also, Y_t and X_t are said to be cointegrated. Cointegration implies that Y_t and X_t has similar stochastic trends. (Hill, Griffiths and Lim, n.d.).

Further, all the variables are in first order I (1) means non stationary. Test the cointegration for all the non-stationary variables and fitted the multiple linear regression model. Here the results are super consistent, but only few variables result included under empirical analysis. When non stationary variables are used in regression analysis, such regression are said to be spurious if the variables are not co-integrated. Then it will be a false consistency.

Augmented Dickey – Fuller test (ADF) and also Phillips – Perron tests (PP) used to look into especially the stationarity of the regression study variables. In all the cases, the result provided by Phillips – Perron (PP) tests are consistent compared to Augmented Dickey – Fuller (ADF) tests. All the variables are I (1) which means they are non-stationary. Since the variables are non-stationary, then run the cointegration test to identify the relationship. Also, cointegration tests showed the relationship between variables then run the multiple linear regression model to identify the determinants of USA's trade balance. These results are called super consistent.

Cointegration methods used to observe the short and also the long run relationship between United States trade balance with the selected two countries. Engle and Granger suggested the simple ordinary level least squares (OLS) based estimation procedure and also maximum likelihood methods advocated by Johansen have been used. Johansen's method integrates both the long run and also the short run dynamic. Moreover, the number of cointegrating vectors can be determined by Johansen's method. A cointegrating relationship amongst I (1) series exist if the residual series is stationary.

The multiple linear models used to determine the factors affecting United States trade balance compared to Australia and Germany. The following variables used in the multiple linear regression model, GDP per capita (GR) ratio, nominal exchange rate (ER) ratio, youth dependency (DE) ratio, money supply (MR) ratio, lending rate (LR) ratio, real exchange rate (RER) ratio, and GDP price deflator (PR) ratio.

Error correction method (ECM) is applied to analyze multivariate time series data that is not stationary, but cointegration occurs between the variables used in the model. This method will also be used to see how much influence independent variable have effect on the dependent variable in the long run. Error correction model allows for the existence of an underlying or fundamental link between variables (the long run relationship) as well as for short run adjustments.

3.3. Stationary Timeseries.

The statistical properties of a time series such as mean, variance, and autocorrelation are constant over time period is defined as a stationary time series. Another reason for stationaries a time series is, which is only the series is stationary is to be able to obtain a meaningful statistic as descriptors of future behavior. The time series which has a stable long run trend, then by detrending may possible to stationaries that time series. Such series is said to be relevant trend stationary.

Moreover, sometimes relevant detrending also not sufficient to make this time series as stationary. Also, it is necessary for us to transform it into a time series of season-to-season differences in time series. In some series, the variance, mean, and also autocorrelation of the relevant original time series is not constant over time period, also even after the relevant detrending, perhaps the required statistical changes in time series between season to season will be constant. Such kind of a time series is referred as a difference stationary.

The changes of the series from one period to the next period is defined as first difference of a time series. If Y_t defined as the dependent value of the relevant time series Y at time period t, then also the first difference of a time series Y value at period t is also equal to $Y_t - Y_{t-1}$. The time series Y is a random walk model, which means the first difference of Y is stationary and completely random. Before one embarks on a regression analysis, it's also very important thing to know whether a relevant time series is also stationary or its non-stationary. Moreover, the relevant time series explained as unpredictable and cannot be modeled or forecasted is referred as non-stationary data time series. The result obtaining by using relevant non-stationary of the time series also known as may be spurious, where it may be indicated that a relationship analysis between relevant two variables and where one variable does not exist. (Hill, Griffiths and Lim, n.d.)

3.4. Unit root test.

Unit root stationary test used to analysis whether, time series variable is non-stationary and processes a unit root test. The presence of unit root is defined as null hypothesis, and alternative hypothesis is either. If trending data should be considered first differenced on deterministic level functions of time to render the relevant data stationary will be determine using unit root tests. The number of unit roots stationary test carried in the series described as the order of integration, or in other words number of types differencing the operations needed to make the time series stationary. (Hill, Griffiths and Lim, n.d.)
There are many more tests to determine that, a series is stationary or series is non-stationary.

Following unit root tests exists,

- Dickey Fuller Test is a test tests for the null hypothesis, where a unit root is also present in necessary to an auto regressive model time series sample. Also, the alternative hypothesis is also mostly stationarity or trend stationarity. The lower the p value or more negative p value and hence we want to reject the null hypothesis.
- The Phillips–Perron (PP) Test is defined, as a modification version of the Dickey Fuller test tests and also it corrects for the autocorrelation and also the heteroscedasticity also in the error terms.
- Ng – Perron Test statistics are modified form of Phillip – Perron statistics.

- The Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) Test statistics is based on the residuals from OLS (ordinary lease squares) regression.

H_0: Time series has a unit root (non-stationary)
H_1: Time series hasn't a unit root (stationary)

3.4.1. Dickey-Fuller Unit Root Tests.

Dickey Fuller (1984), whose augment defines as the basic autoregressive unit root stationarity test used to accommodate general ARMA (p, q) models and also with the unknown orders of parameters and their test is only referred to as the augmented Dickey- Fuller (ADF) test. This test is valid in large samples.
Augmented Dickey- Fuller (ADF) test used to test tests for the null hypothesis that a unit root stationary is present in the timeseries. Autoregressive and also the random walk models, where stochastic level processes in the time series can include here or exclude here a constant term and also time series can include or exclude a time trend as well. (Hill, Griffiths and Lim, n.d.)
There are three required variations available in Dickey – Fuller unit root test for the role of constant term and the trend.

AR (1) process,
$Y_t = \rho Y_{t-1} + \varepsilon_t$ is stationary when $|\rho| < 1$, but when $\rho = 1$, it becomes the non-stationarity random walk process $Y_t = Y_{t-1} + \varepsilon_t$.
One way to test stationarity is to examine the value of ρ. In other words, whether $\rho = 1$ or significantly less than one.

Case I: <u>No constant and no trend.</u>
AR (1) model,

$$Y_t = \rho\, Y_{t-1} + \varepsilon_t$$

Where, ε_t : iid N (0, σ^2)

Where ε_t are independent random errors with zero mean and constant variance σ^2. Test for non-stationarity by testing the null hypothesis that $\rho = 1$ against the alternative $|\rho| < 1$.

$$Y_t - Y_{t-1} = (\rho - 1)\, Y_{t-1} + \varepsilon_t$$
$$\Delta(Y_t) = (\rho - 1)\, Y_{t-1} + \varepsilon_t$$
$$\Delta(Y_t) = \gamma\, Y_{t-1} + \varepsilon_t$$

$H_0 : \rho = 1$ or $H_0 : \gamma = 0$
$H_1 : \rho < 1$ or $H_0 : \gamma < 0$

Null hypothesis is that the time series is non-stationary. If we do not reject the null hypothesis, we conclude that the series is non-stationary process. If we reject the null hypothesis that $\gamma = 0$, then we conclude that the series is stationary.

Case II: <u>With constant but no trend.</u>
AR (1) model,

$$\Delta(Y_t) = \alpha + \gamma\, Y_{t-1} + \varepsilon_t$$

Where, ε_t : iid N (0, σ^2)

$H_0 : \rho = 1$ or $H_0 : \gamma = 0$
$H_1 : \rho < 1$ or $H_0 : \gamma < 0$

Null hypothesis is that the time series is non-stationary. If we do not reject the null hypothesis, we conclude that the series is non-stationary. If we reject the null hypothesis $\gamma = 0$, then we conclude that the series is stationary.

Case III: <u>With constant and with trend.</u>

AR (1) model,

$$\Delta(Y_t) = \alpha + \gamma Y_{t-1} + \lambda_t + \varepsilon_t$$

Where, ε_t : iid N (0, σ^2)

$H_0 : \rho = 1$ or $H_0 : \gamma = 0$

$H_1 : \rho < 1$ or $H_0 : \gamma < 0$

Null hypothesis is that the time series is non-stationary. If we do not reject the null hypothesis, we conclude that the series is non-stationary. If we reject the null hypothesis $\gamma = 0$, we conclude that the series is stationary.

Here we use t-statistic to test zero null hypotheses for coefficients.

In general, ARMA (p, q) model,

$$\sum_{i=1}^{p} \rho_i \ \Delta(Y_{t-i}) = \alpha_0 + \sum_{j=1}^{q} \rho_j \ \Delta(Y_{t-j}) + \varepsilon_t$$

Where, ε_t : iid N (0, σ^2)

3.4.2. Phillips-Perron Unit Root Tests.

The Phillips-Perron (PP) unit root stationarity tests differ from the ADF tests. The reason for the difference is mainly in how they deal with one of the assumptions as serial correlation condition and also the other assumption heteroskedasticity conditions in the errors. Where, the ADF unit root stationarity test tests use a parametric autoregression to approximate the ARMA structure of the errors in the test regression, the PP tests which ignore any serial correlation in the test regression.

This test is used in time series analysis to test the null hypothesis that a time series is integrated of order 1. Phillip-Perron test makes a non-parametric correction to the t-test statistic. Phillip-Perron test performs worse in finite samples than the augmented Dickey-Fuller test (Hill, Griffiths and Lim, n.d.).

$$\Delta Y_t = \alpha_0 + \pi Y_{t-1} + \varepsilon_t$$

Where ε_t is I (0) and may be heteroscedastic. This test corrects for any serial correlation and heteroscedasticity in the errors ε_t of the model. These modified statistics Z_t and Z_π are given by,

$$Z_t = \left(\frac{\sigma^2}{\lambda^2}\right)^{\frac{1}{2}} . t_{\pi=0} - \frac{1}{2} . \left(\frac{\lambda^2 - \sigma^2}{\lambda^2}\right) . \left(\frac{T . SE(\pi)}{\sigma^2}\right)$$

$$Z_\pi = T\pi - \frac{1}{2} . \left(\frac{T^2 - SE(\pi)}{\sigma^2}\right) . (\lambda^2 - \sigma^2)$$

The terms σ^2 and λ^2 are consistent estimates of variance parameters.

$$\sigma^2 = \lim_{T \to \infty} T^{-1} \sum_{t=1}^{T} E(U_t)^2$$

$$\lambda^2 = \lim_{T \to \infty} \sum_{t=1}^{T} E(T^{-1} S_T)^2$$

$$S_T = \sum_{t=1}^{T} U_t$$

The sample variance of the least square's residual U_t is a consistent estimate of σ^2 , and the Newey-West long run variance estimate of U_t using U_t is a consistent estimate of λ^2.

One advantage of Phillips-Perron Unit Root tests over Dickey-Fuller Unit Root tests are robust to general forms of heteroscedasticity in the error term U_t. Also do not have to specify a lag length for the test regression.

3.4.3. Ng – Perron Tests.

Phillip and Perron found that use of SD could improve the performance of the test result.
Ng-Perron designed new test combining GLS detrending with SD. It consists of four test statistics namely MZα, MZt, MSB^d, MP_T^d. The Ng-Perron test conducted to investigate the order of integration of the series. This test is suitable for small samples. Since the test statistic do not follow student distribution.

$$\Delta Y_t = \alpha\, Y_{t-1} + x_t{}^1\delta + \beta_1\, Y_{t-1} + \beta_2\, \Delta Y_{t-2} + \cdots + \beta_P\, \Delta Y_{t-p} + \varepsilon_t$$

$$H_0 : \alpha = 0$$
$$H_1 : \alpha < 0$$

The test of Ng-Perron consists of four-unit root test based on the modifications.

$$k = \sum_{t=1}^{T} \frac{(Y_{t-1}^d)^2}{T^2}$$

$$MZ_\alpha^d = \frac{(T^1\, Y_T^d)^2 - f_0}{2k}$$

$$MZ_t^d = MZ_\alpha \times MSB$$

$$MSB^d = \left(\frac{k}{f_0}\right)^{\frac{1}{2}}$$

$$MP_T^d = \frac{(\bar{c}^2 k - \bar{c}T^1)\,(y^d{}_T)^2}{f_0} \text{ when } d_t^0$$

$$MP_T^d = \frac{(\bar{c}^2 k + (1-\bar{c})\, T^1)\,(y^d{}_T)^2}{f_0} \text{ when } d_t^1$$

Here f_0 represents the estimate of spectral density at frequency zero. d_t^0 represents drift and d_t^1 represents drift and trend.
Unit root test based on long run variance estimates the serial correlation and heterogeneity.
The spectral density at frequency zero represent about heteroscedasticity and auto correlated standard error. Normally we use two ways to estimate the spectral density at frequency zero, those are autoregressive spectral density and kernel based spectral density.

3.5. Unit root test with structural breaks.

Zivot – Andrews unit root test.

The Zivot – Andrews's test to analyse the presence of unit root and structural break in the series of variables. Also, the unit root test which found that the series has one-unit root, then it must transform the data by differencing the variables. A well-known weakness of this ADF unit root test is their structural break for the non-stationary series with the required structural break date.

H_0 : The times series is said as non-stationary with a structural break in relevant both the intercept and trend. (Has unit root)
H_1 : The time series is said as stationary with a structural break in relevant both the intercept and trend. (hasn't unit root)

3.6. Cointegration Tests.

Cointegration technique, which is used to find a possible correlation between time series in the long run period. Also, when two or else more time series are considered as non-stationary time series, but a linear time series combination of the time series is said as stationary series, these series are considered as cointegrated series. Cointegration detects any common stochastic trends in the series.

$X_t = W_t + \varepsilon_{xt}$
$Y_t = W_t + \varepsilon_{yt}$
$W_t = W_{t-1} + \varepsilon_t$

All the errors are independent and identically distributed also independent of each other.

$X, Y \sim I\ (1)$
$X - Y \sim I\ (0)$

$X_t\ and\ Y_t$ have a common stochastic trend given by random walk component.

There is an important case when $\varepsilon_t = Y_t - \beta_1 - \beta_2 X_t$ is a stationary I (0) process.
Here variable $Y_t\ and\ variable\ X_t$ are cointegrated. Cointegration implies that $Y_t\ and\ X_t$, has similar very relevant stochastic trends and also considered as the difference ε_t is also stationary, never diverge these series too far from each other. When $Y_t\ and\ X_t$ are cointegrated, then the errors $\varepsilon_t = Y_t - \beta_1 - \beta_2 X_t$ are stationary. We can't observe ε_t, then stationarity of the least squares $\widehat{\varepsilon_t} = Y_t - \beta_1 - \beta_2 X_t$ will be tested using Dickey – Fuller test.

If the residuals are considered as stationary, then $Y_t\ and\ X_t$ are also said as cointegrated. If the required residuals are considered as not stationary, then $Y_t\ and\ X_t$ are not cointegrated, they will be considered as spurious regression between the variables.

The test for stationarity of the residuals,
$\Delta\widehat{\varepsilon_t} = \gamma\widehat{\varepsilon_{t-1}} + e_t$

H_0 : $The\ series\ are\ not\ contegrated\ OR\ Residuals\ are\ non\ statioanry.$
H_0 : $The\ series\ are\ contegrated\ OR\ Residuals\ are\ stationary.$

There are two main methods of testing for cointegration. Linear combinations of the integrated series are best to define the relevant long run period equilibrium relationships considered between two or more set of variables.

1. Eagle - Granger Test.
2. Johansen Test.

3.6.1. Eagle – Granger Cointegration Test.

The Eagle – Granger method is defined, as a diagnostic purpose to test the null hypothesis of these unit root stationary test for the residuals of cointegration using the Augmented Dickey – Fuller (ADF) test. Residuals will be stationary if the time series is cointegrated (Hill, Griffiths and Lim, n.d.).

This is a two-step process,

1. Estimate an OLS (ordinary least squares) on the I (1) series.
2. Test whether residuals are stationary (ADF Test).

$X_t = c + \alpha Y_t + \varepsilon_t$

X and Y will be cointegrated if and only if ε_t is stationary.

Cointegration vector is $(1 - \alpha)$ and long run equilibrium relationship between X and Y is, $X = c + \alpha Y$.

For n different I (1) variables, the cointegration vector is $(1 - \beta_1 - \cdots - \beta_{n-1})$, here $\beta_1 \ldots . \beta_{n-1}$ are the coefficients of the n-1, I (1) variables used as explanatory variables also other I (1) variable used as independent variable.

The results of the Eagle – Granger single equation test that the null hypothesis of a unit root can be rejected at the 5% significance level. In other words, series are cointegrated. It implies long run equilibrium does exist between variables.

$H_0 : Residuals\ have\ a\ unit\ root$

$H_1 : Residuals\ hav'nt\ a\ unit\ root$

As the Eagle – Granger test referred as statistic decreases, more likely to reject relevant the null hypothesis testing, which is considered as there is no any cointegration. Therefore, time series variables are cointegrated, which is strong evidence.

3.6.2. Johansen Cointegration Test.

Johansen approach is more efficient and less bias than the Eagle and Granger single equation test method, where the number of series is more than two. The reason for more efficiency is, the maximum likelihood procedure, which has finite and good large sample properties. Moreover, Johansen cointegration test considers a simple case, where a time series is integrated of order one I (1), such that the first difference of a time series is stationary. (Hill, Griffiths and Lim, n.d.)

The Johansen procedure uses two considered the likelihood ratio tests, a required maximum eigen value test and relevant trace test to tests for the analysis for the number of cointegration relationships. Multivariate generalization of the unit root tests, here ΔY_t is regressed on Y_{t-1}. If the process has a unit root, based on stochastic trend analysis the coefficient on the lagged level should be zero.

The VAR (1) model,

$\Delta Y_t = \alpha_0 + (A - I)Y_{t-1} + \varepsilon_t$
The error terms are stationary, then $(A - I)\ Y_{t-1}$ must be stationary.

$H_0 : (A - I) = 0\ (Linear\ combination\ is\ not\ cointegrated)$
$H_1 : (A - I)\ \neq 0\ (Atleast\ one\ linear\ combination\ is\ cointegrated)$

The rank of matrix is number of non – zero eigenvalues. Johansen test tests the number of eigen values in (A – I).
Johansen & Juselius (1990) recommended the standard Trace Test for the number of non-zero eigen values in the matrix.

$H_0 : r\ \leq R$
$H_1 : r > R$

$T_r = -T\ \sum_{i=R+1}^{n} \ln\,(1 - \lambda_i)$

Trance statistic T_r must be calculated for every R = 0 to n-1.
Here, T is sample size and n is number of test statistics in the system. Real number of eigen value is λ, such that $0\ \leq\ \lambda\ <\ 1$.

3.7. Linear regression.

Dependent variable Y is explained by a component that varies systematically with the independent variable X and by the random error term ε.
$Y = \beta_1 + \beta_2 X + \varepsilon$, where $\varepsilon \sim N(0, \sigma^2)$.

Regression is referred as a parametric approach that makes assumptions about the data for the purpose of data analysis. It's essential to validate the assumptions for the successful regression analysis. Important assumptions of a regression analysis. (Hill, Griffiths and Lim, n.d.)

There should be an additive linear relationship between dependent and independent variables. Where change in response Y due to one-unit change in X is constant.
$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$

The covariance between the two random errors corresponding to any two different observation is zero. The size of an error for one data observation has no bearing on the likely size of an error for another data observation. Any pair of residual terms is uncorrelated.
$Cov\ (\varepsilon_i, \varepsilon_j) = 0$ and $Cov\ (Y_i, Y_j) = 0$.

Independent variables shouldn't be highly correlated with each other. That means no correlation between independent variables.
$Cov\ (\varepsilon_i, X_j) = 0$

The values of Y are normally distributed about their mean.
Defined as $Y \sim N\ [(\beta_0 + \beta_1 X)\ , \sigma^2]$ which is equivalent to error terms are normally distributed about their mean.
$\varepsilon_i \sim N\ [0\ , \sigma^2]$.

In linear regression, random error has a probability distribution with variance σ^2. Where non constant variance referred as heteroscedasticity.
$Var\ (\varepsilon_i) = \sigma^2$

Linear and Additive.
$Y = \alpha + \beta * X + \varepsilon$
Where Y is defined as a dependent variable, X is defined as an explanatory variable, β is defined as the vector regression coefficient and ε is error terms.
For non-additive and non-linear data set, the linear regression won't fit the model. Residual vs fitted value plots need to be tested to check the linearity of the data set. Polynomial terms can be included to the model to detect non-linear effect.

Auto correlation.
Auto correlation takes place when residuals are not independent from each other. Model's accuracy reduces by correlations in error terms. When next instant is dependent on previous instant on time series models. The standard error reduces in the presence of autocorrelation which results a prediction interval also narrow down. The auto correlation test is done to check the seasonal or correlated pattern in residual values using Breusch – Godfrey Serial Correlation LM tests.

Multicollinearity.
Multicollinearity exists when there are two independent variables are highly correlated. Standard error tends to increase due to correlated predictors. Also, when the standard errors have large values, the confidence interval become wider leading to less precise. It will be a hard task to determine the true relationship between predictors and response variable when a model is with correlated variables. Also, difficult to discover the variable, which is contributing to predict the response variable.

Moreover, predictors are correlated in the model, the estimated regression coefficient of a correlated variable depends on the rest of the predictors in the model. This will lead to incorrect conclusion. Scatter plots used to visualize correlation effect among variables. Also, VIF factor (variance inflation factor) also must use. $VIF\ \leq 4$ suggests no multicollinearity and
$VIF\ \geq 10$ indicates serious multicollinearity.

Heteroscedasticity.
Heteroscedasticity is mainly due to the presence of outlier or extreme leverage values in the dataset. In the mode, heteroscedasticity occurs when there is a non-constant variance in the error terms. These values get too much weight, which will disproportionately influence the model's performance.
Residual vs fitted values plot need to be tested for the series. If heteroscedasticity exists there will be a funnel shape in the plot. White general test or Breusch- Pagan Godfrey tests conducted to detect the heteroscedasticity.

Normal distribution of error terms.
In the normal distribution data set, the error terms are considered as normally distributed. If, the error terms are not normally distributed distribution, which means that the confidence level interval of the data set become narrow or wide. Jarque -Berra test, QQ plots, Kolmogorov – Smirnov test and Shapiro-Wilk tests carried out to satisfy the normality of the data.

3.8. Logarithmic models with logarithm transformation.

Logarithmically transforming variables, when there is a non-linear relationship exists between the independent and dependent variables. Logarithmic transforming is defined as, transforming a highly skewed variable into one that is more approximately normal variable. Also, when logarithm is normally distributed, then it's defined as log normal distribution.

Log- log model.
$logY_i = \alpha + \beta \, logX_i + \varepsilon_i$

Dependent variables and independent variables are log transformed variables. Expected percentage change in variable Y when variable X increases by some percentage.
When both Y variable and X variable are considered as log transformed, are referred to as elastic in econometrics. Also, the coefficient of $\log X$ variable is referred to as an elasticity. (Hill, Griffiths and Lim, n.d.)

3.9. The Error Correction Model.

Cointegration explains the relationship analysis between required I (1) variables also such that the considered residuals are I (0). Also, I (1) set of variables relationships is also often referred to as a considerable long run term relationship variable, while I (0) set of variables relationship is said often defined as considerable short run term relationship variable.

Dynamic analysis relationship considered between the I (0) variables, which embeds a relevant cointegrating relationship which explained as a relevant short run period error correction model.

General model that contains lags of y and x, the autoregressive distributed lag (ARDL) model,

$$Y_t = a_0 + a_1 Y_{t-1} + \theta_0 X_t + \theta_1 X_{t-1} + \varepsilon_t$$

If variable y and variable x are considered as cointegrated, that means there is a long run relationship analysis between these variables.

$$Y_t = a_0 + a_1 Y_{t-1} + \theta_0 X_t + \theta_1 X_{t-1} + \varepsilon_t$$

Add the term $(Y_{t-1} - Y_{t-1} + \theta_0 X_{t-1} - \theta_0 X_{t-1})$ *to the right hand side,*

$$Y_t = a_0 + a_1 Y_{t-1} + Y_{t-1} - Y_{t-1} + \theta_0 X_t + \theta_0 X_{t-1} - \theta_0 X_{t-1} + \theta_1 X_{t-1} + \varepsilon_t$$

$$Y_t = a_0 + (a_1 - 1)\, Y_{t-1} + Y_{t-1} + (\theta_0 + \theta_1)\, X_{t-1} + \theta_0 (X_t - X_{t-1}) + \varepsilon_t$$

$$Y_t - Y_{t-1} = a_0 + (a_1 - 1)\, Y_{t-1} + (\theta_0 + \theta_1)\, X_{t-1} + \theta_0 (X_t - X_{t-1}) + \varepsilon_t$$

$$\Delta Y_t = a_0 + (a_1 - 1)\, Y_{t-1} + (\theta_0 + \theta_1)\, X_{t-1} + \theta_0\, \Delta X_t + \varepsilon_t$$

Let $\alpha = a_1 - 1 = -1(1 - a_1)$

Let $\beta = \frac{\theta_0 + \theta_1}{1 - a_1} = \frac{\theta_0 + \theta_1}{-\alpha}$

$$\Delta Y_t = a_0 + \alpha\, Y_{t-1} - \alpha\beta\, X_{t-1} + \theta_0\, \Delta X_t + \varepsilon_t$$

$$\Delta Y_t = a_0 + \alpha\, (Y_{t-1} - \beta\, X_{t-1}) + \theta_0\, \Delta X_t + \varepsilon_t$$

The expression in parenthesis is the cointegrating relationship, cointegrating relationship between y and x in a general ARDL framework. This is called an error correction equation. The error correction model allows for the existence of long run relationship as well as for short run adjustments.

CHAPTER 04
EMPIRICAL ANALYSIS

This section illustrates and discusses the application of economic procedures that we choose to implement their outcomes. Descriptive statistics, multiple linear regression model and cointegration test results are presented using tables. Statistical tests were conducted and the result and interpretation shown using tables.

4.1. Descriptive Statistics

Descriptive statistics of the variables Gross Domestic Product (GR), real exchange rate (RER), nominal exchange rate (ER), money supply (MR), GDP price deflator (PR), lending rate (LR), USA net exports vs Australia (NE), import share of the country Australia (IS), export share of Australia (ES), youth dependency ratio (DE) for the pair of USA and Australia shown in Table 4.1 and USA and Germany shown in Table 4.2.

Coefficient of variation (CV) selected values describe the real considerable volatility level of the regression variables considered in percentages terms. For the pair of USA and Australia, the very low-level relevant variability of 6.58% is also known as depicted by youth dependency ratio and determinants followed by GDP ratio and export share of Australia. For the pair of USA and Germany, the low-level relevant variability of 5.28% is also depicted by youth dependency ratio and determinants followed by GDP price deflator ratio.

Table 4.1: Summary statistics on variables for the pair of USA and Australia.

Variables	**Mean**	**S. D**	**C. V (%)**
Per person real GDP Ratio (GR)	1.031172	0.291868	11.25
Nominal Exchange rate (ER)	1.324304	0.231657	17.49
Real Exchange rate (RER)	0.787184	0.144815	18.40
GDP Price Deflator ratio (PR)	1.324304	0.231657	17.49
Money Supply ratio (MR)	13.14542	7.180663	34.62
Lending rate ratio (LR)	0.813294	0.290770	25.75
USA net exports to Australia (NE)	10.51929	1.950362	18.54
Export share of Australia (ES)	0.567918	0.066483	11.71
Import share of Australia (IS)	0.666237	0.099671	14.96
Youth Dependency (DE)	1.004260	0.066118	6.58

S. D = Standard deviation

C. V = Coefficient of variation = (S. D / Mean) * 100

Table 4.2: Summary statistics on variables for the pair of USA and Germany.

Variables	**Mean**	**S. D**	**C. V (%)**
Per person real GDP Ratio (GR)	1.261190	0.226050	17.92
Nominal Exchange rate (ER)	1.075316	0.145844	13.56
Real Exchange rate (RER)	0.875694	0.150930	17.24
GDP Price Deflator ratio (PR)	0.909772	0.073267	8.05
Money Supply ratio (MR)	5321561	2777186.	52.18
Lending rate ratio (LR)	0.033124	0.067426	203.56
USA net exports to Germany (NE)	1.463750	0.217931	14.89
Export share of Germany (ES)	0.322457	0.116404	36.10
Import share of Germany (IS)	0.299626	0.082823	27.64
Youth Dependency (DE)	1.407715	0.074334	5.28

S. D = Standard deviation

C. V = Coefficient of variation = (S. D / Mean) * 100

Correlation coefficient of selected variables for the pair of USA and Australia shown in Table 4.3 and USA and Germany shown in Table 4.4.

Table 4.3: Correlation between selected variables. (USA and Australia)

Variable 1	**Variable 2**	**Correlation**
Nominal exchange rate (ER)	Real exchange rate (RER)	0.780891
GDP ratio (GR)	Nominal exchange rate (ER)	0.936172
GDP ratio (GR)	Money supply ratio (MR)	0.323533
GDP ratio (GR)	Lending rate ratio (LR)	-0.275829
Nominal exchange rate (ER)	Money supply ratio (MR)	0.294359
Nominal exchange rate (ER)	Lending rate ratio (LR)	0.287821
Money supply ratio (MR)	Lending rate ratio (LR)	-0.417083
USA net exports of AUS (NE)	GDP ratio (GR)	0.870123
USA net exports of AUS (NE)	Nominal exchange rate (ER)	0.758911
USA net exports of AUS (NE)	Money supply ratio (MR)	-0.494111
USA net exports of AUS (NE)	Lending rate ratio (LR)	-0.475089
Export share AUS (ES)	Import share AUS (IS)	0.976769

Table 4.4: Correlation between selected variables for the pair of USA and Germany.

Variable 1	**Variable 2**	**Correlation**
Nominal exchange rate (ER)	Real exchange rate (RER)	0.893110
GDP ratio (GR)	Nominal exchange rate (ER)	0.980066
GDP ratio (GR)	Money supply ratio (MR)	0.638692
GDP ratio (GR)	Lending rate ratio (LR)	0.126989
Nominal exchange rate (ER)	Money supply ratio (MR)	0.616013
Nominal exchange rate (ER)	Lending rate ratio (LR)	0.244507
Money supply ratio (MR)	Lending rate ratio (LR)	-0.111039
USA net exports of GER (NE)	GDP ratio (GR)	0.558102
USA net exports of GER (NE)	Nominal exchange rate (ER)	0.494928
USA net exports of GER (NE)	Money supply ratio (MR)	0.600450
USA net exports of GER (NE)	Lending rate ratio (LR)	-0.099637
Export share GER (ES)	Import share GER (IS)	0.990141

4.2. Stationary Tests.

ADF unit-root test and also the Phillip – Perron unit-root test conducted to check the stationarity of the following variables, GDP ratio (LNGR), nominal exchange rate (LNER), price deflator ratio (LNPR), real exchange rate (LNRER), lending rate (LNLR), money supply (LNMR), USA's net export (LNNE), export share value of Australia (ES), export share value of Germany (ES), import share value of Australia (IS), import share value of Germany (IS), youth dependency ratio (LNDE) for both pairs.

4.2.1. USA and Australia.

ADF unit-root test and Phillip – Perron test for the pair of USA and Australia shown in Table 4.5 and Table 4.6. All the variables are stationary at the first difference.

Table 4.5: ADF Unit root test for the pair of USA and Australia.

Variables	Level Zero			First difference			Integration
	None	Intercept	Intercept + Trend	None	Intercept	Intercept + Trend	
LNGR	-0.9934	-1.7890	-2.5737	-4.4526 ***	-4.3908 ***	-4.3743 ***	I (1)
LNER	-1.1875	-2.4253	-2.9987	-4.2395 ***	-4.1820 ***	-4.1343 ***	I (1)
LNRER	-0.7251	-3.1504	-3.1376	-4.3280 ***	-4.3220 ***	-4.3859 ***	I (1)
LNPR	-1.1875	-2.4253	-2.9986	-4.2395 ***	-4.1820 ***	-4.1343 ***	I (1)
LNMR	-5.0903 ***	-1.8695	-0.4506	-2.8791 ***	-3.8411 ***	-4.1883 ***	I (1)
LNLR	-2.1651 **	-3.4400 **	-3.1304	-4.2396 ***	-4.1926 ***	-4.3601 ***	I (1)
LNNE	-0.8165	-0.8381	-1.8119	-5.5563 ***	-5.5674 ***	-5.5309 ***	I (1)
ES	-0.4416	-1.7289	-2.1280	-6.0360 ***	-5.9675 ***	-5.8834 ***	I (1)
IS	-0.1887	-1.8986	-1.8702	-5.0926 ***	-5.0309 ***	-4.9895 ***	I (1)
LNDE	-1.7752	-1.8424	-0.7620	-6.0000 ***	-6.1596 ***	-6.6734 ***	I (1)

Notes: All the tests are run using the Akaike Information Criterion (AIC). Models without constant term (none), with constant term (only intercept) and constant with linear trend term (intercept + trend). (***), (**) and (*) denotes 1%, 5% and 10% level of significance respectively.

Table 4.6: Phillip - Perron Unit root test for the pair of USA and Australia.

Variables	Level Zero			First difference			Integration
	None	Intercept	Intercept + Trend	None	Intercept	Intercept + Trend	
LNGR	-1.1107	-1.5501	-1.9872	-4.4548 ***	-4.3934 ***	-4.3750 ***	I (1)
LNER	-0.9507	-1.9948	-2.3911	-4.2757 ***	-4.2201 ***	-4.1766 ***	I (1)
LNRER	-0.9371	-2.4897	-2.3750	-4.3279 ***	-4.3219 ***	-4.3859 ***	I (1)
LNPR	-0.9507	-1.9948	-2.3912	-4.2757 ***	-4.2021 ***	-4.1766 ***	I (1)
LNMR	-4.1348 ***	-1.7019	-0.7688	-2.7921 ***	-3.8441 ***	-4.0534 ***	I (1)
LNLR	-1.7204 *	-2.4221	-1.9716	-4.1650 ***	-4.1167 ***	-4.2790 ***	I (1)
LNNE	-0.8167	-0.8760	-1.8712	-5.5405 ***	-5.5715 ***	-5.5342 ***	I (1)
ES	-0.4417	-1.7074	-2.1460	-6.0360 ***	-5.9675 ***	-5.8834 ***	I (1)
IS	-0.1887	-2.0334	-2.0645	-5.0995 ***	-5.0371 ***	-4.9912 ***	I (1)
LNDE	-1.7758 *	-1.8824	-0.4347	-6.0000 ***	-6.1620 ***	-9.3244 ***	I (1)

Notes: All the tests are run using the Newly - West Bandwidth. Models without constant term (none), with constant term (only intercept) and constant with linear trend term (intercept + trend). (***), (**) and (*) denotes 1%, 5% and 10% level of significance respectively.

4.2.2. USA and Germany.

ADF unit-root test and Phillip – Perron test for the pair of USA and Germany shown in Table 4.7 and Table 4.8. All the variables are stationary at the first difference.

Table 4.7: ADF Unit root test for the pair of USA and Germany.

Variables	Level Zero			First difference			Integration
	None	Intercept	Intercept + Trend	None	Intercept	Intercept + Trend	
LNGR	-1.0676	-2.2529	-2.3164	-5.3601 ***	-5.2676 ***	-5.1839 ***	I (1)
LNER	-2.5495 **	-2.8231 *	-2.7262	-4.6998 ***	-4.6092 ***	-4.5540 ***	I (1)
LNRER	-1.8694 *	-2.2643	-2.8058	-4.7714 ***	-4.6875 ***	-4.5880 ***	I (1)
LNPR	-1.6332 *	-0.5495	-2.1498	-4.4291 ***	-4.8185 ***	-4.5974 ***	I (1)
LNMR	-0.6514	-1.1177	-1.1839	-4.6391 ***	-4.6577 ***	-4.6817 ***	I (1)
LNLR	-0.9279	-0.3126	-1.2234	-5.8389 ***	-5.8768 ***	-6.2356 ***	I (1)
LNNE	-0.9568	-1.8711	-2.3866	-5.8105 ***	-5.7862 ***	-5.7521 ***	I (1)
ES	1.2166	-0.4416	-2.6787	-5.2709 ***	-5.5805 ***	-5.4768 ***	I (1)
IS	0.6872	-0.5255	-3.4674	-5.7034 ***	-5.8465 ***	-5.7378 ***	I (1)
LNDE	0.6501	-2.6982 *	-2.3449	-6.0000 ***	-6.1088 ***	-6.3917 ***	I (1)

Notes: All the tests are run using the Akaike Information Criterion (AIC). Models without constant term (none), with constant term (only intercept) and constant with linear trend term (intercept + trend). (***), (**) and (*) denotes 1%, 5% and 10% level of significance respectively.

Table 4.8: Phillip - Perron Unit root test for the pair of USA and Germany.

Variables	Level Zero			First difference			Integration
	None	Intercept	Intercept + Trend	None	Intercept	Intercept + Trend	
lnGR	-1.2318	-2.5336	-2.6804	-5.4506 ***	-5.3423 ***	-5.4213 ***	I (1)
lnER	-2.0386 **	-2.4658	-2.5703	-4.6655 ***	-4.5534 ***	-4.6108 ***	I (1)
lnRER	-2.0898 **	-2.6218 *	-3.1106	-4.9268 ***	-4.9218 ***	-4.9956 ***	I (1)
lnPR	-3.1211 ***	-1.7224	-2.3815	-4.4290 ***	-4.8124 ***	-4.6115 ***	I (1)
lnMR	-0.5734	-1.2495	-1.5649	-4.6509 **	-4.6033 ***	-4.5976 ***	I (1)
lnLR	-0.9241	-0.3592	-1.2426	-5.8405 ***	-5.8729 ***	-6.9669 ***	I (1)
lnNE	-0.9363	-1.8925	-2.3866	-6.0165 ***	-6.5336 ***	-8.3584 ***	I (1)
ES	1.2166	-0.4416	-2.8519	-5.2709 ***	-5.5759 ***	-5.4625 ***	I (1)
IS	0.6872	-0.5985	-3.5475	-5.7047 ***	-5.9211 ***	-5.7843 ***	I (1)
lnDE	0.6609	-3.1365 **	-2.1046	-6.0000 ***	-6.1097 ***	-6.6553 ***	I (1)

Notes: All the tests are run using the Newly - West Bandwidth. Models without constant term (none), with constant term (only intercept) and constant with linear trend term (intercept + trend). (***), (**) and (*) denotes 1%, 5% and 10% level of significance respectively.

4.3. Cointegration Test.

Since Engle – Granger cointegration test and Johansen cointegration test used to find the existence of long run relationship between selected variables for the pair of USA / Australia and USA/ Germany.

4.3.1. USA and Australia.

Engle – Granger cointegration test used to find out the correlation relationship analysis between Australia's export share value and import share value (ES/ IS) and also output growth (GR) shown in Table 4.9 based on ADF test statistic and MacKinnon critical values. Unit roots in residuals means there is no significant long run relationship between the variables. So, the variables in the cointegrating vector are not cointegrated. Unit root stationary tests suggests that Australia's export share value and import share value (ES/ IS) and also output growth (GR) are I (1) processes.

It's witnessed from Table 4.9 that, where trend term is removed/excluded in the model, there is no any considerable strong cointegration shown among the selected cointegrating vectors. However, when the trend is included, there is cointegration analysis between the Australia's import value of share (IS) and the output growth (GR), and also Australia's export value of share (ES) and the output growth (GR) at 10% level of significance.

Table 4.9: Engle – Granger Cointegration test for Australia's export/import (ES/IS) shares and output growth (GR).

Cointegration Vector	ADF Test	MacKinnon Critical values at 1%	5%	10%	Cointegrated at 1%	5%	10%
1. No trend							
GR, ES	-3.5461	-4.65	-3.93	-2.59	NO	NO	YES
ES, GR	-3.8271	-4.65	-3.93	-2.59	NO	NO	YES
GR, IS	-0.6454	-4.65	-3.93	-2.59	NO	NO	NO
IS, GR	-2.4311	-4.65	-3.93	-2.59	NO	NO	NO
2. With Trend							
GR, ES, T	-3.5947	-5.11	-4.42	-3.18	NO	NO	YES
ES, GR, T	-3.7905	-5.11	-4.42	-3.18	NO	NO	YES
GR, IS, T	-4.7866	-5.11	-4.42	-3.18	NO	YES	YES
IS, GR, T	-3.6238	-5.11	-4.42	-3.18	NO	NO	YES

Engle – Granger cointegration test used to find out the correlation relationship between nominal exchange rate (LNER) (US/AUS) and USA's trade balance (NE) shown in Table 4.10 based on ADF test statistic and MacKinnon critical values. It's witnessed from Table 4.10, when trend is excluded, there is a correlation between nominal exchange rate (LNER)/real exchange rate (LNRER) and USA's net export (LNNE) at 10% significance level. However, when trend is included, there is a cointegration between nominal exchange rate (LNER)/ real value of exchange rate (LNRER) and also trade balance of USA (LNNE) at 10% significance level.

Table 4.10: Engle – Granger Cointegration test for Nominal Exchange Rate (ER) and Trade Balance (NE).

Cointegration Vector	ADF Test	MacKinnon Critical values at 1%	5%	10%	Cointegrated at 1%	5%	10%
1. No trend							
LNNE, LNER	-0.9854	-4.65	-3.93	-2.59	NO	NO	NO
LNER, LNNE	-2.9944	-4.65	-3.93	-2.59	NO	YES	YES
NE, ER	-0.8433	-4.65	-3.93	-2.59	NO	NO	NO
ER, NE	-3.2117	-4.65	-3.93	-2.59	NO	YES	YES
2. With Trend							
LNNE, LNER, T	-3.5794	-5.11	-4.42	-3.18	NO	NO	YES
LNER, LNNE, T	-2.9264	-5.11	-4.42	-3.18	NO	NO	NO
NE, ER, T	-3.2923	-5.11	-4.42	-3.18	NO	NO	YES
ER, NE, T	-3.0751	-5.11	-4.42	-3.18	NO	NO	NO

Johansen approach is considered as more efficient and less bias compared to the Eagle and Granger. Engle – Granger is known as a single equation test method, where Johansen approach is more than two series. Because the maximum likelihood procedure used in Johansen method, has finite sample properties and also large in sample size. Johansen cointegration tests, which suggest that a significant long run relationship between USA and Australia net exports (NE) and its determinants shown in Table 4.11.

$H_0: No\ coinegration\ equations$
$H_1: H_0\ is\ not\ true$
It is concluded that, there is a long run relationship exists among USA's net exports to its determinants.

Table 4.11: Johansen Cointegration Test.

Series in the model: LNNE, LNGR, LNRER, LNPR, LNMR, LNLR				
Hypothesized No. of CE (s)	Eigen value	Trace Statistic	0.05 Critical value	Prob **
None *	0.7385	169.42	117.71	0.0000
Almost 1 *	0.6731	119.78	88.80	0.0001
Almost 2 *	0.5683	78.41	63.88	0.0019
Almost 3 *	0.4949	47.32	42.92	0.0170
Almost 4	0.2835	22.05	25.87	0.1391
Almost 5	0.2308	9.71	12.52	0.1410

4.3.2. USA and Germany.

Engle – Granger cointegration test used to find the correlation relationship between Germany's import / export share (IS/ ES) and output growth (GR) shown in Table 4.12 based on ADF test statistic and MacKinnon critical values. It's witnessed from Table 4.12 that there is no strong correlation between Germany's import / export share (IS/ ES) and output growth (GR) when trend is excluded and also included.

Table 4.12: Engle – Granger Cointegration test for Germany's export/import (ES/IS) shares and output growth (GR).

Cointegration Vector	ADF Test	MacKinnon Critical values at 1%	5%	10%	Cointegrated at 1%	5%	10%
1. No trend							
GR, ES	-2.3470	-4.65	-3.93	-2.59	NO	NO	NO
ES, GR	-0.5437	-4.65	-3.93	-2.59	NO	NO	NO
GR, IS	-2.2258	-4.65	-3.93	-2.59	NO	NO	NO
IS, GR	-0.3108	-4.65	-3.93	-2.59	NO	NO	NO
2. With Trend							
GR, ES, T	-2.2959	-5.11	-4.42	-3.18	NO	NO	NO
ES, GR, T	-1.9983	-5.11	-4.42	-3.18	NO	NO	NO
GR, IS, T	-2.2037	-5.11	-4.42	-3.18	NO	NO	NO
IS, GR, T	-2.5235	-5.11	-4.42	-3.18	NO	NO	NO

Engle – Granger cointegration test used to find out the correlation relationships between nominal exchange rate (LNER) (US/ EURO) and USA's trade balance (NE) shown in Table 4.13 based on ADF test statistic and MacKinnon critical values. It's witnessed from Table 4.13, when trend is excluded, there is a correlation analysis between the nominal exchange rate (LNER), the real exchange rate (LNRER) and USA's net export (LNNE) at 10% significance level. However, when trend is included, there is a cointegration between nominal value exchange rate (LNER)/ real value exchange rate (LNRER) and USA's trade balance (LNNE) at 10% significance level.

Table 4.13: Engle – Granger Cointegration test for Germany's Nominal Exchange Rate (ER) and Trade Balance (NE)

Cointegration Vector	ADF Test	MacKinnon Critical values at 1%	5%	10%	Cointegrated at 1%	5%	10%
1.No trend							
LNNE, LNER	-2.8454	-4.65	-3.93	-2.59	NO	NO	YES
LNER, LNNE	-4.2250	-4.65	-3.93	-2.59	NO	YES	YES
NE, ER	-2.5103	-4.65	-3.93	-2.59	NO	NO	NO
ER, NE	-4.6529	-4.65	-3.93	-2.59	YES	YES	YES
2.With Trend							
LNNE, LNER, T	-3.1082	-5.11	-4.42	-3.18	NO	NO	NO
LNER, LNNE, T	-4.1617	-5.11	-4.42	-3.18	NO	YES	YES
NE, ER, T	-3.8924	-5.11	-4.42	-3.18	NO	NO	YES
ER, NE, T	-4.5821	-5.11	-4.42	-3.18	NO	YES	YES

Johansen approach is more efficient and less bias compared to the Eagle and Granger. Engle – Granger is known as a single equation test method, where Johansen approach is more than two series. The reason for more efficiency is, the maximum likelihood procedure used here which has a finite sample property and also large in size. Johansen cointegration test suggests that, there isn't any significant long term relationship analysis between USA and Germany net exports (NE) and its determinants shown in Table 4.14.

H_0: $No\ coinegration\ equations$
H_1: $H_0\ is\ not\ true$

It is concluded that, there is no long run term relationship exists in among USA's net exports to its determinants.

Table 4.14: Johansen Cointegration Test.

Series in the model: LNNE, LNGR, LNRER, LNDE				
Hypothesized No. of CE (s)	Eigen value	Trace Statistic	0.05 Critical value	Prob **
None *	0.6964	85.4577	63.8761	0.0003
Almost 1	0.4200	41.3491	42.9152	0.0711
Almost 2	0.2829	21.1941	25.8721	0.1714
Almost 3	0.2135	8.8868	12.5179	0.1874

4.4. Multiple Linear Regression

Since my research objective is to analyse the linear relationship among the dependent variable USA's net export (LNNE) and independent variables GDP (LNGR) ratio, money supply (LNMR) ratio, nominal exchange rate (LNER) ratio, lending rate ratio (LNLR), GDP price deflator ratio (LNPR) and youth dependency ratio (LNDE) for both pair of countries (Australia and Germany). We ran three multiple linear regression to determine the significance of selected variables. All these variables used in natural log form.

Models described below using the specific variables for the sample years 1980 – 2018. Also, changes considered in this price level are described by the following changes in the variable GDP deflator, and also 2017 used as the base year. This GDP Deflator taken as a ratio of USA/Australia (LNPR). Per person's real value of output growth is reflected by the level of growth rate of per person's real amount of gross domestic product per capita (GDP Per Capita). GDP ratio taken as a ratio of USA/Australia (LNGR). Export value of share calculated by taking the total value of exports as a percentage of GDP. Similarly, import value of share also calculated by taking the total value of imports as a percentage of GDP.

4.4.1. USA and Australia.

Model A

We present Model A result in Table A1 using the following selected variables, such as USA's net export (LNNE) and independent variables are Gross Domestic Product ratio (LNGR), money supply ratio (LNMR), nominal exchange rate ratio (LNER), lending rate ratio (LNLR), and youth dependency ratio (LNDE). From this table its witnessed that the variable LNDE is not significant at 5% level. Therefore, we excluded LNDE and ran the regression again and the output is given in Table A2.

Model A: $\boldsymbol{lnNE = f\ (lnGR, lnER, lnMR, lnLR, lnDE, \varepsilon_t)}$

From the results presented in Table A2, it's clear that the variable GDP ratio (LNGR) and money supply ratio (LNMR) are significant at 1% level and nominal exchange rate (LNER), lending rate ratio (LNLR) are significant at 5% level.

The negative nominal exchange rate (ER) sign suggests that, when other external factors are equal, nominal exchange rate (ER) ratio rises by 1% explains that US dollar rate weakens against to the Australian dollar. As ER rises by 1% net exports (NE) ratio falls by 0.46%, because even though the value of USA's exports increases, value of imports also increases accordingly but by a bigger value than the exports amount, leading to decline in net exports (NE).

Ramsey Regression Equation Specification Error Test (RESET) test is a general misspecification test for linear regression models. We ran RESET and output shown in Table A3.
$H_0: \rho_1 = \rho_2 = \rho_3 = \rho_4 \dots \dots = 0$ (All coefficients are zero)
$H_1: \rho_i \neq \rho_j$ (At least one coefficient is not equal to zero)
P value > 0.05. we do not reject the null hypothesis. Then all the coefficients are equal to zero which implies that model A do not suffer from misspecification.

Normality tests output given in Table A4 for the Model A of USA and Australia.
$H_0: Residuals\ are\ normally\ distributed.$
$H_1: Residuals\ are\ not\ normally\ distributed.$
P value > 0.05. we do not reject the null hypothesis. Residuals are normally distributed in model A.

Breusch – Godfrey test is for autocorrelation test ran for Model A for the pair of USA and Australia. The result shown in Table A5.
$H_0: \rho = 0. (There\ is\ no\ serial\ correlation\ between\ variables)$
$H_1: \rho \neq 0. (There\ is\ an\ autocorrelation\ between\ vriables)$
P value < 0.05. we reject the null hypothesis. There is an autocorrelation between net exports and determinant variables in model A.

Variance inflation factor (VIF) is defined as a measured amount of multicollinearity in a set of multiple regression variables. $VIF \leq 10$ for the pair of USA and Australia shown in Table A6. $VIF \leq 4$ suggest that there is no multicollinearity between variables.
VIF values indicates that low correlation between variables in model A. $VIF \leq 10$ is acceptable.

Heteroscedasticity is an error variance which means unequal scattering within a particular sample. The variance of the residuals is unequal, over a range of measured values. Table A7 shows that there is no heteroscedasticity for Model A for the pair of USA and Australia.
$H_0: \rho = 0$ (There is no heteroscedasticity in the model).
$H_1: \rho \neq 0$ (There is heteroscedasticity in the model).
P value > 0.05. There is no heteroscedasticity in the model A.

Model B

We present Model B, by substituting the nominal level exchange rate considered by its two sub components, the price deflator (LNPR), and real exchange rate (LNRER). We present Model B using the following variables, such as USA's net export (LNNE) and independent variables are GDP ratio (LNGR), real exchange rate ratio (LNRER), lending rate ratio (LNLR), price deflator ratio (PR), money supply ratio (LNMR), and youth dependency ratio (LNDE).

The variable LNDE is not significant at 5% level. Therefore, we excluded LNDE and ran the regression again and the output is given in Table A8. We ran misspecification RAMSEY test where all the coefficients are equal to zero which implies that model B do not suffer from misspecification. From the results above presented in Table A8, it's very from clear f that the variable GDP ratio (LNGR), real exchange rate (LNRER), lending rate (LNLR), price deflator ratio (LNPR) and money supply ratio (LNMR) are significant at 1% level.

Nominal exchange rate substitution is done to find out if the inflation differential or price deflator between two countries significantly explains the trade flow among these two specific countries, and if that the real value of exchange rate significantly explains trade flows, given the fact that the value of nominal exchange rate was floating during the selected survey period. Floating nominal value rate which makes each nation's monetary policy control inflation rather than serve the value of exchange rate.

These strong significance of the value of price deflator ratio implies that the researchers and the policy makers interested in USA's and Australia's trade issues together with other macroeconomic fundamentals to include the nation's trade balance considered among the other countries throughout the certain time period. Since Australia and USA are known as low inflation countries then these dominance level of the relevant relative price index effects with the particular exchange rate considered is consistent over the time period. 1% rise in the price deflator ratio results in 0.91% fall in the United States of America's net export to Australia. Price deflator ratio and real exchange rate were significant, since USA/Australia rate was floating exchange rate.

As a result of model B shown in Table A8, 1% rise in GDP ratio results in 0.72% fall in the United States of America's net export to Australia. Also, USA's imports increased considerably more relative to relevant level exports, which reduces relevant level of trade gap. Hence, the found negative value of GDP ratio (GR) seems reasonable. While other factors being kept as equal, then the negative considerable sign of money supply ratio (MR) shows that M_2 in the followed USA relative to Australia rises by 1% outputs in 0.21% reduction in the relevant USA's value of net export. Even though a considerable rise in USA's value of export, the increase in USA's imports also exceeds the rise in USA's value of exports.

These positive value lending rate ratio (LR) shows that USA relative to Australia falls by 1% outputs as in 0.13% reduction in the result of America's net exports, because USA's imports considerably rise by a bigger amount than USA's exports rise. These parameters estimate the trade pattern which characterizes the trade balance between the output of USA and Australia countries until perhaps this balanced wise trade is also achieved.

Model B: $\boldsymbol{lnNE = f\ (lnGR, lnRER, lnPR, lnMR, lnLR, lnDE, \varepsilon_t)}$

Normality tests output given in Table A9 for the Model B of USA and Australia.
H_0: $Residuals\ are\ normally\ distributed.$
H_1: $Residuals\ are\ not\ normally\ distributed.$
P value > 0.05. we do not reject the null hypothesis. Residuals are normally distributed in model B.

Breusch – Godfrey test is for autocorrelation test ran for Model B for the pair of USA and Australia. The result shown in Table A10.
$H_0: \rho = 0. (There\ is\ no\ serial\ correlation\ between\ variables)$
$H_1: \rho \neq 0. (There\ is\ an\ autocorrelation\ between\ vriables)$
P value < 0.05. we reject the null hypothesis. There is an autocorrelation between net exports and determinant variables in model B.

Variance inflation factor (VIF) is a measure of the amount of multicollinearity in a set of multiple regression variables. $VIF \leq 10$ for the pair of USA and Australia shown in Table A11.
$VIF \leq 4$ suggest that there is no multicollinearity between variables.

VIF values indicates that low correlation between variables in model B. $VIF \leq 10$ is acceptable.
Heteroscedasticity is an error variance which means unequal scattering within a particular sample. The variance of the residuals is unequal over a range of measured values. Table A12 shows that there is no heteroscedasticity for Model B for the pair of USA and Australia.
H_0: $\rho = 0$ (There is no heteroscedasticity in the model).
H_1: $\rho \neq 0$ (There is heteroscedasticity in the model).
P value > 0.05. There is no heteroscedasticity in the model B.

Model C

We present Model C result in Table A13 using the following selected variables, such as USA's net export (LNNE) and independent variables are GDP ratio (LNGR), real value of exchange rate (LNRER) ratio, money supply (LNMR) ratio, lending rate (LNLR) ratio, and youth dependency ratio (LNDE). We present Model C, to explore the significance level of real value of exchange rate if this amount of price deflator ratio is excluded. The variable GDP ratio (LNGR) is significant at 5% level. Even though the real value of exchange rate is now shows as insignificant in this model, the significance level of other regressors is also reduced sufficiently. The adjusted coefficient of determination reduces from 0.897 to 0.871.

Model C: $\boldsymbol{lnNE = f\ (lnGR, lnRER, lnMR, lnLR, lnDE, \varepsilon_t)}$

Model D

We present Model D result in Table A14 using the following selected variables, such as USA's net export (LNNE) and independent variables are GDP ratio (LNGR), GDP price deflator ratio (LNPR), real exchange rate ratio (LNRER), lagged lending rate ratio (LNLR), money supply ratio (LNMR), and youth dependency ratio (LNDE). The variable real exchange rate (LNRER) isn't significant at 5% level.

We present the result of model D, where lending rate ratio exhibited more importance with other variables. Lending rate ratio describes the relevance of these interest rates in net exports determination. These lending rate ratios, which is another important factor of these relative level growth potential between analysing among these two countries, where monetary tensions also may not be fully captured to influence trade flows.

Model D, to find out the significance of a lagged version lending rate differential explains the United States net exports value with Australia. Natural logarithm of lending rate (LNLR) ratio was replaced by the amount of one year of the lagged version (LNLR (-1)) to find out the significance of results.

When compared with model B shown in Table A8, a very slightly a smaller value adjusted coefficient of the determinant factors. Hence, the GDP ratio is also still a very important model regressor, followed by price deflator value, money supply value, lagged level of lending rate which are significant at 5%, also real exchange rate and dependency ratio are insignificant even at 10%.

Model D: $\boldsymbol{lnNE = f\ (lnGR, lnRER, lnPR, lnMR, lnLR(-1), lnDE, \varepsilon_t)}$

4.4.2. USA and Germany.

Model A

We present Model A result in Table A15 using the following selected variables, such as USA's net export (LNNE) and independent variables are Gross domestic price ratio (LNGR), money supply value ratio (LNMR), nominal value exchange rate ratio (LNER), lending rate ratio (LNLR), and youth dependency ratio (LNDE). From this table its witnessed that only the variable LNDE is significant at 5% level. Therefore, we included one by one variable with youth dependency ratio (LNDE) and ran the regression again and the output is given in Table A16 and Table A17.

This youth dependency ratio (DE), is defined as the number of persons 0 – 14 years old compared to the working age population 15 – 64 years olds as a percentage. This ratio is more important in the developed and also developing countries. The number of young people at age 0 – 14 years old who are economically inactive compared to the number of working people at age 15 – 64 years old.

Higher youth dependency ratio referred as higher-level investments necessary to be made in the child care and also in the schooling needs a lot of potential workers for the future. When we analyse the global population, it is increasing but the rate of increasing is reducing during the recent 10 years. Youth population composition of any economy is expected to reduce in the future. Therefore, in this study, we paid more attention on youth dependency ratio.

Model A: $\boldsymbol{lnNE = f\ (lnGR, lnER, lnMR, lnLR, lnDE, \varepsilon_t)}$

Since youth dependency ratio (LNDE) is significant at 5% level. We include one by one variable with LNDE and determined the final model. GDP ratio (LNGR) and LNDE are significant at 5% level as shown in Table A16. All multiple linear regression assumptions also checked (normality test, serial correlation LM test, Variance inflation factor, heteroscedasticity) for LNGR and LNDE.

The negative youth dependency ratio (LNDE) sign suggests that, when other external factors are equal, youth dependency increase by 1% explains that USA's net exports weakened against youth dependency ratio. GDP per capita (LNGR) and youth dependency (LNDE) have negative relationship. Youth dependency likely to reduce economic growth. As youth dependency ratio (LNDE) rises by 1% USA's net export falls by 1.37%, because higher youth dependency referred as higher investment which is necessary to be made in child care and also in the schooling for the higher improvements.

Since youth dependency (LNDE) is significant at 5% level. We include LNDE and LNGR as shown in Table A16. Also, money supply ratio (LNMR) and LNDE are significant at 5% level as shown in Table A17. All multiple linear regression assumptions also checked (normality test, serial correlation LM test, Variance inflation factor, heteroscedasticity) for LNMR and LNDE.

It's witnessed from Table A17 that, when other external factors are being equal, then the negative sign shown of money supply (LNMR) suggests that as money supply amount of M2 in USA increases by 1% with respect to Australia, USA's net export (LNNE) reduces by 0.09%. Even though or still the amount of USA's exports increase, at the same time this import also increases but by a bigger value than the number of exports, due to reduction in economic growth and higher youth dependency, leading to decline in net exports (NE).

Model B

We present Model B result in Table A18 using the following selected variables, such as USA's net export (LNNE) and independent variables are GDP ratio (LNGR), money supply (LNMR), real value exchange rate (LNRER), lending rate (LNLR), price deflator value ratio (LNPR), and youth dependency ratio (LNDE). We present Model B, by substituting the variable nominal exchange rate by its following other two components, amount of this real value exchange rate (LNRER), and also the amount of price deflator (LNPR).

From this table its witnessed that only the variable LNDE is significant at 5% level. Therefore, we included one by one variable with youth dependency ratio (LNDE) and ran the regression again and the output is given in Table A19.

Nominal exchange rate substitution is done to find out if the inflation differential or price deflator between two countries significantly explains the trade flow among the two other specific countries, and if the amount of real value exchange rate significantly explains the trade flows, where the fact that the amount of nominal exchange rate was floating during this research study's sample period. Floating nominal rate which makes each of the nation's monetary policy control inflation rather than serve the exchange rate.

Model B: $\boldsymbol{lnNE = f\ (lnGR, lnRER, lnPR, lnMR, lnLR, lnDE, \varepsilon_t)}$

Since youth dependency ratio (LNDE) is significant at 5% level. We include one by one variable with LNDE and determined the final model. GDP ratio (LNGR), real exchange rate (LNRER) and LNDE are significant at 5% level as shown in Table A19. All multiple linear regression assumptions also checked (normality test, serial correlation LM test, Variance inflation factor, heteroscedasticity) for LNGR, LNRER and LNDE.

When other external factors are equal, real exchange rate (RER) increases by 1% explains that USA's US dollar weakens relative to the Germany Euro. As RER rises by 1% net export falls by 1.12%. Imports increase by a larger amount. As shown in Table A19. 1% rise in GDP ratio output shows in a 0.62% fall in the USA's net value export to Germany, USA's imports increase than exports, which reduces trade gap. Hence negative GDP ratio (GR) seems reasonable.

4.5. F – Tests.

A null hypothesis is defined as multiple conjectures, and also expressed with more than one equal sign. These tests used for testing these results of a joint null hypothesis is called as F – test. F – tests are only valid if the value of error variances of these two equations are same and also the error uncorrelated over time and over two firms.

4.5.1. USA and Australia.

These F – test was used, for the test of the significant and also asymmetric parameter shifts in the given model with dummy and model with dummy interactions for the pair of USA and Australia, because of rising and also falling the value of exchange rate. The outputs shown in Table A20 and Table A21. Calculated F – test values are less than F table critical values for Table A20 and Table A21 calculations. Therefore, we accept the null hypothesis. Which implies that net export does not depend on exchange rate. Therefore, it's also concluded that as there is no any significant difference among these analysed outcomes of increasing and also reducing value of exchange rate regimes. Moreover, that implies that net export responds to falling and also rising exchange rate regimes in a symmetrical manner.

$$\boldsymbol{lnNE = f\ (lnGR, lnER, lnMR, lnLR, dummy\ (D01)\ \varepsilon_t)}$$
H_0 : *Net export does not depend on exchange rate*. $(D = 0)$
H_1 : *Net export depend on exchange rate*. $(D \neq 0)$

$$F = \frac{(SSE_R - SSE_U)\ /\ J}{(SSE_u)\ /\ (N-K)}$$

$SSE_R = 18.34$ *and* $SSE_u = 18.31$

$$F = \frac{\frac{(18.34057 - 18.30896)}{1}}{\frac{(18.30896)}{(39-5)}} = \frac{0.03161}{0.5384988} = 0.0587$$

$$\boldsymbol{lnNE = f\ (lnGR, lnER, lnMR, lnLR, dummy\ (D01)\ \varepsilon_t)}$$
H_0 : *Net export does not depend on exchange rate*. $(D = 0)$
H_1 : *Net export depend on exchange rate*. $(D \neq 0)$

$$F = \frac{(SSE_R - SSE_U)\ /\ J}{(SSE_u)\ /\ (N-K)}$$

	Critical 1%	Critical 5%	Critical 10%
$F_{1,34}$	7.56	4.17	2.88
$F_{5,30}$	3.70	2.53	2.05

$SSE_R = 18.34$ *and* $SSE_u = 15.64$

$$F = \frac{\frac{(18.34057 - 15.64075)}{5}}{\frac{(15.64075)}{(39-9)}} = \frac{0.539964}{0.521358} = 1.0357$$

4.5.2. USA and Germany.

These F – test was used to test for the significant and also asymmetric parameter shifts in model with dummy and model with interactions for the pair of USA and Germany, because of increasing and reducing exchange rate. These results are shown in Table A22 and Table A23.

Calculated F – test values are less than F table critical values for Table A22 and Table A23 calculations. Therefore, we accept the null hypothesis.

Which implies that net export does not depend on exchange rate. Therefore, its concluded for the results that there is no any significant difference required between the outcomes of falling and also rising exchange rate regimes. Moreover, that implies that USA's net export responds as to falling and also rising exchange rate regimes results in a symmetrical manner.

$$\boldsymbol{lnNE = f\ (lnGR, lnER, lnMR, lnLR, lnDE, \varepsilon_t)}$$
H_0 : *Net export does not depend on exchange rate*. $(D = 0)$
H_1 : *Net export depend on exchange rate*. $(D \neq 0)$

$$F = \frac{(SSE_R - SSE_U)\ /\ J}{(SSE_u)\ /\ (N-K)}$$

$SSE_R = 0.748058$ $\qquad$ $SSE_u = 0.711640$

$$F = \frac{(0.748058 - 0.711640) / 1}{(0.711640) / (39 - 4)} = \frac{0.036418}{0.0203326} = 1.79111$$

$\boldsymbol{lnNE = f\ (lnGR, lnRER, lnPR, lnMR, lnLR, lnDE, \varepsilon_t)}$
H_0 : $Net\ export\ does\ not\ depend\ on\ exchange\ rate. (D = 0)$
H_1 : $Net\ export\ depend\ on\ exchange\ rate. (D \neq 0)$

	Critical 1%	Critical 5%	Critical 10%
$F_{1,35}$	7.56	4.12	2.88
$F_{4,32}$	4.02	2.67	2.14

$$F = \frac{(SSE_R - SSE_U) / J}{(SSE_u) / (N-K)}$$

$SSE_R = 0.748058$ $\qquad$ $SSE_u = 0.251520$

$$F = \frac{(0.748058 - 0.251520) / 4}{(0.251520) / (39 - 7)} = \frac{0.1241345}{0.00786} = 15.79319$$

4.6. Error Correction Model.

An error correction model (ECM) falls under the area of multiple time series models. ECM approaches beneficial for estimating both short run term effects as well as the long run term effects of time series. The error influences the short-term dynamics as well as known error correction term relates to last period deviation from long run equilibrium. This error correction term results also explains the speed of adjustment of any result disequilibrium towards the long run effect. This term represents the long run relationship in the time series. The negative and also the significant sign of error correction coefficient suggest the presence of long run relationship. Error correction statistical model (ECM) run for both pairs USA/ Australia and USA/Germany.

Error correction model (ECM) is a part of Engle and Granger two steps procedure, short run value as well as the long run value adjustments. If all these variables, are I (1) and error, is I (0), it means cointegration or long run relationship exists.

4.6.1. USA and Australia.

It's witnessed from Table A25 that, USA's net export (NE) and nominal value of exchange rate (ER) are cointegrated at 10% level of significance. An error correction model (ECM) estimated to explore long term as well as short term effects of expected following changes (ER) on the level of United States net exports (NE).

$$NE_t = a_0 + a_1 NE_{t-1} + \theta_0 ER_t + \theta_1 ER_{t-1} + \varepsilon_t$$

Add the term $(NE_{t-1} - NE_{t-1} + \theta_0 ER_{t-1} - \theta_0 ER_{t-1})$ $to\ the\ right\ hand\ side,$

$$NE_t = a_0 + a_1 NE_{t-1} + NE_{t-1} - NE_{t-1} + \theta_0 ER_t + \theta_0 ER_{t-1} - \theta_0 ER_{t-1} + \theta_1 ER_{t-1} + \varepsilon_t$$

$$NE_t = a_0 + (a_1 - 1)\ NE_{t-1} + NE_{t-1} + (\theta_0 + \theta_1)\ ER_{t-1} + \theta_0 (ER_t - ER_{t-1}) + \varepsilon_t$$

$$NE_t - NE_{t-1} = a_0 + (a_1 - 1)\ NE_{t-1} + (\theta_0 + \theta_1)\ ER_{t-1} + \theta_0 (ER_t - ER_{t-1}) + \varepsilon_t$$

$$\Delta NE_t = a_0 + (a_1 - 1)\ NE_{t-1} + (\theta_0 + \theta_1)\ ER_{t-1} + \theta_0\ \Delta ER_t + \varepsilon_t$$

Let $\alpha = a_1 - 1 = -1(1 - a_1)$

Let $\beta_2 = \frac{\theta_0 + \theta_1}{1 - a_1} = \frac{\theta_0 + \theta_1}{-\alpha}$

Let $\beta_1 = \frac{a_0}{\alpha}$

$$\Delta NE_t = a_0 + \alpha\, NE_{t-1} - \alpha\beta\, ER_{t-1} + \theta_0\, \Delta ER_t + \varepsilon_t$$

$$\Delta NE_t = a_0 + \alpha\, (NE_{t-1} - \beta\, ER_{t-1}) + \theta_0\, \Delta ER_t + \varepsilon_t$$

$$\Delta NE_t = \alpha\, (NE_{t-1} + \beta_1 - \alpha\beta_2\, ER_{t-1}) + \theta_0\, \Delta ER_t + \varepsilon_t$$

Exchange rate (ER) and United States net exports (NE) are I (1) variables and error are I (0) as shown in Table A24, it means cointegration or long run relationship exists. Error correction term (ECT) is stationary.

We ran short term model with the lag of error correction term (ECT) as independent variable as shown in Table A25.

$\Delta NE_t = \alpha + \beta \Delta ER_t + \gamma\, ECT_{t-1} + \epsilon_t$.
It's witnessed from the table that, lag of error correction term (ECT (-1)) shows negative sign and significant at 5% level of significance. That means, there is a long run period relationship exists.
Based on error correction term (ECM), the long run period effect of expected value exchange rate (ER) on the level of USA's net export (NE) is positive. This explains that, exchange rate (ER) expected to rise then expected USA's net export (NE) also rise, which implies that Australian dollar strengthen relative to US dollar. Also, short run term dynamics also showed the positive relationship between USA's net export (NE) and exchange rate (ER).

4.6.2. USA and Germany

It's witnessed from Table 4.13 that, USA's net export (NE) and nominal exchange rate (ER) are cointegrated at 10% level of significance. An error correction model (ECM) estimated to explore short run and long run effects of expected changes (ER) on the level of USA's net exports (NE).

Exchange rate (ER) and USA's net exports (NE) are I (1) and error is I (0), which means that, there is a cointegration or long run period analysis relationship also exists. Error correction term (ECT) is also stationary.

We ran short term model with the lag of error correction term (ECT) as independent variable as shown in Table A26.

$\Delta NE_t = \alpha + \beta \Delta ER_t + \gamma\, ECT_{t-1} + \epsilon_t$.
It's witnessed from the table that, lag of error correction term (ECT (-1)) is negative sign and significant at 5% level. That means there is a long run relationship exists.

Based on error correction term (ECM), the long run effect of exchange rate (ER) on the level of United States net export (NE) is shown positive. This explains that, exchange rate (ER) expected to rise then expected USA's net export (NE) also rise, which implies that US dollar weakens relative to Germany's Euro. In the short run dynamics also showed the positive relationship between USA's net export (NE) and exchange rate (ER).

CHAPTER 05
CONCLUSIONS

5. CONCLUSIONS.

To determine the factors affecting the trade balance of United States especially with the Australia and Germany including a demographic variable. Since our variables are non-stationary, check the cointegration between variables and fitted the multiple linear regression model to determine the factors affecting United States trade balance with these selected two countries.

For the pair of USA and Australia, Eagle and Granger tests shows that, Australia's import share (IS) and the output growth (GR) are cointegrated at 10% significance level, when trend is included. There is relationship between Australia's import value share (IS) and the output growth (GR), are cointegrated. There exists a relationship between net exports (NE) and the real of exchange rate (RER) at 10% significant level. When trend is included, there is a cointegration between nominal exchange rate (LNER)/ real exchange rate (LNRER) and USA's trade balance (LNNE) at 10% significance level.

Regression result based on Model A shows that, Gross domestic product (LNGR), money supply (LNMR), nominal rate (LNER), and lending rate (LNLR) are taken as ratios in descending order explain 88.9% of observed variation, and also Model B shows that, GDP (LNGR), money supply ratio (LNMR), price deflator ratio (LNPR), real exchange rate (LNRER) and lending ratio (LNLR) in descending order explain 89.7% of these observed level of variation shows in the United States net value exports with Australia. All the above considered regressors results are 1% significant, except lending rate (in Model A) which is 5% significant and real exchange rate (in Model B) which is 5% significant.

All the regressors have negative relationship with net exports (NE), except lending rate ratio. Lending ratio has a positive relationship with net exports (NE). These Johansen cointegration tests shows that, there exists a long run term relationship analysis among USA's net exports and its other determinant factors at 1% level of significance. As a result of these signs of parameters, rapid expansion in USA's economy compared with the Australia, where USA's value of imports also increases more than its value of exports. Moreover, this trade pattern shows that trade estimated by estimated parameters between USA and Australia trade throughout the time period.

F test suggests that, when both intercept and slope change, net exports respond to both regimes in a symmetric manner, then there is no significant difference between the effects of falling and rising exchange rate regimes even at 10% significant level.

Finally, for the pair of USA and Australia, there is a long run relationship between USA's net exports (NE) and the real value of exchange rate (RER) at 10% significant level. Also, Australia's import share (IS) and the output growth (GR) are cointegrated at 10% significance level. The error correction model shows that the long run effect of exchange rate changes shown on the desired level of USA's net value exports (NE) is positive, USA dollar weakens relative to Australia, which implies that exchange rate (ER) expected to rise then expected net exports (NE) also rises. The short run dynamics which depict a positive relationship analysis between USA's net value export (NE) and the exchange rate (ER).

For the pair of USA and Germany, Engle – Granger cointegration tests shows that, there isn't any strong correlation between Germany's export and the import share (ES/ IS) and output growth (GR) when trend is excluded and included. Moreover, when trend is included or else excluded, as a result there is a cointegration between nominal exchange rate (LNER)as well as real exchange rate (LNRER) also it's USA's trade balance (LNNE) at 10% significance level. The Johansen cointegration tests shows that, there isn't any sufficient evidence for the long run relationship analysis considered between net exports as well as its determinants.

Linear regression of USA and Germany obtained based on Model A given that, GDP ratio (LNGR), money supply ratio (LNMR), nominal rate ratio (LNER), lending rate ratio (LNLR), and youth dependency ratio (LNDE) explain 44.64% of observed variation, which model is not significant at 5% level. Model A1 shows that, youth dependency ratio and GDP ratio explain 46.27% of observed variation, model is significant at 5% level. Model A2 shows that, youth dependency ratio and money supply ratio explain 415% of observed variation, model is significant at 10% level. Model B shows that, real exchange rate ratio, GDP ratio and youth dependency ratio explain 76.88% of observed variation, model is significant at 5% level. Real exchange ratio, GDP ratio and youth dependency ratio have negative relationship with net export.

F test suggests that, when both intercept and slope change, net exports respond to both regimes in a symmetric manner, then there is no any significant difference outcome between the effects of falling as well as rising exchange rate regimes also even at 10% significant level.

Finally for the pair of USA and Germany, there is a long run relationship among United States net exports (NE) and the real value of exchange rate (RER) at 10% significant level. This result of error correction model shows that, there exists a long run term effect of exchange rate for the changes shown on the desired level of USA's net value exports (NE) is also shows as positive, USA dollar weakens relative to Germany Euro, which implies that exchange rate (ER) expected to rise then expected net exports (NE) also rises. Then in the short run dynamics also depicts a positively shown relationship among the net export (NE) as well as the exchange rate (ER).

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APPENDIX

Table A1: Multiple linear regression Model A (USA and Australia).

Dependent Variable: LNNE
Method: Least Squares
Sample: 1980 2018
Included observations: 39

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.855537	0.169496	10.94740	0.0000
LNGR	0.853692	0.150081	5.688196	0.0000
LNER	-0.395047	0.179741	-2.197875	0.0351
LNMR	-0.163248	0.067867	-2.405428	0.0219
LNLR	0.097314	0.034953	2.784108	0.0088
LNDE	0.585578	0.429333	1.363926	0.1818

R-squared	0.906597	Mean dependent var	2.342930
Adjusted R-squared	0.892446	S.D. dependent var	0.196111
S.E. of regression	0.064316	Akaike info criterion	-2.509389
Sum squared resid	0.136505	Schwarz criterion	-2.253456
Log likelihood	54.93308	Hannan-Quinn criter.	-2.417562
F-statistic	64.06188	Durbin-Watson stat	1.490833
Prob(F-statistic)	0.000000		

Table A2: Multiple linear regression Model A corrected (USA and Australia).

Dependent Variable: LNNE
Method: Least Squares
Sample: 1980 2018
Included observations: 39
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 40000)

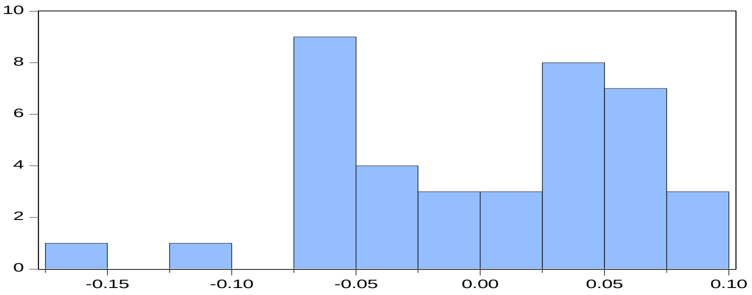
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.066873	0.085173	24.26686	0.0000
LNGR	0.939235	0.129899	7.230497	0.0000
LNER	-0.461789	0.169899	-2.718022	0.0103
LNMR	-0.077585	0.028140	-2.757106	0.0093
LNLR	0.100840	0.044925	2.244619	0.0314

R-squared	0.901332	Mean dependent var	2.342930
Adjusted R-squared	0.889724	S.D. dependent var	0.196111
S.E. of regression	0.065124	Akaike info criterion	-2.505830
Sum squared resid	0.144200	Schwarz criterion	-2.292553
Log likelihood	53.86368	Hannan-Quinn criter.	-2.429308
F-statistic	77.64758	Durbin-Watson stat	1.471209
Prob(F-statistic)	0.000000	Wald F-statistic	92.59783
Prob (Wald F-statistic)	0.000000		

Table A3: Ramsey Reset test of Model A (USA and Australia).

Ramsey RESET Test			
Equation: UNTITLED			
	Value	df	Probability
t-statistic	0.702550	33	0.0000
F-statistic	0.493576	(1, 33)	0.0000
Likelihood ratio	0.578998	1	0.0000
F-test summary:			
	Sum of Sq.	df	Mean Squares
Test SSR	0.002125	1	0.002125
Restricted SSR	0.144200	34	0.004241
Unrestricted SSR	0.142075	33	0.004305
LR test summary:		Value	
Restricted LogL	53.86368		
Unrestricted LogL	54.15318		
Dependent Variable: LNNE			
Method: Least Squares			
Sample: 1980 2018			
Included observations: 39			
bandwidth = 4.0000)			
Variable	Coefficient	Std. Error	t-Statistic
C	3.122463	1.683232	1.855040
LNGR	1.994249	1.685810	1.182962
LNER	-0.974730	0.862851	-1.129662
LNMR	0.165672	0.140327	1.180619
LNLR	0.208477	0.168947	1.233979
FITTED^2	-0.248239	0.392297	-0.612783
R-squared	0.902786	Mean dependent var	
Adjusted R-squared	0.888057	S.D. dependent var	
S.E. of regression	0.065615	Akaike info criterion	
Sum squared resid	0.142075	Schwarz criterion	
Log likelihood	54.15318	Hannan-Quinn criter.	
F-statistic	61.29154	Durbin-Watson stat	
Prob(F-statistic)	0.000000	Wald F-statistic	
Prob (Wald F-statistic)	0.000000		

Table A4: Normality test of Model A (USA and Australia).



Series: Residuals	
Sample 1980 2018	
Observations 39	
Mean	4.18e-16
Median	0.007921
Maximum	0.099036
Minimum	-0.162815
Std. Dev.	0.061601
Skewness	-0.379633
Kurtosis	2.484269
Jarque-Bera	1.369001
Probability	0.504342

Table A5: Serial correlation LM test of Model A (USA and Australia).

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.129055	Prob. F (2,32)	0.0106
Obs*R-squared	2.570670	Prob. Chi- Square (2)	0.0070

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 1980 2018
Included observations: 39
Pre sample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.023953	0.071968	-0.332828	0.7414
LNGR	0.002408	0.137666	0.017495	0.9862
LNER	-0.039872	0.178051	-0.223938	0.8242
LNMR	0.011545	0.027560	0.418914	0.6781
LNLR	-0.014714	0.037428	-0.393121	0.6968
RESID (-1)	0.248314	0.185979	1.335173	0.0132
RESID (-2)	0.137389	0.211904	0.648353	0.2724

R-squared	0.065915	Mean dependent var	4.18E-16
Adjusted R-squared	-0.109226	S.D. dependent var	0.061601
S.E. of regression	0.064878	Akaike info criterion	-2.471453
Sum squared resid	0.134695	Schwarz criterion	-2.172865
Log likelihood	55.19334	Hannan-Quinn criter.	-2.364322
F-statistic	0.376352	Durbin-Watson stat	1.943577
Prob(F-statistic)	0.288579		

Table A7: Heteroscedasticity test of Model A (USA and Australia).

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.993457	Prob. F (4,34)	0.4244
Obs*R-squared	4.081213	Prob. Chi-Square (4)	0.3951
Scaled explained SS	2.301975	Prob. Chi-Square (4)	0.6804

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Sample: 1980 2018
Included observations: 39
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009558	0.002604	3.671065	0.0008
LNGR	-0.002999	0.005681	-0.527857	0.6010
LNER	0.009489	0.007322	1.295924	0.2037
LNMR	-0.002999	0.001098	-2.731454	0.0099
LNLR	0.000662	0.001773	0.373412	0.7112

R-squared	0.104646	Mean dependent var	0.003697
Adjusted R-squared	-0.000689	S.D. dependent var	0.004563
S.E. of regression	0.004565	Akaike info criterion	-7.821561
Sum squared resid	0.000709	Schwarz criterion	-7.608284
Log likelihood	157.5204	Hannan-Quinn criter.	-7.745039
F-statistic	0.993457	Durbin-Watson stat	2.066253
Prob(F-statistic)	0.424418		

Table A6: Variance inflation factor of Model A (USA and Australia).

Variance Inflation Factors
Sample: 1980 2018
Included observations: 39

Variable	Coefficient Variance	Uncentered VIF	Centred VIF
C	0.007254	62.30101	NA
LNGR	0.016874	11.94487	6.747172
LNER	0.028866	17.66966	6.823159
LNMR	0.000792	46.70882	2.471017
LNLR	0.002018	3.796048	2.560480

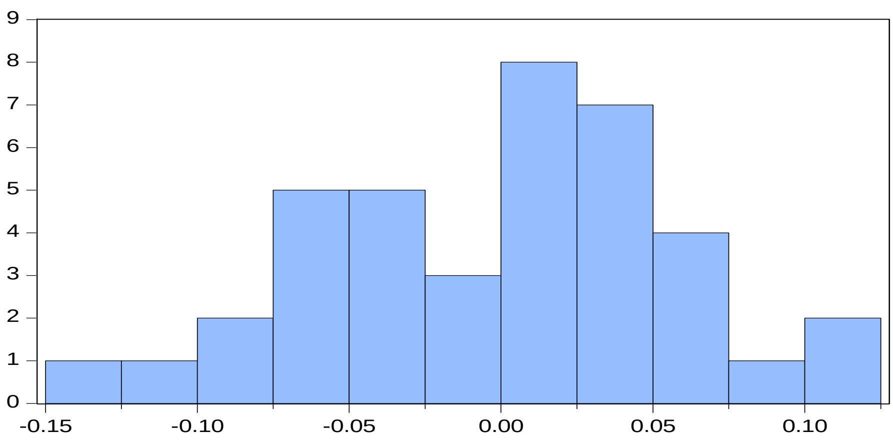
Table A8: Multiple linear regression Model B (USA and Australia).

Dependent Variable: LNNE
Method: Least Squares
Sample: 1980 2018
Included observations: 39
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.768720	0.138106	12.80696	0.0000
LNGR	-0.721720	0.151729	4.756628	0.0000
LNRER	-0.628497	0.249968	-2.514307	0.0170
LNPR	-0.908057	0.239648	-3.789126	0.0006
LNMR	-0.210301	0.057986	-3.626729	0.0010
LNLR	0.160753	0.050955	3.154828	0.0034

R-squared	0.910485	Mean dependent var	2.342930
Adjusted R-squared	0.896922	S.D. dependent var	0.196111
S.E. of regression	0.062963	Akaike info criterion	-2.551897
Sum squared resid	0.130824	Schwarz criterion	-2.295964
Log likelihood	55.76199	Hannan-Quinn criter.	-2.460071
F-statistic	67.13034	Durbin-Watson stat	1.593239
Prob(F-statistic)	0.000000	Wald F-statistic	107.1901
Prob (Wald F-statistic)	0.000000		

Table A9: Normality test of Model B (USA and Australia).



Series: Residuals
Sample 1980 2018
Observations 39

Mean	3.39e-16
Median	0.008872
Maximum	0.101504
Minimum	-0.134950
Std. Dev.	0.058675
Skewness	-0.263421
Kurtosis	2.355907
Jarque-Bera	1.125181
Probability	0.569731

Table A10: Serial correlation LM test of Model B (USA and Australia).

Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	0.527493	Prob. F (2,31)		0.5953
Obs*R-squared	1.283559	Prob. Chi-Square (2)		0.5264
Test Equation:				
Dependent Variable: RESID				
Method: Least Squares				
Sample: 1980 2018				
Included observations: 39				
Presample missing value lagged residuals set to zero.				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.007251	0.178415	-0.040644	0.9678
LNGR	-0.007667	0.184607	-0.041534	0.9671
LNRER	-0.016872	0.350636	-0.048117	0.9619
LNPR	-0.009233	0.300958	-0.030680	0.9757
LNMR	0.003328	0.077701	0.042831	0.9661
LNLR	0.003201	0.052436	0.061039	0.9517
RESID (-1)	0.168888	0.195495	0.863896	0.3943
RESID (-2)	-0.111001	0.228111	-0.486609	0.6300
R-squared	0.032912	Mean dependent var		3.39E-16
Adjusted R-squared	-0.185463	S.D. dependent var		0.058675
S.E. of regression	0.063884	Akaike info criterion		-2.482798
Sum squared resid	0.126518	Schwarz criterion		-2.141555
Log likelihood	56.41457	Hannan-Quinn criter.		-2.360363
F-statistic	0.150712	Durbin-Watson stat		1.892379
Prob(F-statistic)	0.992674			

Table A12: Heteroscedasticity test of Model B (USA and Australia).

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	1.946665	Prob. F (5,33)		0.1130
Obs*R-squared	8.882989	Prob. Chi-Square (5)		0.1138
Scaled explained SS	4.311791	Prob. Chi-Square (5)		0.5055
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Sample: 1980 2018				
Included observations: 39				
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.023957	0.011696	2.048315	0.0486
LNGR	0.008071	0.010909	0.739877	0.4646
LNRER	0.025261	0.022827	1.106633	0.2765
LNPR	0.024234	0.018903	1.282008	0.2088
LNMR	-0.009187	0.005336	-1.721828	0.0945
LNLR	-0.000346	0.003321	-0.104195	0.9176
R-squared	0.227769	Mean dependent var		0.003354
Adjusted R-squared	0.110764	S.D. dependent var		0.003957
S.E. of regression	0.003732	Akaike info criterion		-8.203364
Sum squared resid	0.000459	Schwarz criterion		-7.947431
Log likelihood	165.9656	Hannan-Quinn criteria.		-8.111538
F-statistic	1.946665	Durbin-Watson stat		1.979457
Prob(F-statistic)	0.113022			

Table A11: Variance inflation factor of Model B (USA and Australia).

Variance Inflation Factors
Sample: 1980 2018
Included observations: 39

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.019073	249.8046	NA
LNGR	0.023022	20.90600	6.79472
LNRER	0.062484	49.66594	7.05844
LNPR	0.057431	47.11966	8.73924
LNMR	0.003362	292.7471	7.78643
LNLR	0.002596	9.939179	6.09479

Table A13: Multiple linear regression Model C (USA and Australia).

Dependent Variable: LNNE
Method: Least Squares
Sample: 1980 2018
Included observations: 39

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.132094	0.144868	14.71749	0.0000
LNGR	0.803633	0.197024	4.078858	0.0003
LNRER	0.232288	0.218472	1.063236	0.2952
LNMR	0.035994	0.057192	0.629355	0.5333
LNLR	0.071238	0.041429	1.719552	0.0946

R-squared	0.884978	Mean dependent var	2.342930
Adjusted R-squared	0.871446	S.D. dependent var	0.196111
S.E. of regression	0.070315	Akaike info criterion	-2.352468
Sum squared resid	0.168100	Schwarz criterion	-2.139191
Log likelihood	50.87313	Hannan-Quinn criter.	-2.275946
F-statistic	65.39906	Durbin-Watson stat	1.242313
Prob(F-statistic)	0.000000		

Table A14: Multiple linear regression Model D (USA and Australia).

Dependent Variable: LNNE
Method: Least Squares
Date: 06/02/21 Time: 16:03
Sample (adjusted): 1981 2018
Included observations: 38 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.903341	0.179142	10.62473	0.0000
LNGR	0.912897	0.168813	5.407751	0.0000
LNRER	-0.432364	0.289439	-1.493799	0.1450
LNPR	-0.959531	0.299530	-3.203460	0.0031
LNMR	0.160910	0.070948	2.267995	0.0302
LNLR (-1)	0.150263	0.060094	2.500473	0.0177

R-squared	0.902553	Mean dependent var	2.340530
Adjusted R-squared	0.887327	S.D. dependent var	0.198162
S.E. of regression	0.066517	Akaike info criterion	-2.438786
Sum squared resid	0.141583	Schwarz criterion	-2.180220
Log likelihood	52.33694	Hannan-Quinn criter.	-2.346790
F-statistic	59.27677	Durbin-Watson stat	1.161699

Prob(F-statistic)	0.000000	Wald F-statistic	50.10830
Prob (Wald F-statistic)	0.000000		

Table A15: Multiple linear regression Model A (USA and Germany).

Dependent Variable: LNNE
Method: Least Squares
Sample (adjusted): 1 39
Included observations: 39 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.225208	1.324707	-0.170006	0.8660
LNGR	0.892406	0.624793	1.428322	0.1626
LNER	-0.886794	0.746315	-1.188231	0.2432
LNMR	0.055211	0.086568	0.637775	0.5280
LNLR	0.004029	0.014143	0.284865	0.7775
LNDE	-1.100392	0.298715	-3.683753	0.0008

R-squared	0.519301	Mean dependent var	0.370393
Adjusted R-squared	0.446468	S.D. dependent var	0.147057
S.E. of regression	0.109410	Akaike info criterion	-1.446797
Sum squared resid	0.395025	Schwarz criterion	-1.190865
Log likelihood	34.21255	Hannan-Quinn criteria.	-1.354971
F-statistic	7.130015	Durbin-Watson stat	0.280823
Prob(F-statistic)	0.000128	Wald F-statistic	35.68831
Prob (Wald F-statistic)	0.000000		

Table A16: Multiple linear regression Model A1 (USA and Germany).

Dependent Variable: LNNE
Method: Least Squares
Date: 10/18/21 Time: 16:44
Sample (adjusted): 1 39
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.774183	0.124512	6.217740	0.0000
LNGR	0.282439	0.109132	2.588062	0.0138
LNDE	-1.366277	0.332590	-4.107986	0.0002

R-squared	0.490980	Mean dependent var	0.370393
Adjusted R-squared	0.462702	S.D. dependent var	0.147057
S.E. of regression	0.107793	Akaike info criterion	-1.543398
Sum squared resid	0.418299	Schwarz criterion	-1.415431

Log likelihood	33.09626	Hannan-Quinn criter.	-1.497485
F-statistic	17.36210	Durbin-Watson stat	0.400674
Prob(F-statistic)	0.000005		

Table A17: Multiple linear regression Model A2 (USA and Germany).

Dependent Variable: LNNE
Method: Least Squares
Date: 10/18/21 Time: 16:47
Sample (adjusted): 1 39
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.685049	0.909930	-0.752859	0.4564
LNMR	-0.094779	0.052836	-2.393837	0.0812
LNDE	-1.181478	0.420707	-2.808314	0.0080

R-squared	0.445810	Mean dependent var	0.370393
Adjusted R-squared	0.415021	S.D. dependent var	0.147057
S.E. of regression	0.112475	Akaike info criterion	-1.458376
Sum squared resid	0.455419	Schwarz criterion	-1.330410
Log likelihood	31.43834	Hannan-Quinn criter.	-1.412463
F-statistic	14.47982	Durbin-Watson stat	0.537849
Prob(F-statistic)	0.000024		

Table A18: Multiple linear regression Model B (USA and Germany).

Dependent Variable: LNNE
Method: Least Squares
Date: 11/29/21 Time: 17:36
Sample (adjusted): 1 39
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.551167	0.678958	2.284628	0.0291
LNGR	-0.371669	0.277221	-1.340695	0.1895
LNRER	0.889316	0.272808	3.259867	0.0026
LNPR	-0.573062	0.405586	-1.412923	0.1673
LNMR	-0.043349	0.046056	-0.941221	0.3536
LNLR	0.026828	0.016867	1.590520	0.1215
LNDE	-0.740462	0.363206	-2.038683	0.0498

R-squared	0.807766	Mean dependent var	0.370393
Adjusted R-squared	0.771722	S.D. dependent var	0.147057

S.E. of regression	0.070261	Akaike info criterion	-2.312043
Sum squared resid	0.157973	Schwarz criterion	-2.013455
Log likelihood	52.08485	Hannan-Quinn criter.	-2.204913
F-statistic	22.41066	Durbin-Watson stat	0.967584
Prob(F-statistic)	0.000000		

Table A19: Multiple linear regression Model B1 (USA and Germany).

Dependent Variable: LNNE
Method: Least Squares
Sample (adjusted): 1 39
Included observations: 39 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed 4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.018605	0.109518	9.300833	0.0000
LNRER	-1.123009	0.218764	-5.133439	0.0000
LNDE	-1.027033	0.305802	-3.358486	0.0019
LNGR	-0.619527	0.167102	-3.707487	0.0007

R-squared	0.787055	Mean dependent var	0.370393
Adjusted R-squared	0.768802	S.D. dependent var	0.147057
S.E. of regression	0.070709	Akaike info criterion	-2.363566
Sum squared resid	0.174993	Schwarz criterion	-2.192944
Log likelihood	50.08954	Hannan-Quinn criter.	-2.302348
F-statistic	43.12045	Durbin-Watson stat	0.939050
Prob(F-statistic)	0.000000	Wald F-statistic	28.94252
Prob (Wald F-statistic)	0.000000		

Table A20: F – Test for model with dummy (USA and Australia).

Dependent Variable: NE				
Method: Least Squares				
Sample: 1980 2018				
Included observations: 39				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.721279	0.751408	4.952406	0.0000
D01	-0.074703	0.312927	-0.238723	0.8128
GR	7.708710	1.450933	5.312935	0.0000
ER	-3.747447	1.712238	-2.188625	0.0358
MR	0.041567	0.019309	2.152691	0.0387
LR	1.448929	0.491756	2.946441	0.0059
R-squared	0.868096	Mean dependent var		10.59752
Adjusted R-squared	0.848110	S.D. dependent var		1.911220
S.E. of regression	0.744860	Akaike info criterion		2.389398
Sum squared resid	18.30896	Schwarz criterion		2.645331
Log likelihood	-40.59326	Hannan-Quinn criter.		2.481224
F-statistic	43.43631	Durbin-Watson stat		1.136904
Prob(F-statistic)	0.000000			

Table A21: F – Test for model with dummy and interaction (USA and Australia).

Dependent Variable: NE				
Method: Least Squares				
Sample (adjusted): 1981 2018				
Included observations: 38 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.687460	1.337944	2.756064	0.0102
D01	0.140430	1.692217	0.082986	0.9345
GR	6.843444	2.314272	2.957061	0.0062
ER	-3.992262	2.848014	-1.401770	0.1720
MR	0.079843	0.049804	1.603163	0.1201
LR	2.970050	1.113048	2.668392	0.0125
D_ER	-1.481244	3.752744	-0.394710	0.6960
D_GR	2.643493	3.157229	0.837283	0.4095
D_LR	-1.879339	1.307074	-1.437821	0.1616
D_MR	-0.022908	0.055355	-0.413837	0.6821
R-squared	0.886771	Mean dependent var		10.57625
Adjusted R-squared	0.850376	S.D. dependent var		1.932189
S.E. of regression	0.747394	Akaike info criterion		2.476486
Sum squared resid	15.64075	Schwarz criterion		2.907430
Log likelihood	-37.05324	Hannan-Quinn criter.		2.629813
F-statistic	24.36523	Durbin-Watson stat		1.606236
Prob(F-statistic)	0.000000			

Table A22: F – Test for model with dummy (USA and Germany).

Dependent Variable: NE
Method: Least Squares
Date: 08/03/21 Time: 14:48
Sample (adjusted): 1 39
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.248282	0.573642	5.662564	0.0000
D01	0.068344	0.051813	1.319058	0.1960
GR	1.085267	0.551359	1.968351	0.0572
ER	-1.198889	0.833743	-1.437961	0.1596
DE	-1.351573	0.349919	-3.862528	0.0005

R-squared	0.605688	Mean dependent var	1.463750
Adjusted R-squared	0.559298	S.D. dependent var	0.217931
S.E. of regression	0.144674	Akaike info criterion	-0.909457
Sum squared resid	0.711640	Schwarz criterion	-0.696180
Log likelihood	22.73441	Hannan-Quinn criter.	-0.832935
F-statistic	13.05653	Durbin-Watson stat	0.327072
Prob(F-statistic)	0.000002		

Table A23: F – Test for model with dummy and interactions (USA and Germany).

Dependent Variable: NE
Method: Least Squares
Sample (adjusted): 1 39
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.562508	2.387181	-0.654541	0.5176
D01	4.220995	2.395743	1.761873	0.0880
GR	-0.945962	0.189813	-4.983655	0.0000
RER	2.100393	0.296028	7.095263	0.0000
DE	1.601798	1.619202	0.989252	0.3302
D_GR	0.867842	0.456211	1.902283	0.0665
D_ER	-1.384421	0.684000	-2.024009	0.0517
D_DE	-2.603430	1.618975	-1.608073	0.1180

R-squared	0.860635	Mean dependent var	1.463750
Adjusted R-squared	0.829166	S.D. dependent var	0.217931
S.E. of regression	0.090075	Akaike info criterion	-1.795659
Sum squared resid	0.251520	Schwarz criterion	-1.454416
Log likelihood	43.01535	Hannan-Quinn criter.	-1.673224
F-statistic	27.34828	Durbin-Watson stat	1.167707
Prob(F-statistic)	0.000000		

Table A24: Unit root test for residuals (USA and Australia).

Null Hypothesis: ECT has a unit root			
Exogenous: Constant, Linear Trend			
Lag Length: 1 (Automatic - based on SIC, maxlag=9)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.768956	0.0298
Test critical values:	1% level	-4.226815	
	5% level	-3.536601	
	10% level	-3.200320	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ECT)
Method: Least Squares
Date: 11/26/21 Time: 11:22
Sample (adjusted): 1982 2018
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECT(-1)	-0.684616	0.181646	-3.768956	0.0006
D(ECT(-1))	0.203714	0.170387	1.195597	0.2404
C	0.760161	0.395352	1.922745	0.0632
@TREND("1980")	-0.042360	0.017973	-2.356857	0.0245

R-squared	0.313845	Mean dependent var	-0.110169
Adjusted R-squared	0.251467	S.D. dependent var	1.054328
S.E. of regression	0.912181	Akaike info criterion	2.755850
Sum squared resid	27.45846	Schwarz criterion	2.930003
Log likelihood	-46.98322	Hannan-Quinn criter.	2.817247
F-statistic	5.031365	Durbin-Watson stat	1.827256
Prob(F-statistic)	0.005562		

Table A25: Error Correction model (USA and Australia).

Dependent Variable: D(LNNE)
Method: Least Squares
Date: 11/26/21 Time: 11:45
Sample (adjusted): 1981 2018
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.008171	0.011566	-0.706470	0.4846
D(LNER)	0.188884	0.130089	1.451958	0.1554
ECT(-1)	-0.228033	0.105667	-2.158034	0.0379

R-squared	0.134469	Mean dependent var	-0.009049
Adjusted R-squared	0.085011	S.D. dependent var	0.074433
S.E. of regression	0.071199	Akaike info criterion	-2.371031
Sum squared resid	0.177423	Schwarz criterion	-2.241748
Log likelihood	48.04960	Hannan-Quinn criter.	-2.325034
F-statistic	2.718812	Durbin-Watson stat	1.754679
Prob(F-statistic)	0.079881		

Table A26: Error Correction model (USA and Germany).

Dependent Variable: D(LNNE)
Method: Least Squares
Date: 11/26/21 Time: 15:33

Sample (adjusted): 2 39
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.008808	0.009949	-0.885327	0.3820
D(LNER)	0.842483	0.132215	6.372083	0.0000
ECT(-1)	-0.217223	0.082176	-2.643391	0.0122

R-squared	0.537765	Mean dependent var	-0.004316
Adjusted R-squared	0.511351	S.D. dependent var	0.087482
S.E. of regression	0.061153	Akaike info criterion	-2.675233
Sum squared resid	0.130887	Schwarz criterion	-2.545949
Log likelihood	53.82942	Hannan-Quinn criter.	-2.629235
F-statistic	20.35950	Durbin-Watson stat	1.359999
Prob(F-statistic)	0.000001		