DETERMINING IF KENYA'S FOREIGN DEBT PORTFOLIO MANAGEMENT IS OPTIMAL

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Project contains no material previously published or written by another person except where due reference is made in the Research Project itself.

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ABSTRACT

The study seeks to define Kenya's optimal external debt portfolio. The optimization scheme employed minimizes foreign liabilities in a foreign debt portfolio which includes a combination of foreign assets and liabilities of the country in question, which in this case is Kenya. It will involve comparing the optimal foreign debt portfolio with the currency exchange rates. The time series data that will be used consists of exchange rate data for the period from 1970 to 2016 and the percentage of external long-term public and publicly-guaranteed debt share contracted in Japanese yen, swiss Franc, U.K pound sterling for Kenya. The study will apply the cointegration methodology where it involves first carrying out unit root tests on the data to find out whether it is stationary. Thereafter, introduce the cointegration tests which will be used to form the results and discussions of this study. Ideally, a debt portfolio will be deemed optimal if movements in the exchange rates do not granger cause changes in the debt shares denominated in the corresponding currency.

Key words: Cointegration tests, foreign debt portfolio optimization.

Chapter One: Introduction

1.1. Theoretical Background

External debt refers to the total debt a country owes to foreign creditors. The creditors being foreign lenders including but not limited to commercial banks, governments or international financial institutions. External debt is a resource required to support sustainable economic growth as it is one of the methods through which countries finance their deficits and carry out economic projects that are capable of increasing peoples' standard of living and promoting sustainable levels of economic development (Kanu, 2014). Ucak (2006) defines external debt as transfer flows which are taken from foreign resources and as they are repaid have booster effects on national income.

Kenya has been receptive to external debt which has been used to finance various projects within the country. This increased level of external debt brings into question whether it is sustainable (Ryan & Maana, 2014). Sustainable debt provides confidence that the government will be able to borrow and pay potential creditors. Unsustainable debt levels, on the other hand, present risks to government expenditures on development and social programmes since a large proportion of tax revenue would be diverted to debt service. In the 1980s, debt was important more so because those years were defined as the "foreign debt crisis years". Many of the countries that experienced foreign debt crisis were developing nations while industrialized countries like USA and Germany experienced constant current account deficits (Ozkan, 2006).

Sustainability is interpreted as whether underlying policies can be sustained under plausible macroeconomic conditions without endangering solvency (Debrun, Celasun and Ostry, 2006). The IMF defines "debt sustainability" as a situation in which a borrower is expected to be able to continue servicing its debts without an unrealistically large correction to the balance of income and expenditure (Assessing Sustainability, 2002). The question raised is whether Kenya's external debt is sustainable. The solution can be found using various models or theories for instance, external debt can be observed and if the present value of a country's net future foreign earnings equals the current value of its

external debt, its external debt is considered sustainable. In addition, the IMF also provide a framework known as debt sustainability analysis (DSA) in which they use to assess the sustainability. There is also use of cointegration tests that take into consideration use of foreign debt portfolios to analyze sustainability.

However, use of such a conventional approach suffers from several shortcomings; Firstly, it neglects country-specific correlation between main drivers of public debt and does not include these correlation patterns in forecasting (deterministic scenarios do not consider the effects of correlation); Secondly, it neglects country specific shocks that affect the public debt drivers and does not use them to produce simulations; instead, it applies arbitrary selection of shocks that might not be supported by empirical facts at all; Thirdly, it produces single point forecast instead of giving distribution of possible forecasting outcomes.

Due to these shortcomings, a study conducted using stochastic simulation methods seeks to take into account the various factors left out by the DSA framework. Furthermore, debt sustainability is a forward-looking concept, it cannot be assessed with certainty (Wyplosz, 2011), hence stochastic approach to debt sustainability as an alternative to conventional debt analysis takes into account the high degree of uncertainty surrounding medium-term debt trajectories, which cannot be captured by simple bound tests as these are limited in number (ECB, 2012). The sustainability then brings to mind another important aspect of debt; whether the debt is constantly serviced and if at all the country is likely to default.

Debt servicing is paying back what a country has borrowed. Governments make these payments using revenue raised through taxes from citizens. Debt relief or debt default refers to any action by a creditor that officially changes the terms previously agreed for payment of a debt. It may be in the form of lowering the amount repayable at a set period, extending or postponing the repayment period, and canceling the debt altogether, but with conditions.

A circumstance in which we see debt relief is when Kenya was in January 2004 could not qualify for debt relief as stipulated by the Paris club. In April, President Mwai Kibaki called for debt relief to free Kshs 70 billion the country needed to fight poverty and improve the general welfare of its people. According to the ministry of finance website

DSAs conducted in Kenya have shown that the debt is sustainable. The HIPC threshold ratios have equally shown the same. Kenya has gone to Paris Club three times for rescheduling 1994, 2000, and 2004. In 2000, Kenya rescheduled US$ 298 Million. In January 2004, US$ 350 Million was rescheduled for consolidation period of 3 years. Japan rescheduled US$ 197.4 Million. These cases of debt relief raise concern over whether Kenya is likely to default in the coming years.

1.2 Contextual Background

Kenya has been making major strides in its developments in infrastructure over the past five years, financed more so by foreign debt. The country's external debt has increased five-fold, from a record low of Sh361.73 billion in May 2003 to a high of Sh1.8 trillion as at June 2016. This increase in external debt is believed to be driven by the US$2 billion Eurobond issued in June 2014, an additional US$750 million in December 2014 and US$3.6 billion borrowed from China to finance the 500-kilometer Standard Gauge Railway from Mombasa to Nairobi (Kenya Economic Update, 2014).

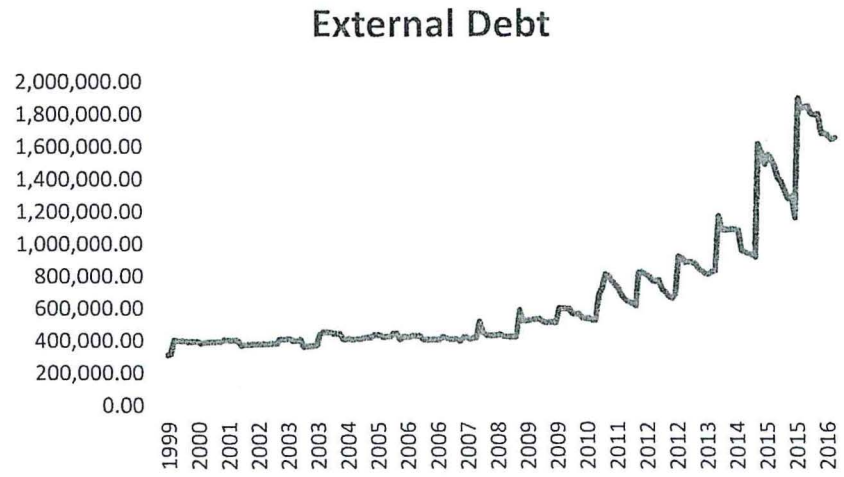


Figure 1: External debt

According to the World Bank, China has become Kenya's largest creditor, accounting for 57% of the country's total external debt of $4.51 billion. A report by the world bank on China's impact in Kenya indicates that Kenya still has a heavy debt burden and China's loans can bring debt to unsustainable levels. Furthermore, some of China's loans are non-concessional, which can raise debt to GDP levels quickly (Sanghi & Johnson, 2016)

Beijing now accounts for 10.7 per cent of Nairobi's total debt, to take pole position as Kenya's top external lender ahead of Japan and the World Bank's International Development Association (IDA). China now accounts for an estimated 23 cents out of every shilling paid out in external debt service in the half year to December.

Data from the National Treasury shows that Nairobi wired to Beijing a total of Sh12.72 billion in debt servicing out of the total Sh56.37 billion external debt repayment in the six months to December 2016. This comprised Sh2.17 billion in principal and Sh10.56 billion in interest payments to China. The second largest debt service payout between July and December was Sh12.1 billion to IDA, followed by Japan (Sh4.43 billion), France (Sh4.23 billion), and Sh1.1 billion to the European Investment Bank. Foreign-denominated debt, owed to bilateral and multilateral lenders, commercial banks, and suppliers, stands at $18.50 billion in the period under review. This includes the Eurobond. (Kenya Debt relief Network, 2009)

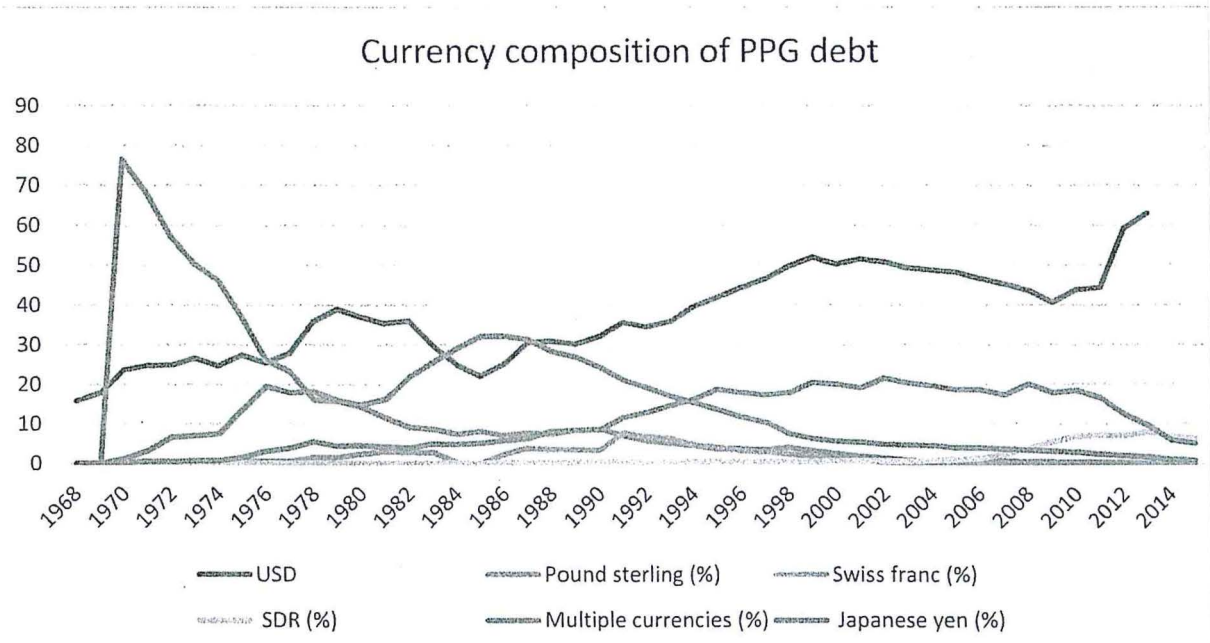


Figure 2: Currency composition of PPG debt

These developments bring into question whether the country's external debt is sustainable. Through analysis of trends, previous works and various debt sustainability reports this

study seeks to assess the sustainability of Kenya's external debt using stochastic debt sustainability approaches.

1.3 Research Objectives

To determine whether Kenya's currency composition of foreign liabilities has offset adverse exchange rate movements.

1.4 Research Questions

Is Kenya's external debt portfolio management optimal?

Does Kenya's currency composition of foreign liabilities offset adverse exchange rate movements?

1.5 Problem Statement

External debt has become a common phenomenon across the world. Every country has some form of debt that they owe the world bank, IMF or simply another country. The debt, depending on the issuer, will vary in terms of the currency hence a foreign debt portfolio would have different currency shares. Mello & Hussein (2001) state that the currency composition of foreign debt stocks can be deemed to be an efficient tool for foreign debt portfolio management where they researched and found that foreign debt portfolios were managed sub-optimally in the countries they examined.

Borrowing from asset pricing and portfolio selection models that suggest that the portfolio share of an asset should be proportional to its rate of return and the investors should hedge against risk and unexpected movements in liability values (Markowitz,1952). These models applied to the foreign debt portfolio would therefore suggest that an external debt portfolio would be deemed optimal if the exchange rate movements do not granger cause changes in the debt shares denominated in the corresponding currencies. Much has been done in Public debt portfolio optimization but the aspect of foreign debt portfolio optimization has not been fully addressed.

This study contributes to the foreign debt portfolio optimization literature by using panel co-integration techniques in order to determine whether Kenya's foreign debt portfolios are managed optimally.

1.6 Importance of the study

This research will be useful to governments seeking to establish for how long is their external debt sustainability. The government of Kenya more so the Ministry of Finance will be able to use these findings to develop policy recommendations that will assist the policy makers in coming up with regulatory measures and guidelines of debt management. It can be incorporated into the banking system such that a bank will be able to assess an individual's loan repayments and estimate a likelihood of default by the individual. In addition, the findings of this study will be useful to researchers and academicians who will use this study as a source of theoretical information on external debt optimality and also to add to the existing body of knowledge on this topic.

Chapter Two: Literature Review

2.1 Introduction

This chapter explores the theoretical and empirical literature on external debt optimization. Section 2.2 presents the theoretical literature on external debt sustainability. Section 2.3 analyses the empirical evidence relating to approaches of optimization and tests on external debt in relation to economic growth and finally section 2.4 will form a conclusion based on the findings of previous papers.

2.2 Theoretical Literature

The Asset Liability Management (ALM) application for a financial institution proposes that risk can be contained by matching the financial features of the assets and liabilities, as this means one side of the balance sheet will be immunized by the other side. The ALM approach helps institutions analyze situations that can threaten their profit maximization objective.

Applying this concept to the risk analysis of a foreign liability portfolio is not very simple, though the ALM principles remain relevant. Governments are concerned about their liabilities because of the financial and economic costs that result from unexpected increases in debt servicing flows. Therefore, governments have two policy alternatives: for a given level of government spending, taxes are to be raised, or the other option is for a given level of taxes then government spending cuts can be implemented. If the unexpected shocks are so severe that the government is unable or unwilling to raise taxes or cut spending, there is a third alternative which is for the government to default on its obligations.

Tax-smoothing literature proposes that taxes, other than lump sum, create deadweight welfare losses, and that volatility of tax rates increases these losses (Barro, 1979). In this context, it could also be argued that higher long-term growth is more likely to be achieved if tax variability is minimal, since it reduces uncertainty. Tax volatility creates inefficiencies as it distorts economic decision-making, complicates long-term investment decisions, depresses consumption and possibly channels excess savings into short-term financial instruments (Alesina & Tabellini, 1989). The second alternative of reducing

government spending may entail severely curtailing services and programs the government was expected to deliver involving high social and economic costs.

If the volatility in debt service is so great the government is either unable or unwilling to raise taxes or cut spending enough to pay it, they must default, which adds severe economic costs. These include output losses from economic recession and financial institutions and private sector bankruptcies and higher costs of future borrowing both for the public and private sector as a result of the government's reputational loss (Alesina, 1992).

The nature of government's assets makes the application of the traditional ALM framework more complex. The stream of government revenues and expenditures are highly responsive to macroeconomic policies which makes it difficult to discover their response to changes in inflation, interest or exchange rates. For instance, depending on whether inflation is caused by a demand or a supply shock, the net fiscal position could improve or worsen. Short term interest rates and government revenues could be positively correlated. Government revenue may have lagging effects which may lead to a negative correlation with short-term interest rates. A currency devaluation may increase government revenues if a real depreciation boosts economic activity, but may trigger a contraction as a result of inflation or a severe reduction on imports.

In economic literature, we learn two ways in which a country can grow its economy. It can be growth brought about by innovations through use of competition, which is described as the dynamic completion model (Ellig, 2001). On the other hand, according to the Solow (1956) neoclassical model, economic growth can be achieved by increasing the amount of investment which increases its savings. This implies that for developing nations to grow economically they need to put in place policies that support greater savings that will then increase investment and hence growth.

A country can finance its activities using two ways. It can raise funds through internal sources such as taxes or it can borrow from external sources. According to Adegbite et al (2008), the Dual Gap theory is a good explanation of the reason for choosing external finance as opposed to domestic financing. In developing nations, the level of domestic savings is not sufficient to finance the needed investment to ensure economic

development. Also since most of the developing countries are far from their steady state, any investment injection may lead to accelerated economic growth.

The country should borrow externally if it is anticipated that the return on the borrowed funds will be higher than the cost. Hence, a country should invest in projects that have higher expected returns than the cost of foreign debt. According to Adegbite et al (2008) in an optimal condition, the marginal return on investment is greater than or equal to the cost of borrowing, in this case debt will show a positive impact on growth.

According to the neoclassical growth theory, debt has a positive direct effect on economic growth. This is because the amount borrowed if used optimally is anticipated to increase investment. Debt affects growth through its reduction on the resources available for debt servicing. According to the debt overhang hypothesis, a specific level of external debt has a positive effect on economic growth up until a certain point where by an additional debt will have a negative effect on growth.

According to Krugman (1988), the debt overhang theory shows that if there is some probability that in the future debt will be more than the country's repayment ability then this will discourage further investments because the expected rate of return from the productive investment projects will be very low to support the economy as the significant portion of any subsequent economic progress will accrue to the creditor country. This will eventually downsize economic growth (Krugman, 1988, Sachs, 1989a).

Claessens and Diwan (1990) argue that debt overhang is a situation in which the illiquidity effect, the disincentive effect, or both effects are strong enough to discourage growth in the absence of loans by creditors. This definition of the debt overhang is narrow as the impact of a high external debt is linked to the tax disincentives argument. The argument is that any success in indebted country's economic performance is taxed away by creditors (Hjertholm, 2001).

According to Were, M (2001) debt overhang is much wider in that the effects of debt do not only affect investment in physical capital but any activity that involves incurring costs such as investment in human capital and in technology acquisition whose effects on growth may be even stronger over time.

Agenor and Montiel's (1996) approach to external debt is motivated by several observations, which were mostly policy-oriented discussions centered on the question of whether the debt crisis was one of solvency or of liquidity problem. The difference between the two terms is that liquidity problem is the inability of a country to service its debts as they fall due, that means it occurs when a county does not have enough cash on hand to pay current obligations while solvency issue relates to whether the value of a country's liabilities exceeds the ability to pay at any time; a country is insolvent when it is incapable of servicing its debt in the long run (Ajayi, 1991).

Taking this into consideration then it is observed that most of the developing nations were and still are solvent. As pointed out by Kletzer (1988), the present value of the most developing countries prospective resources measured by discounted value of the real outflows was larger than the debt obligations they have.

Jonse G. Leta (2002) in his research on external debt and economic growth in Ethiopia pointed out that although the indebted poor countries are solvent, the willingness to pay declines due to certain factors. These could be domestic and external factors. The domestic factors include wrong macroeconomic policies such as exchange rate misalignment, fiscal irresponsibility and policies that deter savings such as negative real interest rates, which reduce investment and encourage capital flight. External factors include rising foreign interest rates, deterioration in the terms of trade and oil shocks.

The Debt Laffer curve hypothesis of which relates the magnitude of country's debt and the value of repayment is important in explaining the debt overhang theory. According to Freytag, A et al (2008) the Net Present Value (NPV) of the debt repayments increases with stock of debt up to a certain threshold. Thus, a higher face value of the debt will be associated with lower investments which leads to lower economic growth and eventually lower NPV of expected debt service.

According to Clements, B et al (2005) high levels of debt can depress economic growth in developing nations, external debt slows growth only after its face value reaches a threshold level estimated to be about 20-25 percent of GDP in net present value terms or 45 percent of GDP. Debt overhang depresses growth by increasing private investor's uncertainty about governmental action taken to meet the debt service obligations.

Therefore, the debt overhang problem is linked to the transfer of resources from capital scarce to capital surplus countries.

The debt Laffer curve argument introduced by Jeffrey Sachs is derived from the tax laffer curve hypothesis introduced by Arthur Laffer (1981). He argues that if personal tax rates were raised then they would generate a negative impact on government tax revenue. The reason is that high tax rates either discourages investment or leads to tax evasion.

Claessens et al, (1996) highlights other channels through which the service of large amounts of external debt obligations can affect economic performance. An example is the crowding out effect. The crowding out effect occurs when there is a reduction in the current debt service that lead to an increase in current investment for any given level of future indebtedness (Cohen, 1993).

If a greater portion of export revenue is used to service external debt, very little is available for investment and growth. Moreover, debt servicing difficulties lead to a deterioration of relations with creditors, thus reducing the amount of finance poor countries can access (Khan and Villaneuva, 1991).

2.3 Empirical literature

There is limited literature on optimal foreign debt portfolios and therefore to clearly define this study a lot has been borrowed from the literature that have employed the cointegration technique. Other techniques such as (Markowitz, 1952) that highlight that an optimal portfolio is one that provides the best combination of risk and return based on the investor's degree of tolerance have been reviewed. This model is widely used because of its simplicity and cost effectiveness. Some papers that consider this methodology would minimize the debt service cost in order to arrive at the optimal portfolio. However, (Dooley, 2000) shows that minimizing debt service costs may be inefficient for developing country governments because such a policy may increase default risks and therefore borrowing costs.

Debt Sustainability

The IMF have come up with a Debt sustainability analysis tool that indicates whether a country's debt is sustainable. There is a variety of literature on debt sustainability such as

working papers by the IMF and world bank. Theories have also been adopted so as to explain debt sustainability. These theories show that if there is some likelihood that in the future debt will be larger than the country's repayment ability; expected debt-service costs will discourage further domestic and foreign investment.

Sachs (1989) explains in his paper that a heavy foreign debt burden in a developing nation slows economic growth. Higher debt tends to increase budget deficits which undermines macroeconomic stability. By increasing taxes in order to cover debt service, the high rates of taxation tend to undermine growth by bringing about distortions in the economy such as increased barriers to trade, capital flight, tax evasion and reduced work effort.

There are varied approaches to analyze external debt sustainability that have been extensively studied. The key determinants of such analyses include the dynamics of fiscal and external repayment abilities, the prevalent stocks of external debt and access to additional external financing. There are two approaches to debt sustainability analysis have been pursued.

The first one focuses on the financial sustainability in which a fiscal deficit is considered sustainable if it is able to generate a constant debt-to-GDP ratio (Cuddington, 1996). As long as the growth rate of the economy is higher than the interest rate then it is possible to run a sustainable fiscal deficit, which will in turn ensure the stability of debt-to-GDP ratio.

The second approach evaluates if there is a present value borrowing constraint that could limit the quantities to borrow (Gupta, 1992). This concept is derived from the work of (Hamilton and Flavin, 1986). An entity's liability position is sustainable if it satisfies the present value budget constraint without the major correction in the balance of income and expenditure, given the costs of financing it faces in the market (IMF, 2002).

Other than the two approaches, (Meltem Ocal and Serhan Oksay, 2011) have developed the concept of Solvency Ratio to monitor country's ability to meet its external debt obligations. Underwood (1991) and Cohen (1996) tried to find a discontinuity in the relationship between debt burden indicators for example the incidence of default and the external debt-to-export ratio. These papers found that above a threshold range of about 200-250 percent of the present value of debt-to-export ratio, the likelihood of debt default

increased rapidly. This range has since been adopted as the benchmark by the original HIPC initiative and was lowered in 1999 under the enhanced HIPC framework.

Reinhart, Rogoff, and Savastano (2003), looked at the historical determinants of debt intolerance which is defined as the extreme duress which many emerging markets experience at debt levels that seem quite manageable by industrial standards. Their key finding was that the institutional investor sovereign risk ratings can be explained by variables measuring the countries' external debt burden, its repayment history, and its history of macroeconomic stability.

External debt on economic growth

External debt has been attributed to being a contributor of economic growth. Developing countries in aggregate differ significantly in terms of their economic and political environment, organizations and institutions. Most literature on external debt have compared the external debt service to Gross domestic product or Gross national product of the countries. Karagol (2002) and Wijeweera et al. (2005) investigated the relationship between external debt service and GNP by applying extended production function model.

Karagol (2002) argued that debt service burden has a negative impact on investment and capital accumulation. The main reason is that the greater the percentage of foreign currency goes to meet debt service and subsequently there us a reduction in external capital because of a decrease in credit worthiness. The paper employed the multivariate cointegration techniques to develop a vector error correction model. They also consider the (Johnson, 1998 and Johnsen & Juselius, 1990) in variables in order to specify the correct model. The paper found a long run relationship exists between GNP and debt burden and accepted the debt overhang hypothesis in Turkey.

However, the case of Sri Lanka, Wijeweera et al. (2005) where the long run estimations relied on the cointegration methodology and the short run analysis employed an error correction method, he found conversely that external debt affected GNP positively in the long run equation and negatively in the short run. The paper concluded that Sri Lanka does not have a debt overhang problem because external indebtedness was not too high.

Were (2001) and Isa Audu (2004) investigate the relationship between external debt service and growth for Kenya and Nigeria respectively. Were and Isa find that external debt service has a negative effect on growth.

Moreover, Sachs (1989) concludes that higher debt service payments can also have negative effects on the composition of public spending by squeezing the pool of resources available for infrastructure and human capital spending which ultimately has a negative effect on growth. This effect therefore arises because highly indebted poor countries tend to frequently switch resources, including foreign aid and other foreign exchange resources to keep off pressing debt service obligations particularly debt owed to multilateral institutions (Iyoha, 1999). However, Pattillo et al. (2002) finds no statistically significant relationship between debt service and growth. Fosu (1999) as well finds no relationship between debt service and growth for countries in sub Saharan countries.

Econometric tools

The vast majority of studies have employed OLS method to investigate external debt and economic growth relationship in sample countries, where the sample countries are at different stages of development and have different debt burden. Hofman and Reisen (1991) argued that (IMF,1989) picks a group of middle income debtor countries to consider as indebted countries. These countries are arbitrary and classified as indebted countries and also have not faced serious debt servicing problem. It is clear that the effect of debt burden may vary across these countries.

Even though some studies have used the Engle-Granger two step procedure, this method makes the implicit assumption that the cointegrating vector is unique, which means that we are bound to end with a model that is a linear combination of independent cointegrating vectors. Moreover, the test procedures do not have well defined limiting distributions and as a result testing for cointegration is not a straightforward procedure. Another disadvantage of the Engle and Granger two-step procedure is that it examines only the dominant cointegrating vector between series.

Using a utility-maximizing framework, (S. Claessens, 1992) suggests that a country can manage its external exposure if they choose an optimal currency composition. The optimal

risk-minimizing currency composition depends on the relation between export receipts and the costs of borrowings in each currency. A simple methodology is applied to Mexico and Brazil in order to derive the optimal shares of individual currencies. The results show that if these countries continuously altering the currency composition of their debts they could have lowered their external exposure. The low correlations between the costs of borrowings and export and import prices make the currency composition of debt a very imperfect hedging tool, and it is likely that hedging instruments directly linked to prices are preferable.

2.4 Conclusion

The papers reviewed have mostly based their arguments on the level of debt in a particular country and its impact on the GNP, GDP or growth of that country. The similarity is that in all cases they highlight that a large debt has an impact on either of the three macroeconomic elements. They have a similar conclusion in that the level of debt does in fact impact growth in some-way. Other papers have highlighted debt service to try an explain debt as an impact of growth. The general principle they are all trying to find a solution to is debt and its relation to growth. This is similar to this study such that the methodology followed will seek to find an optimal portfolio of foreign denominated debt that would subsequently positively impact the growth of the country.

This study focuses on currency-denominated debt and uses this to make comparisons to various variables that explain external debt optimality. Taking into consideration currency risk factors and providing hedging strategies to maintain optimality will be key. The study develops a comprehensive understanding of a firm's risk management activities. Prior work by Geczy, Minton, and Schrand, (1997) and Allayannis and Ofek, (2001) examines foreign currency–denominated debt at the aggregate level and has been used in this study.

A new concept adopted is the foreign debt management. Literature has focused on consolidating market oriented reforms and macroeconomic stability in indebted countries such as Latin America and eastern Europe. These countries have progressively liberalized their investment and trade, facilitated international capital movements and phased out capital controls. In this more liberal environment, foreign debt management has become a key element of fiscal policy making, particularly in terms of exchange and interest rate

volatility, as well as volatility in capital flows (cassard and folkers-Landu, 1997). This study will propose applying the foreign debt management system in Kenya in order to maintain the optimal foreign debt portfolio that will be formulated.

Chapter Three: Methodology

3.1 Introduction

This chapter outlines the research methodology used in this study. Section 3.2 explains the research design applied in the study; section 3.3 covers the nature and sources of data for the study, section 3.4 covers the theoretical approach. Section 3.5 outlines the empirical approach of the study.

3.2 Research Design

Babbie, (2002) defines research design as the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in the procedure.

The proposed research design for the study is the exploratory approach. Churchill (1991) explains the importance of exploratory studies which include help with clarifying concepts, increasing the researcher's familiarity with the problem, in formulating a problem for more specific investigation and establishing priority for further research Exploratory research is characterized by its flexibility with respect to the way it is used to gain insight and develop hypothesis.

3.3 Nature and sources of data

The study used secondary data obtained from the International Monetary Fund data bank and supplemented by Central Bank of Kenya and the Kenya National Bureau of Statistics databases. The population of the study was drawn from yearly level of Kenya's External debt for the period from 1970 to 2016, the percentage of external long-term public and publicly-guaranteed debt contracted in Japanese yen, swiss Franc and U.K pound sterling for Kenya. The exchange rates over the period of 1970 to 2016.

3.4 Conceptual Framework

The objective of this paper is to find the optimal composition of external debt portfolio issues which will be done by minimizing the total value of the foreign liabilities in the portfolio. The study utilizes a cointegration technique to establish the optimal portfolio.

The main variables in use are foreign currency exchange rates, currency denominated debt and foreign assets. The following methodology will be employed:

3.5 Model Specification

Let there be n currencies such that a country's total foreign debt at time t can be denominated in any of these n currencies. Let currency n be used as a numeraire such that exchange rates (e_k for k=1,….,n-1) can be defined as the value of currency k per unit of currency n. The researcher's objective is to minimize the total value of the foreign liabilities in the portfolio;

Min $C_t(A_t : D_{kt})$,

where A_t is total foreign assets and D_{kt} is foreign debt denominated in currency k.

Assets and liabilities are additively separable.

Let $C_k < 0$ and $C_{kk} > 0$, where $C_k = \frac{\delta C}{\delta D}$ and $C_{kk} = \frac{\delta^2 C}{\delta D^2}$, such that C_t admits a minimum in D_{kt}.

In addition, let there be exchange rate uncertainty such that the value of foreign debt, denominated in currency n, is affected by unpredictable cross-exchange rate movements. The researcher's problem can be formalized as:

Min $_D C_t(A_t : D_{kt})$,

S.t $D_t = \sum_{k=1}^{n} \frac{D}{E\ e}$

Where E_t is the expectation operator.

Standard manipulation of the first-order conditions for cost minimization yields:

$\lambda = C_1 E_i e_{1t} = \ldots = C_n$

(1)

By equation (1), it follows that $\frac{c_1}{c_1} = \frac{1}{E_t e_1}, \ldots, \frac{C_{n-1}}{Cn} = \frac{1}{E_t e_{n-1,t}}$. In particular, if currency k is expected to appreciate with respect to currency n ($E_t e_{kt}$ falls), the impact of k-denominated debt on portfolio C rises relative to that of n. Because $C_k < 0$, the share of foreign debt denominated in k, D_{kt}, falls. As a result, the expected appreciation of a given currency k

(relative to currency n) implies a fall in share of total debt denominated in k (relative to n).

Letting C_t-$\frac{1}{2}\{A_t - \Sigma_{k=1}^{n}\left(\frac{Dkt}{e_{kt}}\right)^2\}$, for example, and assuming $E_t e_{kt}$=e_{kt}, it follows from equation (1) that $\frac{D_{kt}}{D_{Kt}}$ =e_{kt}. As a result, an appreciation of k with respect to n (a fall in e_{kt}) leads to a fall in the share of k-denominated debt, relative to the debt share denominated in n. A change in the volume of debt denominated in k relative to n offsets the appreciation of k to keep the n-value of the debt portfolio constant.

3.6 Econometric Analysis

3.6.1 Introduction

Unit root testing is first carried out on the data then it is subjected to cointegration analysis. It is argued that more thorough analyses of the unit root and cointegration properties of the data can be made by combining information derived from time series dimension of the data set and that obtained from its cross-sectional dimension, especially when the time series available for the variables under examination are not long enough (Mello and Hussein, 2001).

3.6.2 Unit Root Testing

As time series stipulates the first step in the estimation of dynamic panels is to test whether the variables at hand do not contain unit roots, i.e are stationary. If the relevant variables in the time series data are non-stationary, the system can be tested for cointegration. It is not necessary that the variables of interest be stationary in order to estimate the long run relationship. The tests used on the data were; (1) Augmented Dickey Fuller with the null hypothesis that a unit root is present in a time series sample and the alternative hypothesis is different depending on which version of the test is used, but is usually stationarity or trend-stationarity. (2) Phillips Perron test which is used in time series analysis to test the null hypothesis that a time series is integrated of order 1 and (3) the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests used to test the null hypothesis that an observable time series is stationary around a deterministic trend (i.e. trend-stationary) against the alternative of a unit root.

3.6.3 Correlation Analysis

In correlation analysis, we estimate a sample correlation coefficient which ranges between negative one and positive one ($-1 < r < +1$) and quantifies the direction and strength of the linear association between the two variables. The correlation between two variables can be positive that is higher levels of one variable are associated with higher levels of the other or negative such that higher levels of one variable are associated with lower levels of the other. The sign of the correlation coefficient indicates the direction of the association. A correlation close to zero suggests no linear association between two continuous variables.

3.6.4 Estimating the Cointegration

Literature on dynamic panels provides two residual based tests. The first one was proposed by (Pedroni, 1995,1999) and (Kao. 1999) which uses residuals derived from the engle and granger, (1987) two step regression to construct the test statistics. The second test was developed by (McCoskey and Kao, 1998). The null hypothesis is what clearly distinguishes both tests.

This study employs the use of Johansen Cointegration tests. The Johansen test has two forms: the trace test and the maximum eigenvalue test. These two tests carry out cointegration test only that they have different alternative hypothesis.

a) Trace Test

The trace test examines the number of linear combinations where the null hypothesis is that the linear combinations denoted by K be equal to a given value (K_0), and the alternative hypothesis for K to be greater than K_0.

$$H_0 : K = K_0$$

$$H_0 : K > K_0$$

In order to test for cointegration we set K_0 to be equal to 0 which will mean no cointegration. This being the null hypothesis, if rejected will lead to the conclusion that there is at least one cointegration relationship. In this case, we need to reject the null hypothesis to establish the presence of Cointegration between the variables.

b) Maximum Eigenvalue Test

The maximum eigenvalue test, we ask the same central question as the trace test the only difference being the alternate hypothesis.

$H_o : K = K_o$

$H_o : K = K_o + 1$

So, starting with K_0=0 and rejecting the null hypothesis implies that there is only one possible combination of the non-stationary variables to yield a stationary process. If we have more than one, the test may be less powerful than the trace test for the same K_0 values.

Once the null hypothesis of no cointegration is rejected, the coefficients of the long run relationships can be estimated using methods such as the pooled Mean Group estimator developed by (Pesaran and others, 1999) or the fully modified estimator developed by (Pedroni, 1996). This study will use the Vector Error Correction Model (VECM) and supplement the results using the dynamic Ordinary Least squares (DOLS).

Kao and Chiang (1998) proposed the Dyanimic Ordinary Least squares estimator, it is based on the (stock and Watson, 1993) estimator for time series. It involves running a regression where lags and leads are included in the cointegration regressors in order to produce unbiased estimators. The Monte Carlo simulations presented in (Kao and Chiang, 1998) show that the DOLS estimator outperforms both OLS and FM estimators.

Using time-series analysis, the foreign debt portfolio is optimal, when the US dollar value of the debt share denominated in a given currency is not affected by exchange rate movements and making correlation between changes in debt shares and exchange rates equal to zero. The U.S dollar-value of debt shares should also be less volatile than the exchange rate movements. Using graphs, the results will be interpreted based on whether the lines move together; a downward (upward) slope indicates an appreciation (depreciation) of the exchange rate relative to the U.S dollar and a fall (rise) in the US dollar-value of the debt denominated in that particular currency.

Chapter Four: Data Analysis

4.1 Introduction

This chapter outlines the data analysis of this study. Section 4.2 includes the descriptive statistics of the data as well as tests for stationarity; it also covers econometric tests for cointegration and dynamic OLS as outlined in the methodology. In section 4.3 the results of the study will be discussed. Finally, Section 4.4 will provide the conclusion to the chapter.

4.2 Data Analysis

The descriptive statistics was carried out on the five variables of exchange rate that will be used in the analysis. The means and skewness of the data are outlined in the figure below:

Sample: 1970 2017

	YEN	SWISSFRANC	SWISS_FRAN	POUND_STE	JAPANESE_Y	GBP
Mean	163.6933	1.705279	1.724273	10.91374	10.98242	1.762274
Median	126.4558	1.475242	0.726200	5.137000	9.695100	1.651850
Maximum	344.7018	4.090891	7.722500	68.16240	21.56400	2.486600
Minimum	79.45000	0.881700	0.000000	0.079900	0.525800	1.321750
Std. Dev.	74.52954	0.729826	2.017099	16.14885	7.067669	0.299873
Skewness	0.855639	1.534843	1.247201	2.160319	0.023328	1.051497
Kurtosis	2.339675	5.175133	3.932166	6.855677	1.425689	3.311591
Jarque-Bera	6.308440	26.53908	13.29557	62.87654	4.651186	8.474382
Probability	0.042672	0.000002	0.001297	0.000000	0.097725	0.014448
Sum	7366.200	76.73757	77.59230	491.1183	494.2091	79.30232
Sum Sq. Dev.	244404.7	23.43639	179.0223	11474.55	2197.885	3.956644
Observations	45	45	45	45	45	45

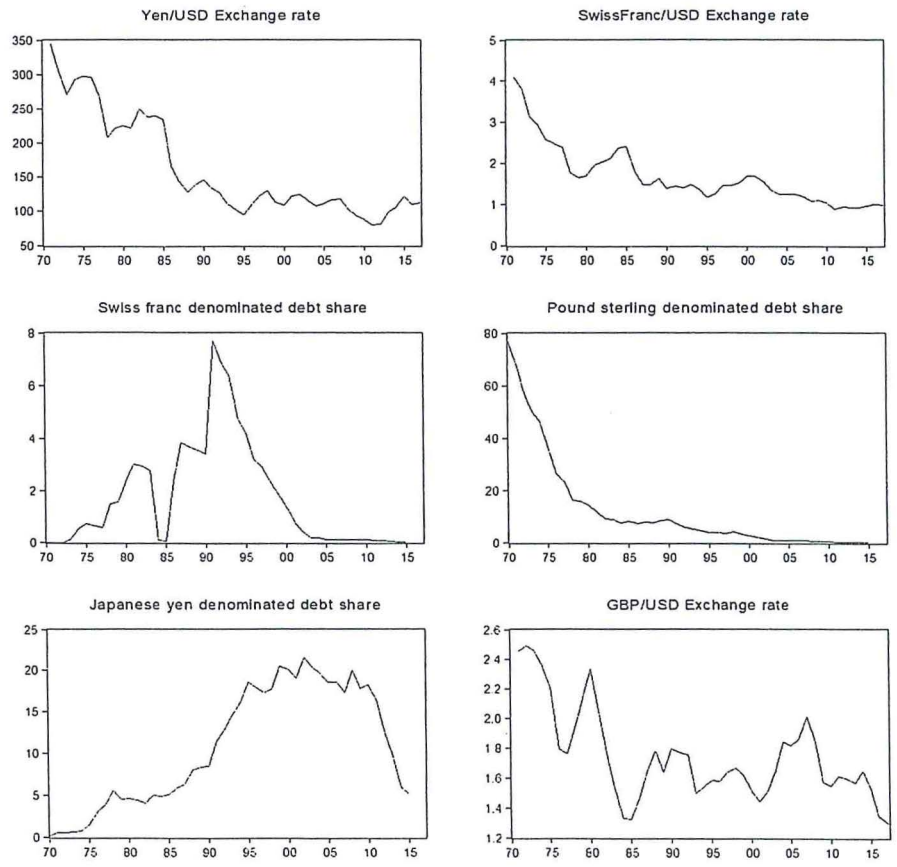
The mean value for the Yen/USD exchange rate is 163.6933, Swiss Franc/USD exchange rate is 1.705279 and the GBP/USD exchange rate is 1.762274. The currency denominated debt share mean are; Japanese Yen is 10.98242, Swiss Franc is 1.724273 and Sterling pound is 10.91374.

The standard deviations as well are of importance. In order for a debt portfolio to be termed optimal, the ratio of the currency denominated US dollar value debt share to the exchange rate should be less than 1.

Name of currency	**Ratios**
Yen/USD against Yen denominated debt share	0.0948
Swiss Franc/USD against Swiss Franc denominated debt share	2.7638
GBP/USD against Pound sterling denominated debt share	53.852

As per the results above, only the Yen denominated debt share to the Yen/USD exchange rate is below 1, this would be termed as optimal. The other variables would be termed sub-optimal. However, Further analysis is carried out to determine this hypothesis.

The graphical trends of the variables in the study are observed below;



4.2.1 Correlation Results

Correlation tests were then carried out on the variables and the following were observed;

Yen/ US dollar to Yen debt shares	Swiss Franc/US dollar to Swiss Franc debt shares	GBP/US dollar to GBP debt shares
-0.825132	-0.171044	0.788167

For the bivariate correlations, the null hypothesis is that the correlation between changes in debt shares and exchange rates movements is equal to zero. Optimal debt portfolio management is characterized by having a correlation between the exchange rates and the debt share being zero. These results indicate correlations as being significantly different from zero hence we cannot assume optimal debt portfolio management.

The correlation between the GBP/US dollar and the Sterling pound denominated debt share is 0.788167 which implies there is a strong positive association between the two variables whereas the correlation between the Swiss Franc/US dollar and the Swiss Franc denominated debt share is -0.171044 which implies a weak negative association between the two variables. The correlation results are outlined in Appendix 3.

4.2.2 Unit Root Tests

The results of the panel unit root tests are indicated in Appendix 1. The t-bar statistics suggest that the six variables are non-stationary. The debt share variables and exchange rate variables results fail to reject the null hypothesis of having a unit root. With further investigation, adding a trend and first order differencing, the variables become stationary. The findings strongly suggest that all six variables are I(1) with first differencing, intercept and trend. However, the pound sterling denominated debt share is I(1) only with first differencing.

4.2.3 Johansen cointegration tests

Given the results of the unit root tests, we proceed to the panel cointegration tests. Based on the Johansen cointegration tests, the trace test indicates two cointegrating equations at the 0.05 level of significance whereas the maximum eigenvalue test indicates two cointegrating equation. Therefore, we conclude that the panel has two cointegrating equations.

The long run equations are as follows:

GBP exchange rate= 0.096523Pound sterling debt share - 0.060670Swiss Franc debt share - 0.548369swissfranc exchange rate – 0.000525Yen exchange rate

Japanese yen debt share = 5.930021Pound sterling debt share – 4.912904Swiss franc debt share – 65.0276 Swiss franc exchange rate + 0.272285 Yen exchange rate

A unit increase in the pound sterling increases the GBP exchange rate by 0.096523. A unit increase in the Pound sterling debt share will increase the Japanese yen debt share by 5.930021 in the long run.

4.2.4 Vector Error Correction Model

The Vector Error Correction Model is modelled using two cointegrating equations as per the results in the Johannsen test of cointegration. The error correcting term is -0.116945. A negative and absolute value less than 1 is required to make sure that the model converges to the steady-state. Otherwise, it would be divergent. The negative sign means it's a positive move to balance. This implies that 11.69% was adjusted to equilibrium in the previous period. The results provide strong evidence of the existence of long-run relationships between the debt shares and the corresponding exchange rate. The VECM equations are outlined in Appendix 4.

4.2.5 Granger causality test

The granger causality test is carried out to determine the direction of causality. The null hypothesis is that x does not Granger-cause y in the first regression and that y does not Granger-cause x in the second regression. As per the hypothesis, we fail to reject the null hypothesis for four variables with the exception of the swiss franc and sterling pound exchange rates that reject the null hypothesis when tested against the swiss franc denominated debt share. This implies that the debt share denominated in swiss franc does granger cause the swiss franc exchange rate and GBP exchange rate movements.

4.2.6 Dynamic Ordinary Least Squares (DOLS)

The estimated long run relationship using the DOLS procedure is reported in Appendix 7. The GBP/ US dollar exchange rate has a significant impact on the debt share denominated pound sterling. The GBP/US dollar exchange rate, swiss franc/ US dollar exchange rate and the Japanese yen/Us Dollar exchange rate all significantly impact the debt share denominated in Japanese Yen. These are estimated at 5 percent level of significance.

4.3 Discussion

Optimal portfolio management would be evident if the value of a debt share denominated in a given currency is not affected by exchange rate movements of its respective currency. The findings of this study show that the foreign debt portfolio management in Kenya is sub-optimal. Sub-optimality may result from some rigidity in the currency composition of the country's foreign debt stock which may be attributed to factors such as limited availability of instruments to hedge against exchange rate risk.

Sub-optimality in foreign debt management can also be attributed to the term-structure of international lending contracts. Li (1992) states that a high share of foreign assistance in terms of grants and concessional loans in a country's total foreign borrowing may lead to sub-optimal foreign debt management.

Chapter Five: Summary, Recommendations and Conclusion

5.1 Introduction

This chapter covers the summary of the study, conclusion and recommendation for further studies. Section 5.2 covers the summary of the study, section 5.3 presents the conclusions, section 5.4 analyzes the limitations of the study and section 5.5 gives recommendation for further study.

5.2 Summary of the study

There has been an increase on the reliance on external debt by developing countries. The aim of carrying out this study was to establish the optimal external debt portfolio and determine whether Kenya's currency composition of foreign liabilities offset adverse exchange rate movements. The study exclusively depended on secondary data to achieve the objective. The data was collected from CBK and World Bank data banks and it covered the period from 1970 to 2015. Descriptive statistics was the statistical method used to analyze the data and findings are presented in the form of frequency tables and graphs for easier interpretation.

This was an analytical study that used time series or longitudinal approach. The data was exposed to sensitivity analysis using cointegration and regression analysis. From the regression model for the sampled period, the study found that foreign debt portfolio management is sub-optimal.

5.3 Conclusion

This study used a simple model of foreign debt portfolio management and used time series data analysis to test for the existence of a stable long run relationship between the currency composition of Kenya's foreign debt portfolio and exchange rate movements. The results observed from this study suggests that the foreign debt portfolio has been managed sub-optimally in Kenya.

An effective tool for foreign debt portfolio management is the currency composition of foreign debt. However, the results suggest that foreign debt portfolio managers may be unable to adjust the currency composition of foreign debt portfolios with exchange rate

movements. These findings may be due to some inflexibility in the currency composition of foreign debt which have a constrain on portfolio diversification.

Other constraints that may lead to sub-optimal portfolio management include institutional factors, imperfections in the domestic credit market and the depth of markets for longer term hedging. It may be true to say that the currency composition of foreign debt portfolios may be due to supply factors rather than portfolio diversification.

5.4 Limitations of the study

The study considered only three currency denominated debt share and three exchange rates. There are other currency denominated debt shares such as Chinese, deutsche mark, euro and French Franc but the data was missing values for several years and it would provide wrong conclusions unless major assumptions were made which would have led to some bias in the conclusions.

The study is limited in accuracy as it depends on the quality of data obtained from the secondary sources. However, the data was verifiable since it came from the Central Bank publications and was also supplemented from data by the World Bank.

This study is based on the period between the year 1970 to 2015. This period of study encapsulates periods of different economic significances and even political instability. This could therefore have influenced the results.

5.5 Recommendations

There are policy implications that should be taken into consideration. It would be ideal to put in place policies that improve risk management. This can be done by ensuring that there are adequate prudential regulations as well as develop the capital markets in Kenya. In addition, including policies that bring about creation of more sophisticated hedging instruments would also improve risk management in the country.

Policies geared towards reducing the restrictions on holding foreign exchange. This can be done by liberalizing capital movements which in turn could reduce transaction costs. The reduction in costs would then encourage efficient foreign debt management.

There has been debate on whether the government should take up the role of debt portfolio manager. This would mean that the government would actively participate in financial intermediation. There is lack of well-developed financial markets in developing nations which is a requirement in order for them to have efficiency in private sector-led portfolio management.

The governments as the foreign debt portfolio manager should ensure that the asset and liability structure they take up does not trigger defaults and ultimately increase portfolio management costs. There is also the matter of the government taking up the role of lender of last resort which is particularly important as an active portfolio debt manager. If they are placed in a position where they need to utilize their role as lender of last resort then the government should regulate the private sector so as to control the growth of implicit liabilities.

The governments participation in financial markets may lead to an increase in corporate and sovereign default risks which ultimately increases portfolio management costs. It now leads to the question of whether the benefits of foreign debt portfolio management by the government outweighs the costs and risks associated with the government as the foreign debt portfolio manager.

APPENDIX

Appendix 1: Augmented Dickey Fuller test

Lag Length: 2 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.538376	0.5049
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

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

Figure 3: Japanese yen debt denominated share

Lag Length: 7 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.686136	0.4300
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

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

Figure 4: Pound Sterling denominated share

Lag Length: 0 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.642268	0.4531
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

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

Figure 5: Swiss Franc denominated share

Lag Length: 1 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.996859	0.7463
Test critical values:	1% level	-3.588509	
	5% level	-2.929734	
	10% level	-2.603064	

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

Figure 6: US Dollar denominated share

Lag Length: 4 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.154448	0.0301
Test critical values:	1% level	-3.596616	
	5% level	-2.933158	
	10% level	-2.604867	

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

Figure 7: Japanese yen Exchange rate

Lag Length: 6 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.637922	0.0940
Test critical values:	1% level	-3.605593	
	5% level	-2.936942	
	10% level	-2.606857	

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

Figure 8: Swiss Franc Exchange rate

Lag Length: 1 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.377702	0.0171
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

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

Figure 9: Pound Sterling Exchange rate

Appendix 2: Cointegration tests

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.722982	133.1032	95.75366	0.0000
At most 1 *	0.560197	79.18896	69.81889	0.0074
At most 2	0.446284	44.68894	47.85613	0.0962
At most 3	0.242924	19.86257	29.79707	0.4322
At most 4	0.135406	8.174294	15.49471	0.4470
At most 5	0.047943	2.063486	3.841466	0.1509

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.722982	53.91421	40.07757	0.0008
At most 1 *	0.560197	34.50002	33.87687	0.0421
At most 2	0.446284	24.82638	27.58434	0.1084
At most 3	0.242924	11.68827	21.13162	0.5786
At most 4	0.135406	6.110808	14.26460	0.5990
At most 5	0.047943	2.063486	3.841466	0.1509

Appendix 3: Correlation tests

Covariance Analysis: Ordinary
Date: 10/31/17 Time: 00:43
Sample: 1971 2015
Included observations: 45
Balanced sample (listwise missing value deletion)

Correlation	POUND_ST...	JAPANESE...	GBP	SWISS_FR...	SWISSFRA...	US_DOLLA...	YEN
POUND_STERLI...	1.000000						
JAPANESE_YEN_...	-0.686464	1.000000					
GBP	0.788167	-0.492797	1.000000				
SWISS_FRANC__...	-0.175978	0.048933	-0.162812	1.000000			
SWISSFRANC	0.924880	-0.672589	0.603496	-0.171044	1.000000		
US_DOLLAR___	-0.676575	0.658551	-0.441413	-0.308049	-0.657975	1.000000	
YEN	0.848941	-0.825132	0.615967	-0.177613	0.912880	-0.669788	1.000000

Appendix 4: VECM equations

D(GBP) = C(1)*(GBP(-1) + 0.0965233754672*POUND_STERLING____(-1) - 0.0606703704865*SWISS_FRANC____(-1) - 0.548369457008*SWISSFRANC(-1) - 0.000525182938897*YEN(-1) - 1.49379152454) + C(2)*(JAPANESE_YEN____(-1) + 5.93002126586*POUND_STERLING____(-1) - 4.9129039453*SWISS_FRANC____(-1) - 65.0274644067*SWISSFRANC(-1) + 0.272285444719*YEN(-1) + 8.14498286043) + C(3)*D(GBP(-1)) + C(4)*D(GBP(-2)) + C(5)*D(JAPANESE_YEN____(-1)) + C(6)*D(JAPANESE_YEN____(-2)) + C(7)*D(POUND_STERLING____(-1)) + C(8)*D(POUND_STERLING____(-2)) + C(9)*D(SWISS_FRANC____(-1)) + C(10)*D(SWISS_FRANC____(-2)) + C(11)*D(SWISSFRANC(-1)) + C(12)*D(SWISSFRANC(-2)) + C(13)*D(YEN(-1)) + C(14)*D(YEN(-2)) + C(15)

D(JAPANESE_YEN____) = C(16)*(GBP(-1) + 0.0965233754672*POUND_STERLING____(-1) - 0.0606703704865*SWISS_FRANC____(-1) - 0.548369457008*SWISSFRANC(-1) - 0.000525182938897*YEN(-1) - 1.49379152454) + C(17)*(JAPANESE_YEN____(-1) + 5.93002126586*POUND_STERLING____(-1) - 4.9129039453*SWISS_FRANC____(-1) - 65.0274644067*SWISSFRANC(-1) + 0.272285444719*YEN(-1) + 8.14498286043) + C(18)*D(GBP(-1)) + C(19)*D(GBP(-2)) + C(20)*D(JAPANESE_YEN____(-1)) + C(21)*D(JAPANESE_YEN____(-2)) + C(22)*D(POUND_STERLING____(-1)) + C(23)*D(POUND_STERLING____(-2)) + C(24)*D(SWISS_FRANC____(-1)) + C(25)*D(SWISS_FRANC____(-2)) + C(26)*D(SWISSFRANC(-1)) + C(27)*D(SWISSFRANC(-2)) + C(28)*D(YEN(-1)) + C(29)*D(YEN(-2)) + C(30)

D(POUND_STERLING____) = C(31)*(GBP(-1) + 0.0965233754672*POUND_STERLING____(-1) - 0.0606703704865*SWISS_FRANC____(-1) - 0.548369457008*SWISSFRANC(-1) - 0.000525182938897*YEN(-1) - 1.49379152454) + C(32)*(JAPANESE_YEN____(-1) + 5.93002126586*POUND_STERLING____(-1) - 4.9129039453*SWISS_FRANC____(-1) - 65.0274644067*SWISSFRANC(-1) + 0.272285444719*YEN(-1) + 8.14498286043) + C(33)*D(GBP(-1)) + C(34)*D(GBP(-2)) + C(35)*D(JAPANESE_YEN____(-1)) + C(36)*D(JAPANESE_YEN____(-2)) + C(37)*D(POUND_STERLING____(-1)) + C(38)*D(POUND_STERLING____(-2)) + C(39)*D(SWISS_FRANC____(-1)) + C(40)*D(SWISS_FRANC____(-2)) + C(41)*D(SWISSFRANC(-1)) + C(42)*D(SWISSFRANC(-2)) + C(43)*D(YEN(-1)) + C(44)*D(YEN(-2)) + C(45)

D(SWISS_FRANC____) = C(46)*(GBP(-1) + 0.0965233754672*POUND_STERLING____(-1) - 0.0606703704865*SWISS_FRANC____(-1) - 0.548369457008*SWISSFRANC(-1) - 0.000525182938897*YEN(-1) - 1.49379152454) + C(47)*(JAPANESE_YEN____(-1) + 5.93002126586*POUND_STERLING____(-1) - 4.9129039453*SWISS_FRANC____(-1) - 65.0274644067*SWISSFRANC(-1) + 0.272285444719*YEN(-1) + 8.14498286043) + C(48)*D(GBP(-1)) + C(49)*D(GBP(-2)) + C(50)*D(JAPANESE_YEN____(-1)) + C(51)*D(JAPANESE_YEN____(-2)) + C(52)*D(POUND_STERLING____(-1)) + C(53)*D(POUND_STERLING____(-2)) + C(54)*D(SWISS_FRANC____(-1)) + C(55)*D(SWISS_FRANC____(-2)) + C(56)*D(SWISSFRANC(-1)) + C(57)*D(SWISSFRANC(-2)) + C(58)*D(YEN(-1)) + C(59)*D(YEN(-2)) + C(60)

D(SWISSFRANC) = C(61)*(GBP(-1) + 0.0965233754672*POUND_STERLING____(-1) - 0.0606703704865*SWISS_FRANC____(-1) - 0.548369457008*SWISSFRANC(-1) - 0.000525182938897*YEN(-1) - 1.49379152454) + C(62)*(JAPANESE_YEN____(-1) + 5.93002126586*POUND_STERLING____(-1) - 4.9129039453*SWISS_FRANC____(-1) - 65.0274644067*SWISSFRANC(-1) + 0.272285444719*YEN(-1) + 8.14498286043) + C(63)*D(GBP(-1)) + C(64)*D(GBP(-2)) + C(65)*D(JAPANESE_YEN____(-1)) + C(66)*D(JAPANESE_YEN____(-2)) + C(67)*D(POUND_STERLING____(-1)) + C(68)*D(POUND_STERLING____(-2)) + C(69)*D(SWISS_FRANC____(-1)) + C(70)*D(SWISS_FRANC____(-2)) + C(71)*D(SWISSFRANC(-1)) + C(72)*D(SWISSFRANC(-2)) + C(73)*D(YEN(-1)) + C(74)*D(YEN(-2)) + C(75)

D(YEN) = C(76)*(GBP(-1) + 0.0965233754672*POUND_STERLING____(-1) - 0.0606703704865*SWISS_FRANC____(-1) - 0.548369457008*SWISSFRANC(-1) - 0.000525182938897*YEN(-1) - 1.49379152454) + C(77)*(JAPANESE_YEN____(-1) + 5.93002126586*POUND_STERLING____(-1) - 4.9129039453*SWISS_FRANC____(-1) - 65.0274644067*SWISSFRANC(-1) + 0.272285444719*YEN(-1) + 8.14498286043) + C(78)*D(GBP(-1)) + C(79)*D(GBP(-2)) + C(80)*D(JAPANESE_YEN____(-1)) + C(81)*D(JAPANESE_YEN____(-2)) + C(82)*D(POUND_STERLING____(-1)) + C(83)*D(POUND_STERLING____(-2)) + C(84)*D(SWISS_FRANC____(-1)) + C(85)*D(SWISS_FRANC____(-2)) + C(86)*D(SWISSFRANC(-1)) + C(87)*D(SWISSFRANC(-2)) + C(88)*D(YEN(-1)) + C(89)*D(YEN(-2)) + C(90)

Appendix 5: Granger Causality Test

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 10/30/17 Time: 21:49
Sample: 1970 2017
Included observations: 42

Dependent variable: D(JAPANESE_YEN____)

Excluded	Chi-sq	df	Prob.
D(POUND_ST	0.093027	2	0.9546
D(SWISS_FR	0.084465	2	0.9586
D(GBP)	3.058183	2	0.2167
D(SWISSFRA	0.902014	2	0.6370
D(YEN)	0.650497	2	0.7223
All	5.912413	10	0.8226

Dependent variable: D(POUND_STERLING____)

Excluded	Chi-sq	df	Prob.
D(JAPANESE	0.586358	2	0.7459
D(SWISS_FR	2.757198	2	0.2519
D(GBP)	2.243536	2	0.3257
D(SWISSFRA	3.276927	2	0.1943
D(YEN)	2.723996	2	0.2561
All	14.23684	10	0.1625

Dependent variable: D(SWISS_FRANC____)

Excluded	Chi-sq	df	Prob.
D(JAPANESE	5.384483	2	0.0677
D(POUND_ST	0.246655	2	0.8840
D(GBP)	2.610472	2	0.2711
D(SWISSFRA	5.671772	2	0.0587
D(YEN)	2.937253	2	0.2302
All	17.18807	10	0.0703

Dependent variable: D(GBP)

Excluded	Chi-sq	df	Prob.
D(JAPANESE	0.183701	2	0.9122
D(POUND_ST	5.062424	2	0.0796
D(SWISS_FR	9.039002	2	0.0109
D(SWISSFRA	0.459372	2	0.7948
D(YEN)	5.588210	2	0.0612
All	28.93560	10	0.0013

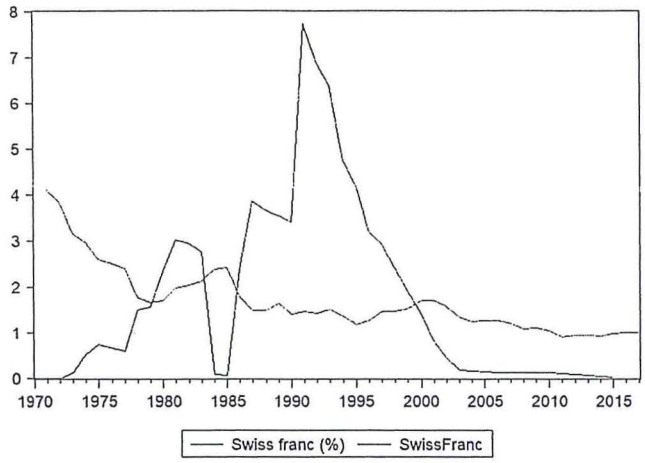
Dependent variable: D(SWISSFRANC)

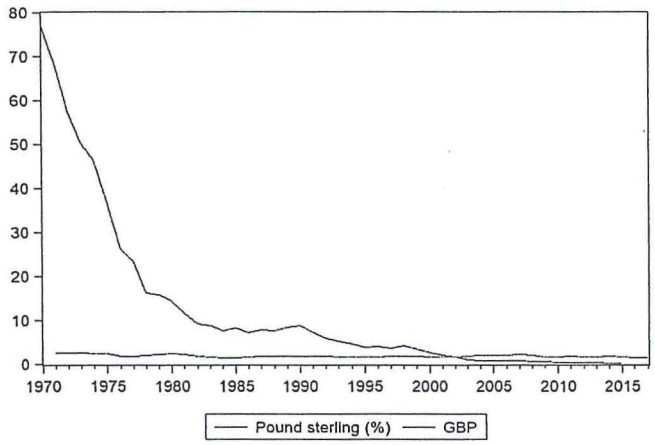
Excluded	Chi-sq	df	Prob.
D(JAPANESE	2.198160	2	0.3332
D(POUND_ST	4.239315	2	0.1201
D(SWISS_FR	9.999592	2	0.0067
D(GBP)	1.792943	2	0.4080
D(YEN)	0.842967	2	0.6561
All	19.97793	10	0.0295

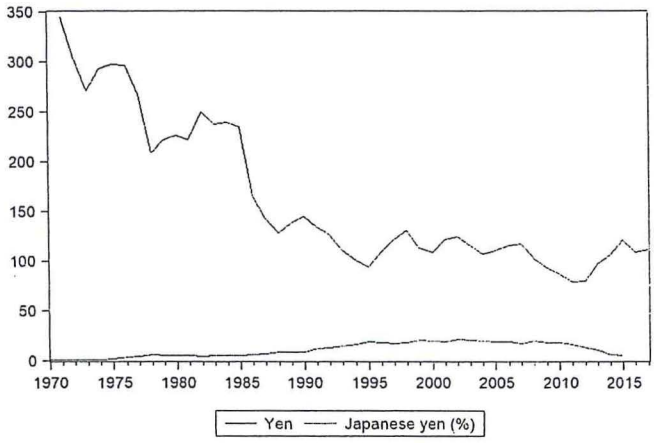
Dependent variable: D(YEN)

Excluded	Chi-sq	df	Prob.
D(JAPANESE	3.431645	2	0.1798
D(POUND_ST	5.611262	2	0.0605
D(SWISS_FR	3.965056	2	0.1377
D(GBP)	1.616010	2	0.4457
D(SWISSFRA	1.452754	2	0.4837
All	15.92778	10	0.1017

Appendix 6: Graphical representations of exchange rates against denominated debt shares.







Appendix 7: Dynamic Ordinary Least squares

Dependent Variable: POUND_STERLING____
Method: Dynamic Least Squares (DOLS)
Date: 10/31/17 Time: 01:35
Sample (adjusted): 1973 2015
Included observations: 43 after adjustments
No cointegrating equation deterministics
Fixed leads and lags specification (lead=1, lag=1)
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GBP	-8.813107	2.211936	-3.984341	0.0004
SWISSFRANC	7.823937	4.676671	1.672971	0.1044
YEN	0.054253	0.038493	1.409436	0.1687

R-squared	0.899186	Mean dependent var	8.504644
Adjusted R-squared	0.863413	S.D. dependent var	11.75135
S.E. of regression	4.343023	Sum squared resid	584.7174
Long-run variance	34.20276		

Dependent Variable: JAPANESE_YEN____
Method: Dynamic Least Squares (DOLS)
Date: 10/31/17 Time: 01:30
Sample (adjusted): 1973 2015
Included observations: 43 after adjustments
No cointegrating equation deterministics
Fixed leads and lags specification (lead=1, lag=1)
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GBP	13.53804	1.990597	6.800993	0.0000
SWISSFRANC	12.05844	4.208697	2.865123	0.0074
YEN	-0.193434	0.034641	-5.583940	0.0000

R-squared	0.810948	Mean dependent var	11.46814
Adjusted R-squared	0.743866	S.D. dependent var	6.848060
S.E. of regression	3.465784	Sum squared resid	372.3615
Long-run variance	27.70019		

Dependent Variable: SWISS_FRANC____
Method: Dynamic Least Squares (DOLS)
Date: 10/31/17 Time: 01:34
Sample (adjusted): 1973 2015
Included observations: 43 after adjustments
No cointegrating equation deterministics
Fixed leads and lags specification (lead=1, lag=1)
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GBP	0.672060	1.381773	0.486375	0.6301
SWISSFRANC	1.992634	2.921467	0.682066	0.5003
YEN	-0.015510	0.024046	-0.645004	0.5237

R-squared	0.198654	Mean dependent var	1.804472
Adjusted R-squared	-0.085694	S.D. dependent var	2.028367
S.E. of regression	2.113491	Sum squared resid	138.4721
Long-run variance	13.34718		

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