DEVELOPMENT OF INFORMATION AND KNOWLEDGE ARCHITECTURES
AND AN ASSOCIATED FRAMEWORK AND METHODOLOGY FOR SYSTEM
MANAGEMENT OF A GLOBAL RESERVE CURRENCY

by

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This is dedicated to my loving wife Karen, my four wonderful children Pamela Ortiz, Mark, Caroline and Paul, and grandchildren Sofia and Daniel Ortiz, Christopher and Alexander Cardullo.

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LIST OF ABBREVIATIONS AND SYMBOLS

Bank for International Settlements…………………………………………………..BIS
Brazil, Russia, India, China, and South Africa…………………………………..BRICS
Chief Information Officer…………………………………………………………....CIO
Communications Enabled Global Reserve Currency Processing………………....CEGRCP
Credit Rating Agency……………………………………………………………....CRA
Currency Process Management……………………………………………………CPM
Dissemination Standards Bulletin Board………………………………………......DSBB
Enterprise Architecture……………………………………………………………EA
Enterprise Service Bus……………………………………………………………ESB
Euro...€
European Central Bank…………………………………………………………..ECB
European Union…………………………………………………………………….EU
Federal Service Oriented Architecture…………………………………………….FSOA
Financial Sector Adjustment Programs…………………………………………....FSAPs
Financial Stability Forum…………………………………………………………FSF
Foreign Exchange Market……………………………………………………Forex, FX
French Franc………………………………………………………………………...FRF
General Data Dissemination System……………………………………………...GDDS
German Deutsche Mark……………………………………………………………DEM
Gross Domestic Product……………………………………………………………GDP
Group of 7 nations…………………………………………………………………G7
Group of 20 nations………………………………………………………………G20
Group of 24 nations………………………………………………………………G24
Guide for Subscribers and user……………………………………………SDDS Guide
Information and Knowledge Architectures for System Management of a Global Reserve
Currency……………………………………………………………………..IKASM-GRC
Integration Definition for Function Modeling…………………………IDEF0, IDEF1x
International Accounting Standards Board………………………………………...IASB
International Financial Reporting Standards……………………………………….IFRS
International Monetary and Financial Committee………………………………....IMFC
International Monetary Fund……………………………………………….......…..IMF
International Organization of Securities Commissions…………………………….IOSCO
International Standardization Organization………………………………………….ISO
Japanese Yen………………………………………………………………….JPY, ¥
Nationally Recognized Statistical Rating Organization………………………...NRSRO
Organization for Economic Co-operation and Development………………………OECD

ABSTRACT

DEVELOPMENT OF INFORMATION AND KNOWLEDGE ARCHITECTURES
AND AN ASSOCIATED FRAMEWORK AND METHODOLOGY FOR SYSTEM
MANAGEMENT OF A GLOBAL RESERVE CURRENCY

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George Mason University, 2013

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The global financial system appears to be heading for a major financial crisis. This crisis is being driven by a growing global debt. This crisis is not limited to nations that are heavily in debt such as Greece, Spain, Portugal, Ireland, Italy or Cyprus but to such others as the United States. While there has been a great deal of emphasis on debt, there are many other issues. In many cases, the underlying causes of this potential crisis are very complex. As this dissertation will show, it is the complexity of these causes and their interrelationships, coupled with a lack of a global financial management system that may be the real culprit in the potentially impending global financial crisis.

One very important aspect of these potential crises is the state of the world reserve currency and how it is managed. The concept of reserve currencies is widely recognized and these currencies are often used for international transactions. There is a very long history of the concept of a reserve currency. This history involves a combination of economic and political powers, real or perceived, that may influence global reserve currencies.

Recent years have witnessed a tremendous growth in information and communication systems that facilitate the design and implementation of complex inter-enterprise processes. The basic

hypothesis of this dissertation is that an appropriately structured global reserve currency, based on use of an information and knowledge management system, can provide stability to currencies, whereas an unmanaged single or unstructured group of currencies will not provide currency stability. The proposed Information and Knowledge Architectures for System Management of a Global Reserve Currency (IKASM-GRC) can provide a system and methodology which can stabilize a reserve currency.

CHAPTER 1: INTRODUCTION

International trade is driven by global finance considerations. The global reserve currencies serve as the basis of settlement and the valuation of trade. This is the currency that is held by many governments and institutions as part of their foreign exchange reserves. It is also the international pricing currency for commodities that are traded on the global market.

Currently the United States (US) dollar is the major global reserve currency; however, this is also a transient condition. In 2013, the United States was the major global reserve currency representing approximately 60% of the total currency in circulation. The major global reserve currency provides the country issuing that currency a definite advantage in the purchase of commodities and also in obtaining marginally lower interest rates because of the larger availability of this currency, i.e. its liquidity. However, as shown by Triffin in 1960 (Reisen, 2010), these benefits are offset by the ease of encouraging the greater debt that results from lower interest rates. The stability of the US dollar and the yields for US Treasury notes and bonds depends upon other central banks maintaining their treasury exposures to US currency. Sovereign central banks currently hold about half of the US treasuries, including both notes and bonds (Mandeng, 2011).

One possible danger of having the major reserve currency is the possibility that other sovereign nations holding US treasuries can become concerned with the stability of the US dollar and the resulting yields for US Treasury notes. This can become a self-fulfilling prophecy, leading to a complete destabilization of the US financial system, which in turn can lead to chaos in the global financial markets. The other possibility is that in a currency war, a country with the major reserve currency could be subjected to a form of economic warfare (Rickards, 2011).

Various sovereign leaders and economists have been discussing how to move from the US dollar as a global reserve currency to other alternatives. Since the US balance of trade is significantly negative, many other sovereign nations do not want the US dollar as a reserve currency. A number of other currencies, or a basket of currencies, have been proposed to possibly replace the US dollar as a major global reserve currency. At meetings of the G20 in March 2011, a number of different proposals have been made by various governments, most of which are self-serving. At present, the leading contender for a replacement of the US dollar is a version of the Special Drawing Rights (SDR) issued by the International Monetary Fund (IMF) (Cardullo and Sage, 2012c).

If the world is to truly maintain a stable reserve currency, it is imperative that a system connecting the various global systems be established and implemented. We will then have a system of systems to consider. To achieve the desired change of reserve currency will require world governmental agreements, similar to what occurred at the Bretton Woods Conference which reached agreements in July 1944 by establishing the dollar as the reserve currency. However, establishing this reserve currency in 1944 did

not establish any agreement indicating how the global reserve currencies would be managed; what in fact was essentially created was a "system without a system", i.e., a means to adjust currencies but no system to manage what was agreed to by the various sovereigns.

One can question the rationale for looking at a new global reserve currency since all indications are that the US dollar appears to be the currency that is valued most in the world in times of economic and social crises. This has been obvious during the economic crises that occurred in 2007 to 2009 and again in 2011. However, the literature is replete with calls to develop a new global reserve currency (Zigler, 2010, UPI, 2010 , Reisen, 2010, Jenkins, 2010, CHAN, 2010, Fitzsimmons, 2010).

It took many years after the US overtook the United Kingdom (UK) as the world's largest economy before the dollar overtook the British pound as the dominant global reserve currency. An important element in developing a stable global financial system is an accepted global reserve currency that all members of the economic system will adhere to. Today no such system exists. There are four components needed to establish a stable global financial system:

- The need for a schedule for G20 leaders to achieve more cooperative solutions to international financial challenges;
- The need for a framework for global financial cooperation;

- The need to change the zero-sum mentality[1] that is the source of prior failures in global financial cooperation; and.
- The need for a global financial management system with governance rules that all participants agree to follow.

This problem is deeply associated with individual sovereign policies which are based on a zero-sum game reliance in order to determine outcomes (Stiglitz, 2011). It appears that few sovereign governments are willing to foster this cooperation until a major global financial collapse occurs, and even then the resulting financial catastrophes may take generations to resolve. However, as history has shown, with the Bretton Woods Agreement and the other agreements which have occurred over time, none of these resolutions have been associated with systems architectures that are capable of being used to manage the associated implementations in accordance with an agreed upon governance system.

Recent years have witnessed a tremendous growth in information, knowledge, and systems management technologies that facilitate the design and implementation of complex inter-enterprise processes. These technologies when coupled with robust information architectures can serve to assist in developing a stable global financial framework. An example of a major information technology innovation is the development of Service Oriented Architectures (SOA) (Andary and Sage, 2010). A SOA can be considered one of the architectural structures that may form the basis for linking

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[1] A zero-sum mentality in game theory and economic theory is a mathematical representation of a situation in which a participant's gain or loss is exactly balanced by the losses or gains of the other participant(s), i.e. "beggar they neighbor" such as to maximize their returns independent of the consequences to other nations.

the global financial markets and yet providing each of the participants with independent design capabilities.

The current global financial system appears to be heading for a major financial crisis. This crisis is being driven by a growing global debt. This crisis is not limited to nations such as Greece, Spain, Portugal, Ireland and Italy that have not been major performers in the global financial system, but to such others as the United States that have been major players. While there has been a great deal of emphasis on sovereign debt in the past, to this must now be added private debt[2]. The current emphasis has often been on the reduction of this debt, either sovereign or private[3], by the debtor; however, the issue also involves the creditors. When the debt is sufficiently large, a default of this debt will quite adversely impact the creditor. The increase in debts or soft assets[4] is a problem that is caused by either a significant increase in available credit to debtors, or by the availability of a low value currency. This increase in debts results in a vicious negative feedback cycle for all debtors and especially for those sovereigns whose currency is a major global reserve currency, due to the global demands for increased liquidity (Reisen, 2010).

In many cases, the underlying causes of the impending financial crisis are much more complex that those just identified. As this dissertation will show, it is the complexity of these causes and their interrelationships, coupled with a lack of a global

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[2]Sovereign debt is also known as public debt, national debt is the debt owed by a central government, while private debt is that owed by corporations and individuals.

[3]Both sovereign and private debts form the majority of all debt. The various types of debt can generally be categorized into: 1) secured and unsecured debt, 2) private and public debt, 3) syndicated and bilateral debt, and 4) other types of debt which are obligations owed by one party (the debtor) to a second party, the creditor.

[4] Debts represent the debtor which are balance by the soft assets of the creditor, both have negative consequences as shown by CARDULLO, M. & LUI, M. 2012. Initial Approach to System Study of Global Finance. *ICFTE 2012*. Singapore.

financial management system, which may be the real culprit in the impending and growing global financial crisis. The underlying causes of this crisis may be grouped as follows: currency markets; reserve currency issues; sovereign financial policies; speculative commodity markets; lack of global financial governance; and lack of global financial management system.(Subacchi and Jenkins, 2011, Reinhart and Rogoff, 2009).

One important aspect of the potential crises brought about by these issues is the world reserve currency and how it is managed. The concept of reserve currencies is widely recognized and often used for international transactions. A reserve currency is generally used as the international pricing currency for products that are traded on a global market: such as oil, grain, gold, etc. There is a very long history of the concept of a reserve currency (Rickards, 2011, Stiglitz, 2011). The major influences on global reserve currencies are a combination of economic and political powers, or perceived political powers.

Dissertation Assumptions and Hypotheses

The following are the main assumptions that were investigated while developing this dissertation:

1. The global financial markets are moving toward a global reserve currency that is comprised of a basket of currencies.

2. History has shown that no single currency can continue to be a major reserve currency indefinitely, primarily due to the Triffin dilemma[5].

3. There is a need for systems management and governance to maintain global

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[5] The Triffin dilemma is that a reserve currency is only sustainable if imports and exports are balanced.

financial stability.

4. There exists robust information technology architectures and systems which could manage a global reserve currency that consists of a basket of currencies coupled with an agreed upon governance process.

5. Robust information technology architectures and systems can be designed to maintain stability of a global reserve currency that consists of a basket of currencies.

The fundamental hypothesis of this dissertation is that a multiple structured global reserve currency which uses an information management system and governance can provide stability to currencies, such as the G20[6] or the SDR as contrasted with an unmanaged single or unstructured group of currencies. This hypothesis is explored by developing information and knowledge architectures and an associated framework and methodology for the system management of a global reserve currency.

Dissertation Methodology

Currently, there is no system of systems for management of global reserve currencies. The values of these currencies are based on market conditions and are thus open to speculation by traders. This means that totally new system architecture must be developed once the various sovereign states have agreed to have such systems architecture. There are a number of steps that must be taken prior to setting up an architectural model for such a system of systems.

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[6] G20 represents the Group of Twenty Finance Ministers and Central Bank Governors (also known as the G-20, G20, and Group of Twenty) is a group of finance ministers and central bank governors from 20 major economies..

The initial step in the process of development of a management system for a new global reserve currency is to achieve agreement between the members of the G20 or the participants in the new reserve currency. This is the most important basic step in the process prior to the development of the design model for a system of systems architecture.

Methodology

To achieve an information and knowledge system for management of a global reserve currency, a methodology elucidating the various steps in the process is critical. The process utilized in this dissertation consisted of the following processes:

1. Identification and development of the currencies that can be included in a new global reserve currency.

2. Development of a mission statement: This process sets forth an analytical framework for development of a detailed mission statement and activity diagram for a proposed architecture.

3. Development of a data model: This process step provides a means of determining the data for the various services that can be included in the architectural framework, such as: Forex Information Services, Global Reserve Currency Services, Sovereign Notification Services, Forex Intervention Services, Notification Services, Analytical Services, and Management Services. Based on the data analysis we develop a system dictionary and concordance.

4. Development of a rule model: It is important to develop a rule model for the stable operation of the proposed architecture. This should include the

development of decision variables and proposed governance and management structures.

5. Development of a possible governance and management structure: Without an agreed upon governance and management structure no architectural framework can be implemented. The participating stakeholders, many of whom are sovereigns, will need to develop and agree upon a governance structure.

6. Development of a stability model: This model can provide an evaluation of the ability of various architectures to handle 4, 5 or more currencies in order to maintain stability.

The methodology outlined here provides an approach to enable systems management of a global reserve currency and understanding of its stability. However, while we can suggest and provide such an approach, it is the provenance of the participating sovereigns and their adherence to acceptable governance which will determine the success or failure of any approach to financial stability. This participation can be assisted by the design and use of a system which minimizes the loss of any sovereignty. This dissertation will provide a means to illustrate the impact of the usefulness of information and knowledge management and governance approaches on currency stability.

To develop an appropriate architecture for managing a reserve currency there are a number of useful approaches discussed by Cardullo and Sage (Cardullo and Sage, 2012c, Cardullo and Sage, 2012 , Cardullo and Sage, 2011, Cardullo and Sage, 2012b, Cardullo and Sage, 2012a, Cardullo and Sage, 2013). The basic methodology utilized

here follows these approaches and also to some extent the process outlined by Levis

(Levis, 2009). This is a systems approach devised for building information and

knowledge based architectures.

Contributions

As of 2013 there appears growing concern relative to the stability of the global

financial system and the identification of the currency or currencies which should serve

as a global reserve currency. This has also raised concern on possible national security

issues which have been raised by the United States Department of Defense. (Rickards,

2011) This dissertation is focused on the following efforts:

1. Development of logical information system management architecture

    for a global reserve currency.

2. Framework and methodology development for system management

    of a global reserve currency and determination of its stability.

CHAPTER 2: BACKGROUND AND RELATED WORK

This chapter provides some important definitions, terminology, properties and aspects related to global reserve currencies.

The underlying causes of global financial instability are very complex. As this dissertation will show, it is the complexity of these causes and their interrelationships, coupled with a lack of a global financial management and governance system, which may be the real culprit in the growing global financial crisis. One important aspect of these potential crises is the world reserve currency and how it is managed.

Reserve Currency

The definition of a reserve currency is that it is a currency which is held in significant quantities by many governments and financial institutions as part of their foreign exchange reserves. The fluctuation in the currency used as foreign exchange reserves has the potential for changing the global financial landscape significantly (Rickards, 2011). There is no essential or necessary world reserve currency; it could be any currency – even one that does not exist yet.

The world reserve currency also acts as the international pricing currency for oil, gold, and many other products that are traded on world markets. Many countries argue that this serves to artificially inflate the US dollar insofar as it becomes the only reason countries need to hold it (MoneyEnergy, 2009). The US has become, since the 1980's, a

deficit nation[7] in terms of current account balances. There have been various studies concerning whether or not a single reserve currency will always dominate the global economy. It has been argued that, since there are strong incentives to conform to the choice that dominates the marketplace, one currency will almost always dominate due to network externalities. However, it must be considered that the Triffin Dilemma would imply that the reserve currency will change and this may lead to instabilities or even 'currency wars' (Rickards, 2011). The United States reliance on exchange rate depreciation to help correct its current account deficit is increasingly being viewed by many other nations as incompatible with its role as the issuer of the international reserve currency (Subacchi and Jenkins, 2011). The Group of 20 nations, also known as the G20, is preparing a roadmap for evolving the global reserve currency away from that of the US dollar (Strupczewski, 2011).

A reserve currency is a currency which is held in significant quantities by many governments and institutions as part of their foreign exchange reserves. In other words, there is no essential or necessary world reserve currency. It could be any currency – even one that does not exist yet. The US dollar now is the major reserve currency and has been since the Bretton Woods agreements of July 1944, at this time the United States was a creditor nation having a positive current account balance and the fastest-growing world economy(MoneyEnergy, 2009).

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[7] Current account balances is the sum of exports minus imports of goods and services (balance of trade), interest and dividends (factor income) and the net transfer payments such as foreign aid. This is the important element in determining financial position of a sovereign nation.

The reserve currency is the international pricing currency for products that are traded on a global market, such as oil, gold, etc. This permits the issuing country to purchase commodities at a marginally lower rate than other nations, which must exchange their currency with each purchase and pay a transaction cost. For major currencies, this transaction cost is negligible with respect to the price of the commodity. It permits the government issuing the reserve currency to borrow money at a better rate, as there will always be a larger market for that currency than others. The price of commodities directly impacts the cost of manufacturing which in turn impacts exports driving the gross domestic product.

Reserve currencies have been in existence for centuries. Certain amounts of the world reserve currency are held in foreign exchange reserves by governments (and sovereign wealth funds) and institutions (like the IMF) around the world. While the US dollar currently represents the majority of these reserve currency holdings, the euro is second, and other major currencies (Swiss francs, yen, pounds, Canadian dollars) are also held (See Figure 1). These can be considered reserve currencies but it is the major currency which is the dominant driver of international trade.
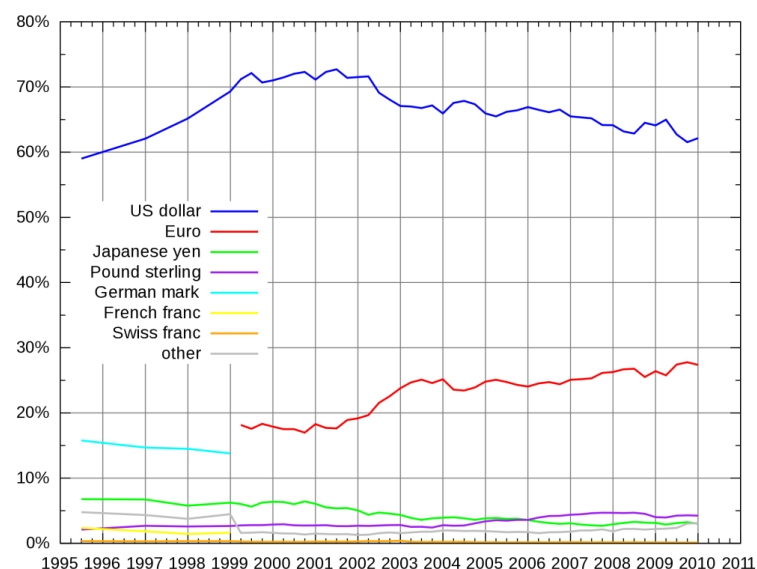
Figure 1 Percentage of global currency reserves held in the particular currency (Wikipedia, 2010)

The major world reserve currency acts as the international pricing currency for oil, gold, and other products that are traded on world markets. The major reserve currency is the basis of trade, for instance oil cannot be traded in euros and countries cannot trade gold in yen. Recently there have been bilateral agreements such as that China can acquire Brazilian commodities and pay in yuan and the Brazilians can then use the yuan to pay for Chinese exports. However such bilateral or multilateral trades currently only represent a very small percentage of international trade where the US dollar is the basic currency for payment. As the major reserve currency, this gives an advantage to the US dollar because other countries that need to transact will exchange their own currency into US dollars (Fratzscher and Mehl, 2011). It has been argued that the status as the major reserve currency serves to artificially inflate the US dollar insofar as it becomes the only reason countries need to hold it (MoneyEnergy, 2009).

Current Situation

As a currency of a nation or region becomes less stable, or as the economy of that nation or region becomes less dominant, the international financial markets will attempt to abandon use of the then existing currency in that nation or region for a currency that has been issued by a larger nation or region with a more stable economy. This happening is not assured however. It can take a relatively long time, as appropriate recognition of the need for this change is important in determining a new reserve currency. The United States appears now to be moving in this direction, such as through increasing sovereign debt and encouraging currency devaluation by increasing the money supply. This may lead to the appearance of a currency which can over time become less stable. In fact, this is a negative feedback cycle where greater availability of the currency of a nation or region leads to less stability for this currency rather than more.

Another situation of importance is the buildup of such soft assets as debt. As has been shown, the buildup of soft assets eventually results in a collapse of the financial markets (Cardullo and Lui, 2012). This potential crisis, especially when this is coupled with the growth of both sovereign and private debts, illustrates well the need for appropriate global financial regulatory structures in nations and in regions. Such a governance structure could reduce a future global financial crisis and provide a stable basis for international trade.

The basis for any global reserve currency is that it provides liquidity for financial transactions. As the international financial markets start to determine that a particular sovereign currency, due to trade imbalances and increasing sovereign debt, appears to be becoming unstable, then there is a concurrent movement towards diversification in

various other sovereign currencies as reserve currencies. Such a movement has been happening over the last decade in reference to the United States dollar. With the growth of China as a major exporter with large positive trade balances, there is growing concern that the US dollar is losing its dominance as a reserve currency.

The Chinese government is seeking to make its currency, yuan, one of the major global reserve currencies. However, there are a number of difficulties since the Chinese yuan is not readily convertible and the government controls the range of its trade ability. This has not stopped the Chinese government from arranging trade with other sovereigns where their currencies are exchanged or their ability to form alternative institutions with other BRICS.

Such actions, as these have shown the susceptibility of the US dollar to remaining a major global reserve currency. The IMF is considering expanding the SDR to include the Chinese yuan, for example. As of 2013, the IMF has not made any decision to expand the SDR. Even if the IMF did expand the SDR, this would not mean that it would become a new global reserve currency. Currently, the SDR is a form of a supplementary foreign-exchange reserve asset defined and maintained by the IMF and not a true currency. As of 2013 the SDR represented less that 4% of the total reserve currency. The SDR represents a claim to currency held by IMF member countries for which the SDR may be exchanged. They can only be exchanged for euros, yen, pound sterling or the US dollars. As such the SDR represents a potential claim on IMF member sovereign's non-gold foreign-exchange reserve assets, which are usually held in the global reserve currencies.

There are discussions among the members of the IMF to expand the SDR's role into a true global reserve currency. Currently, there are no plans at the IMF to implement a change of role for the SDR. In fact, the United States government would likely not give its approval to such a change. However, this can change if and when the US dollar appears weak or otherwise unsuitable to be a foreign-exchange asset as its sovereign debt escalates.

The difficulty in managing any reserve currency is illustrated by a postulated simplified block model[8] (Figure 2) of the impacts for any sovereign in dealing with currency and its impact on domestic issues and sovereign debt. Understanding and impacting change in a financial system as postulated in Figure 2 requires data and sociological, psychological and economic assumptions (Cardullo and Sage, 2011). While these can be approximated from empirical data there is always unknown factors, i.e. 'Black Swan' events that may invalidate initial results.

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[8] This postulated model is illustrative of potential interactions and has not been validated.

Figure 2 Simplified Postulated Block Model of Financial Interactions

Possible Global Reserve Currencies

A rapidly rising world economy creates problems for a single-currency reserve system. These are clearly explained by the Triffin Dilemma, named after a Belgian economist, Robert Triffin, who warned Congress in 1960 that as the main supplier of the world's reserve currency the United States had no choice but to run persistent current account deficits. Triffin's logic was that as the global economy expanded, demand for reserve assets-dollars from economies around the world would increase. These could only be supplied if United States had a continuing current account deficit and issued dollar-denominated obligations to fund it. Indeed, if the United States ceased having a balance

of payments deficits, the global liquidity would dry up and pull the global economy into a downward spiral (Reisen, 2010).

US deficits and saving surpluses in emerging East Asian economies, especially China, and oil-exporting countries have been growing since the early 2000s. Emerging market savings helped to bring down world interest rates, leading investors to seek higher-yielding investments but relatively low-risk assets, including real estate. Low interest rates in turn contributed to the financial excesses that finally culminated in the crisis of 2007-2009. Also as countries want to maintain their exports tend to try and maintain control on their valuation in reference to a global reserve currency. This will likely be the case independent of which currency is the major global reserve currency.

For a number of years, developing countries have responded that the current system forces them to transfer resources to wealthier countries in what has become a form of 'reverse aid'. Some emerging markets have accumulated US dollars not just to pay for trade or to insure themselves against panic attacks by investors, but to bolster their export competitiveness; this has been the case for China.

Emerging market governments have been seriously discussing replacing the US dollar as the major reserve currency because, as net creditors to the rest of the world and with substantial holdings of United States government debt, they fear big valuation losses on these holdings.

In order for the Chinese currency, known as the renminbi[9], to become the global reserve currency, China would first have to ease restrictions on money entering and

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[9] The renminbi is denominated in yuan.

leaving the country, make its currency fully convertible for such transactions, deepen domestic financial reforms, and make its bond markets more liquid. However, a yuan based system would still be a single-currency system, with all the shortcomings already articulated by Triffin and susceptible to the problems illustrated.

China has already set up currency swaps with several countries, including Argentina, Brazil, Belarus and Indonesia, and by letting institutions in Hong Kong, China issue bonds denominated in renminbi, a first step toward creating a deep domestic and international market for its currency. Brazil and China are now working towards using their own currencies in trade transactions rather than the US dollar. Moreover, the IMF Executive Board has approved a framework to issue SDR-based bonds, while China has signaled its intention to invest up to $50 billion, and Brazil and Russia up to $10 billion each in SDRs. This illustrates the movement by the international community to eventually replace the US dollar as the major reserve currency

To avoid crisis-prone current-account imbalances and more 'reverse' aid from emergent to advanced countries, serious attention is needed to a new global reserve currency system, such as the SDR or other approaches. For the Stiglitz Commission[10], the new global reserve system is feasible and non-inflationary, and would contribute to global stability, economic strength, and global equity. The financial crisis of 2007-2009 and the fragility of the euro and global economies may be a possible reason to prepare for a new global currency reserve system.

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[10] Commission of Experts of the President of the UN General Assembly on Reforms of the International Monetary and Financial System

United States Dollar

The US dollar is the world's most widely held reserve currency, making up just under two-thirds (10-year weighted average: 65.2 percent) of central bank holdings worldwide. The US currency's ubiquity, however, has been decreased with increasing velocity over the past decade. As central banks have sought to diversify their reserve positions, dollar concentrations have declined at an average annual rate of 92 basis points (0.92 percent) since 1999 (Zigler, 2010).

There are some rather complex implications of an ever-weakening dollar, such as; oil-rich countries are seeing inflation because while they get paid in dollars for oil, they tend to import much of their goods and services from the EU region. Since the dollar has been fluctuating against the euro and other currencies, these dollars tend to be worth less and hence, have much less buying power, increasing the potential for inflation. The 2011-2012 instability in the euro-zone region has had also serious impacts on currency issues. Similar effects are felt elsewhere, namely China and other large exporters to the US. As the transactions are in dollars, an ever-declining currency, their income is artificially decreasing over time as well as the Treasuries being acquired to cover United States debt. With the US taking on unprecedented debt with bailouts and stimulus plans and impact of a massive entitlement in 'health care reform' the consequences for the dollar do not now appear positive in the long term.

If the US dollar no longer serves as the major global reserve currency, sovereigns would start to convert their US dollar reserves and gradual transition into the new currency standard. This could result in a complete collapse of the US dollar versus virtually all other currencies (Rickards, 2011). While US multinational corporations may

be temporally positively impacted since overseas sales in foreign currencies get a positive impact from a weakening dollar each earnings cycle, eventually, US consumption would suffer; and consumers would not be able to afford imports to the same degree. As foreign economies that have been servicing US debt realize impact these governments could likely stop funding US debt. Interest rates would rise as demand for Treasuries decreased and yields substantially increased (Darwin, 2009). This spiraling of interest cost would likely further increase the US sovereign debt similar that what was seen in the Greek and Italian interest increases. These interest increases under certain conditions could possibly lead to default on debt.

People's Republic of China (PRC) Yuan

China's yuan could become a reserve currency accounting for at least five percent of global foreign exchange reserves as early as 2025, central bankers said in an annual global survey (Banking, 2010). The Chinese yuan has seen initiating of billions of dollars' worth of currency swap agreements[11] with international trading partners authorizing the use of yuan to settle payments for commercial transactions. These pacts have prompted analysts to predict that, within five years, as much as 30 percent of China's $2.3 trillion in annual exports could be settled in yuan rather than dollars, up from just 1 percent in 2011(Fitz-Gerald, 2011). In December 2009 Chinese regulators decided to allow more than 7,000 additional exporters to use the yuan to settle global trade accounts.

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[11] Currency swap agreement is a foreign-exchange agreement between two parties to exchange aspects the principal and/or interest payments of a loan in one currency for equivalent aspects of an equal in net present value loan in another currency

In 2009 an essay by Zhou Xiaochuan, governor of the People's Bank of China (PBOC), in which he called for "Reform of the International Monetary System," the major feature being dismissal of the US dollar as the world's main currency reserve (Xiaochuan, 2009). In December 2010, the President of China, Hu Jintao, the current global monetary exchange system is "a product of the past," and suggested the yuan could serve as the basis for new reserve currency replacement for the dollar (Fitz-Gerald, 2011). This could result in the yuan becoming a store of value on par with the US dollar, the Japanese yen and the euro, all of which could continue to lose value because of the high sovereign debt risks, as well as the unwillingness of their politicians to realistically deal with these issues.

The Chief Economist at Goldman Sachs Group, Inc. has stated that China's yuan is destined to become a global reserve currency rivaling the dollar and the euro, as the nation's economic power increases. The Chinese government could 'eventually' allow the yuan, to trade freely on foreign exchange markets, dropping the system under which it controls its value (Jenkins, 2010).

According to the Chief Economist "*As China moves in this direction, other large emerging economies will presumably gradually move in the same direction and the end result will be something approximating to today's Western monetary system,*".. "*Under such a system, the renminbi, dollar and euro would all form the linchpin of the world's currency markets.*" (Subacchi and Driffill, 2010)

The financial crisis of 2007-2009 showed the Chinese government the defects of the existing international monetary system, and they suggest that the world should look to

diversify beyond the dollar system (Xiaochuan, 2009). Chinese government believe that

the origins of the problems that are impact the global financial system can be traced to the

dismantling of the Bretton Woods dollar gold system in the early 1970s, and the

transition to a dollar system. Furthermore, they believe that loose US fiscal and monetary

policy is the main contributing factors of the past decade of financial system problems

(Subacchi and Driffill, 2010).

A currency such as the yuan to become a global reserve currency will require that

the Chinese economy have the following attributes:

- Size of the domestic Chinese economy – growing

- Importance of the Chinese economy in international trade – major

- Size, depth, and openness of the Chinese financial markets – limited

- Convertibility of the currency – little or none

- Use of the currency as a currency peg – minimum

- Domestic macroeconomic policies – limited

Based on these considerations it is unlikely that the Chinese yuan will become

solely the new global reserve currency. However, as currency policies in China evolve,

the yuan could definitely become part of a basket of currencies such as IMF's Special

Drawing Rights (SDR).

European Union (EU) Euro

The primary beneficiary of world currency realignment has been the euro, which

now comprises a quarter (a weighted average of 25.3 percent) of global reserve

allocations. Since the euro's introduction in 1999, allocations have grown at a 99 basis

point compound annual rate. This has markedly changed due to the serious financial issues in the euro zone region in the 2011-2012 time period.

In the 1970s President Nixon's treasury secretary, John Connally, famously quipped that "*the dollar may be our currency, but it's your problem*". One of the arguments in favor of establishing the euro was that it would quickly come to rival the dollar's status as the world's principle reserve currency and make it hard for the US to abuse its 'exorbitant privilege', that is devaluing the dollar imposes few real costs on the US because its foreign debt is denominated in dollars (Tilford, 2007). But like all aspects of reserve currencies, unforeseen or foreseen events like the Greek and Italian financial crisis in 2011 and 2012 can change perspectives.

However, there is no doubt that the threat to the dollar's status is bigger than at any time since the end of the Second World War (Rickards, 2011). The most likely outcome is that a rapid narrowing of the US current-account deficit and renewed fiscal discipline could combine to restore confidence in the dollar, and that the dollar possibly could retain its status as the world's leading reserve currency for the near future. However, the 'Great Recession 2008-2009' coupled with the growing of sovereign debt of the US and the possibility of a steep rise in inflation, could significantly undercut the willingness of other sovereigns to hold their reserves in the currency US dollar. If the dollar lost its dominance, the euro could be the plausible replacement if its confidence was restored; however at the end of 2011 concern about the entire euro-zone was making this unlikely. The euro is the world's second most important reserve currency, though a distant second to the US (See Figure 1). The euro-zone economy is large (though not

quite as big as the US), its economy is open, and the European Central Bank (ECB) enjoys considerable credibility in the financial markets. But what would it mean for the euro-zone, it would be easier for European companies to operate internationally as there would be less exchange rate risk. With import and export prices denominated in euros, the economy and the inflation rate would be less vulnerable to shifts in exchange rates. Much more important than this, however, would be the gains from seignorage (Grasso, 2009). As is the case at present in the US, the euro-zone would benefit from what are effectively very low interest loans in the form of large central bank holdings of euros. Also, the growth of international trade would boost demand for euros, with the result that the euro-zone could very inexpensively finance an external deficit, much as the US has been doing for a number of decades.

But there are downsides to these potential advantages. As the issuer of a major international reserve currency, the euro-zone would have to cope with different external risks, such as structural imbalances in the global economy, that are to a large extent responsible for the weakness of the dollar. The large US current account deficit is the opposite of mercantilist economic policies being pursued by East Asian governments. Internationalization of the euro could also make it harder to control the stock of euros in circulation and hence growth in the money supply and potentially inflation. An increase in the demand for euros would either cause the currency to appreciate, making exports less competitive, or require that the euro-zone run a substantial external deficit in order to satisfy the external demand for euros. For this to happen, the ECB would need to run a looser monetary policy.

The potential for conflict within the euro-zone is obvious. A stronger euro would be anathema to many euro-zone countries, not least France and Italy, which are already very worried about euro's strength. But a looser monetary policy would be an anathema to countries such as Germany and the Netherlands that worry about the inflation implications of cheaper money. Indeed, it is far from obvious how the euro-zone could run a sizeable current account deficit without exacerbating existing tensions between members of the single currency area with large current-account surpluses, such as Germany and Netherlands, and those with large or rising external deficits – most notably Spain, but also France and Italy. It would be possible for Germany and the Netherlands to continue to run big surpluses at the same time as the euro-zone as a whole ran a bigger deficit, but only if other euro-zone countries ran even bigger deficits. This is politically implausible as the German government has declared. The EU has a number of intra-country issues that will hinder the euro from becoming the major global reserve currency as seen by the Fall 2011 and Spring 2012 lack of decisions on how to handle potential defaults by Greece and Italy. Without a true monetary union the euro will always present a currency on the brink of disassociation in whole or in part.

Therefore becoming the world's principle reserve currency might not have significant value for many of the sovereign states of the EC. This is further illustrated by the Greek, Spanish, Portuguese and Italian financial crisis in the 2010-2012.

Gold

A poll of reserve managers from 43 central banks in 2009 revealed a renewed respect for gold as a reserve asset and store of value with more than half saying official

attitudes to the precious metal had changed resulting from its price rise and high profile

purchases by monetary authorities in India, Russia and China (Banking, 2010). The terms

'flight to quality' and 'safe haven' is used for investments with low risk of losing value

and has been used for gold as investors hedge their investment strategies. When

currencies show instability, gold becomes one of the investment strategies to reduce risk.

The option of using gold as a reserve currency while having a long history has a

number of issues associated with its use. Gold like any commodity poses certain

challenges including:

- Lack of ability to increase the money supply at will

- Difficulty of maintaining the liquidity and range of instruments that
  financial markets need

- Settlement challenges

A gold standard only operates through the link between gold and a particular

reserve currency. Originally, gold was supported initially by the convertibility with the

pound sterling and then the dollar.

International Monetary Fund (IMF) Special Drawing Rights (SDR)
The approach attracting most attention is a new global reserve system based on an

extended version of the International Monetary Fund's SDR, an international reserve

asset set up in 1969 to supplement member countries' official reserves. SDRs are a form

of supplementary foreign exchange reserve assets defined and maintained by the IMF.

Not yet a true currency, SDRs represents a claim to currency held by the IMF member

countries and for which they may be exchanged. As they can presently only be

exchanged for euros, Japanese yen, pounds sterling, or US dollars, SDRs represent a potential claim on IMF member countries' non-gold foreign exchange reserve assets, which are usually held in those currencies. The SDR comes to special prominence when the U.S. dollar is weak or otherwise unsuitable to be a foreign exchange reserve asset. This usually manifests itself as an allocation of SDRs to IMF member countries. Potential perceived problems with the US dollar are not the only stated reason that there allocations have been made, however, the increasing US sovereign debt coupled with political uncertainties have added to these perceptions. The fact that the U.S. dollar has been the principal source of global liquidity as a major reserve currency leading to increasing sovereign debt was forecasted by Triffin (Rickards, 2011).

The SDRs were created in 1969 as a supplement to a shortfall of preferred foreign exchange reserve assets, namely gold and the US dollar. The SDR's value is defined by a weighted currency basket of four major currencies: the euro, the US dollar, the British pound sterling, and the Japanese yen. Consideration is being given to adding the Chinese yuan. The value of the SDR is determined by the value of these several currencies that are significant for the world's trading and financial systems. Initially its value was fixed, so that 1 SDR = 1 U.S. dollar, but this was abandoned, after the 1973 collapse of the Bretton Woods system of fixed exchange rates, in favor of a currency basket . The basket of currencies currently used to value the SDR is 'weighted', which means that the more important currencies have a larger impact on the SDR's value. Currently, the value of one SDR is equal to the sum of 0.423 euros, 12.1 yen, 0.111 pounds, and 0.66 US dollars.

This basket is re-evaluated every five years by the IMF, and the currencies included in the SDR as well as the weights given to them can then change. The value of the SDR was initially defined as equivalent to 0.888671 grams of fine gold—which, at the time, was also equivalent to one US dollar. The value of the SDR is calculated daily as the sum of specific amounts of the four basket currencies valued in US dollars, on the basis of exchange rates quoted at noon each day in the London Forex market.

Building on the SDR, the main global reserve currency would be represented by an extended basket of significant currencies and commodities. The UN-appointed Stiglitz Commission on reforming the international monetary and financial system has suggested a gradual move from the US dollar to the SDR. Moreover, following the G20 Summit in London earlier in 2010, the IMF planned to distribute to its members $250 billion in SDRs. But as this will increase the share of SDRs in total international reserves to no more than 4%, some extra steps will be needed (Reisen, 2010).

However, if the US dollar and other currencies are to be replaced by the SDR as the principal global reserve currency, the method to determine the SDR would have to occur much more frequently than the current five year cycle. A currency's importance is currently measured by the degree to which it is used as a foreign exchange reserve asset, and the amount of exports that are sold in that currency. In the most recent review of the SDR (in November 2010), the weights of the currencies in the basket were revised based on the value of the exports of goods and services and the amount of reserves denominated in the respective currencies that were held by other members of the IMF. These changes became effective on January 1, 2011. The next review will take place by 2015. In

October 2011, the IMF Executive Board discussed clarifications and possible reform options of the existing criteria for broadening the SDR currency basket.

In response to calls by China and Russia to supplant the US dollar with special drawing rights, the Director of the IMF has said, *"That day has not yet come. But I think it is intellectually healthy to explore these kinds of ideas now."* SDR were devised by the IMF in 1969 to replace gold and silver in large international transactions and to serve as a supplement to central bank reserve positions. Though freely convertible in IMF transactions, SDRs are not a true currency, but instead, SDRs are credits that a nation with a trade deficit can use to settle balance-of-payment debts. Since SDRs are ledger entries, their use eliminates the logistics of shipping bullion back and forth to settle national accounts (Zigler, 2010).

The resetting of SDRs will reflect ongoing shifts in central bank reserves positions. In particular, the IMF executive board could consider reordering the SDR to reflect a diminution in the US dollar's strength (Zigler, 2010).

One of the 'intellectually healthy' notions for diversifying away from the U.S. dollar was proposed by the governor of the People's Bank of China, who argued for enlarging the SDR basket to include more currencies and establishing a settlement system that would make SDRs tradable outside of the IMF's books (Reisen, 2010).

The Director of the IMF said on February 2010 that the IMF should reorient itself to better detect systemic risks to the global economy and quickly step in with emergency loans when financial crises emerge (UPI, 2010). In his speech, the Director of the IMF called for a 'renewed vision' for the IMF, which was part of the global financial

architecture created in Bretton Woods, N.H., in 1944, but which faced grave questions about its relevance and survival. In fact in late Fall of 2011 this was being considered as a possible solution to the EU financial problems which were threatening to dissolve the euro.

The Director called for the IMF to improve its tools for financial surveillance and to 'construct a global risk map' of nascent systemic risks. And while noting that the Federal Reserve and other central banks provided liquidity swaps during the worst of the crisis, he said that the IMF should explore options like short-term credit lines for extending emergency lending in future crises.

The governor of China's central bank made a similar proposal in March 2009, arguing that 'special drawing rights' (SDR), baskets of currencies issued by the IMF have served as reserve assets, would be more stable and viable than the dollar. China's large holdings of US dollar reserves in the form of Treasury securities have become a concern for officials on both sides of the Pacific.

Few economists believe that the dollar's status as the dominant foreign exchange reserve will change anytime soon. A new reserve currency could limit dependence on the policies and conditions of a single, though dominant, country. The US Treasury Department has stated that *"as long as the United States maintains sound macroeconomic policies and deep, liquid, and open financial markets, the dollar will continue to be the major reserve currency."*

The trend among central banks is to hold increasingly large positions in currencies that the IMF currently defines as 'other.' To be sure, some central bank holdings

(weighted average: 18 basis points) are still maintained in Swiss francs, but that position

is shrinking by a basis point a year. The 'other' category now represents nearly 3 percent

of global reserve commitments (Zigler, 2010).

The SDR and the value of US dollar are highly correlated and SDRs as a

substitute for dollars really will not offer much risk reduction unless a mechanism for

their separation can be made effective. For most of the five years since the last SDR reset,

the IMF accounting unit was virtual stable with that of the dollar. Their rolling 30-day

correlation has averaged 98.6 percent since February 2005 (Zigler, 2010).

The use of SDRs would require management by a 'super' central bank, a potential

difficult task due to national sovereignty since it is composed of a basket of currencies.

The euro failed to establish hegemony in Great Britain over this very issue a decade ago.

There would be significant resistance in the United States over 'giving away' reserves to

the IMF or another entity would likely be even significantly harder.

To make the SDR the principal reserve asset via allocation, close to $10 to $30

trillion or more in SDRs would have to be created. It has also been suggested a so-called

SDR substitution account be the mechanism to achieve this movement. This would

permit countries who feel their official US dollar holdings are uncomfortably large to

convert dollars into SDRs. Because conversion would occur outside the market, it would

not put downward pressure on the US dollar.

The SDR could be enhanced by making its currency composition more neutral to

global cycles and more representative of the shift in economic power witnessed over the

last two decades by the growth of emerging economies. This could occur through an

increase in the commodity content and the inclusion of major emerging-market currencies. By including the convertible Australian, Canadian, Chilean, Norwegian and South African currencies in the SDR basket of currencies to give it a link to the raw material cycles, as these currencies reflect price developments of copper, iron ore, gold, and oil. Major emerging-country currencies could be included in the SDR mix as soon as they reach a predefined level of convertibility. Such a variable SDR could result in possible speculation and eventual financial crisis could develop if a robust management system and governance structure was not included.

But even with such changes to the SDR, the key question is whether major economies will subscribe to this new reserve currency? International currencies in the past have included the Chinese Liang and Greek drachma, the Roman denari, the Byzantine solidus, the ducato of the Renaissance, the Dutch guilder and sterling (Reisen, 2010). The real issue is the stability of any currency or basket of currencies (See Chapter 13).

The refocusing of global reserves in the SDR would likely greatly impact exchange rate volatility among the main current reserve currencies since this can reduce potential official demand shifts among currencies. If countries are to peg their currencies to the SDR, their effective nominal and probably real exchange rate volatility would decrease, thereby increasing global stability (Obstfeld, 2011). This would definitely impact the commodity markets and reduce their volatility by removing currency speculation as valuations are brought more in line with supply-demand considerations.

Basket of Currencies Not IMF Related

Another potential for a world reserve currency could be a basket of currencies and gold to replace the US dollar as the primary reserve currency globally. A number of countries have been looking to supplant the U.S. dollar as the currency for oil trading, which would have obvious implications for the standing of the United States currency as the reserve currency of choice worldwide (Darwin, 2009). There was according some reports a secret meeting between the central banks of Brazil, France, China, Russia, Japan and several OPEC states where they were discussing to replace the denomination of US dollars with a basket of other currencies and gold (Darwin, 2009). While there was speculation that the recent rise in gold was correlated with this meeting no reliable evidence has been presented.

It must be recalled that the British pound was the global reserve currency for quite some time until the US dollar finally replaced it following World War II. It's evident that the United States is losing is dominance, but if a switch is under way, this is a decades-long process, not something which occurs within a matter of a few years (Darwin, 2009).

Human Energy – Joules

A new measure based on human expenditure has also been proposed (Cardullo and Lui, 2012). The nature of capital is multilevel; it can consist of property, resources, human labor and various other assets. But in reality it is the ability to trade one asset for another asset. In this regard, capital like money can be used to acquire another asset like someone's labor or a physical asset. In a way it is barter because liquid capital is only a way of exchange in fact since any asset, from a market perspective, only has value because someone wants it. If that asset was placed in a forest or desert or a high mountain

and no one was there to claim it, then it would have no value. So for an asset of any type to have value someone must want it otherwise it would be valueless.

However, while its value depends on someone desiring it, the asset has a more fundamental 'value' in the thermodynamic sense. That thermodynamic value is the amount of human labor expended to produce it; therefore the value of global reserve currency could be in joules.

 That value must be the total 'labor' cycle from basic resource acquisition to the final asset. This includes the labor to build any device and the material in that cycle allocated to that device. Thus nothing on this planet is produced 'de novo', that is without human labor. The First Law of Thermodynamics has been shown by Cardullo and Lui (Cardullo and Lui, 2012) determining the stability of financial markets.

Realizing that the maximum amount of real assets is based on labor past and present, the First Law of Thermodynamics says that we cannot obtain assets that exceed a maximum number of 'joules' during any period. Therefore, the world capital will grow through growth in population plus net additions due to World Gross Product (WGP) less losses. To determine this, additional research will be required including quantifying this premise. This preliminary analysis shows that based on the First Law of Thermodynamics, the world financial system is in fact a 'Zero Sum Game.' There are only gainers and losers in this 'game' and it is imperative that we have a methodology to have a level playing field in global finance (Cardullo and Lui, 2012).

Summary of Global Reserve Currency Alternatives

Based on the review of alternatives as shown in Table 1 the new global reserve currency could be a basket of G20 and maybe including other currencies based on changing global financial conditions. Based on the existence of the SDR and a commitment of the sovereign community to expand the basket of currencies composing it and other factors (See Chapter 12), this international financial unit may in the long run be the principle new global reserve currency. A new global reserve currency system to be implemented will require not only robust global cooperation but a robust informational architecture and governance.

Table 1 Summary of Global Reserve Currency Alternatives

Global Reserve Currency	Advantages	Disadvantages
Dollar	World's most widely held reserve currency Perceived safe haven currency	Experiencing a decline Potential for rampant inflation Large and increasing both public and private debt Triffin dilemma
Euro	Plausible replacement for dollar Euro zone economy is large ECB enjoys considerable credibility	Cope with different external risks Growing uncertainty and potential defaults by some member countries Harder to control the stock of euros in circulation
Yuan	Becoming a store of value Size of the domestic economy Large foreign reserves and growing	Growing inflation Convertibility of the currency Triffin dilemma Macroeconomic economic policies
Gold	Renewed respect for gold Increase in value Low risk of losing value	Lack of ability to increase the money supply Difficulty of maintaining the liquidity Settlement challenges Operates through the link between gold and reserve currency
IMF Special Drawing Rights (SDR)	International reserve asset UN commission-gradual move from the US dollar to the SDR Value of a trade and reserve weighted basket of currencies Intellectually healthy	Not a true currency instead are credits Determined every five years Limited of number of basket currencies SDR and the dollar are highly correlated will not offer much risk reduction
Basket of Currencies Not IMF Related	Basket of currencies and gold or commodities Potentially less risk	Sovereign governments have problem Question on who and how this would be managed
Joules	Intellectually interesting Intellectually defensible Can be calculated and measured Would reduce financial manipulation	Very difficult to implement Sovereign governments and financial markets would likely not accept
G20 Basket of Currencies	Economies comprise 85 percent of global gross national product, 80 percent of world trade, two-thirds of the world population	Cascade issues if a basket of currencies is used Decision on management and governance Increasing debt with or without China Analytical foundations for understanding the costs and benefits from cooperation are not clearly visible

Management Alternatives

There are two basic approaches which can be utilized to model a management approach for global reserve currency; object oriented and structured analysis. In model based systems engineering, analysis is the process of studying and defining the problem to be resolved. Once the requirements are defined that the system is specified to perform, analysis involves discovering the underlying assumptions with which the system has to fit, and the criteria by which it will be judged a success or failure. There is a growing

concern that the global monetary system has systematic problems. These problems arise due to use of certain reserve currencies. The global financial markets require a basis of transfer. This basis is called a global reserve currency. For long periods in the economic history of the world, this basis has been the metal gold.

It is important to understand the purpose of currency. It is apparent that currency is really a mean to facilitate exchange of goods and services for other goods and services. That means of exchange is currency. Now what has evolved around this simple concept is a complex financial system. In fact this complex system results in a system where non-participants, in providing goods and services, serve as intermediaries through currency. Let us consider a system in Figure 3 which shows the movement for a simplified exchange system[12]. Currency, in Figure 3, is only a means of obtaining goods and services and not a more complex market where currency is created.

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[12] Figure 3 is meant to show an example of currency movement and not a true system.
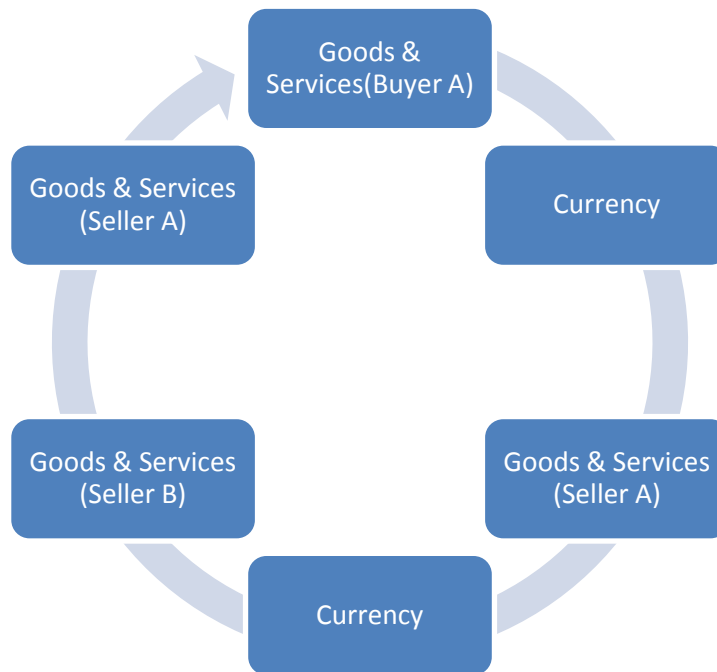
Figure 3 Simplified Financial Cycle

However, choosing a basket of currencies, it is not the final solution to the management of a new global reserve currency. This management should consist of a robust global information and knowledge system. This information and knowledge system must be based upon user requirements which result in a group of services, which will provide a management system which would result in providing stability for a new global reserve currency.

Problem Definition

An important element in developing a stable global financial system is an accepted global reserve currency that all nations will adhere[13] to. Today no such system, or system of systems, exists.

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[13] Adherence means that the new currency will be the only currency used as a global reserve.

The problem can be defined by looking at the need components to establish such a system, four of which are:

- Need for a schedule for G20 leaders to achieve more cooperative solutions to international financial challenges.

- Need for a framework for global financial cooperation

- Need to change the zero-sum mentality[14] that is the source of prior failures in global financial cooperation.

- Need for a global financial management system with governance rules that all participants agree to follow

This problem, and the need components that lead to the problem, is deeply associated with individual sovereign policies which are currently based on use of a zero-sum game mentality and reliance on this mentality in order to determine outcomes. It appears that few sovereign governments are willing to foster the needed cooperation until a major global financial collapse occurs. Then the resulting financial catastrophe may take generations to resolve.

Recent years have witnessed a tremendous growth in information and knowledge technologies that facilitate the design and implementation of complex systems management processes. These technologies, especially when coupled with robust information and knowledge architectures, can serve to assist in developing a stable global financial framework. One of the major innovations here been based on the concept of a Service Oriented Architecture (SOA) (Andary and Sage, 2010). An SOA may form the

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[14] A zero-sum mentality in game theory and economic theory is a mathematical representation of a situation in which a participant's gain or loss is exactly balanced by the losses or gains of the other participant(s), i.e. 'beggar they neighbor' such as to maximize their returns independent of the consequences to other nations.

basis for linking the global financial markets. This can provide each of the participating

enterprises including sovereigns with capabilities for maintaining their existing systems

through using a SOA, yet form a global network.

Related Research

The research on financial markets available is substantial. This research covers

sovereign debt, currency markets, the various currencies and stakeholders. During the

2008-2012 time period there have been substantial studies covering various aspects of

reserve currency and global financial stability. Appendix A contains the Bibliography

used in developing this dissertation.

The psychology of global financial markets is such that as economic conditions

deteriorate, there have been many sovereigns who have indicated that the current

condition of the United States currency dominating international trade may have been the

cause of the crisis of the 2007 – 2009 time period (Tilford, 2007, Darwin, 2009, Li et al.,

2009, MoneyEnergy, 2009, Breitbart, 2010, CHAN, 2010, Fitzsimmons, 2010, Foa,

2010, Jenkins, 2010, Reisen, 2010, Zigler, 2010, UPI, 2010). While a number of studies

have been done covering the stability of the global financial markets (Mandeng, 2011,

Stratégie, 2011, Subacchi and Jenkins, 2011) no solid conclusion has been reached. If we

consider that the problem can be traced to the instability in global trade imbalances plus

the 'gaming of the global financial markets' and the inability of the sovereign states, in

particular the G20, to stabilize the system through a robust governance process

(Strupczewski, 2011, Subacchi and Jenkins, 2011) , then a new global reserve currency

must be combined with an information technology management architecture coupled with an agreed upon governance system.

There is a question on the stability of a multi-sovereign new global reserve currency such as one based on the G20 or a greatly expanded SDR with or without a management and governance system. The question of global reserve currency stability has been under discussion since the early 1990s (Woodford, 1990). If a new global reserve currency based on the G20 currencies is accepted this may be stable with an information management system with or without a governance system. It is the question of the governance system that is likely to lead to the most disagreement among the various sovereign participants, since they would have to give up some of their sovereignty to a management body.

CHAPTER 3: DESIGN APPROACH

Currently, there is no system of systems architecture for management of any global reserve currency. The amounts of various currencies held in reserve by sovereigns are decided by each central bank. The values of these currencies are based on market conditions and are thus open to speculation by traders.   This means that a totally new system of systems architecture must be developed once the various sovereign states agree to have such a system. So there are a number of steps that must be taken prior to even setting up an architectural model for such a system of systems, including the approach to developing the architecture.

The Triffin dilemma resulted in the observation that when a national currency also serves as an international reserve currency (as the US dollar does today), there are fundamental conflicts of interest between short-term domestic and long-term international economic objectives. One approach to help in stabilizing the global financial markets is to choose a basket of currencies that is sufficiently large to ideally eliminate the problems caused by the Triffin dilemma.

In development of the mission for this process, there is a growing concern that the global monetary system has systematic problems which arise through the use of certain reserve currencies. For long periods in the economic history of the world the basis for transactions has been the metal gold. Starting in 1945, with the Bretton Woods

agreement, the US dollar and its conversion to gold ultimately became the global reserve currency.

Structured Analysis

Agreement between the members of the G20 is the most important basic step in the process prior to the development of the design model for a system of systems architecture. Assuming that this basic step has occurred, and then the next step is the development of the mission for the management system. This can be achieved using a structured analysis approach.

The structured analysis systems development life cycle is based on the waterfall model. In this approach, processes and data are independently modeled. Process models, represented by data flow diagrams capture the flow of control among processes and demonstrate how data, information, and knowledge get modified as they flow through the system. Data models are described using entity-relationship diagrams that depict data elements and their associations. Structured analysis is part of a series of structured methods, which represent a collection of analysis, design, and programming techniques that were developed in response to problems facing the systems engineering industry from the 1960s to the present.

Approach for Managing a New Global Reserve Currency

The approach for managing a new global reserve currency requires that an understanding of the various complexities of the system, be developed. These complexities can be seen in Figure 4 which shows an approach that can be used in

developing a new global reserve currency informational architecture. Figure 4 is based

on a completion of concepts derived from Levis (Levis, 2009) and Pallab (Pallab, 2006).

Figure 4 illustrates the four stages in the development of an architectural system

for management of a new global reserve currency. The stages are: 1. definition stage, 2.

services stage, 3. architectural stage, and 4. implementation stage. Numerous authors

have developed similar approaches. The approach shown in Figure 4 shows how

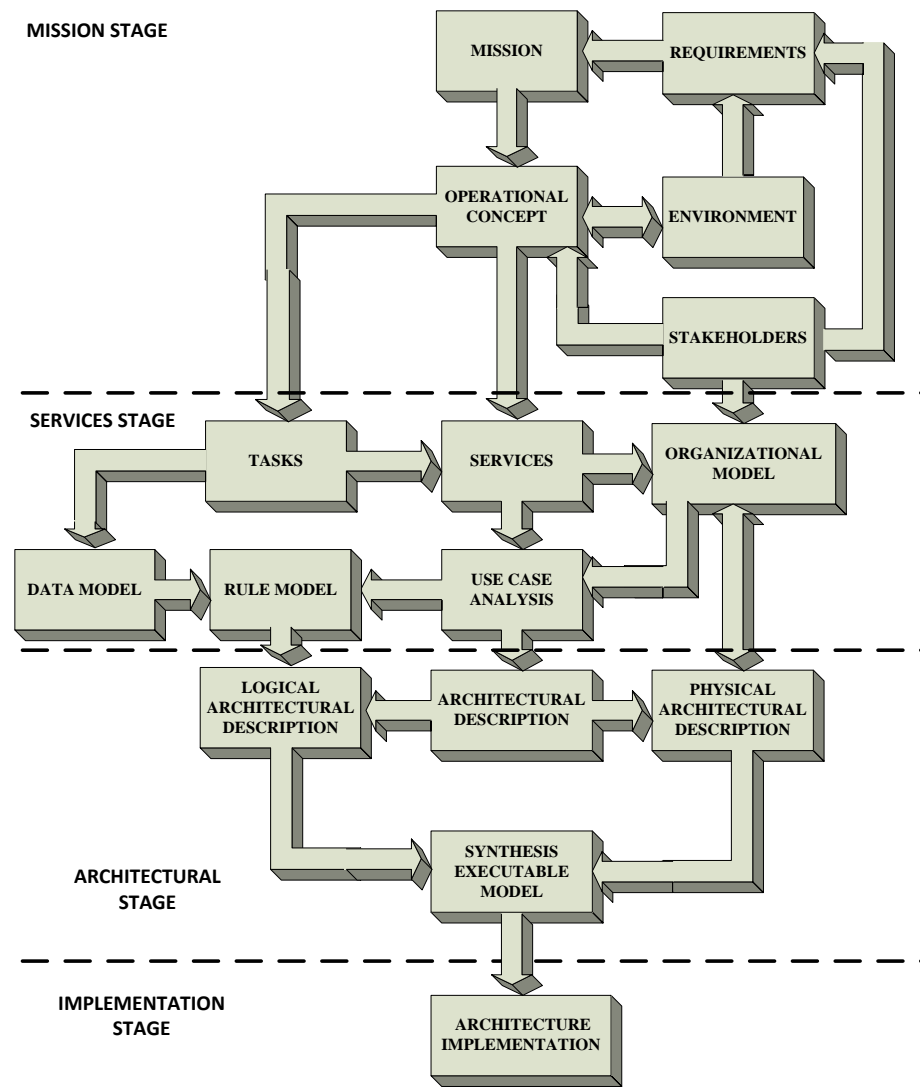feedback from various elements can impact the development of the system.

Figure 4 Knowledge and Information Architecture Model for a New Global Reserve Currency Management System (Cardullo and Sage, 2012b)

Mission Stage

In this mission stage, we identify the principle feedbacks that result in an operational concept. Former studies have usually started with the mission and its decomposition; however, the mission does not stand as a starting point. In fact, the mission must be driven by the requirements. These requirements are the result of a needs

assessment of stakeholders, and the environment in which they all must exist. The

resulting operational concept impacts the environment, and is also impacted by the

stakeholders whom must participate in the system.

Services Stage

After completion of definition stage, the next activity is the development of the

services stage. In this stage the output from the operational concept, which was

developed in the definition stage, results as the inputs in developing the tasks and, from

these tasks, the services of the system. Combining the chosen services and stakeholders

requirements will lead to the development of an organizational model. The output of

these services then can be used as an integral part of a use case analysis for a proposed

architecture. The organizational model is one of the inputs for the architectural stage in

the development of a physical architectural description.

Architectural Stage

The most critical stage in the development of the complete system is the

architectural stage. In this stage, from the output of the services stage, we can generate

both a logical architectural description and a physical architectural description. An

appropriate question to be answered is, *"does this truly result in a stable operational*

potential architecture for management of a new global reserve currency" (See Chapter

13).

Implementation Stage

Once a proposed architecture has been shown to be feasible through the use of an

executable model, the next stage is the finalization through implementation of a proposed

system. While this may appear to be the last stage, it will require acceptance by the

various stakeholders of the final product. Assuming, that there are anywhere from 5 to

20 sovereign states involved and a number of international organizations, this process

may be daunting to implement.

CHAPTER 4: MISSION STAGE

Assuming that a meeting and associated agreement has taken place between the members of the G20 and the IMF, then one of basic steps that must then be taken is to develop a design model for the system of systems architecture. The first objective here is to develop the mission.

The development of the mission requires first a true understanding of the stakeholders and their environment. Historically, the environment is a rapidly changing landscape. The mission is impacted by the requirements which in turn are impacted by the stakeholders and the environment.

Stakeholders
There are a myriad of stakeholders who potentially have strong interest in the development of this important information management system. The major stakeholders include: sovereign governments; central banks; IMF; G20 organization; Forex market; Bank for International Settlements (BIS); International Organization of Securities Commissions (IOSCO); International Financial Reporting Standards (IFRS); Financial Stability Forum (FSF); and Rating Agencies. In many cases, each of these major stakeholders has individual stakeholders that are sovereign states with political and economic objectives. These nested sets of objectives must be realized as part of developing a workable architectural framework.

Sovereign Governments

These are the central stakeholders for the global reserve currency. These governments are concerned with the stability of their economies and currencies. Therefore, these stakeholders will need to approve any system for managing the global reserve currency. They will need to agree to abide by the rules of governance for the management of this system of systems. In the past, a number of sovereigns have utilized a 'zero-sum game' to manage their currencies and thus 'beggar their neighbor', i.e. they achieve their objectives independent of the results on the total financial system. Such actions must be precluded if a new global reserve currency is to serve to stabilize global financial transactions.

Their requirements vary from sovereign to sovereign. There are three categories of sovereign nations: developed nations, developing nations and underdeveloped nations. Each of these categories has various types of requirements. Figure 2 illustrates how requirements are developed by a sovereign.

As Figure 2 shows, the requirements of the sovereign can be derived from a number of interactions. Basically, it is the sovereign's policy that forms the requirements. This can be seen as impacted by the Gross Domestic Product (GDP), and the impact of the sovereign's debt or reserves positions. As a sovereign's debt increases, one of the ways to mitigate this is for the country to increases exports over imports by decreasing the value of its currency. By doing this, the sovereign can increase domestic jobs and possibly reduce sovereign debt. This can be accomplished through financial policies where more currency or liquidity is provided through the central bank. This is the case in many of the developed nations, such as the United States, European Union, and Japan.

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Their requirements consist of increasing exports through financial currency manipulation and/or decreasing imports, which is much harder.

The BRICS have other requirements. These sovereigns are interested in making sure that their competitive advantages are sustained. In the case of Russia, their competitive advantage is income from the sale of resources. Therefore, Russia and Brazil does not want to see the valuation of a reserve currency such as the US dollar decrease rapidly. Similarly, China is interested in maintaining their currency advantage over the US dollar and the euro due to both exports, and therefore impacts on employment and their high investment in US dollar reserves. The developed nations will not interact in a new global reserve currency management system, except through possible interactions with the influence of the International Monetary Fund (IMF) or the World Bank.

Table 2 is a summary of the major requirements for the participants, who could be in the new global reserve currency. As Table 2 shows, the major sovereign requirements are basically the stability of any new global reserve currency, independent of the country involved.

Central Banks

This is the monetary authority which usually issues the currency, regulates the money supply, and controls the interest rates in a nation. It possesses a monopoly on printing the national currency, which usually serves as the nation's legal tender and intervening when necessary. The primary function of a central bank is to provide the nation's money supply, but also include controlling interest rates and acting as a lender of last resort to the banking sector during times of financial crisis. The role for central banks

in influencing macroeconomic outcomes has also changed as a result of the inter-

connectedness of capital markets and the internationalization of financial flows. In recent

years there has been a shift from a direct and administered system to market determined

and market based systems of determining interest rates, exchange rates and other key

financial variables (Williams, 2008). In general, central banks follow the dictates of the

sovereign. Therefore, their requirements will be identical to the sovereigns, they

represent.

Table 2 Summary of Critical Sovereign Requirements

Sovereigns	Requirements	Comments
United States	Increased exports though balanced currency with major export countries such as China and remaining the major global reserve currency	Increasing exports can provide increased employment within the United States. However, actions to devalue the US dollar through quantitative easing, can lead to possibly higher levels of inflation. It is unlikely that over the long run, 10 to 20 years, that the US dollar will maintain its position as the major reserve currency. Also, increasing the liquidity of the US dollar can in the long run lead to higher ratios of debt to GDP.
Eurozone Countries	Increased exports though balanced currency with major export countries such as China	The euro zone countries face a different problem. The nations that form the euro zone have very different economics. The northern members have robust economies and exports. The sovereign members such as Greece, Italy, Spain, and Portugal have declining populations and high ratios of debt to GDP. The euro zone cannot easily increase its overall exports, the southern members and their high debts. Therefore, there major requirements is stability of currency.
United Kingdom	Increased exports though balanced currency with major export countries such as China	The UK, while tied to the EU, is not part of the euro zone. However, their requirements is for stability of the British pound.
Japan	Increasing exports through currency devaluations	Japan, through its many multinational companies such as Sony, Toshiba and others is interested in maintaining their lead in exports, basically, autos and technology. Their various interventions in the currency markets appear to maintain their current stability ratio which is the United States and the European Union.
China	Maintaining position as major world exported through currency stability where possible.	China is faced with a problem of maintaining a lower valuation of their currency, in respect to all their major importing countries. Also, due to the impact of increasing their valuation against the US dollar, the major reserve global currency, and its impact on acquisition of commodities, they resist a reevaluation of the Yuan. China would like to change the makeup of the global reserve currency. They are in the process of forming bilateral relationships with other countries where the Yuan would be used for financial settlements.

International Monetary Fund (IMF)

The IMF has the important role to be the lender of last resort facilities to many countries both developing and developed. In addition to lender of last resort, it also provides an important economic and financial monitoring function through its Article IV consultations and the Financial Sector Adjustment Programs (FSAPs).

The IMF has been upgraded by the G20 to become the main forum for international financial and economic affairs, and including reforms to the international monetary system. This may signal that the IMF will become the key institution to deal with the functioning of the global foreign reserve currency system envisioned by this dissertation. There are a number of problems which first must be overcome. This includes the IMF governance that must change to match the different political and economic landscape. Another is the deep mistrust of the IMF that has built up over the years among developing countries, especially after its response to the Asian financial crisis in 1997–98 (Subacchi and Driffill, 2010).

The IMF principal objectives are to stabilize exchange rates and assist the reconstruction of the world's international payment system. The IMF started the development on dissemination standards with the objective of guiding member countries to disseminate their economic and financial data to the public. The member sovereigns endorsed the guidelines for the dissemination standards. These standards were divided into two tiers; the General Data Dissemination System (GDDS), and the Special Data Dissemination Standard (SDDS). The GDDS is focused primarily at statisticians and its objective is to improve many aspects of statistical systems in a country. Both systems are part of the World Bank Development Goals and, the Reduction Strategic Papers. The

primary objective of the systems is to encourage IMF member countries to build a

framework to improve data quality and increase statistical capacity building. This

requires that the sovereign members will prepare metadata describing current statistical

collection practices and setting improvement plans.

The SDDS act's to provide the dissemination of economic and financial data and

it has four dimensions of data dissemination:

- Data – coverage, periodicity, and timeliness;

- Access by the public;

- Integrity of the disseminated data; and

- Quality of the disseminated data.

Therefore, we can state that the requirements for the IMF appear to be:

- Stabilization of exchange rates;

- Reconstruction of the global international payment system; and

- Data dissemination standards.

G20 Organization

While the G20 are a grouping of twenty sovereign nations, it has no permanent

secretariat structure. The G20 was established in 1999, in the wake of the 1997 Asian

Financial Crisis, to bring together major advanced and emerging economies to stabilize

the global financial market.

The G20 was established for cooperation and consultation on matters pertaining

to the international financial system. It studies, reviews, and promotes discussion among

key industrial and emerging market sovereigns of policy issues relating to the building of international financial stability, and seeks to address those issues that go beyond the responsibilities of any one sovereign.

The basic requirements of the G20 are linked to each of the sovereign members. However, the basic requirement is providing for financial stability of the global system. Therefore, a knowledge information architecture which can demonstrate its ability to provide stability to the global financial system should be acceptable.

Bank for International Settlements (BIS)
The mission of the Bank for International Settlements (BIS) is to serve central banks in their pursuit of monetary and financial stability, to foster international cooperation in those areas and to act as a bank for central banks. The BIS is a forum to promote discussion and policy analysis among central banks and within the international financial community. It also serves as an international center for economic and monetary research. It also acts as a prime counterparty for central banks in their financial transactions and trustee in connection with international financial operations.

Within the Bank for International Settlements is the Financial Stability Forum (FSF). This organization was established in 1999 to promote international financial stability. It does not include developing countries among its members, but makes recommendations and calls for their implementation relating to financial centers in both emerging markets and in developing countries. The FSF comprises 12 countries (G7 plus Hong Kong, Switzerland and Netherlands, Australia and Singapore including related institutions in those countries and 9 international standard setting organizations). The FSF

is part of the BIS and if it widened its mandate to continual monitoring rather than issue based approaches it could become the kind of entity which has the track record needed to coordinate regulatory and oversight functions of bank regulation, securities, insurance accounting rules and payment system issues and monetary and financial stability issues and possibly a global reserve currency (Williams, 2008).

Based on the mission of the BIS, we can conclude that the requirements in reference to a new global reserve management system would be monetary stability and assist in cooperation with central banks.

International Organization of Securities Commissions (IOSCO)
The International Organization of Securities Commissions (IOSCO) is an association of global regulatory bodies, which regulates securities and futures markets. The IOSCO, which consists of the global regulators, can impact the global Forex markets.

As an organization of regulators of the securities industry whose objective is to cooperate together to promote high standards of regulation, to exchange information and to provide mutual assistance and generally protect the integrity of the securities markets, it could provide a stabilization means for currency trading. Reliable data and information is a key to successful regulatory actions.

Based on the nature of his organization, it is possible to conclude that the requirements of the IOSCO would really be to provide a system that assists in stabilizing currency trading and the exchange of standardized information.

Rating Agencies

The international rating agencies have a very important role to play in determining the operation of the global reserve currency. In fact it is these agencies and their ratings that can 'trigger' currency speculation. Therefore, a close integration with the informational systems of these agencies is critical.

The assignment of risk is basically the providence of credit rating agencies. A Nationally Recognized Statistical Rating Organization (NRSRO) is a credit rating agency (CRA) which issues credit ratings that the US Securities and Exchange Commission (SEC) permits other financial firms to use for certain regulatory purposes (Wikipedia, 2011).

There are ten organizations which have been designated as NRSROs:

- Moody's Investor Service

- Standard & Poor's

- Fitch Ratings

- M. Best Company

- Dominion Bond Rating Service, Ltd

- Japan Credit Rating Agency, Ltd

- R&I, Inc.

- Egan-Jones Rating Company

- LACE Financial

- Realpoint LLC

Ratings by NRSRO are used for a variety of regulatory purposes in the United States and other countries. In addition to net capital requirements, the SEC permits certain bond issuers to use a shorter prospectus form when issuing bonds if the issuer is older, has issued bonds before, and has a credit rating above a certain level.

The credit ratings issued on sovereign securities have a definite impact on the currency value of a nation or group of nations. It is important to determine how these agencies assign risk and its impact on currency value. It can be assumed that the basic requirements of the global rating agencies would be for availability, accurate and timely release of data.

Global Financial Environment

The global financial environment consists of a number of environments within which the stakeholders must be cognizant of and who will influence decision making.

Forex Market

The foreign exchange market (Forex) is a global, worldwide decentralized over-the-counter financial market for trading currencies. The foreign exchange market determines the relative values of different currencies base on supply and demand. It supports speculation, and facilitates the carry trade[15], in which investors borrow low-yielding currencies and lend or invest in high-yielding currencies, and which may lead to loss of competitiveness in some countries. The primary purpose of the foreign exchange is to assist international trade and investment, by allowing businesses to convert one currency to another currency. The foreign exchange market is unique

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[15] Carry trade is a currency strategy in which an investor sells a certain currency with a relatively low interest rate and uses the proceeds to purchase a different currency yielding a higher interest rate. A trader using this strategy attempts to capture the difference between the rates, which can often be substantial, depending on the amount of leverage used.

because of: extremely large trading volume, leading to high liquidity[16]; geographical dispersion; continuous operation; covers a variety of factors that affect currency pricing; easy to trade because of low margins of relative profit compared with other markets of fixed income; and use of leveraging resources through usually borrowing against assets to enhance profit margins with respect to account size. This is a dispersed participant with many 'tentacles' and as such can quickly adapt to various reserve currency actions (Dolan, 2011).

The Forex market is a most challenging environment for a new global reserve management system. It is this environment, which is capable of causing instability in any global reserve currency. It is a market where not only traders and speculators are involved, but also sovereign states through their central banks in the buying and selling of currency. However, with a robust knowledge and information architecture for the management of a new global reserve currency, it may be possible to reduce the volatility of this market with its many 'tentacles'. This robustness would require rapid reaction to dampen speculation for a new global reserve currency through extremely current data and response.

Bond Market

The bond market is based on supply demand considerations. The bond market is where participants can issue new debt, known as the primary market, or buy and sell debt securities, known as the secondary market, usually in the form of bonds. These provide a mechanism for long term funding of public and private expenditures. References to the

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[16] Liquidity is an asset's ability to be sold without causing a significant movement in the price and with minimum loss of value

'bond market' usually refer to the government bond market, because of its size, liquidity, relative lack of credit risk and, therefore, sensitivity to interest rates. There is an inverse relationship between bond valuation and interest rates; the bond market is often used to indicate changes in interest rates or the shape of the yield curve. The yield curve is the measure of 'cost of funding' which impacts both sovereign and private debt. Interest rate risk is the risk due to variability of interest rates. As rates rise, the price of a fixed rate bond falls, and vice versa.

Commodity Markets

Commodity markets are markets where raw or primary products are exchanged. These commodities are traded on regulated commodities exchanges, in which they are bought and sold in standardized contracts. The trading of commodities consists of direct physical trading and derivatives[17] trading. The cost of commodities directly impacts costs for both imported and exported products. These costs translate into GDP impacts and current account balances. Therefore, as a currency loses value, the cost of imported commodities increases in reference to other countries.

Impacts of the Environment on Requirements

As Figure 2 shows, the environment is related to the decisions of sovereigns and to the stability of the global financial markets. Unconstrained, in a free market environment this complex system can and does go unstable under certain conditions. Therefore, any knowledge and information system architecture must be prepared to

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[17]Derivatives are contracts whose value is derived from that of other quantities that specifies conditions, in particular, dates and the resulting values of the underlying variables, under which payments, or payoffs, are to be made between the parties. Under U.S. law and the laws of most developed countries, derivatives have special legal exemptions which make them a particularly attractive legal form through which to extend credit.

rapidly respond to any signs of instability. This response will require participants, such as sovereigns and international bodies to be prepared to intervene in the currency markets. This requires a robust and accurate, availability of data and information and knowledge, so that the process of market intervention can be achieved in such a way as to suppress any adverse consequences.

Summary of Requirements

Table 3 is a summary of the requirements that can and should become the basis of the mission for the knowledge and information management system architecture for a new global reserve currency.

Table 3 Summary of Stakeholder Requirements

Stakeholders	Requirements
Sovereign Governments	Their requirements vary from sovereign to sovereign. There are three categories of sovereign nations: developed nations, developing nations (including Brazil, Russia, India, and China - BRICs) and underdeveloped nations. Each of these categories has various types of requirements. Figure 2 illustrates how requirements may be developed by any sovereign. In general all sovereign governments desire stability of currency and necessarily do intervene in the Forex markets to achieve certain desirable economic and political advantages.
Central Banks	Their requirements will be identical to those of the sovereigns that they represent.
International Monetary Fund	The requirements for the IMF appear to be: stabilization of exchange rates; reconstruction of the global international payment system; and data dissemination standards, such as the SDDS.

G20 Organization	The basic requirements of the G20, will be linked to its sovereign members. However, the basic requirement is that of providing for financial stability of the global system. Therefore, a knowledge and information architecture which can demonstrate its ability to provide stability to the global financial system is needed and should be acceptable.
Bank for International Settlements	The basic requirement of the BIS, in reference to a new global reserve management system is the monetary stability and assistance in cooperation with central banks.
International Organization of Securities Commissions	The basic requirement of the IOSCO is to provide a system that assists in stabilizing currency trading and the exchange of standardized information.
Rating Agencies	The basic requirements of the global rating agencies should be availability, accuracy and timely release of data.

Based on this review, the requirements for the mission can be classified into the basic following categories: stabilization of currencies, intervention into Forex markets, data standards and exchange.

Mission Decomposition

The requirements form the basis for the development of the mission, its decomposition into elements which can be used to formulate the operational concept. These elements are:

- stabilization of exchange rates;

- intervention in the Forex markets;

- data dissemination standards;

- exchange of standardized information; and

- available, accurate and timely release of data.

These five elements produce the mission statement for the development of an information and knowledge architecture for system management of a global reserve currency, which is shown in Figure 5.

Name of the system	• Information and Knowledge Architecture for System Management of Global Reserve Currency (IKASM-GRC)
Purpose	• Provide an architecture which can assure accurate and timely data sufficient to assist in providing stability of a global reserve currency through Forex intervention by sovereign particiants. • Provides the basis for determining the value of the global reserve currency.
Composition	• Using existing sovereign and international organziation frameworks and data standards
Responsibilities of the system	• Provide timely and accurate data to the participating sovereigns and international organizations • Provide rapid response system • Provide for Forex intervention response by participating Sovereigns • Provide a management and governance system
Exclusions	• The system does not manage individal sovereign responses • Only participating soverigns are involved

Figure 5 Mission Statement of IKASM-GRC

Using a structured analysis approach, Figure 6 shows the decomposition of the mission into the various functions and tasks that are required to develop the required architecture. These tasks can be divided into the following groups: data, systems, and organizational. From these tasks we can derive the services and data, rule, and organizational models which will need to be implemented in order to develop the

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information and knowledge architectures for the system management of a global reserve
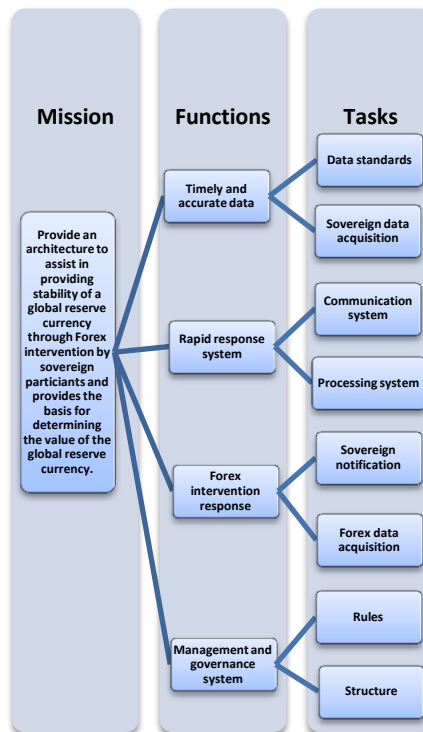
currency.

Figure 6 Mission Decomposition [Based on the data contained in (Cardullo and Sage, 2012)]

Operational Concept

Reserve Currency Concept

The US dollar now serves as the de facto world's reserve currency. However, this

is unlikely to continue, unchanged and unchallenged, into the future. The G20 and the

International Monetary Fund (IMF) appear to be considering a new reserve currency, like

the Special Drawing Rights (SDR), that involves participation of many currencies,

including the Chinese yuan. The question is not only what will become of this new global

reserve currency, but how this currency will be managed and by whom (Cardullo and Sage, 2012c).

In response to calls by China and Russia to supplant the US dollar with special drawing rights, the Director of the IMF has said, *"That day has not yet come. But I think it is intellectually healthy to explore these kinds of ideas now."* (Zigler, 2010)   The SDR comes to prominence when the US dollar is weak or otherwise unsuitable to be a foreign exchange reserve asset. This usually manifests itself as an allocation of SDRs to IMF member countries as was the case in 2009.

Though freely convertible in international transactions, SDRs are not a true currency, instead they are credits that a nation with a trade deficit can use to settle balance-of-payment debts. Since SDRs are ledger entries, their use eliminates the logistics of shipping bullion back and forth to settle national accounts. However, if the SDR or something similar is to become the major global reserve currency it must be tradable and used for all settlements.

SDRs represent the value of a trade and reserve weighted basket of currencies, including the US dollar, the euro, the Japanese yen and the pound sterling. In 2011, there were discussions to include the Chinese yuan. The SDR basket's makeup is determined every five years by the IMF executive board. However, since trade and reserves change on a timely schedule, and technology can be used to provide this timeliness, then a newer approach should be considered.

The resetting of SDRs will reflect ongoing shifts in central bank reserves positions. In particular, the IMF executive board will consider reordering the SDR to

reflect a diminution in the dollar's strength (Zigler, 2010). The weights of the currencies in the SDR basket are revised based on the value of the exports of goods and services and the amount of reserves denominated in the respective currencies that are held by other members of the IMF.

Once the ratio of each participating currency is set by the IMF, currently every five years, the exchange rates used to calculate the official SDR are the noon rates in the London Forex market. When the London Forex market is closed, noon rates in the New York market are used, and Frankfurt Forex market rates are employed when the New York market is also closed.

To calculate the value of the SDR in a sovereign other than the participating nations, the currency (say, in country Y), multiply the four exchange rates of the home country vis-à-vis the basket-currency countries (i.e., Y/USD, Y/EUR, Y/JPY, and Y/GBP) with the basket values indicated above. Add these four numbers together to obtain the Y/SDR exchange rate.

The governor of China's central bank made a proposal in March 2009, in which it was argued that baskets of currencies issued by the IMF and made up of the euro, yen, pound and dollar that have served as reserve assets would be more stable and viable than the dollar. China's huge holdings of dollar reserves in the form of Treasury securities have become a concern for officials for both the US and Chinese governments. A new reserve currency could limit dependence on the policies and conditions of a single, though dominant, country. The trend among central banks is to hold increasingly large positions in currencies that the IMF currently defines as 'other'(Zigler, 2010).

The SDR and the dollar are highly correlated and SDRs as a substitute for dollars really will not offer much risk reduction unless a means is provided to provide stability to the SDR (See Chapter 13). The use of SDRs would require management by a 'super' central bank, a potential problem for national sovereignty since it is composed of a basket of currencies. The euro failed to be established in Great Britain over this very issue a decade ago. There would be significant resistance in the United States over 'giving away' reserves to the IMF or another entity would likely be even significantly harder, however, global trade and financial markets manly driven by China will likely cause a movement away from the US dollar as the major reserve currency. To make the SDR the principal reserve asset via allocation, close to $20 to $30 trillion in SDRs or more may have to be created.

A method to enhance the SDR would be to make its currency composition more neutral to global cycles and more representative of the shift in economic power. This implies an increase in the commodity content and the inclusion of major emerging market currencies within the SDR basket. Major emerging national currencies could be included in the SDR as soon as they reach a predefined level of convertibility. Such a variable SDR could likely result in speculation and possible eventual financial crisis.

The international community appears to favor a reserve currency like the Special Drawing Rights (SDR) but with participation of the Chinese yuan. However, the SDR is not a truly tradable currency due to the few countries it includes and the lack of a reasonable time to determine the proportion of currencies within the 'basket', i.e. every five years instead of a market driven currency. It is likely over time that a modified

basket of currencies may serve the international community better since it can be made

balanced by including the G20 plus several other currencies.

Stability Conditions

To provide stability for a new SDR reserve currency would require that the SDR

remain within a certain range while still allowing for sovereigns to maintain their

independent currency interventions. This can be achieved by the following procedure:

- Setting a range that the SDR would be able to fluctuate within

- Adjusting the percentages of participating currencies composing the SDR
  on a timely basis, i.e. quarterly based on the value of the exports of goods
  and services and the amount of reserves denominated in the respective
  currencies

- Notifying participating sovereigns that they may need to intervene in the
  Forex market when one or more of their currencies where driving the new
  SDR outside the agreed upon range

- If the notified sovereigns did not respond then adjusting the percentages
  that determine the SDR accordingly

Figure 7 shows a possible methodology for sovereigns to provide a response

mechanism to intervene in the Forex markets as to provide stability for a new global

reserve currency based upon an expanded SDR. This can be achieved through a robust

communication system, which is a portion of the total IKASM-GRC.

This possible system could utilize an enterprise service bus (ESB), to provide a

smooth transition in the operations of the proposed system. The ESB can provide

communications with the various systems handling the various protocols and data elements.
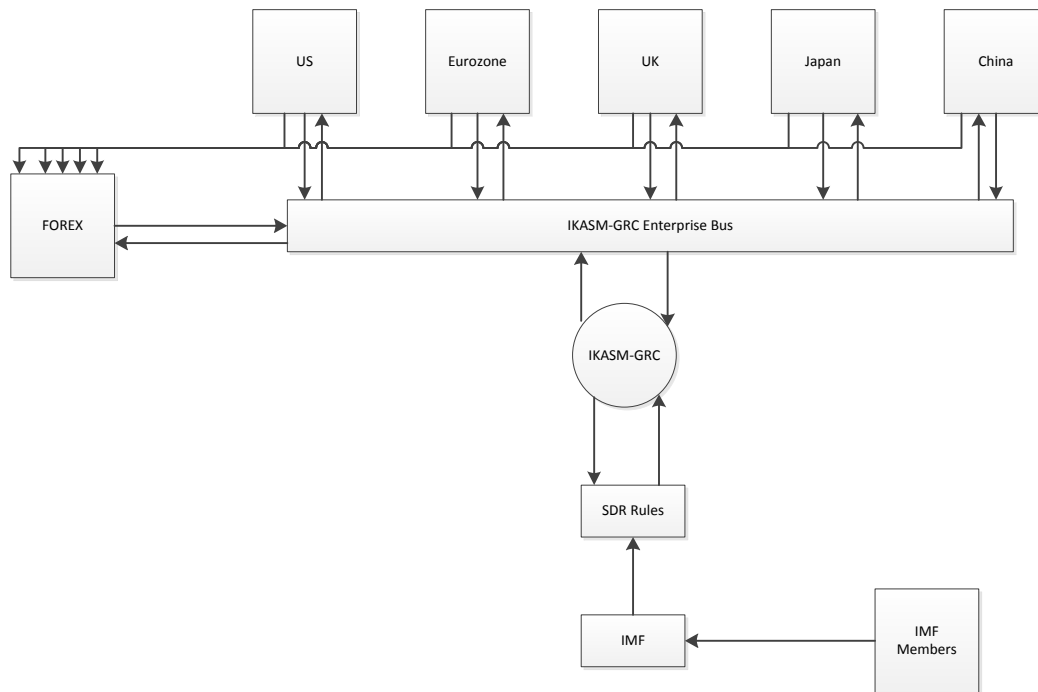
Figure 7 Simplified Informational Flows for IKASM-GRC (Cardullo and Sage, 2012)

Summary of Mission Stage

The global financial system is moving, slowly, toward a new global reserve currency. The US dollar has been dominant since 1948 and the Bretton Woods Agreement. However, there has been a growing movement to replace the US dollar with an expanded SDR. To have a new single global reserve currency will require the development of a new knowledge and information system management architecture capable of assisting in providing stability for the new reserve currency.

This dissertation utilizes a modified form of the structured analysis approach in developing an initial mission structure for this architecture. Using a IDEF0 methodology, and operational concept, which can help provide the required stability is shown. The stability arises from the potential for the participating sovereigns to intervene in the Forex markets. Without a rapid response and robust architecture, this may not be able to be achieved. The total approach can result in an architecture which is implemented and with governance can achieve stability.

CHAPTER 5: SERVICES STAGE

For the service stage, the tasks are as shown in Figure 6. They can be classified as: data, systems, and organizational.

Tasks

Initially, choosing a basket of currencies based on the G20 results in a number of tasks that need to be performed. The G20 is made up of the finance ministers and central bank governors of 19 countries: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, Republic of Korea, Turkey, United Kingdom, and the United States of America. The European Union is represented by the President of the European Council and by the European Central Bank . Each of the sovereign nations has various financial information systems and associated data formats. To develop a unified system will require developing a unified data dictionary and concordance measures for the systems.

Data Elements

The data elements include: data standards, sovereign data, and Forex data acquisition.

Data Standards: The world has learned a great deal in the past decade about the importance of data standards. During the financial crises of the 1990s, data deficiencies, brought about by obscuring important financial conditions and trends, may have

contributed to delaying preventive or corrective actions that might have moderated the economic consequences of the unfolding events. In response, the International Monetary Fund launched two data transparency standards: the Special Data Dissemination Standard (SDDS) in 1996 and the General Data Dissemination System (GDDS) in 1997 (IMF, 2007a). Both initiatives have been successful in enhancing the range, quality, and timeliness of data of each country available to the public, providing better data and information to underpin the operations of international financial markets and economic policy assessments, and thus to facilitate public and private decision making. An associated publication, The Special Data Dissemination Standard: Guide for Subscribers and user (SDDS Guide)[18], delineates key features and operational characteristics of the SDDS, including those pertaining to the Dissemination Standards Bulletin Board (DSBB). The DSBB supports data transparency standards by providing the public with wide and ready access to economic and financial data of countries that subscribe to the SDDS. The DSBB also provides insights into the statistical capacity building of countries that participate in the GDDS.

The GDDS is a structured process through which IMF member countries commit voluntarily to improving the quality of the data that is compiled and disseminated by their statistical systems in order to meet the needs of macroeconomic analysis. Participation in the GDDS by IMF member countries is voluntary and in 2012 over 68 sovereigns participates, including all members of the G20. The GDSS requires that a country

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[18] Throughout this dissertation there are numerous acronyms and symbols which are noted in the List of Abbreviations and Symbols.

undertake three actions and participation depends on completion of these actions. These actions are:

- Commitment to using the GDDS as a framework for the development of national systems for the compilation and dissemination of economic, financial, and socio-demographic data;

- Designation of a country coordinator to work with IMF staff; and

- Preparation of metadata, to be disseminated by the IMF on the DSBB, on (i) current statistical compilation and dissemination practices and (ii) plans for short- and medium-term improvements in each of the four dimensions of the system.

These four dimensions are: 1) data in terms of coverage, periodicity, and timeliness; 2) quality; 3) integrity; and 4) access by the public. This and other IMF standards can form the basis of the data standards utilized by the Sovereign Data Acquisition (SDA).

The basic problem of the SDDS is the various definitions of timeliness for the available sovereign data. However, since all of the G20 sovereigns have signed agreements to provide a multiplicity of data to the IMF then a change in coordinating the appropriate data elements may not prove as difficult as it would initially appear. The IMF acquires a very large amount of varied sovereign data. However, to determine a SDR valuation, only a small segment of that data would be initially required. As the system to manage a reserve currency evolves, it is highly likely participants would increase the

types, frequency and amount of sovereign data utilized to determine more frequent valuations of the modified SDR.

Transforming the US dollar reserve currency into an SDR-based system would constitute a major break with the past. A way to make the SDR the major reserve currency relatively quickly would be to create a massive amount of new SDRs and allocate them to the IMF's members. This configuration of the SDR could help in stabilizing the mitigating fluctuations between the world's major currencies (Wijnholds, 2010). The SDR was designed in the late 1960s to augment international liquidity and to ameliorate the disadvantages of a system based on US dollar reserves.

The determination of the SDR in 2013 is based on financial and trade characteristics of the four basic currencies within the basket. However, if the SDR were to become the only global reserve currency, it would represent the sole liquidity that is used in international trade and settlements. That implies that the SDR would have a value equal to all the current reserve currencies combined and sufficient liquidity to facilitate international trade settlements, thus requiring that all reserve currencies would be exchanged for their value in SDRs.

There have been a number of contemporary recommendations relative to these issues. Members of the Central Bank of China, for example, have made three recommendations: 1) transform the SDR from an artificial basket currency into one backed by assets; 2) establish a settlement system between the SDR and national currencies so as to make the SDR a fully-fledged currency; and 3) linking the SDRs to a specific institution, such as the IMF or BIS that would be responsible for their operational

management and their value (Alessandrini and Fratianni, 2009). The basket composition reflects basket members' importance in global trade and the shares of their currencies in other countries' global foreign exchange reserves.

The data to achieve any recommendations include for each of the currencies involved: balance of payments; amount used by other sovereigns as a reserve currency; current account balances; and trade flows.

Forex Data Acquisition: Foreign exchange market known as Forex (FX) is the largest and most liquid of all the international financial markets. The Forex market is open and active 24 hours a day. Depending on the time zone, a multiple of financial centers are open, and currency trading desks in those financial centers are active in the market. There are several daily currency fixings[19] in the various financial centers. Sovereigns and their Central Banks are active in the Forex market, but not as speculators but to realign or shift values on the major currencies. These sovereigns are active for routine funding of operations, making transfer payments, and managing foreign currency reserves.

The Forex markets trade currencies by pairs with names that combine the two different currencies being traded against each other, or exchanged for one another. The major currency pairs currently involve the U.S. dollar on one side of the trade. The designations of the currencies are expressed using International Standardization Organization (ISO) codes for each currency. The major currency pairs currently traded are shown in Table 4 .

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[19] A currency fixing is a set time each day when the prices of currencies are set, or fixed. Two important ones are 8:55 am Tokyo time and 4 pm London time.

Table 4 Major U.S. Dollar Currency Pairs (Dolan, 2011)

ISO Currency Pair	Countries	Long Name
EUR/USD	Eurozone/United States	Euro-dollar
USD/JPY	United States/Japan	Dollar-yen
GBP/USD	United Kingdom/United States	Sterling-dollar
USD/CHF	United States/Switzerland	Dollar-Swiss
USD/CAD	United States/Canada	Dollar-Canada
AUD/USD	Australia/United States	Australian-dollar
NZD/USD	New Zealand/United States	New Zealand-dollar

As of 2013, the Chinese Yuan and the SDR are not traded on the Forex markets.

If the SDR is adopted as the major reserve currency and China's currency is added to the

basket of currencies forming the SDR, then currency pairs for these will also needed to be

added.

The data on these trades is available through the various Forex markets on an

instantaneous basis which all sovereigns and their central banks have available. All

sovereigns currently buy and sell currency pairs, and their systems are configured to trade

in these markets.

Systems Tasks

The systems tasks include: sovereign notification; communications; and a

processing system.

Sovereign Notification: A simplified version of how the sovereign notification

could operate is shown in Figure 8.

Forex Data

IKASM-GRC ← Forex Market

Sovereign
Notification

Sovereign
Response

Sovereign
Information
System
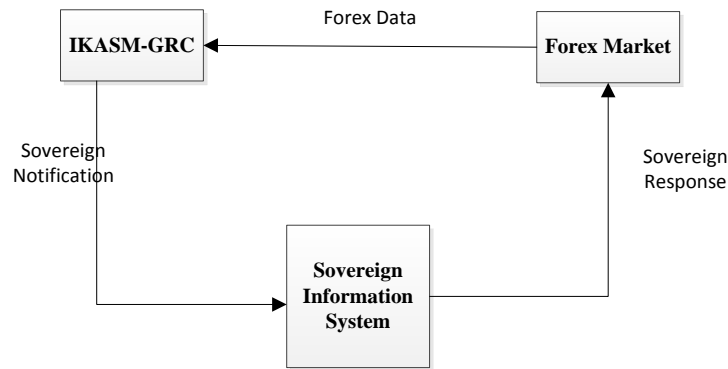
Figure 8 Simplified Sovereign Notification System

The objective of this sovereign notification service is to inform the sovereign that adjustment actions are required to maintain their currency at a level which will not jeopardize the value of the SDR. Depending on the type of governance agreed to by the sovereign, it may be required to intervene in the Forex market in order to bring its currency into line with agreed upon value ranges. This interaction may have various consequences for both the value of the SDR and for the status of the sovereign's currency within the SDR, and in turn for the global financial markets. However, the decision to intervene or not is solely the responsibility of that nation.

Communication Systems: The various sovereign communication systems must be integrated into a new communication system for the systems management of a global reserve currency in the IKASM-GRC. This can be achieved through the use of an enterprise service bus (ESB). An ESB is a systems architecture model for designing and implementing the interactions and communications between mutually interacting applications in SOA which is the basis for the IKASM-GRC. This architectural model for a distributed system is a variant of the general client server model and which promotes

asynchronous message oriented design for communication and interaction between applications. Its primary use is in applications which are heterogeneous and complex landscapes, as would certainly be the case in the IKASM-GRC.

This communication system enables the processing of sovereign interactions to enable maintenance of a SDR global reserve currency through the Forex markets. These interactions can be automated, once both processing and decision rules have been agreed upon by both the IMF and the participating sovereigns. In reference to an initial communications system, this can be an evolutionary process.

Processing System: Processing the various interactions in the IKASM-GRC could be based upon the utilization of an enterprise bus. A currency process management (CPM) system must also be developed to support this effort. In SOA, the objective is to use existing operational functions, both within the IMF and across the various sovereigns involved in the IKASM-GRC. A possible processing system is shown in Figure 9. Many of the systems currently available at sovereigns and the IMF could be modified to make the IKASM-GRC a robust system that is capable of meeting the system requirements, as previously discussed (Cardullo and Sage, 2012c, Cardullo and Sage, 2012).
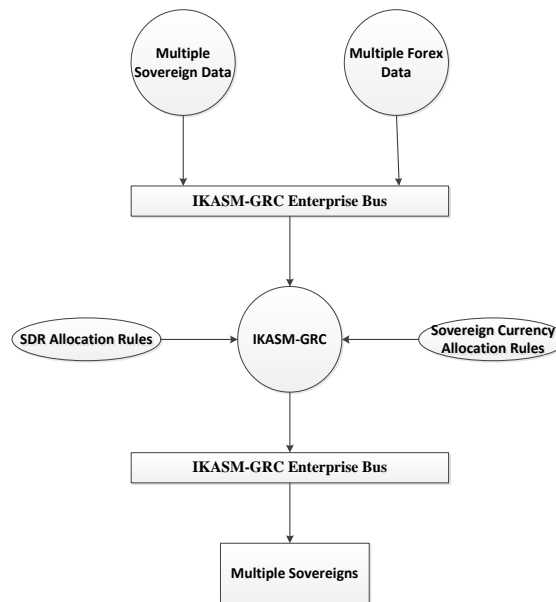
Figure 9 IKASM-GRC Processing System

Organizational Tasks

The organizational tasks include and involve both rules and structures. These tasks consist of the human elements that provide the means for guiding the IKASM-GRC system. This guidance is represented by rules and an organizational structure which consists of both written and operational informational elements. It is envisioned that the rules will consist of two distinct elements, as illustrated in Figure 10 (See Chapters 11 and 12). The SDR allocation rules form the basis for allocating how the SDR is defined by the participating sovereigns' currencies. The sovereign currency application rules define how variations in currencies must be made to provide a stable range for the SDR. These rules will be implemented through a series of algorithms that will provide an automated, but overviewed system.

CHAPTER 6: SERVICE ORIENTED ARCHITECTURE

A service oriented architecture (SOA) approach is intended to identify and promote the shared use of common capabilities across the global financial system. Using this approach, functions and applications are defined and designed as discrete and reusable capabilities or services that may be under the control of different organizational entities. Even though this methodology was initially developed to deal with US governmental agencies, it is very applicable to the international financial community as well.

A SOA can potentially provide a significant advantage in allowing alignment of the various global financial functions. One of the basic concepts of a SOA is that it is an approach to defining integration architectures based on the concept of services. This helps to integrate services, and it allows different applications to exchange messages even if the applications are otherwise incompatible, and to run or operate in different environments.

There are several assumptions that need to be realized if a SOA is to be implemented for the management of a new global reserve currency:

- All participants will have agreed to have a management system.
- All participants will link their sovereign financial information systems into the new system.

- All participants will upgrade their financial information systems to an agreed upon level.

- All participants will need to abide by an agreed upon governance protocol.

To properly use the SOA approach for the development of this new monetary systems management, it is very important, as a necessary condition, to define the services that this requires, and the linkages necessary to form a new global financial system. The proposed global monetary system has no prior precedent and a satisfactory functional services oriented architecture can only be achieved through coordination and cooperation of all the participants. The current global financial system, while fairly mature, is also very fragmented as illustrated by the major recession which the global system has been in since 2008 and from which it is recovering in 2013. The focus initially should be to bring together the leaders of the sovereign global financial systems and then to obtain consensus on the structural formation of this new global reserve currency system. This will likely require the formation of many coordinating teams from the different participants in order to deal with the associated problems. Initially it will be important to develop a proposed scope and strategy for framing and determining an architectural framework for this monumental project.

Services

A 'service' is application logic or an underlying computing resource that is exposed through an interface and which can be invoked over a network. The notion of a SOA has been employed in the financial arena, but only for individual financial institutions and their services. At no place in the literature are we aware of any reference

to the use of SOA in or for a global financial system. Therefore, the basis for the process of defining services must be based upon the agreed upon needs of the G20 and the IMF participants.

Services are reusable modular units of capabilities and processes, or they are technical functions that can be accessed and delivered repeatedly (Marks and Michael, 2006). The notion of a SOA has been employed in the financial arena, but only for individual financial institutions and their services and not in global financial systems (Rabhi et al., 2006).

Since global reserve systems management architecture requires agreement among sovereign states, the initial system that is developed to this end may not contain an optimal set of services as this agreement may not be in place initially. However, the initial systems architecture must have sufficient flexibility to accommodate future services and expansions of existing services as these occur over time. These future services should evolve around the information and knowledge needed to determine and manage a new global reserve currency and to ensure that it is maintained within a certain reference range. The data, information, and knowledge that would be required for this would necessarily have to arise from the currency markets.

In an SOA environment, a Service Manager (SM) is utilized. The SOA-SM is active as long as any service is operating and potential new services are being added. An example of this is shown in Figure 10. An appropriate set of policies would have to be chosen such that the manager of the global reserve currency would have the ability, either directly by the managers or indirectly by individual sovereigns, to intervene in the

currency markets within a set range of values. If the managers of the global reserve

currency did not have the ability to intervene in these markets, the value of the reserve

currency would become volatile and susceptible to manipulations. Currently, sovereigns

do intervene in the currency markets to maintain stability for their particular currency. In

a new reserve currency management system, the manager, in this case the IMF, should

directly intervene in the currency markets or should advise certain of the sovereigns that

they would have to intervene in order to achieve the desired results.
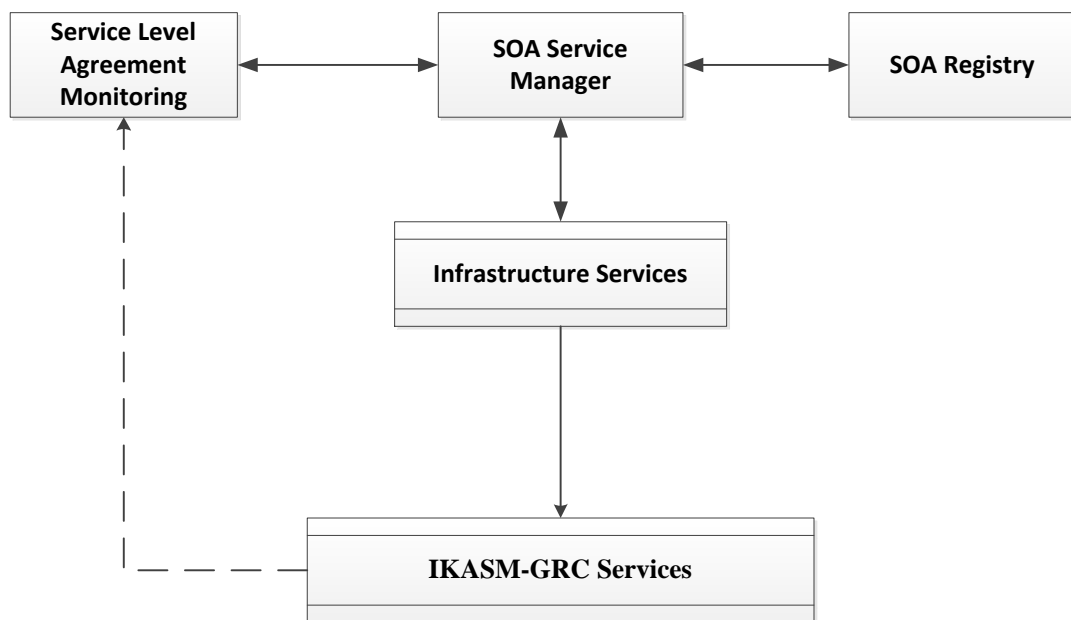
Figure 10 SOA Service Manager

A possible systems architecture for this service manager as Cardullo and Sage

(Cardullo and Sage, 2012c) discussed, is shown in Figure 11.
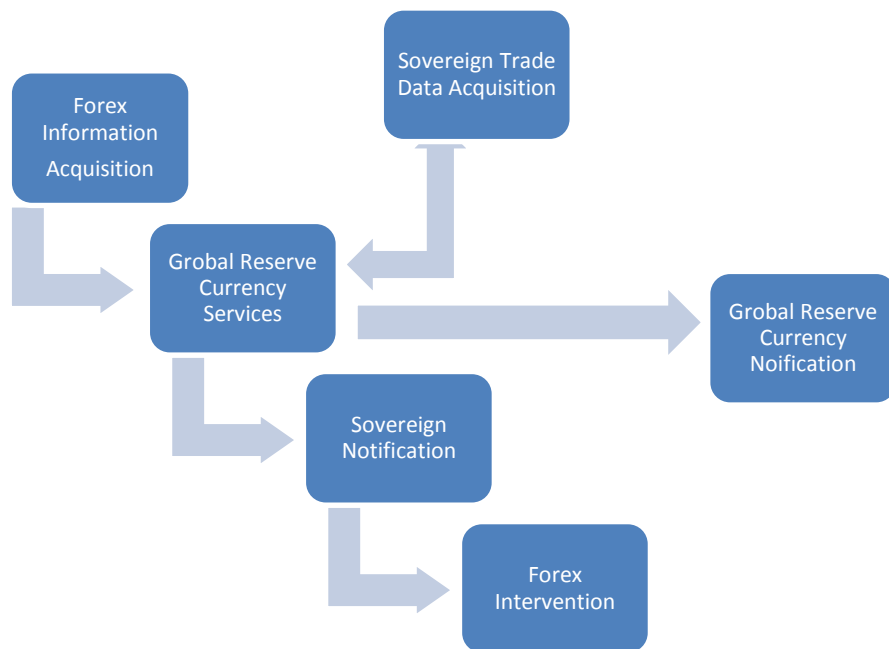
Figure 11 Possible Global Reserve Currency Architecture (Cardullo and Sage, 2012c)

The resulting potential services are shown in Figure 12.
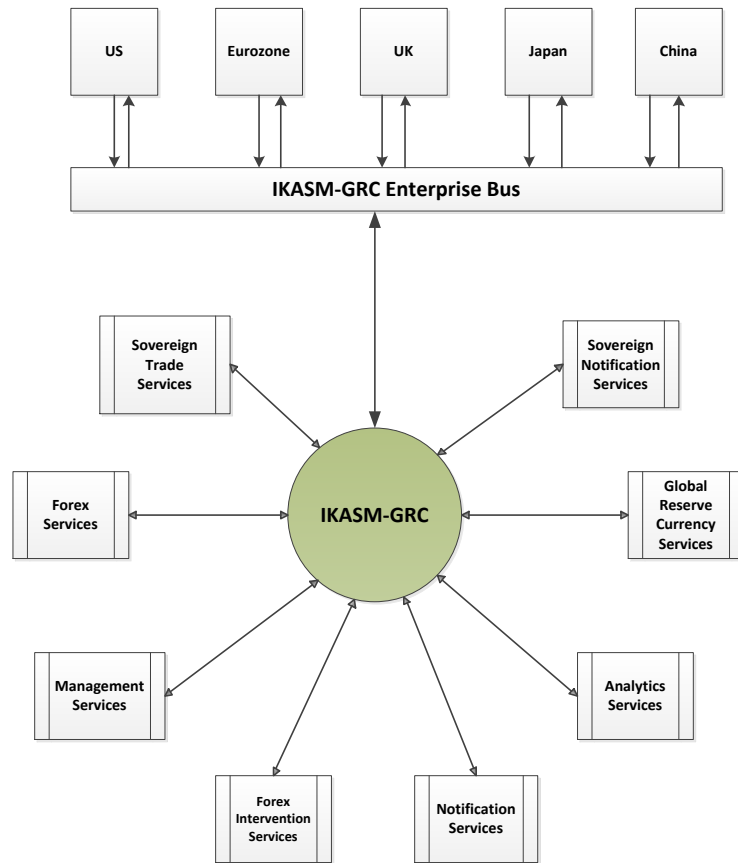
Figure 12 IKASM-GRC Services

The architecture must have sufficient flexibility to accommodate future services as agreements are reached and expanded. These services should revolve around the information needed to set the reserve currency and to ensure that it is maintained within a certain reference range. The data that would be required for this would need to arise from the currency markets. Financial centers around the world function as anchors of trading between a wide range of different types of buyers and sellers around the clock, with the exception of weekends. The foreign exchange market determines the relative values of the different currencies.

To implement this, a set of policies would have to be assumed, such that the manager of the global reserve currency would have the ability, either directly or indirectly, within the agreed-upon range to intervene in the currency markets. If the managers of the global reserve currency did not have the ability to intervene in these markets, the value of the reserve currency would become volatile and also susceptible to manipulation. In a new reserve currency management system, the manager, in this case the IMF, would advise the sovereign on the need to intervene, but not intervene directly. A possible architecture is illustrated in Figure 12, distinguishes the following types of services:

Forex Services

Forex services consist of a transaction-based system that acquires data, information, and knowledge from the Forex exchanges and deals with the currencies contained in the basket used to determine SDR reserve currency value. This data, information, and knowledge will need to be obtained on a real-time basis. Historical data should also be obtained and utilized for statistical analysis and potential forecasts of developments that are correlated with sovereign trade data.

Sovereign Trade Services

These services manage data, information, and knowledge related to the sovereign trade happenings that are used to determine value of the reserve currency based upon specifications set by the G20 and the IMF. The data, information, and knowledge could be historical, or could be obtained in real-time from the appropriate corresponding

systems of the sovereigns. This service would use the SDDS developed by the IMF to support the associated efforts.

Global Reserve Currency Services

These services manage data, information, and knowledge about reserve currency situations (e.g. accounting data, announcements, etc.) over time. This data, information, and knowledge could be historical or could be obtained on a real-time basis. These services would allow the participants, managers and other authorized users to obtain various needed data, information, and knowledge and would also serve to manage the approved policies and should be based on the use of the GDDS of the IMF.

Sovereign Notification Services

These services manage the notification of sovereigns and their central banks about suggested or required interventions in the Forex markets in order to maintain a global reserve currency within agreed upon ranges.

Forex Intervention Services

These services monitor intervention actions by either the sovereigns or their central banks in order to determine adequacy of their intervention actions as based on recommendations of the sovereign notification system. This provides valuable historical and real-time data, information, and knowledge for governance considerations.

Notification Services

These services issue notifications to participants, international bodies, financial markets, and the public on the status and the value of the global reserve currency. The notifications can be real-time for certain of the participants or delayed depending upon the policies that have been approved. The Special Data Dissemination Standard of the

IMF provides a guide for participants (SDDS Guide), and delineates key features and operational characteristics of the SDDS, including those pertaining to the Dissemination Standards Bulletin Board (DSBB). The DSBB provides the public with wide and ready access to economic and financial data of countries that subscribe to the SDDS and could and should keep the financial community and the Bank for International Settlements (BIS) aware of changes in the valuations of the SDR.

The following two potential services can be included but are not initially essential.

Analytical Services

These services allow data mining and visualization applications which analyze real-time or historical data. They comprise a variety of models for different purposes e.g. offering valuable insights on trends for analysts, checking compliance for regulators and for pre-emptive action on the part of the management of the system (Rabhi et al., 2006).

Management Services

Management services can vary widely in the quantity and quality of the services they provide for participants. Common features include: formulating strategy based on some objectives, providing information, implementing plans, managing participant requests, and providing appropriate distribution of internal and external studies.

CHAPTER 7: DATA MODEL

The IMF currently determines the percentage of each of the four currencies used in the SDR. The SDR is presently denominated in U.S. dollars. Currencies are traded in pairs, i.e. one currency valuation in terms of another in an open market environment. Table 5 shows the current and potential currency pairs used to determine the valuation of the SDR. Additional currencies could be added to the basket expanding its capability to represent global trade and capital flows.

Table 5 Current and Future Potential Currency Trading Pairs[*]

	US Dollar	Euro	Yen	Pound	Yuan	SDR	Ci
US Dollar		X	X	X	F	F	F
Euro	X		X	X	F	F	F
Yen	X	X		X	F	F	F
Pound	X	X	X		F	F	F
Yuan	F	F	F	F		F	F
SDR	F	F	F	F	F		F
C_i	F	F	F	F	F	F	

[*]F = Future potential currency trading pairs
C_i = Future currencies which can be added to the SDR basket

The exact methodology used in determining the proportion of each currency is elucidated clearly by the IMF (IMF, 2010). As of 2013, the trade balances and proportion

of each currency held as a reserve are used in the determination of the proportions within

the basket of currencies (See Chapter 11 and 12).

IDEF0 Model

Cardullo and Sage (Cardullo and Sage, 2012) showed the development of an

IDEF0 model for the IKASM-GRC. This activity model graphically represents the

activities or functions of the IKASM–GRC system.

The operational architecture view is a description of the tasks and activities,

operational elements, and information flows required to accomplish or support an

operation (Wagenhals and Levis, 2000). The system operational concept can be shown

using the IDEF0[20] method which was designed to model the decisions, actions, and

activities of an organization or system. Figure 13 shows the first level of an IDEF model

for the IKASM-GRC for a modified SDR.
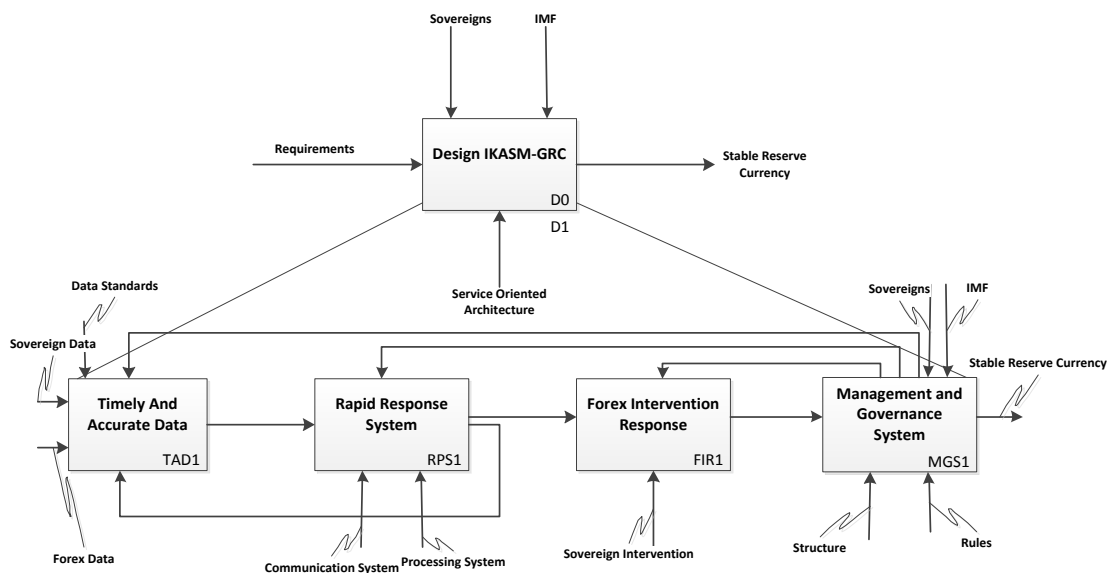
Figure 13 IKASM-GRC IDEF0 Chart

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[20] Integration Definition for Function Modeling

Figure 13 illustrates the interactions between the four basic functions of the proposed system. This illustrates the inputs and outputs of each of the functions and how they are controlled and the mechanisms used to implement them. Each of these functions can be further decomposed into the sub systems, which they represent and their interactions.

Figure 13 illustrates the process model for the IKASM-GRC and forms a portion of the functional architecture. To fully define this functional architecture requires a data dictionary that includes the definitions and descriptions of the activities, inputs, controls, and outputs (Levis, 2009). These combined with a data model, rule model, and dynamics model form the basis of the total functional architecture of the IKASM-GRC system for managing a global reserve currency. The next step in developing a data model is the construction of the IDEF1x model.

IDEF1x Model

Figure 14 illustrates an IDEF1x model for the proposed IKASM-GRC system. This model semantically illustrates relationships between the various pieces of data within the system. This construct shows the entities, attributes, and their relationships. In this figure, there are three independent entities and seven dependent entities. The three independent entities are sovereigns, the IMF, and Forex. This model, also illustrates the feedback loops inherent in the system. Each of the sovereigns and Forex markets are independent, under this system, data and instructions are passed by the IKASM-GRC from the various independent entities to the dependent entities. While this may not be a standard approach in IDEF1x model development, it does illustrate how the system

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should be constructed in order to allow for the acquisition of data, and for the transmission of instructions.

For the IKASM-GRC system to operate properly, intervention by sovereigns into the Forex markets will be required. All the data that will be developed must meet the guidelines of the IMF, GDDS, and SDDS. While the initial development of these standards, primarily by statisticians, is primarily aimed to improve the statistical systems of a sovereign, this also offers an opportunity for the development of a uniform IKASM-GRC data system. The objective in the development of the proposed IKASM-GRC is to provide a means to manage, in a sustainable and stable manner, a new global reserve currency based upon the expansion of the SDR. The basis of this assertion is that a robust management and knowledge system which can be shown to be stable and sustainable, can assist through standardization and definitions of that data and can be expanded to more accurately represent the international GDP and currency movements.
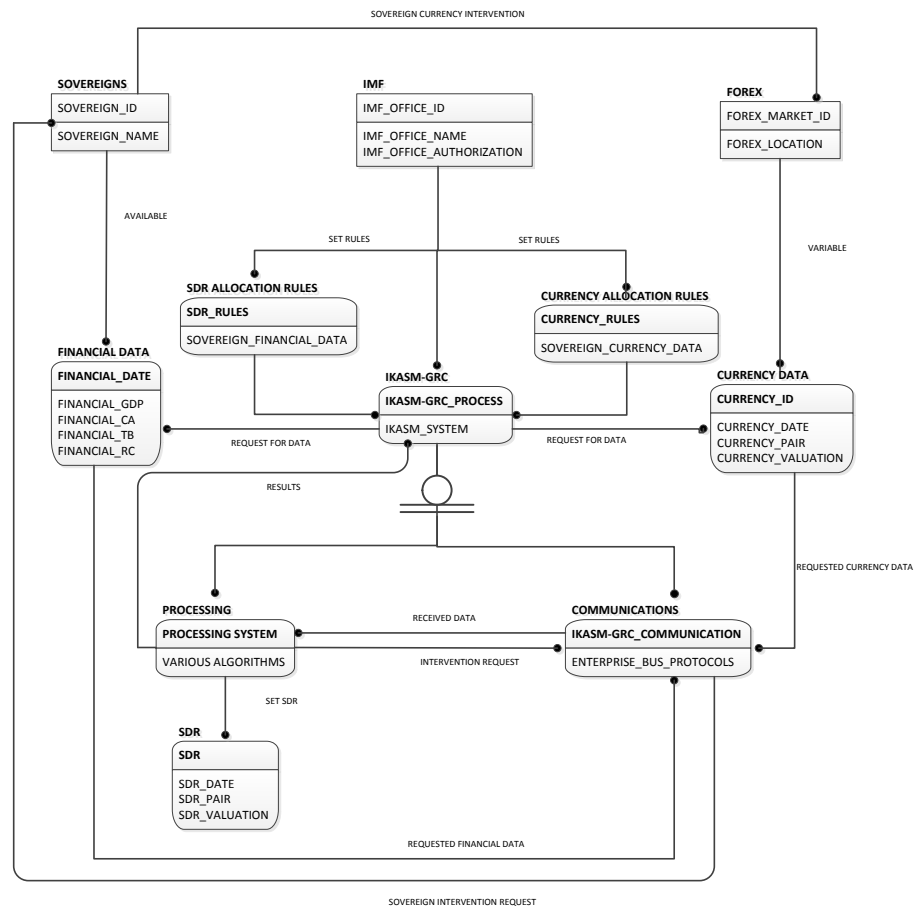
Figure 14 IKASM-GRC IDEF1x Chart

IMF Data

The IKASM-GRC data will be subjected to the Special Data Dissemination

Standard (SDDS) of the IMF (IMF, 2007a). The SDDS was developed using previous

IMF data standards which included: Monetary and Financial Statistics Manual (2000);

Monetary and Financial Statistics: Compilation Guide (2007); International Reserves and

Foreign Currency Liquidity: Guidelines for a Data Template (2001); the Government

Finance Statistics Manual (2001); International Investment Position—A Guide to Data

Sources (2002); External Debt Statistics: Guide for Compilers and Users (2003); and

Financial Soundness Indicators: Compilation Guide (2006). The SDDS identifies four

dimensions of information dissemination: (1) data: coverage, periodicity (frequency),

and timeliness; (2) access by the public; (3) integrity of the disseminated data; and (4)

quality of the disseminated data (IMF, 2007b). Using data coverage, periodicity (or

frequency), and timeliness, the IMF SDDS focuses on disseminating the data considered

most important for assessing macroeconomic performance and policy. It prescribes

categories of data in four key sectors of the economy (real sector, fiscal sector, financial

sector, and external sector). Appendix B gives the IMF table on "SDDS Data Coverage,

Periodicity, and Timeliness" (IMF, 2007b).

The GDDS recommends compilation and dissemination of core indicators relating

to (a) imports and exports of goods and services; (b) the current account balance; (c)

reserves; and (d) the overall balance (IMF, 2007a). The IMF has extensive data collection

systems and exacting standards for this. In the design of the IKASM-GRC the IMF has

already developed data dictionaries which can be easily accepted, since the majority of

the IMF members have subscribed to both GDDS and SDDS.

An operational IKASM-GRC design will require the IMF to quickly access in a

real time fashion Forex currency data. While sovereigns and their central banks have real

time intervention abilities the IMF IKASM-GRC will only need be required to be able to

access the various Forex markets for currency pair valuations. This data has been

standardized and is available through the Forex market systems.

CHAPTER 8: STANDARDS

There are two classes of standards that must be considered in developing a SOA for a new global reserve currency system: financial standards and SOA standards.

Financial Standards

The formulation of internationally acceptable financial standards represents a significant effort. Needed is effort to reform the global financial architecture such as to make a new global currency system stable. The international financial community has started to enhance transparency and to design international financial standards. These standards have been based on the Bretton Woods institutions; IMF, BIS and others, as well as on national governments regulatory agencies. To date, these have not been productive and in fact have often proven problematic (Subacchi and Jenkins, 2011).

It is interesting to note that private sector institutions have been instrumental in identifying and refining international standards for acceptable practices in accounting, auditing, insolvency provision and corporate governance. Many of these international financial institutions have dissimilar activities, varying degrees of international exposure, and divergent preferences for the design of standards for sound managerial practices and data systems. To the extent that private interests, such as Forex and others dominate public purposes, financial standards may be aligned to the preferences of powerful market players, thus skewing the outcomes of a new global reserve currency system.

Given that these standards should promote market stability and public interests, the greater participation of private sector actors in the standard setting process may run counter to their purported objectives and, more importantly, may be in tension with the capacity of sovereigns and their institutions to maintain objectives for a new system. It is very important, therefore to establish comprehensive standards which represent best global practices toward which all countries participating in the global system would strive to achieve, and also to develop a governance system that will assure that these standards are adhered to.

There have been considerable efforts to establish international standards and codes of good practice that build on and which offer the potential to globalize the standards that exist within the most advanced nations. The IMF has been a forum for formulating standards or codes of good practice for governments in its core domain of responsibilities, which are already well advanced or being implemented. It is assumed that the IMF will develop the standards for a SOA for the new global reserve currency management system. Many other agencies have been working to develop standards in their areas of expertise: accounting, auditing, corporate governance, payment and settlement systems, insurance, data and bankruptcy. The Financial Stability Forum (FSF) was established in 1999 in order to encourage dialogue among the many relevant national and international agencies and to contribute to harmonizing global standards for regulation and supervision.

The SDDS has been adopted by the member countries of the IMF, the large majority of which participate actively in capital markets. The IMF together with the BIS,

a representative group of central banks, the World Bank, and the OECD, has issued a

Code of Good Practices on Transparency in Monetary and Financial Policies. The real

question relative to these standards and policies is the difficult challenge of

implementation. Implementation of harmonized financial standards requires that

international policy makers make sufficient allowance for national political economies

and allow enough time to make necessary adjustments. Market participants need to be

familiar with the standards recognized by the FSF as key to sound financial systems or

the IMF-World Bank Reports on Observance of Standards and Codes (ROSCs) (Vojta

and Uzan, 2001). Regulation and supervision of international financial markets and in

particular a new system for managing a global reserve currency, is likely to be very

demanding (Chami et al., 2009).

Determination of information requirements for a new global reserve currency

management will require cooperation from all the stakeholders. The information

standards must be robust and be able to evolve as the system evolves. Sovereigns, their

central banks, tax havens and financial centers in both developed and developing

countries that fail to meet basic standards of transparency, information exchange and

regulation should be given strong incentives to reform their practices.

The global financial crisis of 2007-2009, has made it apparent that there are large

gaps and deficiencies in the regulatory structures in place in many systemically

significant countries and this leads to asymmetry of information. It is apparent that

effective regulatory system must be national and there must be some global regulatory

framework to establish minimum national standards and also govern the global

operations of systemically relevant global financial institutions and their information

systems (Brockmann, 2009).

SOA Standards

A SOA is based upon an information environment that is built upon loosely

coupled, reusable, standards-based services (Andary and Sage, 2010). The integration and

interoperability requirements and standards are derived primarily from industry best

practices and existing standards. There is a difference between interoperability and

integration. Even when following standards, there are interoperability gaps. The SOA for

the management of a new global reserve currency needs to consist of a grouping of

standards: semantic; technical; and portability standards.

Summary of Potential for Management of New Global Reserve Currency

An Enterprise Architecture (EA) framework is the logical structure for classifying

and organizing such complex information as a new global reserve currency. Frameworks

help organize integrated models of systems such as to determine what will be required to

manage a global reserve currency. Currently, there is no system of systems for

management of any global reserve currency. The values of the currencies are currently

based on market conditions and are thus open to speculation by traders concerning

potential individual sovereign governments' interventions.   This means that totally new

system architecture must be developed once the various sovereign states agree to have

such a system. So there are a number of steps that must be taken prior to even

formulating an architecture model for such a system of systems.

The SOA potential, when realized, can provide a significant advantage to aligning the various global financial functions. By employing a repeatable methodology to implement a well-considered architecture within a mature governance model, the new system for managing the reserve currency can ensure the most-cost effective and efficient development of this critical element of the new global financial structure.

A version of SOA, similar to Federal Service Oriented Architecture (FSOA) (Council, 2008), which is based on a shared, standards-based infrastructure, could be useful to support implementation of a new global reserve currency management system if appropriate agreements were concluded among the sovereign participants.

There are a myriad of stakeholders who can potentially have interest in the development of this important information management system. Each of these participants has now and in the past used policies that appear to be of self-interest even though the web of global financial interactions links each with the other, and therefore this complex system can easily be driven unstable by the actions on one or more participants. The various participants will need to modify their self-interest, in the interest of global financial stability.

Another issue which may become contentious is that of standards. The structure of services will revolve around the information needed to set the reserve currency and to ensure that it is maintained within a certain reference range. Again, such decisions may serve as another continuous point of disagreement.

SOA governance has to encompass the successful implementation of the processes required for the implementation and maintenance of the policies which have

been set for the reserve currency architecture (See Chapter 9). The governance is about the way order is brought about in a system to accomplish a specific purpose and this question of stability in the global financial system is one of the principle issues of a new global reserve currency.

The international financial community is in support of reform of the governance, accountability, and transparency of the various international financial institutions (Reisen, 2010). However, there is little agreement on what type of reform the various sovereigns will accept. There is a need for major reforms in the governance of these international institutions, including giving greater voice to developing countries and greater transparency. The issue of governance of the total system must be resolved prior to full implementation of the Global Reserve Currency SOA (GRC-SOA).

The information and knowledge requirements for a new global reserve currency management will require cooperation among all the stakeholders and this can also serve as a contentious issue. The information standards must be robust and be able to evolve as the new SOA will inevitably evolve. The integration and interoperability requirements and standards can possibly be derived primarily from best practices and existing standards. The SOA Reference Architecture is a key enabler for the proposed new system and can be used as a blueprint with modifications.

Technical standards would likely include the use of an enterprise service bus (ESB). Any service can be adapted into the ESB and participate in one or more methods of integration. This should be adapted to many of the systems which the GRC-SOA is

able to interface with if it is to truly serve as the master system for a new global reserve currency management system.

The standards for the management of GRC-SOA will require a dedication to achieving a robust system which can survive the vicissitudes of a global geo-political landscape with many potential pitfalls and become truly a 'system of systems' for the international financial community. The adoption of a robust GRC-SOA, with a governance process adhered by all sovereign participants, could lead to a stable global financial structure that is less 'able to be gamed'.

CHAPTER 9: ORGANIZATIONAL MODEL

The organizational model must be based upon appropriate governance. In this manner, the process for management of the IKASM-GRC is formalized within the existing IMF structure. It is proposed, that the IKASM-GRC be established within these existing structures with a minimum of modifications so as to be easily established and accepted.

Basic Governance

Governance is a process, or a set of processes, which can help ensure that the established laws, policies, standards, and procedures are being adhered to. Governance establishes chains of responsibilities, authority, and communication to empower decision rights (Brown et al., 2009). There is a definite difference between management and governance. In SOA, management is how the integration of widely disparate applications for a Web-based environment, which uses multiple implementation platforms, is to be achieved. In SOA, governance is the successful implementation of the processes required for the implementation and maintenance of the policies which have been set for the reserve currency architecture.

There are a number of deficiencies which have impaired the ability of the international institutions to take adequate actions to prevent and to respond to an impending global financial crisis. There is a need for major reforms in the governance of

these international institutions, including giving greater voice to developing countries and greater transparency (Brockmann, 2009). One of the basic problems in the global financial community is that, with the exception of market prices and regulatory information, only a limited set of data is available in a timely manner and in a manner that facilitates international cooperation. Another basic problem is that there is no single international oversight body in the financial world (Williams, 2008).

Concepts of financial stability represent important elements that need to be developed such that new global reserve currencies involve various financial intermediaries, financial market segments and infrastructure, such that different quantitative and qualitative indicators can be used to forecast and measure the financial situation. Determining the degree of financial stability remains a highly integrated complex task. The governance system, which has responsibility for ensuring financial stability, must therefore be able to monitor information and analyze developments in several financial sectors (Subacchi and Jenkins, 2011).

An important issue in the key question regarding enforcement of any adjustment of imbalances is who should bear the burden of adjustment when domestic policy choices are inconsistent. It has been emphasized that the reserve currency countries ought to have a greater responsibility for meeting the rules, especially given the impact they have on the system (G20, 2009). The governance is manifested by creating organizational structures that follow defined, practiced and perfected processes and which use resources and tools to perpetuate its own existence (Bohra et al., 2005). SOA governance must govern the entire service cycle from strategy

The IMF is accountable to its 188 member governments, and must take into consideration the views of multiple stakeholders, from political leaders and officials to, the media, civil society, academia, and its own internal watchdog. The IMF, in turn, encourages its own members to be as open as possible about their economic policies in order to encourage their accountability and transparency

IMF Governance Structure

The governance tasks include and involve both rules and structure. These tasks consist of the human elements that provide the means for guiding the IKASM-GRC system. This guidance is represented by rules and an organizational structure which consists of both written and operational informational elements. The SDR allocation rules form the basis for allocating how the SDR is defined by the participating sovereigns' currencies. The sovereign currency application rules define how variations in currencies must be made to provide a stable range for the SDR. These rules will be implemented through a series of algorithms that will provide an automated system. The organizational structure will consist of groups of currency specialists and representatives of the various members of the IMF. These groups will review and set guidance, based on established and agreed upon norms.

Current IMF Structure

The IMF's mandate and management structures have evolved as the global economy has evolved. This evolution has allowed the IMF to maintain a central role within the international financial architecture. The IMF is an enterprise which represents its 188 member sovereigns and as such seeks to maintain a level 'playing field' for global

financial structure (IMF, 2012c). Figure 15 shows a simplified IMF management
structure.
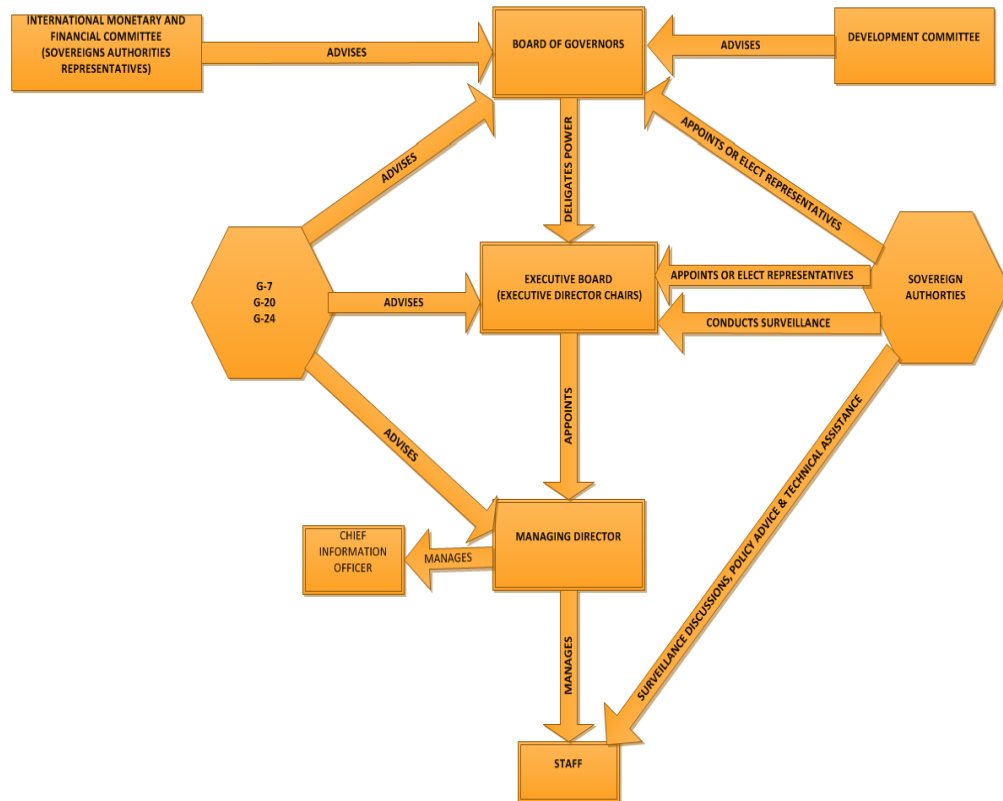
Figure 15 Simplified IMF Governance Structure [Based on data contained in (IMF, 2012c)]

As Figure 15 shows, the principal elements in the IMF management structure are:
Board of Governors; Executive Board; Managing Director and staff. However, to this
basic structure must be appended the various sovereign authorities, such as the
International Monetary and Financial Committee and the various G7, G20, and G24
groups of sovereign nations.

Board of Governors

The highest decision-making body of the IMF is the Board of Governors. This decision making body consists of a governor and one alternative from each of the member of sovereign nations of the IMF. The members of this Board of Governor are usually composed of the chief financial officer, such as the minister finance or head of the central bank of each sovereign nation.

The Board of Governors delegates most of its powers to the IMF's Executive Board; however it retains the right to approve quota increases, SDR allocations, the admittance of new members, compulsory withdrawal of members, and amendments to the Articles of Agreement and By-Laws. The Board of Governors appoints the Executive Director and is the arbiter in interpretation of the IMF's Articles of Agreement.

Advisory Committees

The IMF Board of Governors is advised by two committees, the International Monetary and Financial Committee (IMFC) with 24 members, drawn from the pool of 187 governors representing all the IMF member countries and the Development Committee. The IMFC focuses on matters of concern affecting the global economy and also advises the IMF on the direction its work and which operates by consensus.

The Development Committee is a joint committee, and advises the Boards of Governors of the IMF and the World Bank on issues related to economic development in emerging and developing countries. It represents the full membership of the IMF and the World Bank and mainly serves as a forum for building intergovernmental consensus on critical development issues.

Executive Board

The Executive Board of the IMF has 24 members that represent all of the 188 sovereign members. The major economies, such as the United States, European Union, and China have individual members. Other sovereign states are grouped into constituencies (IMF, 2012c). The Executive Board decisions are based on consensus.

IKASM-GRC Proposed Structural Additions

The current structure of the IMF would need to have certain additions for the operations of the IKASM-GRC. These additions relate to the management of the system and assuring that its operations maintain a stable currency valuation for the newly defined role of the expanded SDR. The proposed modification to the IMF governance structure is shown in Figure 16. This proposed modification to the IMF governance structure gives the IMFC, which are the sovereign member representatives, the responsibilities of surveillance and oversight of the operation of the IKASM-GRC. The actual design, operation and maintenance of the IKASM-GRC would reside with the Chief Information Officer (CIO) of the IMF. The policies and rules governing the system would be the responsibility of the Board of Governors as is the current system for the SDR with the implementation by the Executive Board and its Director.
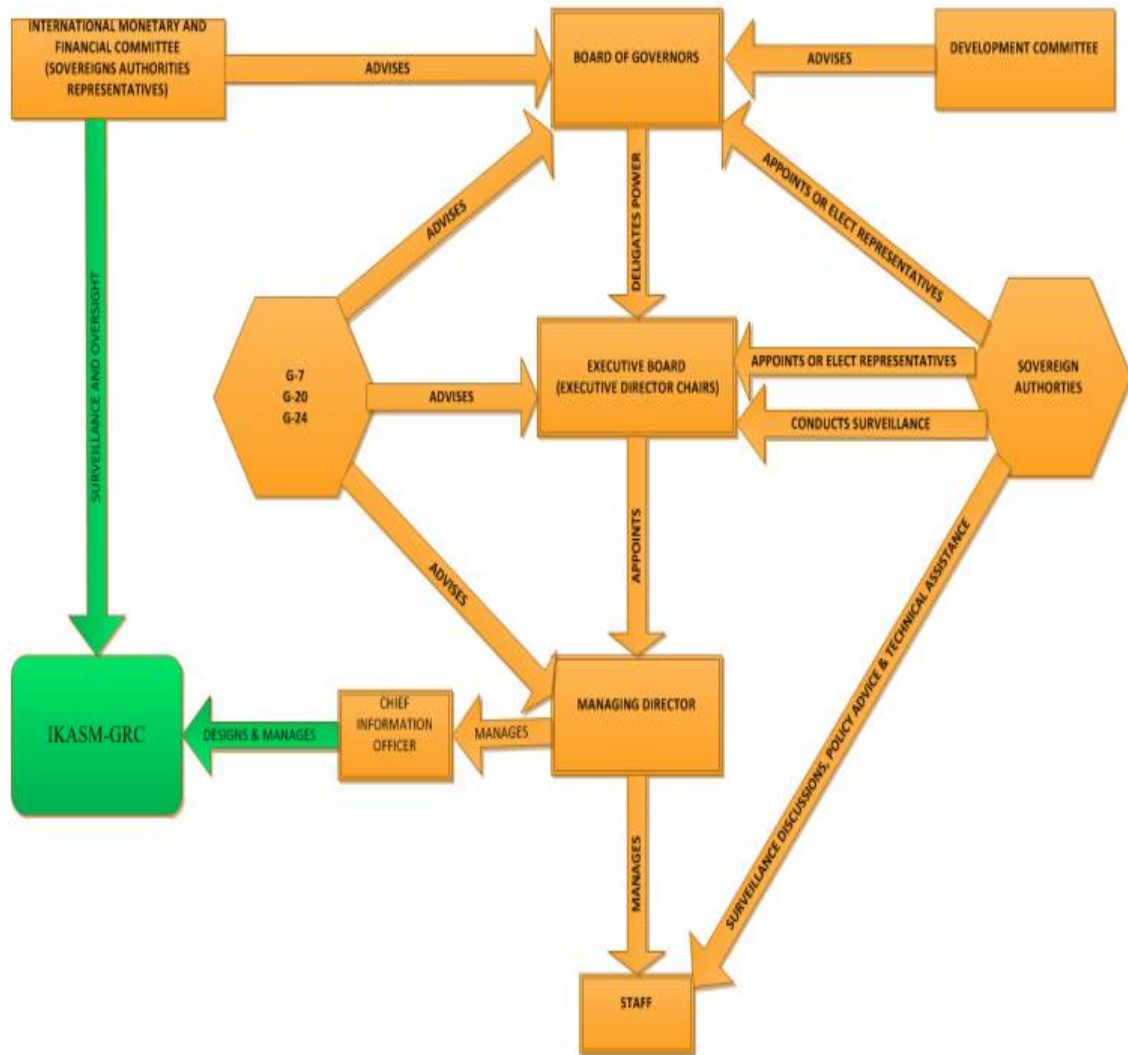
Figure 16 Proposed Modification to the IMF Governance Structure

CHAPTER 10: USE CASE ANALYSIS

Use Case High Level Summary

The use case analysis presented here is a high level summary of a use case for

IKASM-GRC. The high level summary for the use case of the IKASM-GRC can be

stated as follows:

Use Case: Operation of IKASM-GRC

Description: The objective of the IKASM-GRC is to provide a means for

managing a new global reserve currency based on an expanded version of the SDR. This

system would be the responsibility of the IMF. The architecture of the IKASM-GRC

would be developed in a manner that will assure the stability of the revised SDR as a

global reserve currency.

Level: High Level Summary

Primary Actors: International Monetary Fund – Board of Governors, Executive

Committee and Staff

Primary Goal: Maintain a stable and reliable new global reserve currency based

on the SDR

Supporting Actors: Sovereigns, Central Banks and Forex Markets

Stakeholders and Interests: The following are the stakeholders in this use case are:

- International Monetary and Financial Committee (IMFC) of the IMF: This
  committee, which is composed of sovereign member representatives,

would be responsible for the surveillance and oversight of the operation of the IKASM-GRC.

- G7, G20, and G24 organizations: The intent of these organizations are to assure that the international financial markets remain stable and that trade is facilitated.

- BIS: This is an international organization which fosters international monetary and financial cooperation and which serves as the bank for central banks. It also acts as a prime legal entity for central banks in their financial transactions and as a trustee in connection with international financial operations.

- IOSCO: This is an organization of regulators of the securities industry whose objective is to ensure cooperation to promote high standards of regulation, and to provide mutual assistance and generally protect the integrity of the securities markets.

- IFRS: This is an international organization which issue standards adopted by the International Accounting Standards Board (IASB).

- FSF: The objective of this organization is to promote international financial stability.

- Rating Agencies: The international rating agencies have a very important role to play in determining the operation of global reserve currency. In fact it is these agencies and their ratings that can "trigger" currency speculation.

Pre-Conditions: To initiate this use case will require that the sovereign authorities who are members of the IMF agree to major changes in the structure of the SDR so that it can become a global reserve currency. This would include the conditions for its expansion and maintenance so that it can remain within a stable range. These changes would basically change the nature of the IMF from the main forum for international financial and economic affairs where it is the 'lender of last resort' to the world's central bank. As global financial instabilities increase this

change may become inevitable. Another pre-condition is the design of a stable

IKASM-GRC system and they rules for its operation. This pre-condition will

require that the sovereigns agreed to these rules which if fully implemented can

change the nature of global trade and impact economic conditions within various

sovereigns.

Post Conditions: As sovereign agreements are reached as to the expansion of the

role of the SDR as the major global reserve currency, then the operation of

IKASM-GRC will be tested under various scenarios. IKASM-GRC will require a

process by which it will evolve as it is tested in operation.

Success end condition: The successful end condition of the IKASM-GRC is to

provide a management system for an expanded SDR which will remain stable

under all conditions.

Failure End Condition: If the IKASM-GRC fails to provide a stable management

system for an expanded SDR under all market conditions, it would require a

major redesign of the system.

Minimal Guarantee: The guarantee or assurance that the design of the IKASM-

GRC provides to all actors and stakeholders is to protect their interest regardless

of whether the IKASM-GRC ends with success or failure. This minimum

guarantee ensures that the system will ensure that through the oversight of the

IMFC the IKASM-GRC it will not lead to global financial instability.

IKASM-GRC Use Case Diagram

Based upon the high-level summary of the IKASM-GRC, it is possible to develop

a use case diagram. Table 6 identifies and defines the six major actors in this use case and

includes Central Banks, Forex Markets, IMF Board of Governors, IMF Executive Board,

IMF Staff, and Sovereigns. Each of these actors has a principal role to play in this use

case.

Table 6 Use Case Actors

Actor	Justification
Central Banks	Provides the ability to intervene in the Forex markets
Forex Markets	Provides currency markets where sovereign and SDR are traded
IMF Board of Governors	Sets the allocation ratios for the SDR based on economic data
IMF Executive Board	Directs the IMF
IMF Staff	Manages the IKASM-GRC operations
Sovereigns	Provides economic data and instructions to the Central Banks

In the final design of the IKASM-GRC, there are basically eight sub-use cases as shown in Table 7. Figure 17 shows a use case diagram and the interaction of the various actors and sub use cases.

Table 7 Sub Use Cases for IKASM-GRC

Sub Use Cases	Justification
Acquires data	Require data to formulate decisions
Directs Central Bank	Usually central banks have the authority to intervene in Forex currency markets
Intervenes in Forex markets	To maintain SDR stability may require intervention in Forex markets
Manages IKASM-GRC	Operates the IKASM-GRC
Provides currency data	Required to determine if stability is being maintained and what actions may be necessary
Provides economic data	Sovereign economic data is required to determine SDR allocations
Sets allocations of SDR	Based on economic data assigns SDR allocation
Sets the stable range of Expanded SDR	Policy determination
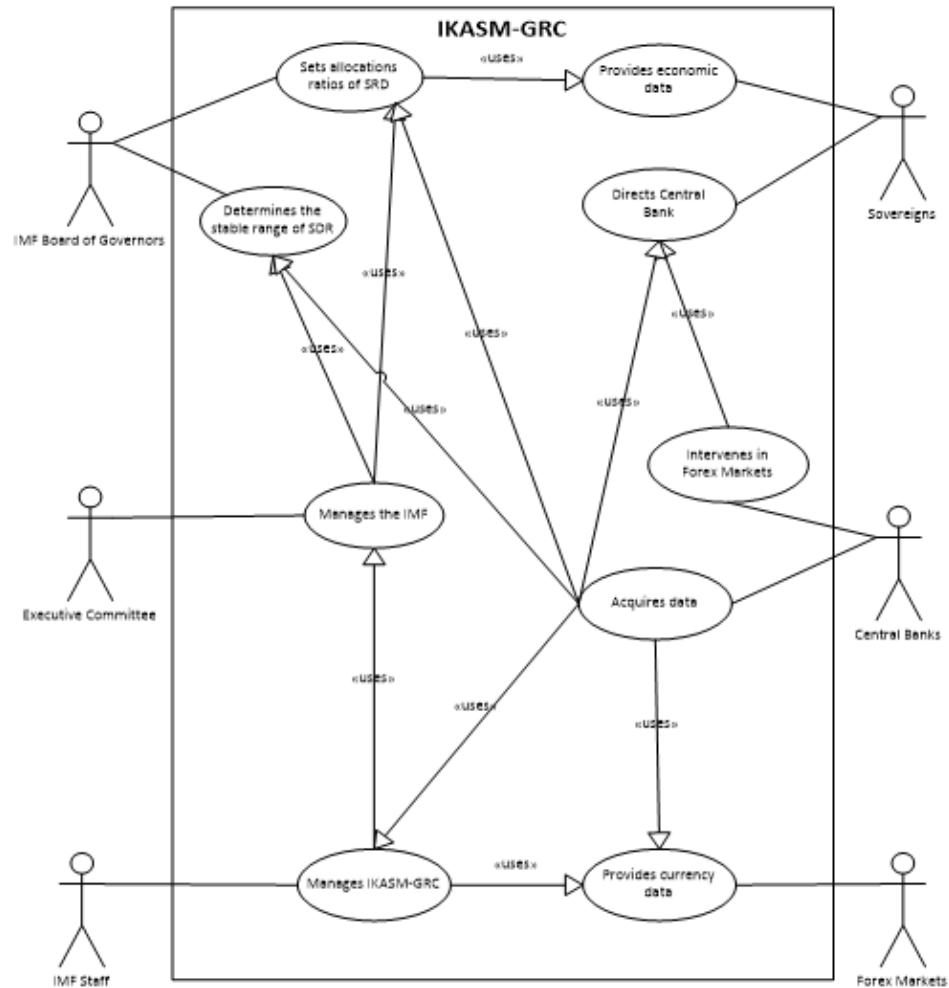
Figure 17 Use Case Diagram for IKASM-GRC

Use Case Scenarios

The operation of the IKASM-GRC can result in three operational scenarios and a

possible fourth alternative scenario. The scenarios are:

      1.   stable expanded SDR (normal scenario)

2. out of bound expanded SDR-sovereigns adjust through Forex intervention (exception scenario 1)

3. out of bound expanded SDR-sovereigns do not adjust (exception scenario 2)

4. alternative scenario

The flow of events in the operation of IKASM-GRC under various situations from stable to possible unstable conditions is shown in Table 8, Table 9 and Table 10.

It is exception scenario 2 which can result in highly complex and difficult operational unless agreement between the various sovereigns has been achieved. The fourth alternative scenario would be for the IMF to directly intervene in the Forex markets to maintain the expanded SDR within the set stability ranges. This would require that the IMF directly sell or buy tradable SDRs or the underlying currencies or commodities. However, this could change the nature of the institution from an international financial body to more of a global central bank with the underlying policy issues that it would engender. Therefore, this alternative scenario is not considered in the development of the IKASM-GRC.

Table 8 Flow of Events – Stable Expanded SDR Normal Scenario

Actor Input	System Response
IMF Board of Governors requests economic data	
	System request current economic data from sovereigns
Sovereigns forward recent economic data to system	
	System provides recent economic data
IMF Board of Governors sets allocation ratios for expanded SDR, and inputs to system	
	System sets allocations ratios for expanded SDR
IMF Board of Governors request currency data	
	System requests currency data from Forex markets
Forex markets forward currency data	
	System provides currency data

IMF Board of Governors assigns stable range for value of expanded SDR and inputs to system	
	System sets stable range for expanded SDR
IMF staff requests current currency data	
	System request currency data from Forex markets
Forex markets send current currency data to system	
	System uses internal algorithms to determine expanded SDR valuation compares to stable range values set by IMF Board of Governors
IMF staff informs sovereigns of expanded SDR valuation	
	If value of expanded SDR is within stable range to additional action required

Table 9 Flow of Events – Out of Bound Expanded SDR Exception Scenario 1

Actor Input	System Response
IMF Board of Governors requests economic data	
	System request current economic data from sovereigns
Sovereigns forward recent economic data to system	
	System provides recent economic data to IMF Board of Governors
IMF Board of Governors sets allocation ratios for expanded SDR, and inputs to system	
	System sets allocations ratios for expanded SDR
IMF Board of Governors request currency data	
	System requests currency data from Forex markets
Forex markets forward currency data	
	System provides currency data
IMF Board of Governors assigns stable range for value of expanded SDR and inputs to system	
	System sets stable range for expanded SDR
IMF staff requests current currency data	
	System request currency data from Forex markets
Forex markets send current currency data to system	
	System uses internal algorithms to determine expanded SDR valuation compares to stable range values set by IMF Board of Governors
IMF staff informs sovereigns of expanded SDR valuation	
	System informs Central Banks that value of expanded SDR is not within stable range and intervention action required
Central Banks intervenes in Forex Markets	
	System request currency data from Forex markets
Forex markets send current currency data to system	
	System uses internal algorithms to determine expanded SDR valuation compares to stable range values set by IMF Board of Governors
IMF staff informs Central Bank of expanded SDR valuation	
	If value of expanded SDR is within stable range no additional action required

Table 10 Flow of Events – Out of Bound Expanded SDR Exception Scenario 2

Actor Input	System Response
IMF Board of Governors requests economic data	
	System request current economic data from sovereigns
Sovereigns forward recent economic data to system	
	System provides recent economic data to IMF Board of Governors
IMF Board of Governors sets allocation ratios for expanded SDR, and inputs to system	
	System sets allocations ratios for expanded SDR
IMF Board of Governors request currency data	
	System requests currency data from Forex markets
Forex markets forward currency data	
	System provides currency data
IMF Board of Governors assigns stable range for value of expanded SDR and inputs to system	
	System sets stable range for expanded SDR
IMF staff requests current currency data	
	System request currency data from Forex markets
Forex markets send current currency data to system	
	System uses internal algorithms to determine expanded SDR valuation compares to stable range values set by IMF Board of Governors
IMF staff informs Central Bank of expanded SDR valuation	
	System informs Central Banks that value of expanded SDR is not within stable range and intervention action required
IMF staff requests current currency data	
	System request currency data from Forex markets
Forex markets send current currency data to system	
	System uses internal algorithms to determine expanded SDR valuation compares to stable range values set by IMF Board of Governors. If the expanded SDR valuation is not within stability range the system calculates suitable sovereign ratios
IMF Board of Governors reviews and decides if the revised ratios are embedded into the system	
	System informs Central Bank in revised ratios for the expanded SDR
IMF request currency data	
	System request currency data from Forex markets
Forex markets send current currency data to system	
	System uses internal algorithms to determine expanded SDR valuation compares to stable range values set by IMF Board of Governors
IMF staff informs Central Banks of expanded SDR valuation	
	If value of expanded SDR is within stable range no additional action required

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CHAPTER 11: RULE MODEL

Rules are used in many areas including business modeling, requirements engineering and information architecture. The rules in information architecture serve as a form of high level programming. The rules for the IKASM-GRC are related to the classes within the system.

Decisions

The decisions for the management of the IKASM-GRC have one basic criterion. That criterion is to maintain the expanded SDR in a stable condition. This is achieved through managing the various elements that are the basis for the SDR that is the values of the currency pairs and their variations impacting the stability range for the expanded SDR. Table 6 shows the various currency pairs that would form the basis of the expanded SDR.

The exact methodology used in determining the proportion of each currency is clearly defined (IMF, 2010). The each sovereign's international trade and proportion of each currency held as a reserve are used in the determination. This relation can be written in the form (See Chapter 13):

This general relation can be written in the form:

$$SDR \equiv \sum_i^n p_i \, S_{US_i}$$

Where

SDR = special drawing rights valuation

p_i = proportion of sovereign 'i' currency considered in valuation

S_{USi} = Forex market pricing for US dollars versus sovereign 'i' currency at time of valuation of SDR

$$p_i \equiv F_i(G_i, C_i, T_i, R_i)$$

Where

F_i = Function of () for sovereign 'i'

G_i = Gross Domestic Product for sovereign 'i'

C_i = current account balances for sovereign 'i'

T_i = trade balances for sovereign 'i'

R_i = reserve currency held by other sovereigns for sovereign 'i'

These are the principal data elements that should be considered in designing the IKASM-GRC. However, currently only the trade balances (T_i) and reserve currency (R_i) are used in determining the proportion of sovereign 'i' currency considered in valuation (p_i).

$$SDR \equiv \sum_i^n p_i\, S_{US_i}$$

Where

SDR = special drawing rights valuation

F_i = Function of () for sovereign 'i'

p_i = proportion of sovereign 'i' currency considered in valuation (sovereign ratio)

S_{USi} = Forex market pricing for US dollars versus sovereign 'i' currency at time of valuation of SDR

$$p_i \equiv F_i(T_i, R_i)$$

Where

T_i = trade balances for sovereign 'i'

R_i = reserve currency held by other sovereigns for sovereign 'i'

The stability range is given by

$$V_l \leq V_i \leq V_u$$

Where

V_l = lower bound of SDR valuation range

V_i = value of the SDR set by the IMF

V_u = upper bound of SDR valuation range

If V_i is outside the bounds set for the SDR, it will be required to be adjusted into the acceptable range either by intervention in the Forex markets by the member

sovereign's currencies causing the deviation from the stability of the SDR or and by revising the sovereign ratios (p_i).

The acceptable lower and upper bounds of the V_i would be set by the IMF Board of Governors. These bounds could reflect the statistical variations of the V_i over a period of time that the IMF Board of Governors decided was appropriate.

Currently the SDR is valued in US dollars, however, any currency such as the Chinese yuan or a commodity can replace the unit of value, and however, this is unlikely under present international financial conditions. The basket of currencies representing the SDR could be expanded or valued differently (See Chapter 12) then it is currently accomplished.

Decision Variables

The decision variable that would be considered in forming the basis for the IKASM-GRC operations would be:

- Sovereign economic data

- Forex currency data

- SDR sovereign ratios

- SDR stability range

- Sovereign-Central bank decisions

The rule model can be constructed based on the conditions or states of each of these variables.

An upper level activity diagram for IKASM-GRC as shown in Figure 18 and

illustrates the decision rules. The activities diagram shows the pathways for the system,

as based on the decision rules.
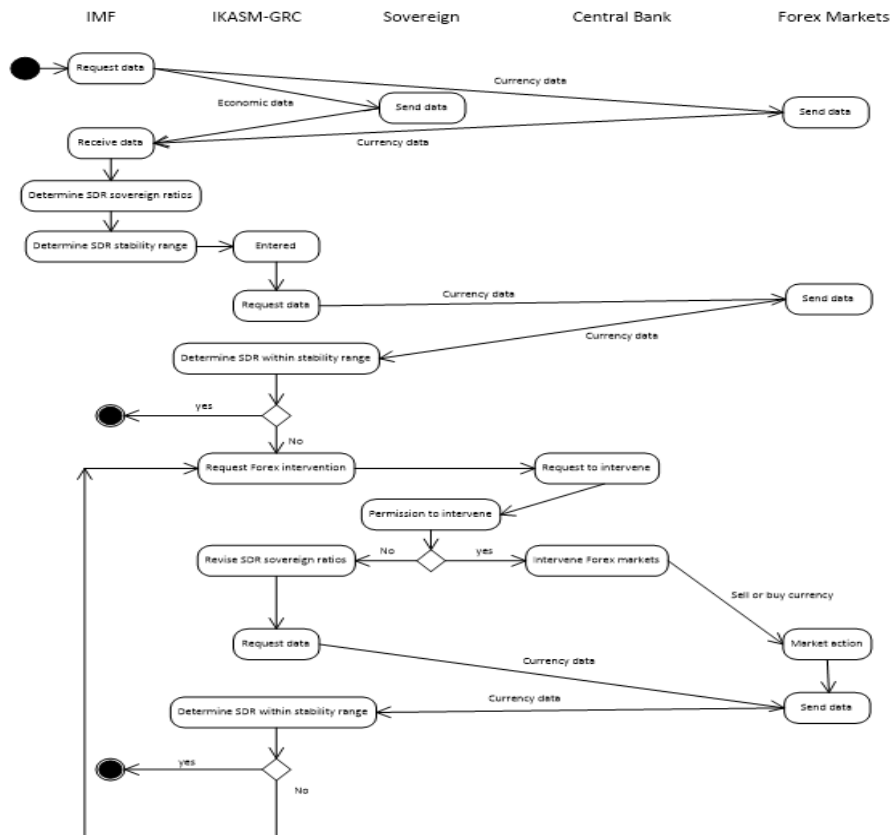
Figure 18 Activity Diagram for IKASM-GRC showing the decision pathways

Summary of Decision Rules

As shown in Figure 18 is the combining of the data model and the use case

analysis. The rule model leads to the logical architecture description of the system. The

data model is shown in Cardullo and Sage (Cardullo and Sage, 2012b). The activities

diagram helps to illustrate the decision pathways. The basic decisions here involved how

to manage the expanded SDR so it maintains with in a given range of values. The SDR is composed of the various currency elements and how they are allocated as based on a sovereign criteria and Forex currency variations. The decision variables include: sovereign economic data; Forex currency data; SDR sovereign ratios; SDR stability range; and the decisions of the sovereigns – central banks. The model shows how to arrive at the rules necessary for the operation of the IKASM-GRC (Cardullo and Sage, 2012a).

CHAPTER 12: SPECIAL DRAWING RIGHTS (SDR)

The basis of the 1946 Bretton Woods Agreement was gold. Sovereign nations either held gold or U.S. dollars as reserve assets. The exchange rate for dollars was set at a fixed rate in terms of gold, i.e., $35 USD per ounce. Due to the rapid rise of trade after World War II, the slow growth of gold supplies resulted in US dollars becoming a growing portion of world currency reserves. To overcome this, the IMF created the SDR in 1969. The SDR was established to supplement member countries' official reserves. The SDR claims on the IMF helped relieve the dollar claims on the US. Thus that SDRs served like demonetized gold to settle international claims (Obstfeld, 2011).

SDR Guiding Principles

The guiding principle for the SDR is that its value should be stable in terms of the major currencies, and the currencies included in the basket should be representative of those used in international transactions (IMF, 2010). Accordingly the relative weights of currencies included in the basket should reflect their relative importance in global trading and financial systems and there should be continuity in the method of SDR valuations. It must be considered that these guiding principles will require modification if and when the SDR becomes a true global reserve currency.

Implementing the SDR as the main global reserve currency would be represented by an extended basket of significant currencies and commodities. The United Nations

appointed Stiglitz Commission, charged with reforming the international monetary and financial system, and has suggested a gradual move from the US dollar to the SDR. Moreover, following the G20 Summit in London in 2010, the IMF distributed to its members $250 billion in SDRs as a step in moving it to become a new global reserve currency (Reisen, 2010). If the SDR was to be able to become a true global reserve currency the IMF would possibly need to have available over $10 to $30 trillion of SDRs to meet global liquidity requirements (WTO, 2012).

The revaluation of SDRs will reflect ongoing shifts in central bank reserves positions. In particular, the IMF executive board will consider revaluation of the SDR to reflect a diminution in the US dollar's strength (Zigler, 2010). One of the major problems with the notion of an SDR is that it does not reflect rapidly changing valuations and trade. A true global reserve currency must reflect rapidly changing conditions and trade.

As stated previously in this dissertation, it is not in the interest of the US Treasury to have the dollar no longer serve as the major foreign reserve currency. This situation, in 2011-2012 and continuing in 2013, allowed the US Treasury and the US Financial Reserve to borrow funds internationally at beneficial rates.

The SDR and the US dollar are highly correlated and SDRs as a substitute for dollars will not offer much risk reduction unless the basket of currencies included are more reflected of total international financial conditions. For most of the years since the last SDR reset, and during this period it was virtually stable in reference to the U.S. dollar. The rolling 30-day correlation has averaged 98.6 percent since February 2005

(Zigler, 2010). This is primarily due to the high portion of US dollars (41.1%) in the SDR and the 60% that is held by sovereign central banks.

A step intended to enhance the utility of the SDR would be to make its currency composition more neutral to global cycles and more representative of the shift in economic power witnessed over the last two decades. This could be achieved by an increase in the commodity content and the inclusion of major emerging-market currencies.

Another approach could be to shift the basket of currencies to those currencies of the G20. The G20 is the premier forum for international economic development that promotes open and constructive discussion between industrial and emerging-market countries on key issues related to global economic stability (G20, 2011).The advantages of this approach would be that the as the currencies increase included, the more closely the balance between exports and imports of the sum of these nations is in balance which then averts the Triffin dilemma. The disadvantage of this approach is that it is much more complex to manage and achieve consensus on how to incorporate each member. This approach had been tried by the IMF prior to 1980 when the basket of currencies was reduced from 16 to 5 at the time of the introduction of the euro (IMF, 2010). Since then has seen growth of emerging nations like China, Russia, India and Brazil and changing trade patterns and currency flows.

According to Joseph Stiglitz: *"The international monetary system needs fundamental reform. It is not the cause of the recent imbalances and current instability in the global economy, but it certainly has been ineffective in addressing them. So a broad*

set of reforms is required, beginning with an immediate pension of the current system of special drawing rights or money that can be issued by the International Monetary Fund. And here the Group of 20 leading nations must take the lead." (Stiglitz, 2011).

However, it is highly unlikely that either the IMF or the G20 will rapidly move toward a new, unified global reserve currency because of this, it will likely take a major global financial collapse to force the IMF and or the G20 to take steps to rationalize the global financial system. One approach that would support this is for the SDR to gradually increase its membership.

In the current system, the basket components of the SDR are distinct from its operation. The proportion of the currencies comprising the basket components of the SDR determines the valuation and therefore the currency resources that can be obtained by exchanging SDRs with other holders or the IMF. The primary rationale for the basket of currencies is that it stabilizes the weighted-average value of each country's SDR assets in terms of the reserve currencies that are most likely to be needed, based on their currencies' importance in world trade and finance (Obstfeld, 2011).

It is unlikely that a movement to making the SDR the major global reserve currency will be done rapidly. However, this movement toward making the SDR the natural reserve currency will likely occur due to the numerous concerns of the various major economies. One of the major drivers of this is the concern of China which has become a major international exporter and holder of US dollar reserves.

SDR Valuation Methodology

Current Valuation Methodology

SDRs represent the value of a trade- and reserve-weighted basket of currencies, including the US dollar, the euro, the Japanese yen and the UK pound sterling. The method for selection and weighing these currencies as of 2012 is (IMF, 2005, IMF, 2010):

"Selection: The currencies included in the SDR shall be the four currencies issued by Fund members, or by monetary unions that include Fund members, whose exports of goods and services during the five-year period ending 12 months before the effective date of the revision had the largest value and which have been determined by the Fund to be freely usable currencies in accordance with Article XXX (f). In the case of a monetary union, trade between members of the union is excluded from the calculation.

Weighting: The percentage weight of each currency selected shall reflect (i) the value of the balances of that currency held, at the end of each year of the relevant five-year period ending 12 months before the effective date of the revision, by the monetary authorities of other members or, in the case of the currency of a monetary union, by the monetary authorities of members other than those forming part of the monetary union; and (ii) the value of exports of goods and services of the members or monetary unions as defined in the method for selection."

Currently, the SDR basket is that shown in Table 11. This table shows the value of each currency as of the IMF decision date under Rule O-1 and calculated based on the proportion of each as determined.

Table 11 SDR Basket of Currencies (Fund, 2012)

Currency	Currency amount under Rule O-1
Euro	0.4230
Japanese yen	12.1000
Pound sterling	0.1110
U.S. dollar	0.6600

The U.S. dollar-equivalent of the SDR is posted daily on the IMF's website. It is calculated as the sum of specific amounts of the four basket currencies valued in U.S. dollars, on the basis of exchange rates quoted at noon each day in the London market. However, the proportions of the four currencies are only adjusted every five years.

Currency amounts in the SDR basket that are used to determine the values for the next five year period are calculated on the last business day before the date the new basket becomes effective, i.e. January 1 of the next year. On that day, currency amounts are derived from the weights decided by the IMF Executive Board using the average exchange rate for each currency over the preceding three months and the currency amounts are adjusted proportionally to ensure that the value of the SDR is the same before and after the revision. The currency amounts remain fixed for the next five-year period. As a result, the actual weight of each currency in the value of the SDR changes on a daily basis as a function of changes in exchange rates (IMF, 2010). However, if the SDR is to become the major global reserve currency then the proportions of the currencies would likely have to change on a more realistic basis. The proposed IKASM-GRC architecture could serve this purpose.

The actual weights of the currencies within the SDR basket are shown in Figure 19 for the 1999 to 2005 period. The actual rates for the 2000 to 2010 period are shown in Figure 20.
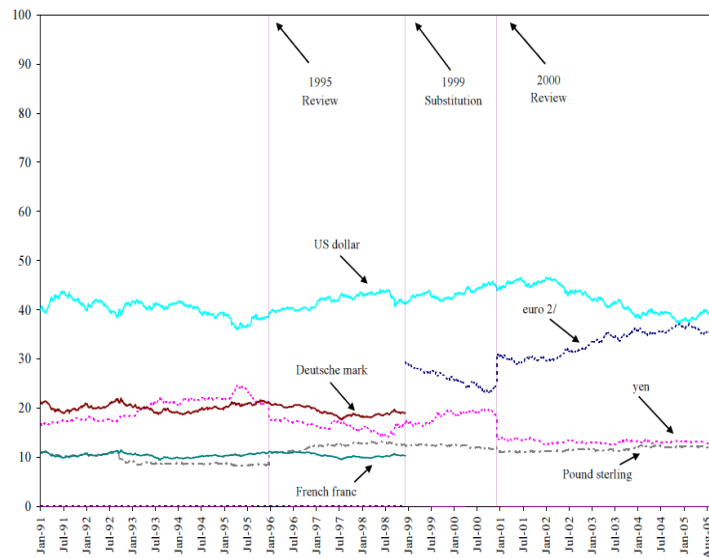
Figure 19 Actual Currency Weights in the SDR Basket, 1991–2005(IMF, 2005)

Sources: Finance Department and International Financial Statistics.
1/ Daily data are through October 22, 2010.
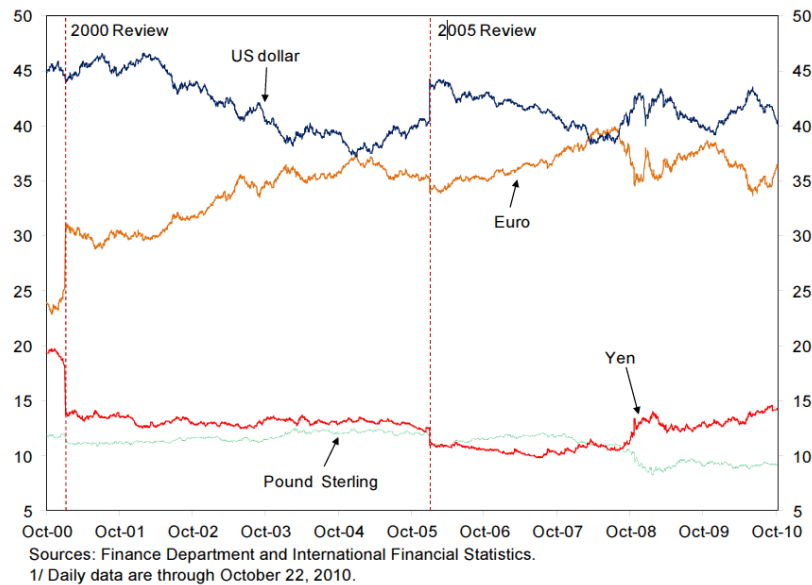
Figure 20 Actual Currency Weights in the SDR Basket, 2000–2010 (IMF, 2010)

As of November 30, 2012 these weights are shown in Table 12.

Table 12 SDR Valuations as of November 30, 2012 (Fund, 2012)

Friday, November 30, 2012			
Currency	**Currency amount under Rule O-1**	**Exchange rate**	**U.S. dollar equivalent**
Euro	0.4230	1.30070	0.550196
Japanese yen	12.1000	82.66000	0.146383
Pound sterling	0.1110	1.60570	0.178233
U.S. dollar	0.6600	1.00000	0.660000
			1.534812
		U.S.$1.00 = SDR	0.651546
		SDR1 = US$	1.53481

The value shown is fixed currently under IMF Rule O-1 for a five year period, while the exchange rate varies daily. Together serve to calculate the US dollar equivalent, with the sum of those equivalents representing the value of the SDR.

Detailed SDR Currency Weights

The current methodology for determining the weights of each currency within the SDR basket of currencies is determined solely by the exports of goods and services of the sovereign issuing the currency and the international reserves of that currency. This methodology gives equivalent weights to both the exports and the reserves. Therefore, a sovereign whose currency is held by others as a reserve currency is more favored than other economic factors. In fact, the United States as a major debtor nation has an advantage due to the large amount of its currency being held as a global reserve.

This is shown in the following equation:

$$\omega_i = \frac{X_i + R_i}{\sum_i X_i + \sum_i R_i}$$

Here ω_i is the weight of the currency in the SDR basket and X_i is the exports of goods and services and R_i is the global reserves held of sovereign "i". Table 13 contains data on exports of goods services and incomes and Table 14 shows data for global reserves held by various sovereigns.

Table 13 Exports of Goods, Services, and Incomes[21] (Billions SDR)

	2005	2006	2007	2008	2009	2010	2011
US	1,229.6	1,451.2	1,619.1	1,668.0	1,400.1	1,640.1	1,800.8
EURO	1,698.1	1,997.8	2,338.6	2,467.9	1,967.8	2,182.4	2,318.6
UNITED KINGDOM	630.0	762.7	860.5	792.0	559.3	595.3	683.3
JAPAN	554.3	611.0	657.7	700.8	550.5	690.9	734.3
CANADA	317.4	353.0	372.1	379.1	281.6	342.6	383.8
CHINA	708.7	880.7	1,065.8	1,207.4	1,062.7	1,236.9	1,413.0
KOREA	233.2	269.4	301.9	337.5	290.4	370.6	421.1
RUSSIA	193.8	247.7	288.1	369.9	245.7	316.8	391.6
SINGAPORE	214.8	258.5	290.8	316.4	270.4	341.9	350.7
SWITZERLAND	205.1	224.9	253.9	255.8	221.3	301.6	339.1

Table 14 Composition of Foreign Exchange Allocated Reserves[22] (Billions SDR)

	2005	2006	2007	2008	2009	2010	2011
US DOLLARS	1,288.6	1,476.2	1,725.5	1,708.5	1,853.0	2,100.9	2,222.1
EURO	464.2	565.7	708.0	703.6	816.3	896.5	894.6
POUND STERLING	69.3	99.2	126.5	106.6	128.1	142.1	136.9
JAPANESE YEN	69.3	69.9	78.1	82.6	86.4	111.6	126.2
SWISS FRANCS	1.9	4.5	5.4	2.7	3.0	3.4	4.0
OTHER CURRENCIES	32.7	40.6	48.5	58.6	92.4	128.6	191.2

[21] Based on data contained in IMF 2010. Review of the Method of Valuation of the SDR. Washington, DC: International Monetary Fund, IMF 2012d. World Economic Outlook Database. *In:* IMF (ed.). Washington, DC: IMF.
[22] Based on data contained in IMF 2012a. Currency Composition of Official Foreign Exchange Reserves (COFER). *In:* IMF (ed.). Washington, DC.

This data for average five year periods is used by the IMF to calculate the weights of currency in the SDR basket. However, as has been noted the foreign exchange allocation reserves have a definite impact in biasing the currency weights toward the U.S. dollar. Also it must be noted that the composition would vary in yearly increments as shown in Table 15.

Table 15 Currency Weight Allocations for SDR Valuation[23]

| | BASED ON CURRENT SYSTEM | | | | | | | AVG |
	2005	2006	2007	2008	2009	2010	2011	2006-2010
US	41.9%	41.6%	41.2%	41.0%	44.3%	44.8%	45.1%	42.6%
EURO	36.0%	36.4%	37.5%	38.5%	37.8%	36.8%	36.0%	37.4%
UNITED KINGDOM	11.6%	12.3%	12.2%	10.9%	9.3%	8.8%	9.2%	10.7%
JAPAN	10.5%	9.7%	9.1%	9.6%	8.6%	9.6%	9.7%	9.3%

The staffs of the IMF have suggested a number of alternative methodologies for future calculations of the currency weight allocations (IMF, 2010). These methodologies would consider that the relative weights of currencies included in the basket should reflect their relative importance in the world's trading and financial system. The weight of the currency could be expressed as a combination of financial (FI_i) and trade (TI_i) indicators as given by the following equation:

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[23] Based on data contained in IMF 2012d. World Economic Outlook Database. *In:* IMF (ed.). Washington, DC: IMF, IMF 2012a. Currency Composition of Official Foreign Exchange Reserves (COFER). *In:* IMF (ed.). Washington, DC, IMF. 2012c. *Governance Structure* [Online]. Washington, DC: IMF. Available: http://www.imf.org/external/about/govstruct.htm [Accessed 06/3/2012 2012].

$$\omega_i = \alpha * TI_i + (1 - \alpha) * FI_i$$

Here α is the relative weight on trade and is approximately 67 percent (IMF, 2010). Table 17 illustrates the changes in the currency weights within the SDR basket for the 2005 to 2011 period. This illustrates how the SDR basket of currencies can vary.

Table 16 Impact of Varying the Proportions within the SDR Basket of Currencies[24,25]

	IMF STAFF WEIGHING – 67% EXPORTS PLUS 33% FOREIGN EXCHANGE RESERVES							AVG 2006-2010
	2005	2006	2007	2008	2009	2010	2011	
U.S.	42.1%	41.8%	40.1%	41.0%	41.4%	42.0%	42.3%	41.4%
EURO	35.6%	36.0%	37.3%	38.1%	38.5%	37.4%	36.3%	37.5%
UNITED KINGDOM	11.5%	12.0%	12.0%	10.8%	9.8%	9.2%	9.5%	10.8%
JAPAN	10.2%	9.5%	9.0%	9.4%	9.2%	10.2%	10.0%	9.4%

The IMF and the G20 are considering various alternatives to the formation of the SDR basket of currencies. One element in this possible change is moving toward having the global reserves held of a sovereign's currency by other sovereigns be applied for a third of the value for the formation of the basket as shown in Table 17 (IMF, 2010). Another consideration is the inclusion of the Chinese yuan as one of the currencies within the basket (IMF, 2010). Furthermore, there has been some discussion as to increasing the currencies within the basket of the major exporting nations (Strupczewski, 2011).

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[24] Based on data contained in IMF 2012d. World Economic Outlook Database. *In:* IMF (ed.). Washington, DC: IMF, IMF 2012a. Currency Composition of Official Foreign Exchange Reserves (COFER). *In:* IMF (ed.). Washington, DC, IMF. 2012c. *Governance Structure* [Online]. Washington, DC: IMF. Available: http://www.imf.org/external/about/govstruct.htm [Accessed 06/3/2012 2012], IMF 2010. Review of the Method of Valuation of the SDR. Washington, DC: International Monetary Fund.
[25] Basis calculated on foreign reserves including those outside of basket of currencies.

Table 17 illustrates, for the 2005 – 2011 time period, the impacts of the various IMF policies for choosing how the basket of currencies for the SDR is calculated. As Table 17 shows, such changes would have significant impacts on the value of the SDR by changing the proportion of the currencies within the basket. In almost all instances, the US dollar will become a small portion of the value of the SDR. It is realized that may result in variations in the value of the SDR and increase possible instabilities. The IKASM-GRC if implemented could reduce these possible instabilities as we will show in later.

However, some of these alternatives not shown in Table 17 include a range of indicators for international financial activity, including financial flows as measured by the balance of payments, turnover of foreign exchange markets, and stocks of international banking liabilities and outstanding international debt securities. All of these financial indicators have been shown to outpace export growth over the past two decades (IMF, 2010). Therefore, the IMF has a significant number of alternatives that will impact the value of the SDR for maintaining the stability of the SDR if it becomes the major global reserve currency. The IKASM-GRC could be the means to provide this stability independent of the methodology chosen to calculate the basket of currencies.

Table 17 Impact of IMF Policies in Calculating SDR Currency Ratios (AVG 2006-2010)

IMF POLICY	U.S.	EURO	UNITED KINGDOM	JAPAN	CANADA	CHINA	KOREA	RUSSIA	SINGAPORE	SWITZERLAND
BASED ON CURRENT SYSTEM	41.9%	37.4%	11.3%	9.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BASED ON CURRENT EXPANDED SYSTEM	32.0%	28.1%	8.0%	7.0%	3.3%	10.4%	3.0%	2.8%	2.8%	2.4%
BASED ON CURRENT SYSTEM PLUS CHINA	37.4%	32.9%	9.4%	8.2%	0.0%	12.2%	0.0%	0.0%	0.0%	0.0%
BASED ONLY ON EXPORTS	20.2%	28.5%	9.3%	8.3%	4.5%	14.2%	4.1%	3.8%	3.8%	3.3%
BASIC - BASED ON IMF STAFF WEIGHING FORMULA- 67% TRADE	41.4%	37.5%	10.8%	9.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BASIC+CHINA - BASED ON IMF STAFF WEIGHING FORMULA- 67% TRADE	37.8%	32.4%	9.1%	8.0%	0.0%	11.8%	0.0%	0.0%	0.0%	0.0%
EXPANDED - BASED ON IMF STAFF WEIGHING FORMULA- 67% TRADE	34.6%	27.8%	7.6%	6.6%	3.0%	9.5%	2.7%	2.5%	2.6%	2.2%

The historical values of the SDR ratios under IMF Rule O-1 are given by Table 18.

Table 18 Historical Values of SDR Ratios – IMF Rule O-1(Wikipedia, 2013)

Value of 1 SDR (XDR 1)[26]					
Period	US$	DEM	FRF	JPY	GBP
1981–1985	0.540 (42%)	0.460 (19%)	0.740 (13%)	34.0 (13%)	0.0710 (13%)
1986–1990	0.452 (42%)	0.527 (19%)	1.020 (12%)	33.4 (15%)	0.0893 (12%)
1991–1995	0.572 (40%)	0.453 (21%)	0.800 (11%)	31.8 (17%)	0.0812 (11%)
1996–1998	0.582 (39%)	0.446 (21%)	0.813 (11%)	27.2 (18%)	0.1050 (11%)
Period	US$	EUR		JPY	GBP
1999–2000	0.5820 (39%)	0.2280 (21%)	0.1239 (11%)	27.2 (18%)	0.1050 (11%)
		= 0.3519 (32%)			
2001–2005	0.5770 (44%)	0.4260 (31%)		21.0 (14%)	0.0984 (11%)
2006–2010	0.6320 (44%)	0.4100 (34%)		18.4 (11%)	0.0903 (11%)
2011–2015	0.6600 (41.9%)	0.4230 (37.4%)		12.1000 (9.4%)	0.1110 (11.3%)

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[26] SDRs are denoted with the ISO 4217 currency code XDR

Table 19 shows the impact of applying the various policies on the value of currency components of the SDR under IMF Rule O-1.

Table 19 Impact of IMF Policy on Currency Components of SDR (Based on SDR Value 12/30/2010)

IMF POLICY USING RULE O-1	U.S.	EURO	UNITED KINGDOM	JAPAN	CANADA	CHINA	KOREA	RUSSIA	SINGAPORE	SWITZERLAND
BASED ON CURRENT SYSTEM	0.6453	0.5765	0.1740	0.1448	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BASED ON CURRENT EXPANDED SYSTEM	0.4924	0.4331	0.1239	0.1076	0.0512	0.1609	0.0463	0.0432	0.0436	0.0377
BASED ON CURRENT SYSTEM PLUS CHINA	0.5754	0.5061	0.1448	0.1258	0.0000	0.1880	0.0000	0.0000	0.0000	0.0000
BASED ONLY ON EXPORTS	0.3117	0.4385	0.1430	0.1285	0.0692	0.2183	0.0628	0.0585	0.0592	0.0503
BASIC - BASED ON IMF STAFF WEIGHING FORMULA-67% TRADE	0.6383	0.5768	0.1659	0.1455	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BASIC+CHINA - BASED ON IMF STAFF WEIGHING FORMULA-67% TRADE	0.5826	0.4987	0.1408	0.1225	0.0000	0.1817	0.0000	0.0000	0.0000	0.0000
EXPANDED - BASED ON IMF STAFF WEIGHING FORMULA-67% TRADE	0.5321	0.4276	0.1177	0.1017	0.0464	0.1463	0.0421	0.0392	0.0396	0.0337

The value of the SDR is derived from the weights decided by the Executive Board using the average exchange rate for each currency over the preceding three months and by adjusting the currency amounts proportionally to ensure that the value of the SDR is the same before and after the revision (IMF, 2010). However, this only provides the starting SDR value some continuity. The actual weight of each sovereign currency in the

value of the SDR changes on a daily basis as a function of changes in exchange rates.

This causes the value of the SDR to vary as shown in Figure 19.

These fluctuations will vary for each of the various IMF policy decisions shown

in Table 19 since the proportions forming the value of the SDR vary as shown in Table

17. The consequences of even a constant policy can cause variations in the value of the

SDR as shown in Figure 21. As shown, these variations can be significant in the

valuation of the SDR. If these new policies are implemented, then these variations can

vary with significant consequences as will be shown by a stability analysis.
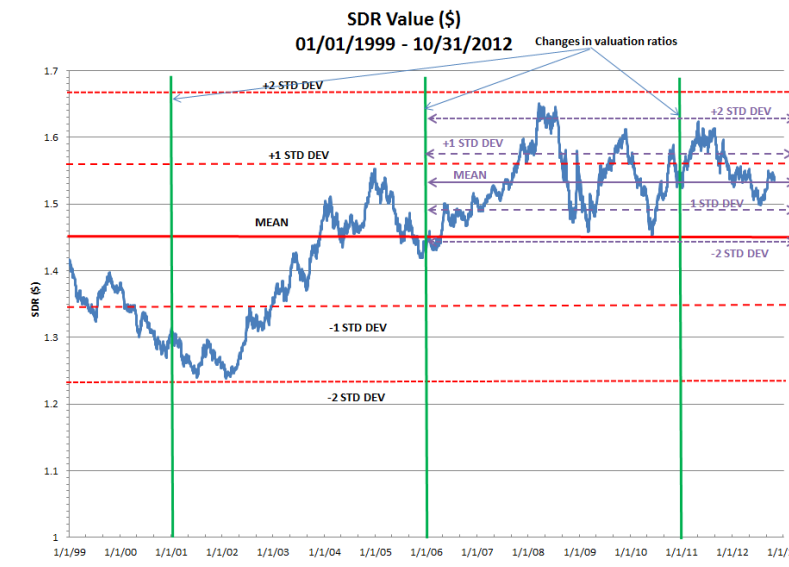
Figure 21 SDR Value Fluctuation

Possible Implementation Mechanism

A possible implementation mechanism if the SDR is to become the major global

reserve currency, is through a substitution account (Obstfeld, 2011, Williamson, 2009).

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The use of a substitution account is based on sovereigns depositing their currency

reserves with the IMF in return for SDR's. It is also possible that the IMF could employ

an allocation process for the SDR's, instead of through substitution. Obstfeld (Obstfeld,

2011) has suggested that the IMF use the process whereby *"SDR claims could be*

presented directly to central banks in return for their own currencies because this change

would make the outside supply of reserve currencies elastic in a crisis." Therefore, it will

be important that an implementation mechanism be developed that would be acceptable

to the participating IMF sovereigns and which would not increase potential instabilities in

global liquidity. The IMF staff analysis of the roadmap of moving to the SDR as the

major global reserve currency is shown in Figure 22. Each of these movements will

encounter potential resistance.
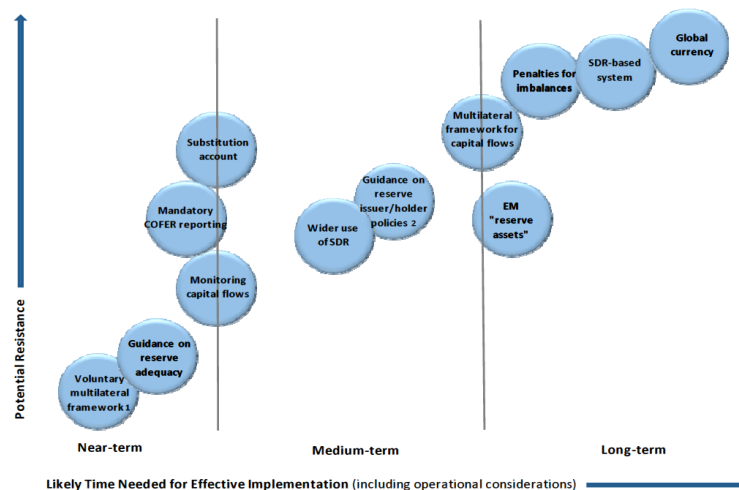
[1] Members voluntarily commit to policy adjustments for IMS stability, including through quid pro quo
agreements if needed.
[2] E.g., Fund supported reserve diversification standards for reserve holders; guidance to reserve issuers to
limit currency volatility and broaden use of alternative instruments.

Figure 22 IMF Concept to Mitigate Demand and Diversity of Supply for International Monetary Stability(Strategy,
2010)

Impact of Currency Rates

The stability considerations for a new global reserve currency based on the SDR

is critical if this currency is to become the major source of global liquidity. Table 20

shows that the individual currencies in the current basket of currencies used to calculate

the SDR had a higher volatility than the SDR from 2005 to 2012 based on US dollar

currency pairs.

Table 20 Exchange Rate Volatility[27], 2005-2012

	2005[28]	2006[27]	2007[27]	2008[27]	2009[27]	2010[29]	2011[28]	2012[28,30]
EURO	0.43	0.37	0.30	0.65	0.59	0.57	0.56	0.43
JAPANESE YEN	0.40	0.44	0.44	0.75	0.66	0.52	0.41	0.39
POUND STERLING	0.37	0.38	0.33	0.63	0.81	0.52	0.44	0.31
SDR	0.23	0.21	0.16	0.31	0.29	0.25	0.26	0.18

Volatility is one measure (Simpson, 2012) of a security's risk and is normally

defined by the standard deviation of the currency exchange rates over a certain time

period. However, the IMF defines it as the mean of absolute daily percentage change in

spot exchange rates. As the volatility increases for an exchange rate, more uncertainty is

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[27] IFM volatility is measured as the mean of absolute daily percentage change in spot exchange rates against the dollar IMF 2010. Review of the Method of Valuation of the SDR. Washington, DC: International Monetary Fund.
[28] Ibid.
[29] Calculated based on IMF methodology and daily spot currency rates.
[30] Based on data from January 3 to October 31, 2012.

indicated for that currency pair movement. Currency volatility is a function of the underlying variability of the economy (Simpson, 2012). In the case of the SDR, volatility would be impacted by the variability of the global economy.

The global long term economic performance will be influenced by a number of factors. However, if the SDR is to become the main global reserve currency it will be subject to the market pressures exercised through this basket of currencies.

The SDR daily percentage variations in valuation denominated in US dollars (See Table 12 for calculation method) are shown in Figure 23. These variations usually span a range between -1% and 1% in the daily change except for a few periods during the global recession of 2008 - 2010. However, these variations must be considered in terms of the distribution between values that the IMF would likely require in order to maintain a stability of the SDR global liquidity. Currently, the total amounts of SDRs that have been issued are approximately $300 billion SDRs. The percentage variations from the mean in the 2006 – 2012 time-periods are shown in Figure 27. As this figure shows, these variations have been significant when measured against the mean value during the period.

If and when the SDR becomes the major global reserve currency it will be required to handle global liquidity of more than $10-$30 trillion SDRs. In this case, the impact of the variations, as shown in Figure 24, can be significant and could possibly lead to global financial instability. These possibilities of global liquidity variations have been discussed in detail by the Committee on the Global Financial System of the Bank for International Settlements (Group, 2011).
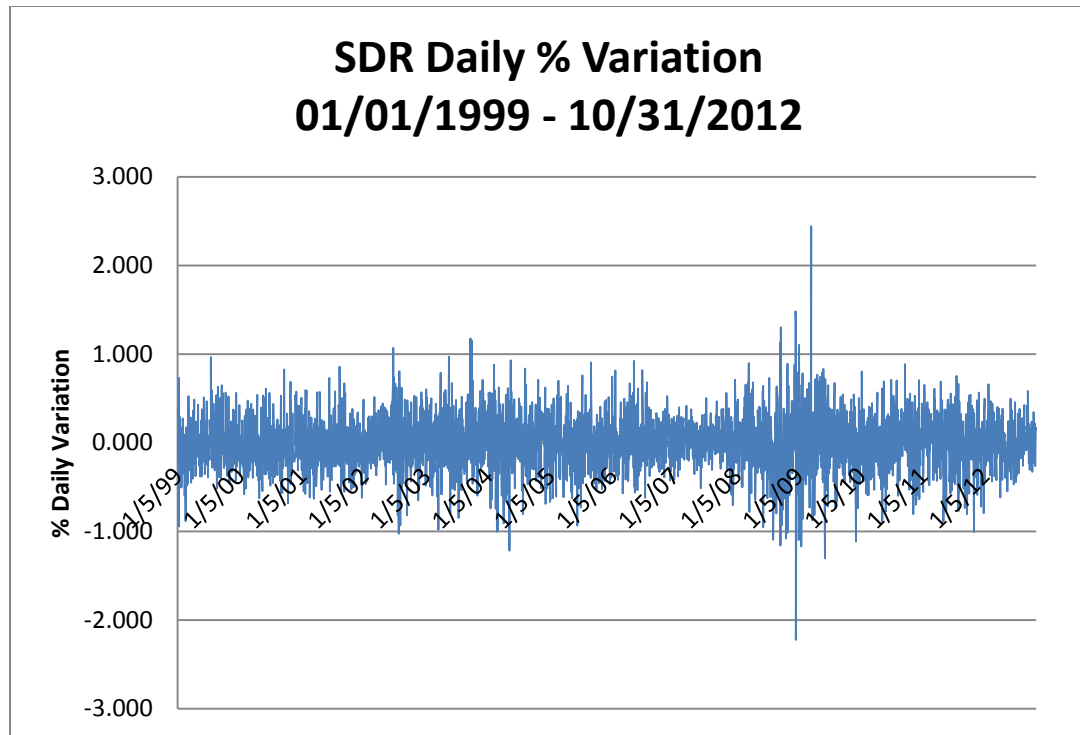
Figure 23 SDR Daily % Variation (1999-2012)
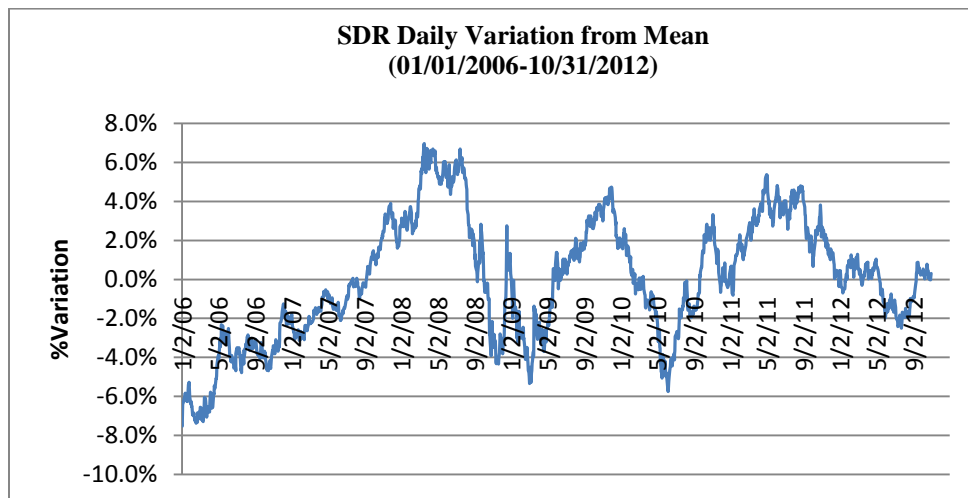
Figure 24 SDR Daily Variation from Mean (2006-2012)

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One of the main objectives of the IKASM-GRC is to provide a means of dampening the possible variations in the global liquidity, as shown in Figure 25. The mean for the period, 01/01/2006-10/31/2012, is a value of the SDR of $1.52741 with a standard deviation of $0.04806 or 3.145 percent. This standard deviation would imply a variation of global liquidity of $944 to $1,416 billion SDRs.

Currently, the entire SDR valuation process is relative to the US dollar and unlikely to change in the near future (Strategy, 2010, IMF, 2010). However, the method of maintaining a relatively stable SDR valuation presented in this dissertation, i.e., continuous variation of the IMF Rule O-1 would be applicable for any basis of SDR valuation provided that a basket of currencies including commodities was employed.
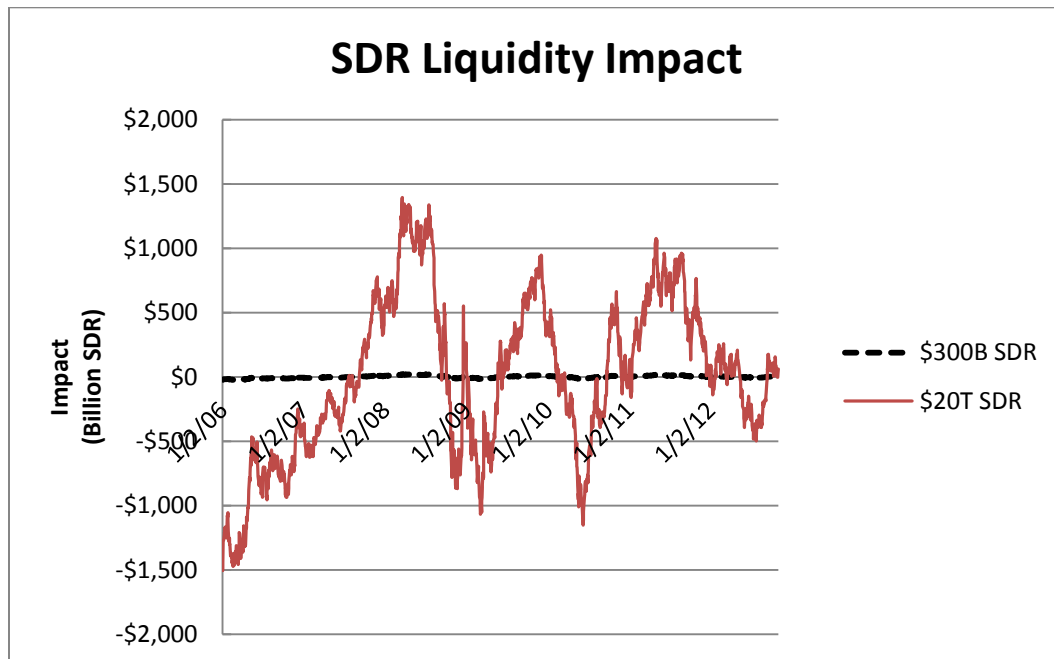
Figure 25 SDR Liquidity Impact

The variations for the current four pairs used to calculate the value of the SDR are determined and shown in Appendix C. The statistical variations are used in developing a simulation of how the IKASM-GRC could provide stability in the value of the SDR when it becomes the dominant global reserve currency, as shown in Appendix D and E.

Impact of IKASM-GRC

The IKASM-GRC can be employed to provide SDR stability by dampening the impact shown in Figure 25 which illustrates the variation due to the amount of SDRs that serve as global liquidity. If the SDR does not become the major global reserve currency, then its stability will have little impact on global liquidity. However, if the SDR does indeed becoming the major source of global liquidity as the major global reserve currency, then variations as little as 1% can cause major fluctuations in the global reserve liquidity.

The IKASM-GRC can serve as a means to automate the SDR value without impacting individual sovereignties. This has been shown by Cardullo and Sage (Cardullo and Sage, 2012a) to be the case. The various currencies currently within the SDR basket and possible future changes to this basket of currencies can have significant impacts. One of the current impacts to the value of the SDR is the euro – U.S. dollar currency pair as shown in Figure 27. However, while this has been the case in the 2010 – 2012 time period, the US dollar/euro currency pair may not always have the major influence on the SDR value. The value of any currency pair is a function of the individual sovereigns and cannot be changed by the IMF but is driven by the Forex market. The IMF, through its Executive Committee, can only impact the percentage of currencies within the SDR

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basket through Rule O-1. Figure 26 is an example of how the IMF can vary the

proportion[31] of the euro within the SDR basket to meet the fluctuations shown in Figure

27. This approach is used to stabilize the value of the SDR independent of the types of

variations, including the number of currencies used in determining the basket of

currencies and IMF policies that can be implemented. Such an approach does not require

approval of the participating sovereigns, but it does require the approval of the IMF

Executive Committee.
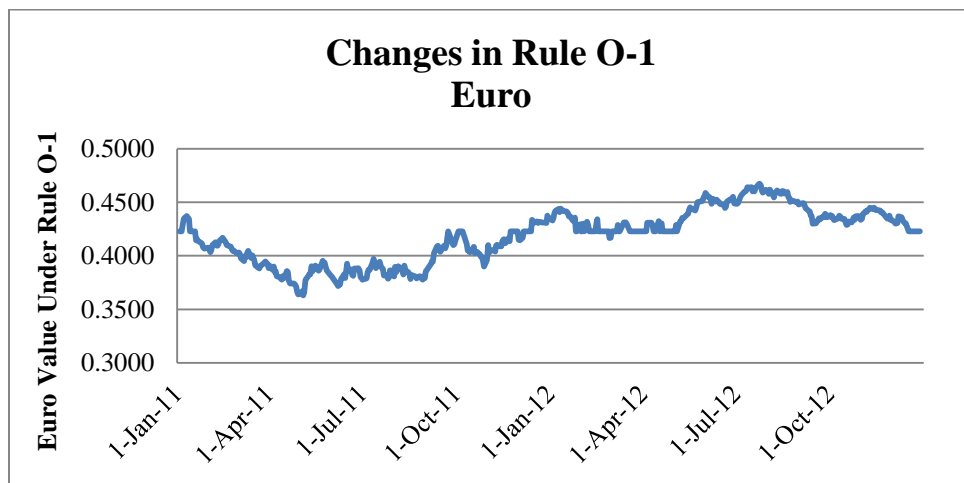
Figure 26 Possible IMF Rule O-1 Changes Necessary to Maintain SDR Balance

Employing the IKASM-GRC approach to stabilizing the SDR value, Figure 27

shows the results of using the methodology to maintain a relatively constant SDR value

using the data for the period 01/01/2010 to 12/31/2012. This result was based on

maintaining the SDR value within a range of -1% and +1%. The IMF Rule O-1 was

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[31] The variation in Figure 28 is based on changing the proportion of the currency due to the US dollar/euro pair variation with a one day delay and feedback.

employed with the algorithm to modify the daily percentages of the four major currencies

so that the value would be maintained within a reasonable limit in this range.
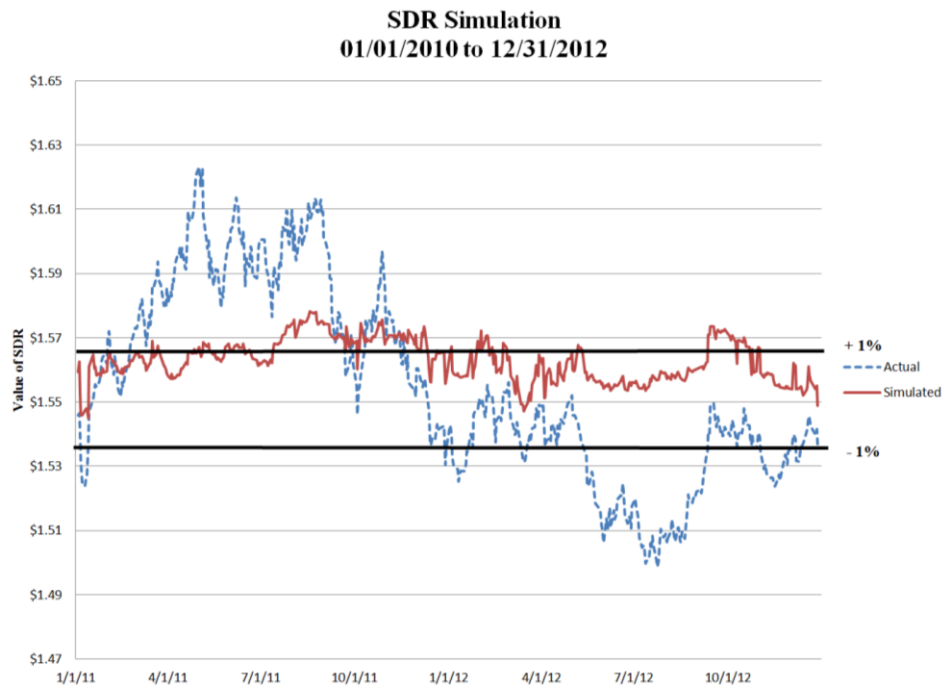
Figure 27 Impact on SDR Valuation with and without Modifications

Time series distributions for the four major currencies during the period

01/01/2010 to 12/31/2012 were developed. These time series where used to develop a

simulation of the SDR value for a year. A sample of one of the distributions and the

ability of the IKASM-GRC methodology to maintain the SDR value within an acceptable

range is shown in Figure 28. Additional examples, showing the ability of the system to

maintain the SDR value within an acceptable range even for major deviations of the SDR

value without this methodology, are given in Appendix E. This appears to indicate that it

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is possible for the proposed IKASM-GRC to develop methodologies that will maintain

the SDR value within selected ranges.
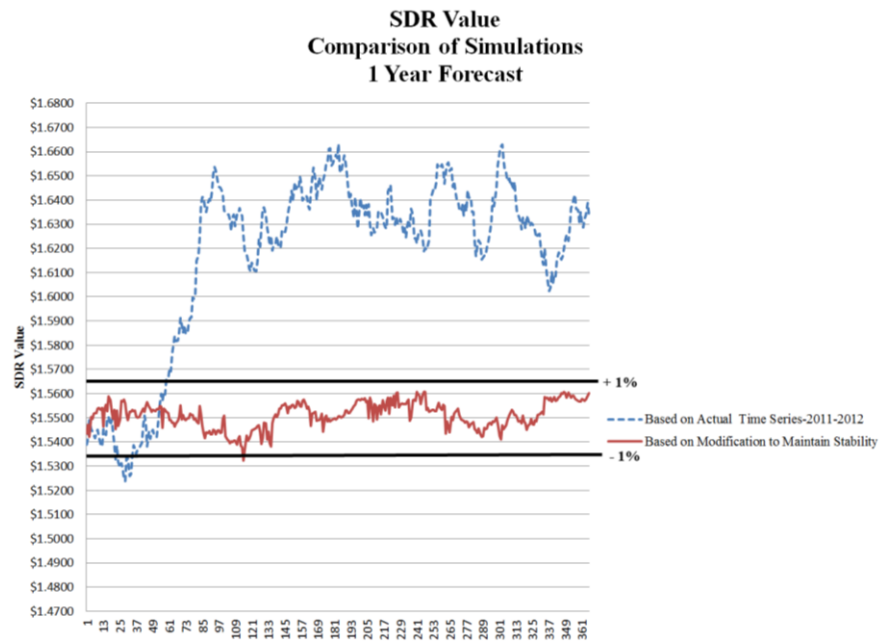
Figure 28 Time Series Simulation 1 Year Forecast

Figure 29 (based on 01/01/2010 to 12/31/2012 data) shows the impact of one of

the possible IMF policies (Table 17) on the value of the SDR and the impact of the

IKASM-GRC methodology needed to maintain the SDR value within an acceptable

range. The IMF policy used to develop this analysis requires expansion of the SDR

basket of currencies to 10 sovereigns and employing the rule that exports represent 67%

of the weighting factor and the balance (the foreign reserve allocations of each of the

currencies). The proposed approach used in the IKASM-GRC methodology illustrates the

potential to maintain the SDR within a stable range.
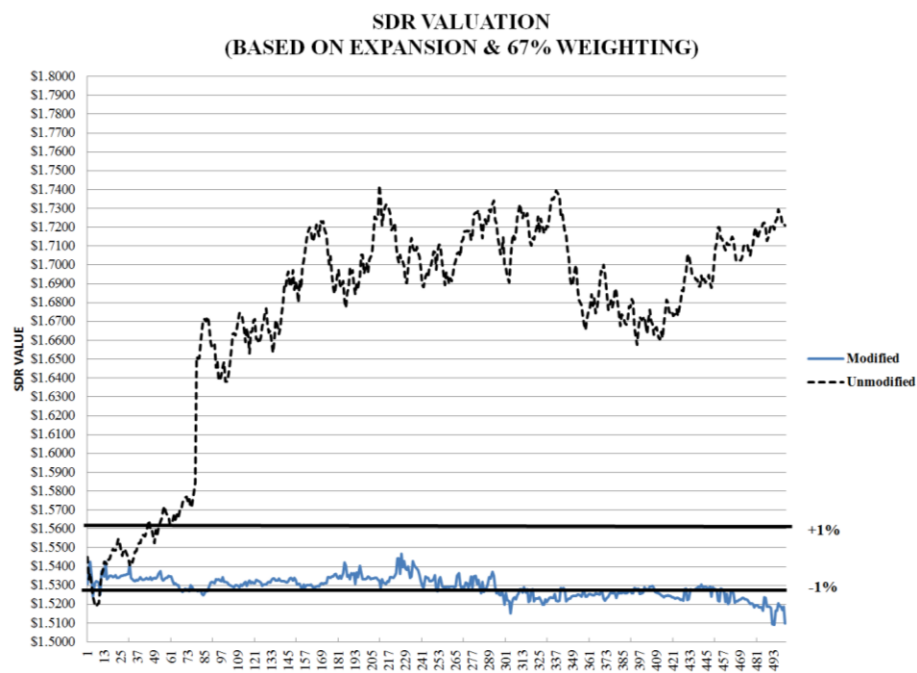
Figure 29 Impact of Adding Currencies and IMF Policy Changes on SDR Valuation

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CHAPTER 14: CONCLUSIONS

This dissertation has examined the concept of a means to manage a new global reserve currency intended to help maintain global financial stability. The management system for a new reserve currency cannot be developed without understanding the framework, services, standards and governance needed for successful operation. While many of the items discussed are very speculative, the international financial structure is striving to move to a reserve currency that can be managed and which offers some stability. Without such a revision in the global reserve currency, and its robust management, the financial crises which the world has experienced over the last three decades will not only reoccur but the severity of the resulting crises will continue to increase. It is imperative that the major sovereigns (G20, and their financial institutions, IMF and SIB) agree upon a roadmap to develop a global reserve currency that can add to and augment global financial stability. An important element in obtaining this stability is an informational architecture which is robust, capable of evolving, and manageable through an accepted and enforceable governance structure.

Once the G20, IMF and the BIS have chosen an approach to what will become a new global reserve currency, the question will arise concerning how it is to be managed. A service oriented architecture (SOA) appears to offer a significant approach to a management system. SOA can identify and promote the shared use of common

capabilities across the global financial system. Under this approach, functions and applications are defined and designed as discrete and reusable capabilities or services that may be under the control of different organizational entities.

International trade is driven by global finance considerations. The global reserve currencies serve as the basis of settlement and valuation of trade. In 2012, the United States is the major global reserve currency representing approximately 40% to 60% of the total. Various sovereign leaders and economists have been discussing how to move from the US dollar as a global reserve currency to other alternatives. However, the leading contender for a replacement of the U.S. dollar is a version of the Special Drawing Rights (SDR) issued by the International Monetary Fund (IMF) (Cardullo and Sage, 2012c). Special drawing rights (SDRs) are a form of supplementary foreign exchange reserve assets defined and maintained by the International Monetary Fund (IMF). Not yet a true currency, SDRs represent a claim to currency held by IMF member countries for which they may be exchanged.

To develop an appropriate architecture for managing a reserve currency there are a number of approaches as discussed by Cardullo and Sage (Cardullo and Sage, 2012c, Cardullo and Sage, 2012). The basic methodology utilized follows somewhat the process outlined by Levis (Levis, 2009). This is a total systems approach devised for building information architectures. The four stages of the development of an architectural system for management of a new global reserve currency are: 1. Definition stage, 2. Services stage, 3. Architectural stage, and 4. Implementation stage. Numerous authors have developed similar techniques, but most of the techniques appear to be linear, without

feedback. The data tasks in developing the architecture of the IKASM-GRC include: data standards, sovereign data, and Forex data acquisition.

Using the described services, it was possible to show the progression from the development of an IDEF0 activity model to a more detailed IDEF1x data model. For the IKASM-GRC system to operate, intervention by sovereigns will be required into the Forex markets as shown. All the data that will be developed must also meet the guidelines of the IMF GDDS and SDDS which the majority of the IMF members have agreed to follow in submission of their data to the IMF. To have an operational IKASM-GRC will require the IMF to quickly access currency data from the Forex markets in a real time fashion. While sovereigns and their central banks have real time intervention abilities the IMF IKASM-GRC will be required to be able to access the various Forex markets for currency pair valuations.

This dissertation and other research papers have proposed that if the SDR becomes the global reserve currency, it will then be possible to implement an information and knowledge architecture which can provide stability to the SDR. The SDR is based at this time on four major currencies including the US dollar, UK pound sterling, Japanese yen and the EU euro. The IMF management of this basket of currencies is based on assigning percentages which represent of the sum of trade and currency reserves. Using this approach, the volatility of the SDR over recent periods has been less than the individual volatility of the four currencies. However, the variation of the SDR from a mean value has been as high as 2%.

These variations have not had a major impact on global liquidity, since the SDR represents less than 4% of all the global reserves. As the SDR becomes the only major global reserve currency, such a variation can possibly result in global financial instability to the variability in global liquidity. The proposed IKASM-GRC can provide a system and methodology which can stabilize the SDR independent of policy changes that the IMF's Executive Committee can implement.

Using historical and simulated time series data, this dissertation has shown the ability to maintain a stable range for the SDR under various scenarios and policies. It is possible to develop a system such as the proposed IKASM-GRC which can manage any new global reserve currency based on a basket of currencies, such as to reduce variability and provide stability for global liquidity.

This dissertation has presented an IKASM-GRC which if implement can be used to manage a global reserve currency based on the SDR. It has shown that this methodology can maintain the value of a basket of currencies within a specific range therefore providing stability in a single global reserve currency such as the SDR. This is independent of the number of currencies and policy chosen to derive the proportion of each currency within the basket. This approach can also provide a means by which the stability can be maintained without causing the loss of sovereignty.

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APPENDIX A: BIBLIOGRAPHY

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APPENDIX B: SDDS DATA COVERAGE, PERIODICITY, AND TIMELINESS"(IMF, 2007B)

This appendix presents the IMF data standards that would be used in developing

the IKASM-GRC. These standards have been implemented in all of the IMF sovereigns.

Coverage			Periodicity[1]	Timeliness[1]
Prescribed		Encouraged		
Category[2]	Components	Categories and/or Components		
Real sector				
GDP: nominal, real, and associated prices or price indices*	• GDP in current prices and GDP volume by production approach, with disaggregated components; or • GDP in current prices and GDP volume by expenditure category, with disaggregated components	Saving; Gross national income.	Q	Q
Production index/ indices**	Industrial, primary commodity, or sector, coverage as relevant		M (as relevant)	6W (as relevant) (M encouraged)
		Forward-looking indicator(s) (FLIs), for example, qualitative business surveys, orders, composite leading indicators	M or Q	M or Q
Labor market	• Employment, as relevant; • Unemployment, as relevant; and • Wages/earnings, as relevant		Q (as relevant)	Q (as relevant)
Price indices	• Consumer prices; and • Producer or wholesale prices		M	M
Fiscal sector				

General government operations (or public sector operations, as relevant)*	For subscribers using the *Manual on Government Finance Statistics 1986 (GFSM 1986)* framework:
	 • revenue;
	 • expenditure;
	 • balance (deficit/surplus);
	 • aggregate financing, disaggregated by:
	   – domestic financing (bank, nonbank);
	   – foreign financing
	
	 If disaggregation by domestic (bank, nonbank) and foreign financing is not feasible, disaggregated by:
	   – maturity, and either
	   – instrument or
	   – currency of issue
		For subscribers using the GFSM 1986 framework:
		 • Interest payments, indicated separately as a component of expenditure
		 • Financing of public enterprises separately identified
			A (Q encouraged)	2Q (Q encouraged)

	For subscribers using the *Manual on Government Finance Statistics 2001 (GFSM 2001)* framework, see Tables 4.1a, 4.1b, and 4.1c of *The Special Data Dissemination Standard: Guide for Subscribers and Users (SDDS Guide)*	For subscribers using the GFSM 2001 framework, see Tables 4.1a, 4.1b, and 4.1c of the *SDDS Guide*		

Coverage			Periodicity[1]	Timeliness[1]
Prescribed		Encouraged		
Category[2]	Components	Categories and/or Components		

Central government operations**	For subscribers using the *GFSM 1986* framework:
	• revenue;
	• expenditure;
	• balance (deficit/surplus);
	• aggregate financing, disaggregated by:
	  – domestic financing (bank, nonbank);
	  – foreign financing
	
	If disaggregation by domestic (bank, nonbank) and foreign financing is not feasible, disaggregated by:
	  – maturity, and either
	  – instrument or
	  – currency of issue
		For subscribers using the *GFSM 1986* framework:
		• Interest payments, indicated separately as a component of expenditure
		• Financing of public enterprises separately identified
			M	M

	For subscribers using the *GFSM 2001* framework, see Tables 4.1a, 4.1b, and 4.1c of the *SDDS Guide*	For subscribers using the *GFSM 2001* framework, see Tables 4.1a, 4.1b, and 4.1c of the *SDDS Guide*		
Central government debt	Total, with disaggregated components: • by maturity; and • by residency (domestic, foreign); or • by instrument; or • by currency of issue Non-central-government debt guaranteed by central government, as relevant	Debt-service projections: • Projected interest and amortization payments on medium- and long-term debt, provided quarterly for the coming four quarters, and annually thereafter; and • Quarterly data on projected repayments of short-term debt	Q	Q
	For subscribers using the *GFSM 2001* framework, see Tables 4.1a and 4.1d of the *SDDS Guide*	For subscribers using the *GFSM 2001* framework, see Tables 4.1a and 4.1d of the *SDDS Guide*		
Financial sector				
Depository corporations survey* (formerly, the analytical accounts of banking sector)	• Broad money (for example, M3); • Domestic claims, disaggregated into: (1a) net claims on general government (covering central, state, and local governments); or (1b) claims on nonfinancial public sector (if public sector operations represent the comprehensive framework for the fiscal sector); and (2) claims on other resident sectors • Net foreign assets Or • Total foreign assets • Total foreign liabilities	• Narrower (lower-ordered) monetary aggregates (such as M1 and M2); • Claims on other resident sectors, disaggregated into: (1) Other financial corporations; (2) Public nonfinancial corporations (not applicable if claims on nonfinancial public sector are disseminated); (3) Other nonfinancial corporations; and (4) Other resident sectors	M	M

Coverage			Periodicity[1]	Timeliness[1]
Prescribed		Encouraged		
Category[2]	Components	Categories and/or Components		
Central bank survey** (formerly the analytical accounts of the central bank)	• Monetary base; • Domestic claims, disaggregated into: (1a) net claims on general government (covering central, state, and local governments); or (1b) claims on nonfinancial public sector (if public sector operations represent the comprehensive framework for the fiscal sector); and (2) claims on all other resident sectors • Net foreign assets Or • Total foreign assets • Total foreign liabilities	Claims on other resident sectors, disaggregated into: • Other financial corporations; • Public nonfinancial corporations (not applicable if claims on nonfinancial public sector are disseminated); • Other nonfinancial corporations; and • Other resident sectors	M (W encouraged)	2W (W encouraged)
Interest rates	• Short-term and long-term government security rates; and • Policy-oriented rate (for example, central bank lending rate)	Range of representative deposit and lending rates	D	[3]
Stock market	Share price index, as relevant		D	[3]
External sector				
Balance of payments*	• Current account, disaggregated by: (1) Goods: exports; (2) Goods: imports; (3) Services: credit; (4) Services: debit; (5) Income: credit; (6) Income: debit; (7) Current transfers: credit; and (8) Current transfers: debit • Capital account, disaggregated by: (1) capital account: credit; and (2) capital account: debit • Financial account, disaggregated by: (1) direct investment abroad; (2) direct investment in reporting economy; (3) portfolio investment, assets; (4) portfolio investment, liabilities; (5) other investment, assets; (6) other investment, liabilities; and (7) reserve assets • Net errors and omissions	• Disaggregation according to the standard components of the IMF's *Balance of Payments Manual*, fifth edition (*BPM5*) • Under financial account, separately report data on financial derivatives; assets and liabilities	Q	Q

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Coverage			Periodicity[1]	Timeliness[1]
Prescribed		Encouraged		
Category[2]	Components	Categories and/or Components		
Official reserve assets**	• Total amount of official reserve assets, disaggregated into: (1) foreign currency reserves; (2) IMF reserve position; (3) SDRs; (4) gold; and (5) other reserve assets.		M (W encouraged)	1W
Template on International Reserves and Foreign Currency Liquidity**	• See Table 6.1 of the *SDDS Guide*.	• See the Pro Memoria component in Section III, item 4 of Table 6.1 of the *SDDS Guide*.	M (W encouraged)	1M (1W encouraged)
Merchandise trade**	Trade balance, disaggregated into: (1) merchandise imports; and (2) merchandise exports	Disaggregation by major components, with longer time lapse	M	8W (4–6W encouraged)
International investment position (IIP)*	Assets, disaggregated by: • direct investment abroad; • portfolio investment, disaggregated by: (1) equity securities; (2) debt securities; • other investment; and • reserve assets. Liabilities, disaggregated by: • direct investment in reporting economy; • portfolio investment, disaggregated by: (1) equity securities; (2) debt securities; and • other investment.	• Disaggregation of assets and liabilities according to the standard components of the IMF *Balance of Payments Manual,* fifth edition • Under assets and liabilities, separately report data on financial derivatives.[4]	A (Q encouraged)	3Q (Q encouraged)
External debt	• See Table 6.2a of the *SDDS Guide*.	• See Tables 6.2b and 6.2c of the *SDDS Guide*.	Q	Q
Exchange rates	• Spot rates; and • three- and six-month forward market rates, as relevant		D	[3]
Addendum: Population		Key distributions, for example, by age and sex.	A	...[5]

Source: IMF Statistics Department.

[1]Periodicity and timeliness: ("D") daily; ("W") weekly or with a lag of no more than one week after the reference date (or the end of the reference period); ("M") monthly or with lag of no more than one month after the reference date (or the end of the reference period); ("Q") quarterly or with lag of no more than one quarter after the reference date (or the end of the reference period); ("A") annual.

[2](*) Denotes comprehensive statistical frameworks; (**) denotes tracking categories.

[3]Given that data are widely available from private sources, dissemination of official producers may be less time-sensitive.

[4]The SDDS encourages subscribers to reclassify financial derivatives from a subcomponent of portfolio investment to a separate functional category, in line with the *International Investment Position—A Guide to Data Sources* (2002), the amendments to the *Balance of Payments Manual,* fifth edition (BPM5) published in *Financial Derivatives: A Supplement to the Balance of Payments Manual,* fifth edition (1993), and in the *Classification of Financial Derivatives Involving Affiliated Enterprises in the Balance of Payments Statistics and the International Investment Position (IIP) Statement, 2002.* Available on the IMF's website: http://www.imf.org/external/data.htm.

[5]Although the SDDS makes no specification for the timeliness of population, it does presume that data are disseminated at least once a year and on a regular basis.
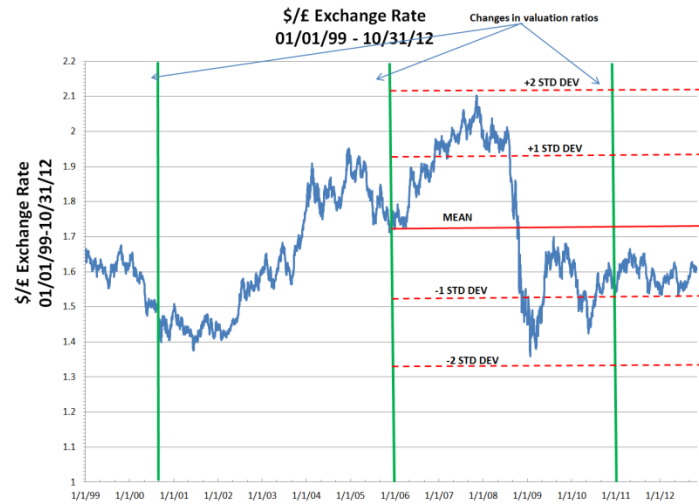
APPENDIX C: CURRENCY VARIATIONS

The currency distribution are based on IMF data (IMF, 2012b). The statistical distributions for all currencies have been computed using @Risk® for Excel® (Palisade, 2012, Microsoft, 2010).
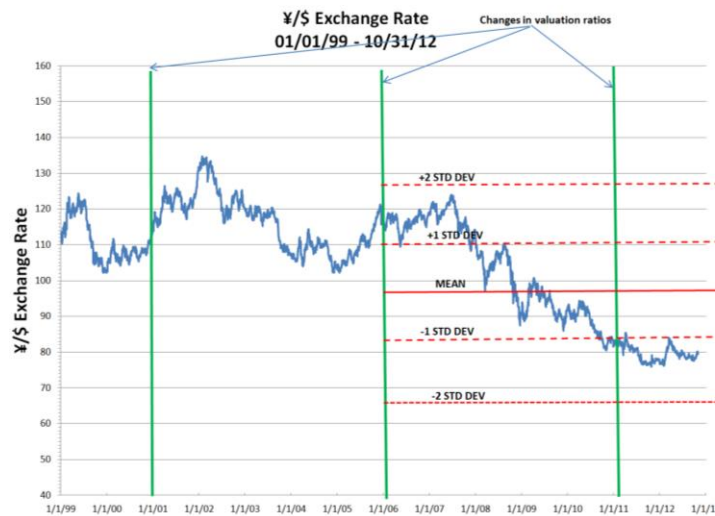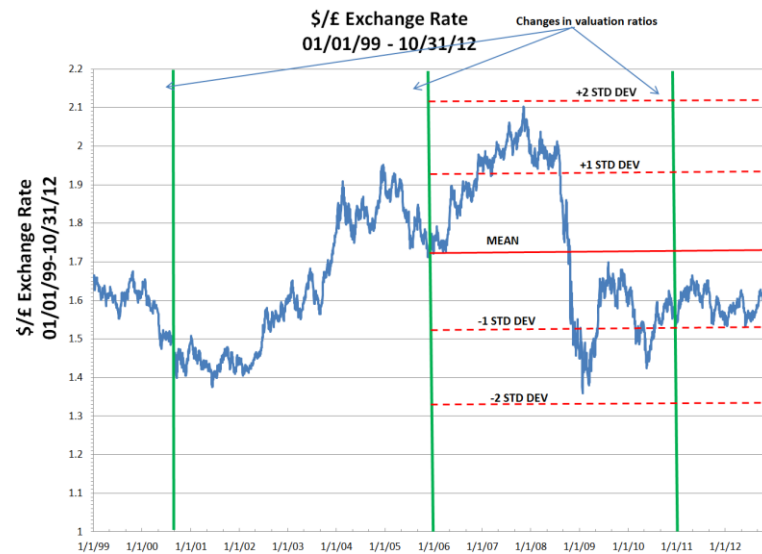
SDR – US Dollar
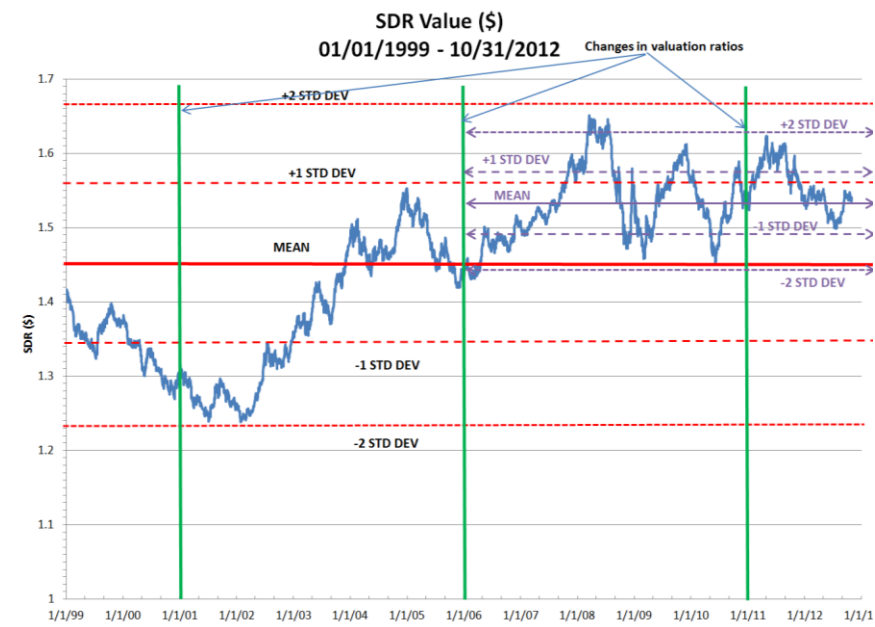
US Dollar – Euro Exchange Rates

Japanese Yen to US Dollar Exchange Rate

US Dollar to Pound Sterling Exchange Rate

$/£ Exchange Rate
01/01/99 - 10/31/12

APPENDIX D: CONSIDERED CURRENCIES

Distribution of Considered Currencies (Palisade, 2012, Microsoft, 2010)
(01/01/2010 to 12/31/2012)

Name	(CAD)	(CNY)	(EUR)	(JPY)	(KRW)	(RUB)	(SGD)	(CHF)	(GBP)	(USD-SDR)
Range	Model-Past!G6:G505	Model-Past!H6:H505	Model-Past!I6:I505	Model-Past!J6:J505	Model-Past!K6:K505	Model-Past!L6:L505	Model-Past!M6:M505	Model-Past!N6:N505	Model-Past!O6:O505	Model-Past!P6:P505
Best Fit (Ranked by AIC)	RiskWeibull(3.0483,0.0672...	RiskInvGauss(0.12840,0.16...	RiskBetaGeneral(1.6276,1...	RiskBetaGeneral(1.6768,3...	RiskTriang(1040.8,1123.1,1...	RiskBetaGeneral(1.6181,2...	RiskBetaGeneral(1.7588,2...	RiskExtValueMin(0.93402,0...	RiskBetaGeneral(2.4128,2...	RiskTriang(0.61262,0.64935...
Function	0.994394579	6.3867	1.339334998	79.76776368	1121.4	30.17476677	1.253561148	0.913473431	1.594226831	0.643663333
AIC	-2250.656	-1100.7506	-1324.5349	2064.3647	4664.3337	1717.1557	-2150.3385	-1685.5149	-2111.5563	-3023.266
Minimum	0.9343	6.2583	1.2075	75.8294	1040.8479	27.2329	1.1994	-Infinity	1.5278	0.6126
Maximum	+Infinity	+Infinity	1.4924	87.0508	1200.2988	34.1133	1.3181	+Infinity	1.6685	0.669
Mean	0.9944	6.3867	1.3393	79.7678	1121.4157	30.1748	1.2536	0.9135	1.5942	0.6457
Mode	0.9933	6.3047	1.3253	78.5637	1123.1004	29.6162	1.248	0.934	1.5917	0.6493
Median	0.9939	6.3509	1.3371	79.5186	1121.8271	30.0789	1.2526	0.921	1.5937	0.6448
Std. Deviation	0.0215	0.115	0.0669	2.2282	32.5532	1.5562	0.0268	0.0457	0.0284	0.0117
Graph										

| Correlation	(CAD)	(CNY)	(EUR)	(JPY)	(KRW)	(RUB)	(SGD)	(CHF)	(GBP)	(USD-SDR)
(CAD)	1.000									
(CNY)	-0.341	1.000								
(EUR)	-0.475	0.514	1.000							
(JPY)	-0.297	0.090	0.075	1.000						
(KRW)	0.619	-0.210	-0.529	-0.235	1.000					
(RUB)	0.588	-0.358	-0.726	-0.326	0.555	1.000				
(SGD)	0.539	0.113	-0.187	-0.064	0.711	0.300	1.000			
(CHF)	0.405	-0.177	-0.750	0.078	0.512	0.636	0.429	1.000		
(GBP)	-0.643	0.268	0.628	0.279	-0.642	-0.595	-0.575	-0.504	1.000	
(USD)	0.504	-0.503	-0.956	0.016	0.549	0.721	0.253	0.812	-0.626	1.000

APPENDIX E: TIME SERIES SIMULATION

Examples of extreme simulation excursions based on time series for 1/1/2010 to 12/31/2012 using @Risk (Palisade, 2012) simulation program with Microsoft® Excel® (Microsoft, 2010). This indicates the relative stability provided by the IKASM-GRC system. These simulations were based on an algorithm developed within Microsoft® Excel® and time series distributions. The algorithm used values of the currency pairs and computed the value of the SDR based on the prior day Rule O-1 proportions. If the value of the SDR was outside of a given range the proportions of the currencies was adjusted to bring the value within the acceptable limits. Due to a delay of one day between calculations the initial algorithm some of the extreme simulations produced a slight excursion of the SDR slightly beyond the set range. In general the algorithm maintained a relatively constant SDR valuation.

SDR Value
Comparison of Simulations
1 Year Forecast
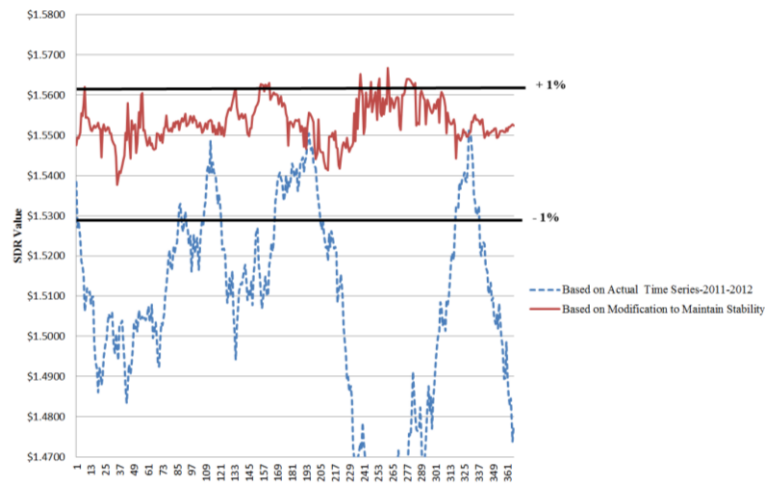
SDR Value
Comparison of Simulations
1 Year Forecast

176

SDR Value
Comparison of Simulations
1 Year Forecast

SDR Value
Comparison of Simulations
1 Year Forecast

177

SDR Value
Comparison of Simulations
1 Year Forecast

SDR Value
Comparison of Simulations
1 Year Forecast
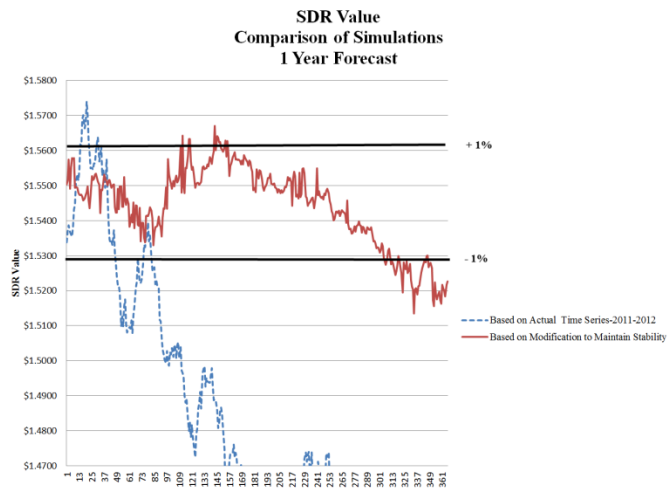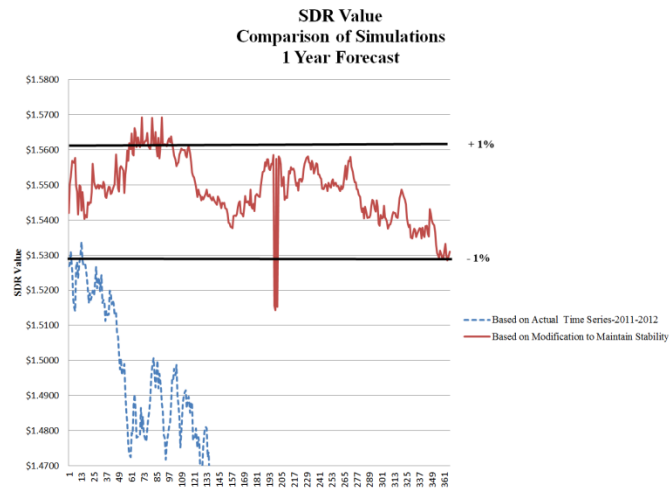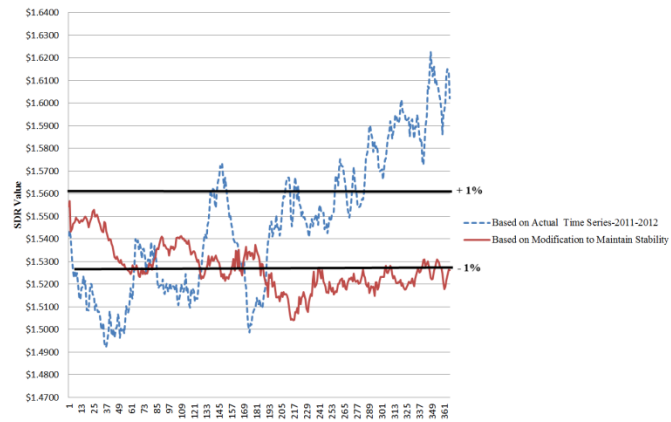
SDR Value
Comparison of Simulations
1 Year Forecast
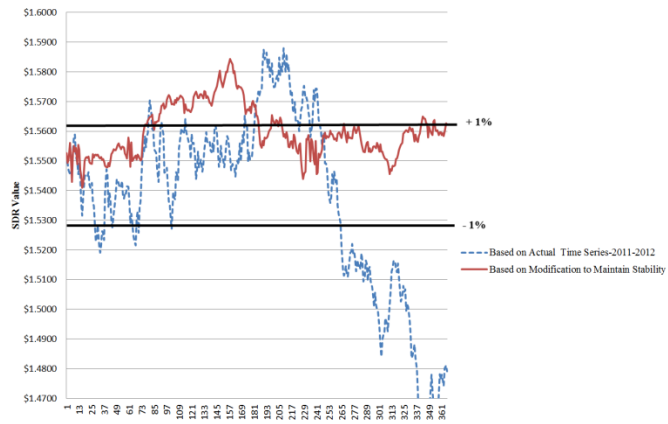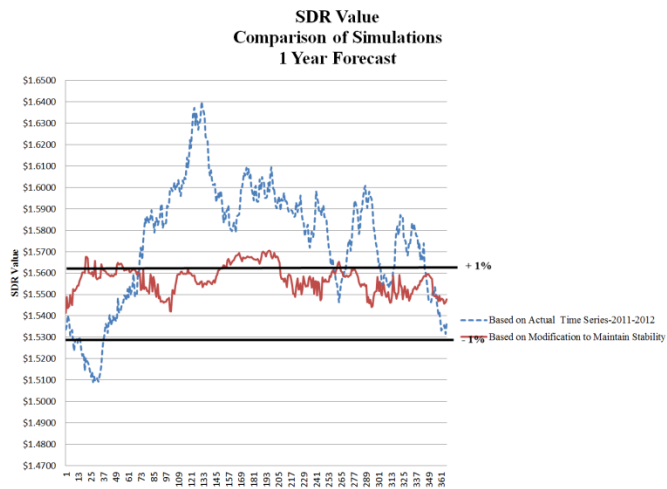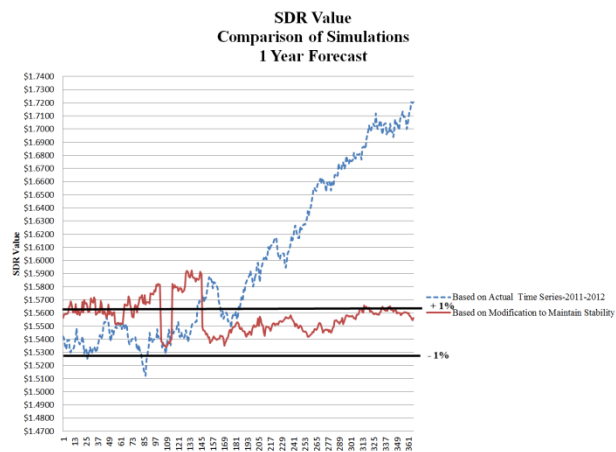
SDR Value
Comparison of Simulations
1 Year Forecast

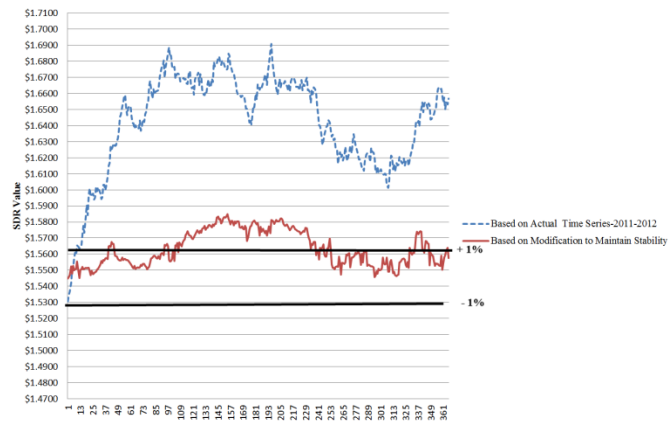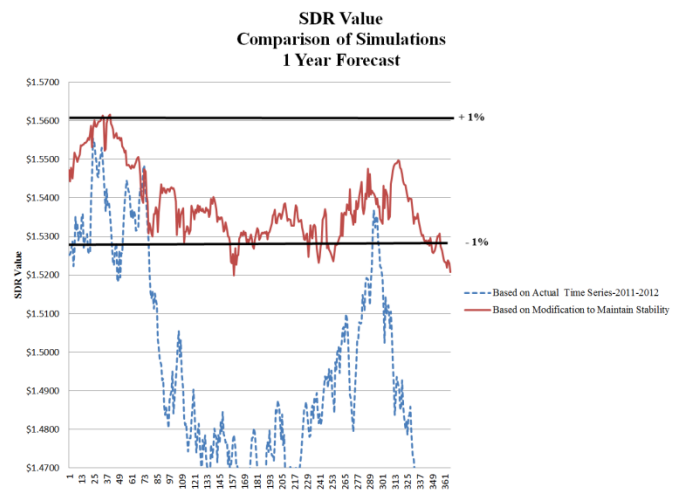SDR Value
Comparison of Simulations
1 Year Forecast

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