Measuring the Optimal Level of Foreign Reserves and Sovereign Risk in Pakistan

PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS

Submitted by: Ayesha Mudassar

Supervised by: Dr. Ahsan ul Haq Satti

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Department of Business Studies

Pakistan Institute of Development Economics

PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS, ISLAMABAD

CERTIFICATE

This is to certify that this thesis entitled **Measuring the Optimal Level of Foreign Reserves and Sovereign Risk in Pakistan."** submitted by **Ms. Ayesha Mudassar** is accepted in its present form by the Department of Business Studies, Pakistan Institute of Development Economics (PIDE) Islamabad as satisfying the requirements for partial fulfillment of the Degree of Master of Philosophy in Economics and Finance.

Supervisor:

Dr. Ahsan Ul Haq
Assistant Professor,
PIDE, Islamabad

Internal Examiner:

Dr. Naseem Faraz
Senior Research Economist,
PIDE, Islamabad.

External Examiner:

Dr. Sajid Amin Javed
Research Fellow,
SDPI, Islamabad

Head, Department of Business Studies:
MPhil Economics and Finance

Dr. Nadeem Ahmad Khan
Assistant Professor,
PIDE, Islamabad.

December 17, 2019

Dedication

This thesis is wholeheartedly dedicated to my parents, my beloved father **Mudassar Iqbal** who always had confidence in me and offered me encouragement and support in all my efforts and to my loving mother **Sofia Mudassar**, her support, encouragement, and constant love have sustained me throughout my life.

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Acronyms

SBP	State Bank of Pakistan
GDP	Gross domestic product
HP-filter	Hedrick-Prescott filter
Sted /resv	Short-term external debt to reserves
	Fiscal deficit to Gross Domestic Product
Vfpi	Volatility of foreign portfolio investment
T-bills	Treasury bill
FDI	Foreign Direct Investment
$gdpt^s$	Smooth GDP

Abstract

During the past few decades, economic policy makers observed an enormous increment in central bank's holding of international reserves. The main reasons behind reserves accumulation includes precautionary motive, achieving confidence and to improve credit ratings. High reserves accumulation will largely reduce country's ability to address their basic issues i.e. health, education and outstanding economic problems. Th study examines optimal level of international reserves for Pakistan over the period 1982-2017 by including sovereign risk associated with default on external debt. For this purpose, we used annual data and adopt reserve optimizing model which require minimization of central bank's total cost of holding reserves. The cost function includes cost of positive reserves, cost of reserve depletion and their associated probabilities. For estimating cost of reserve depletion, the study utilized H-P filter method and imposed range of annual output loss associated with global economic crisis as cost of reserve depletion for the entire period. In order to compute absolute and marginal probabilities, the risk premium equation has been carried out. Through estimating risk premium equation, it is observed that two independent variable that is short-term external debt to reserves and volatility of foreign portfolio investment is significant at 5% level .The approach estimation suggests that simulated optimum reserves remains greater as that of actual reserves till 2004-05 and then in subsequent periods, actual reserves are much higher than optimum reserves. The monetary authority should maintain optimal level of reserves so that the cost of holding reserves should not exceed its benefits. Therefore, appropriate steps should be taken by SBP in order to restructure management policies regarding reserves to enhance its performance.

CHAPTER 1

Introduction

1.1 Background

During the past few decades, economic policy makers observed an enormous increment in central bank's holding of international reserves. Due to expanded globalization and integrated financial markets, the matter of international reserves is experiencing worldwide attention. International reserves are also called foreign reserves, foreign currency reserves and external reserves. These are the foreign assets which are controlled by nation's central bank or other monetary authority for reducing exchange rate volatility and meeting balance of payment needs. (Nzotta, 2009) describes that occurrence of foreign exchange reserves is due to the greater foreign exchange receipts as compared to that of foreign exchange payments.

Historically, international reserves comprise of gold and sometimes silver. However, under the framework of Bretton Woods, the US dollar also considered as nation's international reserves because it started functioning as reserve currency. From the time period 1944-1968, conversion of US dollar into gold was allowed using the system of Federal Reserve. After 1968, central bank would only convert US dollar into gold through official gold reserves but after 1973, conversion to gold ceased. Then no one even the institutions could convert the major currencies even US dollars into gold. Like other commodities, individuals and central bank needs to purchase gold from markets. As the currencies including US dollars are no more allowed to convert into gold from official gold reserve, but they still can play a role as international reserves.

During 1990's although many countries move to flexible exchange rate regime which means less need of foreign reserves in order to prevent currency attacks but still, they hold stockpiles of international reserves in order to avoid exchange rate volatility. Since 1997 Asian

Financial crisis, economies began massive build-up of reserves and it has accelerated sharply. When 1999 ended, World reserve holdings (excluding gold) were equivalent to 15 weeks of imports which is 56% higher as compared to that of end of 1960 and 20% higher than they were at the start of 1990s. Emerging market economies especially the Asian countries hold a significant share of world foreign reserves. By august 2018, countries like China, Japan, Taiwan, South Korea, and Hong Kong hold more than $5000 billion as foreign reserves. In 2007-08, the world faced another crisis, but this time extra expansionary monetary and fiscal policies were adopted by the authorities of developed countries. This process created appreciation of currencies in some emerging markets. The rise in value of currency and chances of losing competitiveness led to prevention of capital inflows and more accumulation of reserves.

Table 1.1: Largest Reserves Accumulating Economies (2018)

Rank	Country	Foreign Reserves (in billions of US dollars)
1	China	$3210.0
2	Japan	$1259.3
3	Switzerland	$804.3
4	Saudi- Arabia	$501.3
5	Russia	$460.6
6	Taiwan	$459.9
7	Hong Kong	$424.8
8	India	$403.7
9	South Korea	$402.4
10	Brazil	$379.4

Source: IMF, 2018; *Central Bank of the Republic of China

Table 1.2: Accumulation of Reserves in Emerging Economies (Billions $)

Position	Countries	2018	2013	2007	2002	1996
1	China	3210.0	3254.6	1202	291	107
2	Japan	1259.3	1304.1	909	461	217
3	Hong Kong	424.8	305.2	135	112	64
4	India	412.9	304.2	309.7	76.1	26.4
5	South Korea	402.4	326.2	244	121	34
	Total	**5709.4**	**5494.3**	**2799.7**	**1061.1**	**448.4**

Source: Department of Investment Services in South Korea

From the above data and tables one can easily conclude that since Asian financial crisis of 1997-98, monetary authorities of emerging economies have significantly increased their holding of foreign reserves. Of these countries, China, Japan, Hong Kong, India and South Korea were the world's biggest holders of foreign exchange reserves in 2018. By the end of 1996 they held $448.4 billion, which were increased to the level of $1061.1 billion by the end of 2002, further increased to $2799.7 and $5494.3 billion in 2007 and 2013 respectively. By the end of 2018, the cumulative value held was $5709.4 billion. The possible reasons for that unusual increase in international reserves includes self-insurance, financial anxieties, precautionary demand, sovereign risk and mercantilist motive.

There has been a debate whether to increase foreign reserves or cut them back. Some authors argued that reserves help to achieve confidence, reduce sovereign risk and improve credit ratings (Azar & Aboukhodor, 2017). The main reason behind reserves accumulation is precautionary i.e. self-insurance against abrupt loss of accessibility to international capital markets and sudden stop in capital inflows (Aizenman & Lee, 2005; (B. E. G. Mendoza, 2010). Countries which hold large amount of reserves has to face lower cost of borrowing and these stockpiles also reduce the probability of occurrence of crisis (Rodrik∗, 2006). Supporters of high reserves holding also argue that contraction in economy due to crisis is much higher when we compared it with cost of accumulating reserves.

However, all these benefits come at some cost. Authors argue that reserves held earn moderate return as compared to government own cost of borrowing (Nancy & Joshua, 2002). As emerging economies are less developed nations, high investment is necessary for growth so if these reserves are invested in beneficial sectors, it will be helpful in achieving prospective returns (Afzal, 2010). High reserves accumulation will largely reduce country's ability to address their basic issues i.e. health, education and outstanding economic problems

(Osabuohien & Egwakhe, 2008). Hence managing international reserves is a challenging problem for the central banks of high reserve holding economies.

Generally, countries maintain reserves so to stabilize exchange rate and reduce its volatility. (Elhiraika & Ndikumana, 2007). (Aizenman & Lee, 2005) say that countries accumulate reserves not only for the sake of managing exchange rate effectively but also for enhancing trade and achieving competitiveness at world level. Some countries have also maintained large stockpiles of reserves in order to boost investors' confidence and to enhance economic growth. In post-East Asian crisis, reserves were held for other motives such as buffer stock in order to meet any outflow due to financial crisis (Nancy & Joshua, 2002). Foreign reserves are used by countries to support monetary and foreign exchange policies, in order to safeguard the stability of currency and to smoothen the normal functioning of domestic and external payment system. Furthermore, reserves are increasingly considered as insurance against domestic weaknesses and external uncertainties. So, reserves held by different countries for different reasons at different times.

The debate regarding what comprises of optimal reserve holding remains unresolved in the previous studies. While some countries are trying to maintain huge stockpiles of reserves, others are struggling to have adequate level of reserves which is based on several international standards. (E. Mendoza & Oviedo, 2004) talked about the 'rule of thumb' while deriving the optimal level of reserves. This rule suggests that reserves should be at least equal to three months' imports. Another criterion named Import based reserve adequacy recommends that a minimum benchmark for reserves adequacy should be equal to 30% of broad money or 4 months of import. Likewise, (J. O. de B. Wijnholds & Kapteyn, 2001) proposed that countries with fixed or managed exchange rate system should hold reserves which is equivalent to 10% and 20% of broad money.

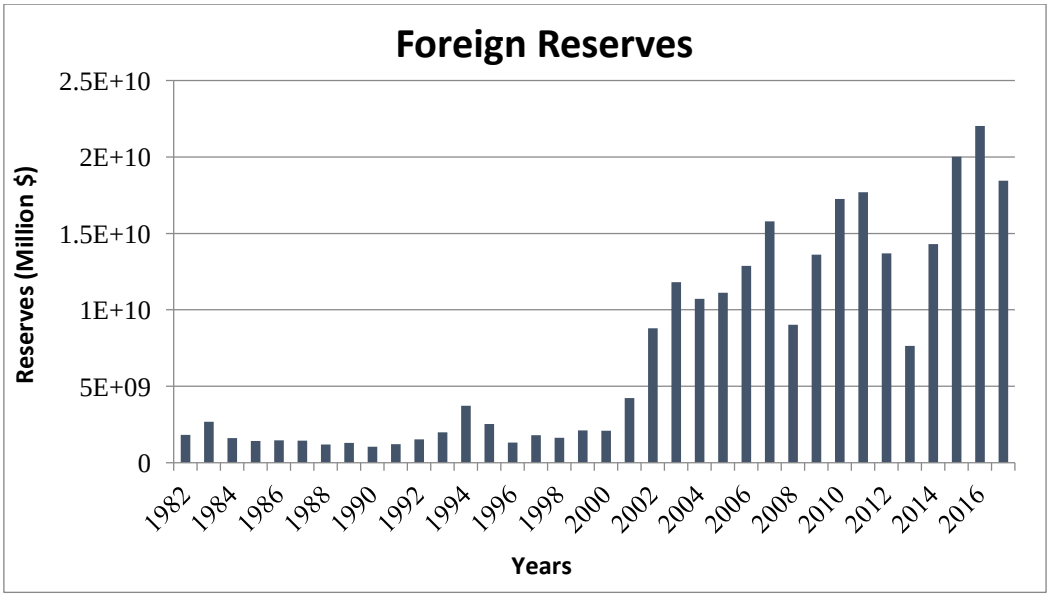
The above traditional reserves adequacy concept might not portray optimal level of foreign reserves holdings. Therefore, estimation of optimal level of reserve accumulation is necessary. This study attempts to apply an empirical approach in evaluating the optimal level of reserves holdings in case of Pakistan. This estimation is made while considering global disturbances, cost of positive reserves and sensitivity of international capital markets. This would help in determining the optimal level of reserves and then understanding the comparison between actual and simulated optimal reserves. The knowledge of how fiscal variables such as volatility of portfolio investment, fiscal deficit to GDP and short-term external debt to reserves may affect country's sovereign risk.

1.2 The Rationale behind Pakistan's accumulation of foreign reserves

Every country is different from others in numerous ways; i.e. population size, geographical location, political regime, wealth, phase of development, share in international businesses and so on. But despite of these identifiable factors, a commonly observed thing in all countries is the requirement of accumulating foreign exchange reserves. Whether the country is small or large, or how much a country involved in trade, holding of international reserves is something which is important for almost all. Even the developed and rich countries have their own strong currency, but even they hold large stockpiles of foreign reserves and they are considered as important determinant of their GDP. Small and emerging economies also involved in massive accumulation of international reserves and their contribution towards growth is much higher. Traditional justifications for the accumulation of foreign reserves include debt servicing, formal backing for the domestic currency, provisions against disasters or emergencies, tool of exchange rate and monetary policy, mercantilist motive, self-insurance and persistence of current account.

The SBP mentions that reserves accumulation is necessary for many reasons. Firstly, is to make Pakistan more creditworthy. As SBP accumulation of reserves has increased as

compared to that of 1999, this helped in improving country rating and has direct influence on foreign investor's decision. Secondly, reserves are used to pay servicing cost of debt. In past, SBP and government used to raise further debts in order to make servicing debt payments. This approach of borrowing more money (debt) at the time of payments led to reducing confidence of credit agencies' in the country. A high level of reserves seems as an assurance to the creditors that country will pay its debt obligations on time. Thirdly reserves help to deal with any unforeseen shock i.e. self-insurance. In time periods (May 1998 and 2000-2001), Pakistan reserves were inadequate to meet even its partial withdrawal of foreign currency deposits. This situation leads to depreciation of currency to 18-20 percent which tremble the confidence of market. By September 2001, country accumulates around $3.2 billion reserves and then no speculative attack on rupee has observed. Fourthly, reserves are used as a tool to maintain confidence in exchange rate policy. As Pakistan liberalized their foreign exchange market, so the objective of stable exchange rate can only be achieved if SBP has adequate reserves to intervene in market when required.



Source: World Bank Database 1982-2017/ Graph constructed by Author

Figure 1.1: Pakistan's Foreign Reserves (1982-2017)

The above graph demonstrates the country's foreign reserves since 1982. Pakistan's foreign reserves started increasing from 2001 due to an increase in aid from the US, and continued to increase until 2011. In 2012, reserve fell by $6 billion. The following year when the PMLN came to power, the party borrowed money from lending agencies which helped in subsequent improvement in reserves of Pakistan. A major increase also occurred in 2015, when Pakistan received an inflow of $717 million under the Coalition support funds. In 2017 Pakistan's reserves increased by $2.5 billion due to the floating of dominated bonds in the international market.

1.3 Problem Statement

Since East-Asian crisis, a noticeable increase in holding of international reserves can be observed especially in low income and developing nations. Countries increased their holding of external reserves so that they could intervene in foreign exchange markets for the purpose of reducing exchange rate volatility, and improving creditworthiness. Pakistan also involved in large accumulation of foreign reserves since 2011. As Pakistan, a developing nation, require higher investment for growth and needs to focus on basic issues. The policy makers have become more worried as these accumulations are made regardless of their cost, they have on the economy of the accumulating nation So, this study therefore analyses the optimal level of reserves for Pakistan so that the cost associated with reserves accumulation might not exceeds its benefits.

1.4 Objectives of the study

The accumulation of foreign reserves is being carried out irrespective of their opportunity cost and the effect the accumulation has on economies. Studies shows that especially low-income countries are engaged in massive accumulation of external reserves. Critics argue that holding of reserves helps in reducing economy's vulnerability to external shocks. Pakistan,

being a developing country, relies heavily on international trade which consequently led to the demand of foreign reserves. The main objectives of this study are:

- To determine optimal level of reserves through incorporating cost of default, opportunity cost and absolute and marginal probabilities.
- To make comparison between actual reserves and simulated optimum reserves based on maximum and minimum output range.
- To check the deviation between time varying optimum reserves based on rolling regression and simulated optimal reserves.

1.5 Significance of Study

After Bretton Woods collapse, a noticeable increase in holding of international reserves is observed especially in emerging and developing countries. Since East-Asian crisis, countries all over the world especially the emerging and developing countries are involved in massive accumulation of external reserves. Pakistan, a developing country has made large accumulation of foreign reserves. Moreover, it is generally believed that the event of September 11 has contributed greatly in building-up such large stockpiles of reserves. At the same time, the government of that time claims that the accumulation of reserves is resulted from the reforms started by the government in 1999 onwards. Pakistan started accumulating foreign exchange reserves excessively in 2001 and continued this practice till the end of 2007. This strategy seems to be very supportive for the overall economy and has shown number of significant positive impact on real and nominal growth rate, growth of exports, fiscal and current account deficit, and has also contributed in stabilizing many macroeconomic indicators including exchange rate and its volatility. At the same time, economy has to face different cost and effects of accumulating reserves. Being a developing country, Pakistan needs higher investment for enhancing growth, so by investing in

productive sectors would lead to more prospective returns. High reserves accumulation will largely reduce country's ability to address their basic issues i.e. health, education and outstanding economic problems (Osabuohien & Egwakhe, 2008). Hence managing international reserves is a challenging problem for the central banks of high reserve holding economies. There are many studies available on external reserves but not much for determining optimal level of international reserves in case of Pakistan. Hence this study adds to existing knowledge and provides suggestions on how to determine the optimal level of reserves.

1.6 Thesis Organization

The rest of the study is organised as follows; Chapter two provides theoretical background and empirical evidences for our analysis. Chapter three comes up with data description, theoretical method and econometric methodology. Chapter four provides empirical results and in chapter six we summarize the study along with policy recommendations.

CHAPTER 2

Literature Review

2.1 Preamble

This chapter examines related literature regarding optimal reserve holdings. Section 2.1 gives the basic definition of foreign reserves, section 2.2 explains the concept of optimality of reserves. Section 2.3. mention about the calculation of foreign reserves, section 2.4 explains how reserves are being used. Section 2.5 refer to ownership of foreign reserves and section 2.6 and 2.7 provide theoretic and empirical evidences respectively.

2.2 Definition

Foreign reserves are the external resources which are held by a central bank of country or other monetary authority in order to satisfy the needs of balance of payment and to achieve macroeconomic stability. They popularly knew as external reserve, foreign currency reserves and international exchange reserves. It consists of gold reserves, foreign deposits, external banknotes and T-bills, foreign government securities, special drawing rights (SDRS), and stock position in IMF. Foreign exchange reserves have incredible importance in countries having fixed exchange rate regime and, in those countries, who wants to avoid costly adjustment costs.

2.3 Optimality of reserves

The optimization of reserves is obtained through equating the marginal cost to marginal benefits of reserves accumulation. The cost of holding reserves can be described as the potential income forgone for holding foreign exchange in reserves rather than utilizing it in other purposes (i.e. investing in productive sectors so that prospective returns could be

earned), with economic benefits, while the benefits is identified as the avoidance of output losses associated with Balance of Payment (BOP) and exchange rate fluctuations.

2.4 How to calculate foreign reserves

The International Monetary Fund (IMF) has recently modified calculations regarding foreign reserves. These guidelines indicate that reserves are those outsider's assets which are held and controlled by nation's monetary authorities in order to finance external imbalance and to stabilize exchange rate fluctuations. Given the range of Assets, we are basically isolating liquid international reserves. These reserve assets must be acceptable for payment of obligations at all times and their value must be known with certainty. Assets that are illiquid are therefore excluded from reserve assets.

According to current methodology, GIR is now being used for the calculation of foreign reserves. GIR can be obtained by subtracting illiquid assets and non-reserves foreign assets from total foreign assets. Before the amendments, a net concept of international reserves was used. (The old calculation of international reserves was: Central Bank's total foreign assets minus short-term foreign-currency liabilities).

For the purpose of the IMF programs Quantitative Performance Criteria, NIR (net international reserves) was introduced as a new measure. NIR is obtained by subtracting monetary authority' short- term foreign currency liabilities and stock of IMF credit from GIR. Both GIR and NIR are acceptable measures of international reserves, and are vital indicators of stability and resistance of external sector.

2.5 How foreign Reserves are being used

There are several ways through which central banks use foreign exchange reserves:

Firstly, nations utilize their stock of reserves so as to maintain home currencies at a specific rate. A case of China, which pegs it currency (Yuan) to the dollar. When China holds more dollars, it often raises the worth of dollar as compared to that of the Yuan. As a result, Chinese exports became cheaper than the products made in America, which increases sales.

Secondly, the countries with floating exchange rate also use the reserves in order to maintain their currency value lower than the dollar. They do this for indistinguishable reasons from those with fixed-rate frameworks. A good example is of Japan whose central banks buys US T. bills so as to keep the value of its currency (Yen) lower than that of dollar. Likewise, China, it enhances Japan's trade and economic growth by making the exports cheaper.

Thirdly, countries hold reserves in order to maintain liquidity during crisis period. Natural disasters may suspend exporters' ability to produce goods in short-run. As a result, the economy has to face reduction in the supply of external currency. This currency is essential for making payments of imports. So, there is a need of proper exchange process by the central bank where external currency can be converted to home currency in order to make payments for imported goods.

Additionally, if country's economy is uncertain, the foreign investors might not be willing to keep their deposits in a risky environment and their withdrawing will cause a shortage in external reserves. This led to an increasing pressure on the currency to depreciate as less individuals need it. As a result, economy's imports become expensive and therefore led to persistent high price level.

In order to have stable market and to attain confidence of foreign investors, the central bank needs to supply foreign currency and buys home currency for supporting the value of domestic currency and for avoiding inflation.

Fourthly, countries use reserves to meet its debt obligations. These include servicing cost of external debt, sovereign debts, commercial debts, financing of imports and to absorb any un-expected capital movement.

2.6 Ownership of Foreign Reserves

The issue regarding ownership of external exchange reserves has always been a subject of numerous debates. In most countries, foreign reserves are owned and decision of managing these reserves is taken by the central bank. However, there are some countries (UK, Japan) where government, the state-owned reserves and the decisions for their governing were undertaken by the government (usually by the Ministry of Finance).

It would be more appropriate to assume that central bank manage foreign reserves directly or being an agent of government. A central bank makes an independent decision regarding domestic currency (i.e. exchange rate policy, dollarization system, intervention) will off course have impact on management of foreign reserves. So, a coordinated action of central bank and government should be there and this is more necessary as that of ownership of foreign reserves.

2.7 Theoretical Evidence

Theories on the roots of Foreign Exchange Reserves

There is a theory of international financial integration which suggests that capital should move from developed countries to developing countries. The developed countries can be labeled as high capital-labor ratios while low capital-labor ratio is mostly observed characteristic of developing or low-income countries (Eswar & Raghuram, 2008). This process would help in facilitating investment and providing access to international capital

market. As a result, foreign investors will get high returns on their investments and growth in developing countries will improve (Eswar & Raghuram, 2008). The liberalization of capital account made this whole process of capital flows possible. The capital account provides record all the inflows and outflows of capital between domestic and foreign residents. It includes foreigner's investments, loans and changes in external exchange reserves.

(Eswar & Raghuram, 2008) observed that in mid-1990s, most of the economists were of the view that liberalization of capital account would help in encouraging flows of capital and subsequently lead towards achieving economic stability. In spite of this, the Asian crisis of 1997-98 made tremendous capital flows and huge volatility of currency. South Korea, a financially strong country at that time also faced the same situation. From that time onwards, the liberalization of capital account became arguable among policy makers.

(Aizenman, Radziwill, & Brian, 2004) estimated how the amount of capital gets affected through expansion of financial integration. Their results illustrate that about 90% of capital is self-produced in case of developing countries. Additionally, (Eswar & Raghuram, 2008) argue that during last three decades, the non-industrial countries, whose reliance on foreign resources was less but even they grew at almost same rate as that of countries who has more reliance. Therefore, this requires a deep investigation in order to explore the causes behind this huge accumulation of assets.

Various authors like (E. Mendoza & Oviedo, 2004), (J. D. B. Wijnholds & Sondergaard, 2007), (Gupta & Mitra, 2004) and Oluba (2008) have encouraged theories regarding accumulation of foreign reserves. Some of them are discussed below:

(ii) Macro and Micro Foundations

There is a Micro/Macro theory which actually consist of the controversies among Monetarists and Keynesians. The monetarists say that the main factors behind holdings of external reserves include excess demand for home currency and expansion of international trade.

According to Keynesians, foreign reserve holdings help in achieving improvement in current account and it positively affect the level of aggregate input. This impact only holds in short-run and will influence the exchange rates only in nominal terms. (Fukuda & Kon, 2010) mentioned that in long-run, a complete adjustment of real exchange rates to the equilibrium values is observed.

(ii) Self-insurance

The significant increase in international reserves in several EMEs throughout the 1990s following Sudden Stop episodes, financial liberalization and increasing trade led to the revival of linking international reserves holdings to precautionary motives. Maintaining reserves as a form of self-insurance is not something a new, (Heller, 1966) also identified the same reason behind the sizeable holding of foreign reserves.(Ben-Bassat & Gottlieb, 1992) reformulated precautionary approach and consider that reserves depletion might lead to default on external debt and consequent output decline. Thus, it is necessary to incorporate cost of reserves depletion against opportunity cost faced due to positive reserves.

There is a self-insurance theory which advocates that countries accumulate reserves so that they can deal with the unexpected disturbances (Elhiraika & Ndikumana, 2007), (Fukuda & Kon, 2010). (Clements, Bhattacharya, & Quoc, 2003) mentioned that as far as country's current account and exchange rate are stable, ratio of short-term external debt to reserves seems to be an important indicator of reducing crisis vulnerability. (E. Mendoza & Oviedo, 2004) also examined a self-insurance reason behind large accumulation after Asian crisis. The study includes 65 low-income countries and the results portrayed that self-insurance framework proves to be a more reasonable reasoning for the recent increase in reserve holdings in these countries.

(Allen, 2013) analyzed South Korea's foreign reserve accumulation after the 1997 Asian financial. Hence, foreign reserve is held as a self-insurance in order to deal with future crisis. Reserves holdings help countries whose currencies are less liquid and have less capital market access in order to reduce the risk and impact of current account shocks or capital.

Another strand of the literature sees international reserves accumulation as a form of precautionary savings against sudden stops and rollover risk (Aizenman & Lee, 2005) ; (E. G. Mendoza, Terrones, & Terrones, 2009); (Laura & Kanczuk, 2007); (Jeanne & Rancière, 2006); (Bianchi, Hatchondo, & Martinez, 2016); (Hur & Kondo, 2015).

(iii) Mercantilist motive

Previous studies suggest that one of the most important reasons behind foreign reserves accumulation is mercantilist motive which talks about the aggressiveness and competitiveness in international trade. It basically relate with expansion of trade and the incremental in transactions internationally, which subsequently increases reserves (Gupta & Mitra, 2004). For enhancing global transactions, Mercantilists recommend that numerous countries hold international reserves as an instrument for handling exchange rate efficiently. (Dooley, Folkerts-Landau, & Garber, 2004) assign this motivation uniquely to China, where export promotion and consequently the deteriorated currency encourage sizeable holding of reserves. Additionally, foreign reserves proved as a guarantee for FDI and for all the loss associated with this investment in tradable sector (Dooley et al., 2004).

(Aizenman & Lee, 2005) observe reserves holdings from the mercantilist viewpoint. They argue that accumulation of reserves not only contribute for the effective management of exchange rate but also promote trade and international competitiveness by maintaining low exchange rate. According to them, reasonable holdings of foreign reserves help to improve confidence of investors and thereby encouraging investment and so the growth.

(Polterovich & Popov, 2002), (Akpan, 2016)argue that by improving capital productivity and ratio of investment/GDP, foreign reserves are helpful in boosting growth. (Yeyati, Schmukler, & van Horen, 2008), also observed that in developing countries, one of the important reasons behind recent increase in stockpiles of international reserves is to control appreciation of real exchange rate so that objective of competitiveness can be preserved.

2.8 Empirical Literature

The issues regarding international reserves accumulation have attained a great attention since 1960s. The earlier studies begins by the work of Heller (1966) , Pagan (1968) and (Frenkel & Jovanovic, 1981), who observed foreign reserves holdings as a process of fulfilling external obligations and provide a framework of ratio of reserves to imports. (Heller, 1966) determines the optimal level of reserves and describes it as a point at which cost of adjustment and cost of financing an external imbalance become minimized. He linked the optimal reserves holdings to three variables i.e. propensity to import, opportunity cost of holding reserves and stability of international accounts. Both marginal propensity to import and opportunity cost have negative relationship with reserves while an increase in stability of international accounts provides an incentive to increase the stock of reserves.

(Clark, 1970), (Kelly, 1970) and (Hamada & Ueda, 1977) tried to modify some assumptions, but their main results was almost the same as of (Heller, 1966) They also derived optimal level of reserves and concluded that Bop volatility has positive relationship with optimality while opportunity cost and marginal propensity to import have negative relationship with it. Meanwhile, (Pagan, 1968) adapts an inventory theory and revised the model suggested by (Heller, 1966). It can be observed that two methodologies are almost same in determining the optimal reserves formula.

(Frenkel & Jovanovic, 1981) extended (Heller, 1966) idea and by considering inventory management principles, the author established a model for determining optimal level of reserves. The model focuses the important role of two costs. The first cost is opportunity cost i.e. as the income forgone for not investing the reserves in higher interest income earning Instruments. The second is the cost of adjustment i.e. a cost an economy has to face when reserves are depleting. For determining optimality of reserves, we need to minimize both costs. However, both the variables i.e. opportunity cost and adjustment cost have negative relationship when author linked them with reserves.

Due to financial liberalization and increasing trade in period of 1990s, holding reserves for the purpose of precautionary purpose has gained a greater significance in international reserves analysis. (Ben-Bassat & Gottlieb, 1992) adapt the conditions of post- Bretton Woods's era and allow for flexible exchange rate and capital flows. As the above approaches talked about adjustment cost in case of reserves depletion while (Ben-Bassat & Gottlieb, 1992) shift the focus towards the cost of sovereign default. There is a possibility that a country might default on its debt obligations after a period of external borrowing. So, cost of default would be output forgone and losing of accessibility to international capital market. Therefore, the author said that while determining optimal level of reserves, sovereign risk needs to be considered as it is a significant element.

In wake of East Asian financial crisis of 1997-1998, the issue of "reserve adequacy" has gained more attention. The researchers and policymakers have also become concerned and proposed some simple policy for insuring the economies which are more vulnerable to crisis. (Feldstein, 1995) argues that holding of reserves can serve as an insuring mechanism against abrupt stops in EMEs capital market. (Greenspan, 1999) mention that reserve level should be equal to country's short-term external debt and suggest it as a measure of optimality of

reserves. Following the concepts by (Feldstein, 1995) and (Greenspan, 1999), (Eichengreen & Mathieson, 2000) capture the currency composition of international reserves for EMEs.

After 1997-98 Asian financial crisis, the Asian economies accumulate reserves in order to prevent future occurrences of similar major disturbances. One of the main aspects of most Asian EMEs after crisis is that they are consistently focusing on current account surpluses. (Dooley et al., 2004) consider current account and mention a theory regarding the determinants of international reserves. A country's current account surplus may appreciate the worth of local currency and current account surplus relationship could be positive or negative when we relate it with reserves demand. If a central bank continuously buys foreign reserves during the periods of current account surplus, it definitely enhances the country's reserve level.

On the other hand, (Aizenman & Lee, 2005) presented that current account surplus and external reserves are negatively related. For them, the current account surplus means that a country is less vulnerable to disturbances, and therefore a decline in level of reserves is observed. If a country faces a situation of current account deficit, then central bank has to sell reserves for purchasing domestic currency and this will cause international reserves to decline.

(Stavros & Caballero J., 2007) talked about the emerging economies where they evaluate the relationship between holding of reserves and abrupt stop in capital inflows by developing a dynamic model. In EMEs, deficit in current account is assumed to be a common phenomenon and these economies generally acquire capital from international markets. But their need for capital inflows is subject to the risk of abrupt changes.

(Nunes, Sapriza, & Ceyhun, 2010) analyze three factors in their study and propose dynamic stochastic general equilibrium (DSGE). The factors include financial globalization, output volatility and self-insurance against a sudden stop. They derive a formula for the optimal

level of reserves and conclude that the main reasons behind reserve accumulation are financial globalization and the risk associated with sudden stop.

(Laura & Kanczuk, 2007) jointly examines the analysis of holding reserves and debt. For this purpose, the study constructs a stochastic dynamic equilibrium model for emerging economies. They conclude that reserve accumulation is not an optimal policy nor it has any important role in quantitative aspects. The main implications recommend that there is a need to focus on sovereign's motivations, constraints and incentives as they are important for analyzing the levels of foreign reserves. Another option suggested by authors for making an economy less vulnerable to crisis is by decreasing the level of country's debt.

(Calvo, 2011) also explore the issue of optimal international reserves while incorporating the effects of reserves on output cost and probability of a sudden stop. In analysis, the key factor was global financial environment and then determined the optimal level of reserves as the one where returns are maximized.

(J.R., 2011) presents a model of an insurance against abrupt stops and determines optimal level of reserves. While determining optimal level of reserves, the key factors include risk aversion behavior of consumers, the size and probability of occurrence of sudden stops, cost of accumulating reserves and output growth. Their results show that ratio of optimality of reserves to GDP is found to be 9% for 34 developing countries for the period 1975-2003. However, for individuals it might be larger or smaller depending on the parameters. The JR model is somehow different from the above-mentioned models used for determination of optimality of reserves. JR provides a formula for optimal level of reserves in terms of output whereas (Stavros & Caballero J., 2007) and (Nunes et al., 2010) solve their models numerically. JR recommends that insurance against abrupt stop is the main reason for maintaining reserves rather than precautionary or mercantilist motive.

(Zhou, Yan, & Luo, 2018)provide simulations and estimations regarding optimality of foreign exchange reserves by considering possible shocks to China's economy because of further opening of financial market and sudden stop of capital inflows. For this purpose, a framework is constructed for analyzing optimal scale based on a utility maximization of foreign exchange reserves. The results indicate that the main reason behind rapid growth of Chinese foreign reserves is its double international payment surplus, which creates long term appreciation expectation expectations for exchange rate. In case of the sudden stop of capital inflows, the average optimal scale of the foreign exchange reserve was calculated to be 13.53% of China's gross domestic product (GDP) between 1994 and 2017. The effect of the foreign exchange reserve maintaining the state's financial security is becoming more and more prominent.

(K.P., 2013) by using the quarterly data for the period 1994-2010, the study empirically derived the condition of optimality of international reserves for India by including sovereign risk as an important element. The reserve optimizing approach proposed by (Ben-Bassat & Gottlieb, 1992) was employed which requires central banks to minimize the total cost of holding reserves. The total cost includes two components: costs of positive reserves and costs because of reserve depletion. Results indicate that actual reserves remain higher than the optimum criteria over the sample period considered, except during 1997-98.

(KHAN & AHMED, 2005) used vector error correction model (VECM) and analyzed Pakistan's demand for reserves for the period 1982:1-2003:2. They present that reserves demand function is stable in long-run. Results suggest that Bop volatility and imports have positive relationship with reserves while opportunity cost vary inversely with reserves. All the relationships found significant in determining long-run external reserves.

(Hussain I., 2002) mentions that reserves accumulation helps Pakistan in many ways. Achieving exchange rate stability, the reversal of flight capital, interest rate reduction, a

sustained decline in prices and reduction in debt burdens are all the benefits of reserves holdings. Building of reserves helped in keeping competitiveness in exports and therefore the world market share of Pakistan is maintained.

(Jalil & Bokhari, 2008)tried to determine optimal demand of foreign reserves in Pakistan over the period 1995-2005. By using buffer stock model, they found that opportunity cost of reserve holdings played a greater role as compared to that of volatility of reserves in determining optimal level of reserves. The result is consistent with the concept that increased capital mobility explains the precautionary motive of reserve holdings. The result also indicates that reserve accumulation in the period considered is largely due to non-debt reserve inflows.

In case of Pakistan, there are various studies on external reserves but not much appears to have been done to determine optimality of international reserves. Hence, this study adds to existing knowledge and provides suggestions on how to incorporate sovereign risk while determining optimal level of reserves.

CHAPTER 3

Data and Methodology

3.1 Preamble

This chapter mentions the methodology used in this study. Section 3.2. refer to theoretical framework, Section 3.3 mentions about the data collection while section 3.4 provide information regarding the econometric methodology.

3.2 List of Variables and Data Sources

Variables	Definition	Data Source
KIBOR	the KIBOR rate is the Karachi Inter Bank Offered Rate, which is equal to the average interest rate at which term deposits are exchanged between prime banks in the Pakistani interbank market.	The data for unemployment rate has been extracted from the site of state bank of Pakistan.
Treasury Bills	These are government bonds or debt	The data for T- Bills has been

	securities with maturity of less than a year.	obtained from the site of SBP.
Discount rate	Discount rate is the minimum interest rate set by national bank for lending to other banks.	The data for debt has been extracted from the World Bank.
Call money rate	We take credit as the loan given out to private investors by the banks, which the borrower has to return later on.	The data for credit has been obtained from the World Bank.
Volatility of foreign portfolio investment *(vfpi)*	Foreign portfolio investment refers to securities and other financial assets held by investors in another country.	Conditional variance of net portfolio investment is used as proxy for volatility of Foreign Portfolio investment *(vfpi)*.
Short term external debt *(sted)* to Foreign reserves *(resv).*	Short-term external debt is the external debt having an original maturity of less than one year. Foreign reserves are the external assets held by country's monetary authorities.	Short term external debt to reserves ratio has been constructed by taking a ratio of sted to resv and data has been obtained from WDI.
Pak-US$ exchange rate	An exchange rate is the value of one nation's currency versus the currency of another nation.	The exchange rate has been used for the purpose of converting variables into Rupees and has taken from Pakistan Economic survey.
GDP (million rupees)	GDP is the final market value of all the goods and services produced within a country in a specific time period.	The data for GDP has been taken at current and constant prices from Pakistan Economic Survey.
Fiscal Deficit (PKR)	Fiscal deficit refers to the difference between total revenue and total borrowings of the government. It is an indication that government's income is small in comparison with its spending.	The data for Fiscal deficit is obtained from Pakistan Economic Survey.
Risk Premium	The market risk premium is the additional return an investor will receive (or expects to receive) from holding a risky market portfolio instead of risk-free assets.	The data for Risk premium has been obtained from the World Bank.

Table 3.1: List of variables, definitions and their sources.

3.2 Theoretical Model

In this study, we are interested to calculate optimality of reserves for Pakistan by utilizing the reserve optimizing model, which was proposed by (Ben-Bassat & Gottlieb, 1992). This framework was used by (K.P., 2013) to determine optimal international reserves in India

between 1994 and 2008. The B-G model implies that a country can optimize its reserves by cutting down the total cost linked with reserves accumulation. The total cost of accumulating reserves comprises of two components:

i. Cost of reserves depletion

ii. Cost of positive reserves

We are interested to minimize the total cost so the cost function can be present as follows:

Minimize

$$E(T_C) = \pi C_D + (1- \pi) C_P \text{ and } C_P = r^{opp} R \quad (1)$$

Where,

E is the expectation parameter

T_C denotes total cost

C_D is the cost due to reserves depletion

π represents probability of reserves depletion

$(1 - \pi)$ implies probability due to positive reserves

C_P refers to total opportunity cost of holding reserves

r^{opp} is the interest rate forgone for holding reserves (i.e. that can be earned otherwise if reserves were converted and invested somewhere in productive sectors) and R is total stock of reserve holdings.

As developing countries borrow from international markets, so in order to maintain credit rating they require a high level of reserves. Due to increased dependence on international trade and finance, economies become more vulnerable to global economy disturbances, which in turn affect the stock of foreign reserves and the value of domestic currency. Thus, every economy has a probability (π) that such disturbance will cause reserves depletion. Reserves depletion might lead an economy to face higher servicing cost on external debt, thus creating a possibility that an economy might default on external debt. This might lessen the

supply of foreign credits which in turn further deplete the level of reserves. As a result, economy has to face immense shortage of debt and contraction in output. Hence, cost of reserves depletion can be seen as output decline because of defaulting on external debt.

Countries with high level of reserves have fewer chances of defaulting on its external debt so it is assumed that there is an existence of negative relationship between reserves holdings and probability of default. The probability of default can be expressed as:

$$\boldsymbol{\pi = f\,(R, Y)} \;\; \boldsymbol{and} \; \frac{\partial \pi}{\partial R} = \pi_{rs} < 0 \qquad \textbf{(2)}$$

Where R is the stock of reserve holdings and Y is the collection of economic variables that determine economy's default risk. π_{rs} is assumed to be negative because high level of reserves indicates fewer chances of default risk.

Optimality in reserves is achieved when expected total cost of reserves holdings is at its minimum level. For arriving at optimal level of reserves, we need to differentiate expected cost function with respect to stock of reserves holdings. Taking 1st order derivative of Eq. (1) with respect to R and equating it to zero we have:

$$\frac{\partial E(TC)}{\partial R} = \frac{\partial \pi}{\partial R} C_D + (1-\pi)\frac{\partial ropp\ R}{\partial R} + r^{opp} R \frac{\partial (1-\pi)}{\partial R}$$

$$= \frac{\partial \pi}{\partial R} C_D + (1-\pi)\, r^{opp} - \frac{ropp\ R\, \partial \pi}{\partial R}$$

$$= (C_D - r^{opp} R)\, \pi_{rs} + (1-\pi)\, r^{opp} = 0 \qquad \textbf{(3)}$$

$$R^* = \frac{(1-\pi)}{\pi_{rs}} + \frac{C_D}{r^{opp}} \qquad \textbf{(4)}$$

Where R^* is optimal level of reserves which is dependent on the marginal and absolute probabilities of default ($\pi_R \; and \; (1-\pi)$), cost of default (C_D) and opportunity cost (r^{opp}). Below we are describing the components of optimal level of reserves:

3.2.1. Cost of default (C_D)

(Ozyildirim & Yaman, 2005), (K.P., 2013) used the same methodology and viewed cost of reserve depletion as cost of default on external debt. They estimated cost of default as GDP loss due to financial crisis through considering the fact that low reserves might threaten economy's ability to meet its debt obligations in period of crisis. As a result, country's rating in terms of credit is likely to drop and the economy would be operating below its pre-crisis period and thus be on lower growth during crisis and immediate post crisis period. Therefore, GDP forgone due to financial crisis is assumed to be a somehow better proxy for measuring the cost of default as most developing countries are borrowing economies. Hence, in this study, we calculated cost of default as Pakistan's output contraction due to global economic crisis 2007-2008.

3.2.2 Probability of default (π)

(K.P., 2013) estimated probability of default as:

$$\boldsymbol{\pi} = \frac{e^{fn}}{1+e^{fn}} \qquad \textbf{(5)}$$

Where fn is the function of economic variable (i.e. output and import value, reserves to imports, and external debt to exports) that determines the likelihood that a country might default on debt obligations. Hence f is defined as the odds of default. Following (Feder and Just, 1977), B-G equates odds of default to discounted risk premium in perfect capital market:

$$\frac{\boldsymbol{\pi}}{1-\boldsymbol{\pi}} = \frac{1-i^{f}}{1+i^{r}} \qquad \textbf{(6)}$$

Where,

i^{f} =rate of return on risk free asset (KIBOR)

i^{r} =rate of return on risky asset (Discount rate)

By substituting Eq. (3) in Eq. (4), we get:

$$\frac{\boldsymbol{\pi}}{1-\boldsymbol{\pi}} = e^{fn} \qquad \textbf{(7)}$$

Applying log on both sides:

$$\log\left(\frac{\pi}{1-\pi}\right) = \log\left(e^{fn}\right)$$

Therefore,

$$fn = \log\left(\frac{1-i^f}{1+i^r}\right) \quad (8)$$

Following (Edwards ,1986), (Nogués & Grandes, 2001), and (Ferrucci, 2003), the risk premium equation can be written as:

$$\left(\frac{1-i^f}{1=i^r}\right) = \gamma_0 + \gamma_1 \ vfpi + \gamma_2 \left(\frac{sted}{resv}\right)_t + \gamma_3 \left(\frac{fcd}{gdp}\right)_t + \varepsilon_t \quad (9)$$

Where $\left(\frac{1-i^f}{1+i^r}\right)$, $vfpi$, $\frac{sted}{resv}$ and $\frac{fcd}{gdp}$ are risk premium, volatility of foreign portfolio investment, short-term external debt to reserves, and fiscal deficit to GDP. γ_1, γ_2 and γ_3 are the parameters and ε_t is the error term.

i. *Spread:* The discounted risk premium$\left(\frac{1-i^f}{1+i^r}\right)$ in a perfect capital market can be explained as the spread between returns on risky assets and returns on risk free assets. A high spread is required in order to encourage investors for investing in risky assets.

ii. *Volatility of Portfolio investment***:** This explains how volatility of foreign portfolio investment affects risk premium. It takes into consideration the mobile nature of international capital flows and the relationship between returns and risk on international borrowings. Sentiments regarding development of economy leads towards abrupt changes in the direction of capital flows. Consequently, VPFI and the spread are positively related because investors are supposed to pay a high premium in order to compensate them for investing in risky financial assets.

iii. *Short-term external debt to reserves:* This captures how government's ability to meet its short-term debt obligations influences the risk premium. The country's ability to meet its short-term debt obligation is determined through existing stock of reserves. The higher the reserves, the greater will be the government capacity to meet its short-term debt obligations and thus lower will be the default risk. A lower default risk

means low compensatory risk must be paid to international investors for investing in risky financial asset. So, we expect a positive relationship between ratio of sted-res to reserves and risk premium.

iv. *Fiscal deficit to GDP:* This captures how government inefficiency regarding management of operations affects risk premium. A high fiscal deficit to GDP indicates that the government is even unable to fund current expenditures through its operations and need to acquire loan in order to cover funding gap. If this is persistent it means heavy reliance on debt and signals inability of government to service its external debt and thus require high compensatory premiums for investing in such risky macroeconomic environment. Thus, risk premium and ratio of fiscal deficit to GDP are positively related.

From the above discussion, we theoretically found a positive relationship exists between risk premium and all three dependent variables.

3.4 Econometric Methodology

3.4.1. HP-filter Method

There are many methods available for the calculation of cost of default (C_D) but following (K.P., 2013) this study adopted the H-P filter method in order to estimateC_D i. e. , output contraction due to financial crisis,. The cost of default used in this paper is the estimated output gap associated with the 2008 global economic crisis. This was imposed as cost of reserve depletion throughout the sample period.

The smoothed series of t^s was computed by filter method of (Hodrick & Prescott, 1997), by minimizing the variance of $gdpt^a$ around $gdpt^s$subject to second difference of $gdpt^s$.

$$\sum_{i=t}^{n}(\boldsymbol{gdpt^a - gdp\,t^s})^2 + \cap \sum_{t=2}^{n-1}(\Delta\, \boldsymbol{gdpt} + 1^s - \Delta \boldsymbol{gdpt^a})^2 \qquad \textbf{(10)}$$

Where,

$\mathrm{gdpt^a}$ = actual GDP

$gdpt^s$ = smooth GDP

$\cap$= smoothing parameter

n = sample size

3.4.2. Johansen's Cointegration Method

In the early 1980s, Engle and Granger introduced the cointegration analysis which involves modelling of variables with both long-term and short-term relationships. In order to examine the time series using cointegration, the series should be non-stationary at level and integrated of order 1, which means that the series became stationary after differentiating once. Cointegration analysis can be utilized in order to assess the co-movement among long-term variables within a model. Firstly, the analysis of cointegration helps in establishing long-term relationship through estimating long-run equilibrium. Next, correlations within error correction model are supposed to be estimated.

There are mainly two cointegration techniques that have been continuously used in the past studies: 1) Eangle Granger Two Step Estimation Method and 2) Johensen's Maximum Likelihood Method. Our study uses the johansen's Method mainly due to the shortfalls of Eangle Granger Two Step Estimation Method as it requires a large sample size and can only run on two variables. As we are examining total four variables, so Johensen's cointegration better suits the data as it can estimate more than two variables. If the cointegration analysis illustrates that there is presence of cointegrating equations in the model, it indicates that any short-term change will not move away the tested series in the long-term and eventually it will get back towards equilibrium.

Using the Johensen's Cointegration approach, this study estimated discounted risk premium equation. The equation is presented in matrix form below:

$$\Delta \boldsymbol{Y_t} = \sum_{t=1}^{p-1} \boldsymbol{\theta} \Delta \boldsymbol{Y_{t-1}} + \Phi\, \boldsymbol{Y_{t-1}} + \boldsymbol{\gamma D} + \boldsymbol{\mu_t}. \qquad \textbf{(11)}$$

Where:

- Y is the vector of dependent variables
- θ, Φ and γ are the matrix of parameters, Φ determine long-run relationship
- D represents the vector of independent variables i.e. constant term, $vfpi$, *sted-resv* and *fcd-GDP*.
- Δ is the change operator
- μ_t represents error term

Johansen (1991) suggests two test statistics for checking the existence of cointegrating equations: i) the Trace Test and ii) the Maximum Eigenvalue Test. Both of these tests help in facilitating hypothesis test of short-run to long-run adjustment.

3.4.3 Rolling Regression

The *Rolling regression* analysis implements a linear multivariate rolling window regression model. The analysis aims to model the relationship between a *dependent* series and one or more *explanatory* series. In rolling regression, we define a window of a certain size that will be kept constant through the calculation. The analysis preforms a regression on the observations contained in the window, then the window is moved one observation forward in time and process is repeated. As such, many regressions will be performed as the window is rolling forward.

CHAPTER 4

Results and Discussions

4.1. Introduction

This chapter consist of all the results we obtain through testing. Section 4.2 mentions the results of descriptive statistics conducted for each variable. Section 4.3 provides the results obtained through econometric methodologies. Sub-section 4.3.1 indicates the results obtained through HP- filter method for cost of default. Sub-section 4.3.2 illustrates the results of probability of default acquired after employing Johnsen's Cointegration technique. Sub-section 4.3.3 shows the comparison between actual and optimal level of reserve holdings and sub-section 4.3.3 refers to results obtained through rolling regress for time varying optimal level of reserves.

4.2. Descriptive statistics

In order to observe the trend of our variables and to present large amount of data in a simpler form, we need to examine the descriptive statistics. The descriptive statistics include measure of central tendency and measure of spread. Here, we are supposed to calculate arithmetic mean, standard deviation and stability ratio of each considered variable. These are presented in table 1 below:

Table 4.1: Descriptive Statistics

Variables	Years	Arithmetic Mean	Standard Deviation	Stability Ratio
GDP **(Rs million)**	1982-1986	444,586	93,336	20.99
	1987-1991	830,419	146,670	17.66
	1992-1997	1,873,406	430,298	22.96

	1998-2002	3,620,935	780,442	21.55
	2003-2007	6,672,486	1,535,630	23.01
	2007-2012	15,405,483	3,796,970	24.64
	2013-2017	27,187,057	3,626,833	13.34
Short-term external debt to reserves **(Ratio)**	1982-1986	0.05	0.03	51.69
	1987-1991	0.10	0.02	22.52
	1992-1997	0.05	0.04	80.16
	1998-2002	0.02	0.01	47.16
	2003-2007	0.002494	0.000851	34.11
	2007-2012	0.002632	0.0001145	43.49
	2013-2017	0.004325	0.000992	22.94
Fiscal deficit to GDP **(Ratio)**	1982-1986	0.07	0.01	17.30
	1987-1991	0.08	0.01	11.43

	1992-1997	0.06	0.03	13.99
	1998-2002	0.05	0.02	25.47
	2003-2007	0.03	0.01	23.02
	2007-2012	0.06	0.01	19.80
	2013-2017	0.05	0.01	22.96
Volatility of portfolio investment	1982-1986	1.94641E+15	1.32742E+15	68.19
	1987-1991	7.32588E+15	1.08159E+16	147.64
	1992-1997	2.86344E+17	2.96756E+17	103.63
	1998-2002	5.39436E+16	5.79794E+16	106.92
	2003-2007	7.0413E+17	6.2138+17	88.24
	2007-2012	4.66837E+17	9.43389E+17	202.08
	2013-2017	2.66172E+18	2.07807E+18	78.07
Risk premium	1982-1986	0.66	0.31	47.26
	1987-1991	1.37	0.39	29.07

	1992-1997	0.74	0.52	71.08
	1998-2002	0.28	0.07	25.17
	2003-2007	0.07	0.02	33.12
	2007-2012	0.03	0.02	54.85
	2013-2017	0.07	0.02	33.31
Treasury Bills	1982-1986	8.78	0.81	9.21
	1987-1991	9.37	1.42	15.22
	1992-1997	14.12	3.48	24.64
	1998-2002	10.64	3.39	31.62
	2003-2007	6.22	3.39	54.57
	2007-2012	12.28	0.85	6.98
	2013-2017	8.69	1.30	14.98

Source: Author's own estimation[1]

[1] The data was sectioned into 7 total sections and the mean was calculated by adding the values and dividing them by the total number of observations. The standard deviations are found out using the

As we can see from the table that both the arithmetic mean and standard deviation for GDP are showing an upward trend. The lower values of standard deviation as compared to that of mean values indicate that the data values are clustered near to mean value. For the period 2009-2010, the stability ratio shows highest percentage of 24.64% which means that the values of GDP are greatly spread out in this period. The stability ratio was lowest in 2013-2017 where its value was 13.34, indicating that values of GDP are closer to their mean value. The stability ratio of GDP is presented in table below:

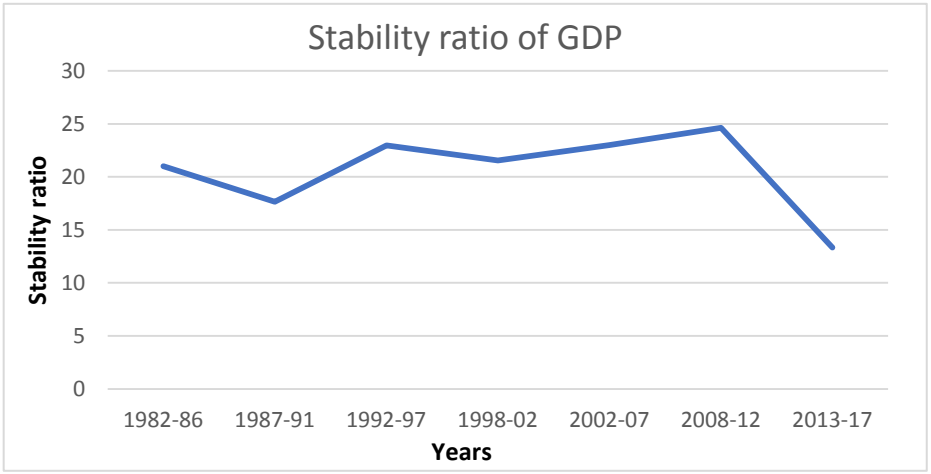
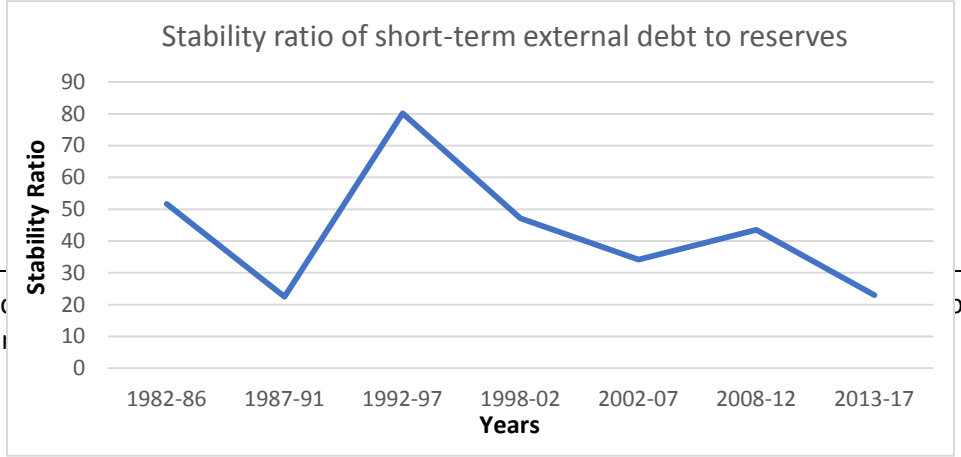


Figure 4.1: Stability ratio of GDP (Source: Author's own estimation)

In case of short-term external debt to reserves, the highest mean value is observed in period 1987-91. Overall, the lower values of standard deviation illustrate that the values are clustered close to mean. The stability ratio reaches all time higher in period 1992-97 which represents that data is greatly spread out in this period. After peak point, various fluctuations can be observed in the graph below:



stand ... the particular mean

Figure 4.2: Stability Ratio of Short- term External Debt to Reserves (Source: Author's Own estimation)

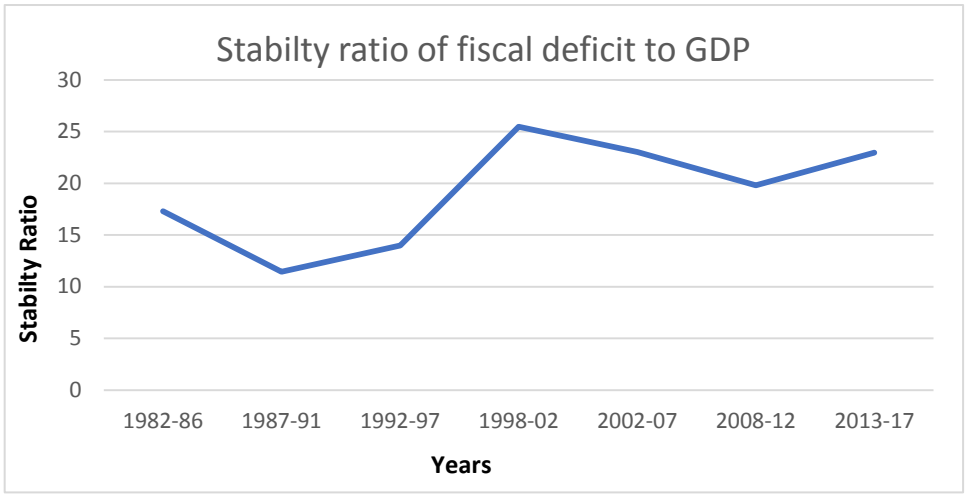


Figure 4.3 : Stability Ratio of Fiscal Deficit to GDP (Source: Author's Own estimation)

Fiscal deficit to GDP shows both increasing and decreasing trend. The mean values are quite close to each other. The standard deviation overall shows lower values illustrating that the data value are clustered near rhe mean value. The stability ratio generally shows lower values for fiscal deficit to GDP data, indicating that the data values are closer to mean. Overall, a mixed trend in this ratio is observed showing the highest value in 1998-02 and lowest in period 1982-86.

The values of arithematic mean of T-bills are close to each other. The highest and lowest mean values is observed in period 1992-97 and 2013-17 respectively. The standard deviation values are low describing that the values are clustered close to the mean va lues. The stability ratio reachs all time high in 2002-07 and then decline reaching to lowest in 2008-12. High value shows that the data values are greatly spread out while low values indicate that values are closer to mean.

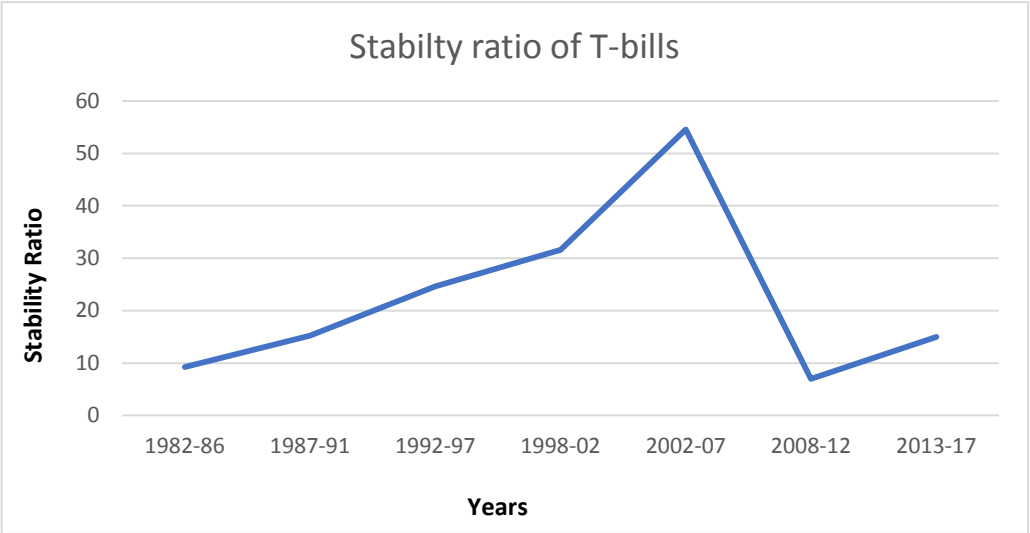
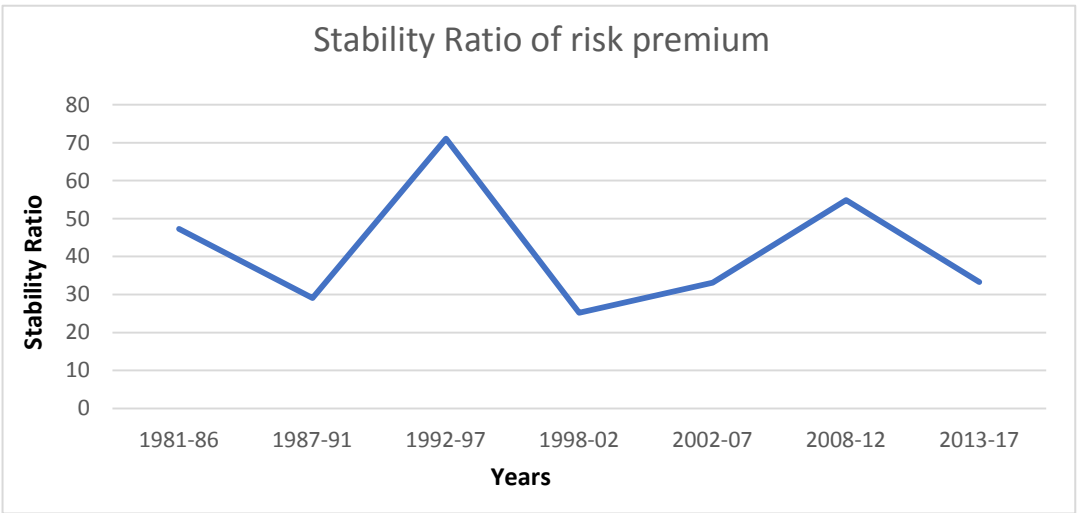


Figure: 4.4: Stability Ratio of T-Bills (Source: Author's Own Estimation)

Risk premium has both increasing and decreasing trend. The highest and lowest mean value can be observed in period 1987-92 and 2007-12 respectiveely. Overall, the lower values of standard deviation potray that the values are clustered close to the mean. Various fluctuations are there in risk premium and graph of stability ratio indicating peak values in 1992-97and



lowest values in 1998-02. Overall, a mixed trend is observed in risk premium.

Figure 4.5. Stability Ratio of Risk Premium (Source: Author's own estimation)

The mean values of volatility of portfolio investment are greatly diverse and highest mean value can be seen in the period 1987-91 while the lowest mean values are that of the period 1982-86. The standard deviation values are also higher pointing that the data points are

greatly spread out from their mean values. Likewise, the stability ratio also shows higher values indicating that that data values are greatly deviate from their mean values. The highest stability ratio is observed in period 2008-12 and lowest in 1982-86.

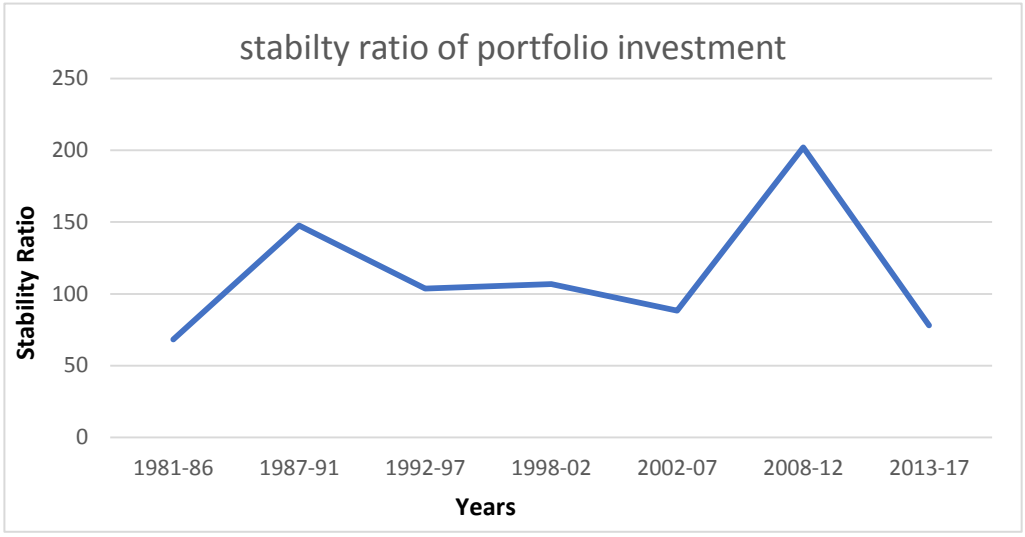


Figure 4.6: Stability Ratio of Portfolio Investment (Source: Author's own estimation)

4.3. Empirical results

4.3.1 Estimation of cost of default:

Using the H-P filter method, we measured the cost of default by calculating the range of GDP forgone associated with global economic crisis of 2008. In order to estimate the extent of output loss we took two series of GDP:

i. GDP at current factor cost

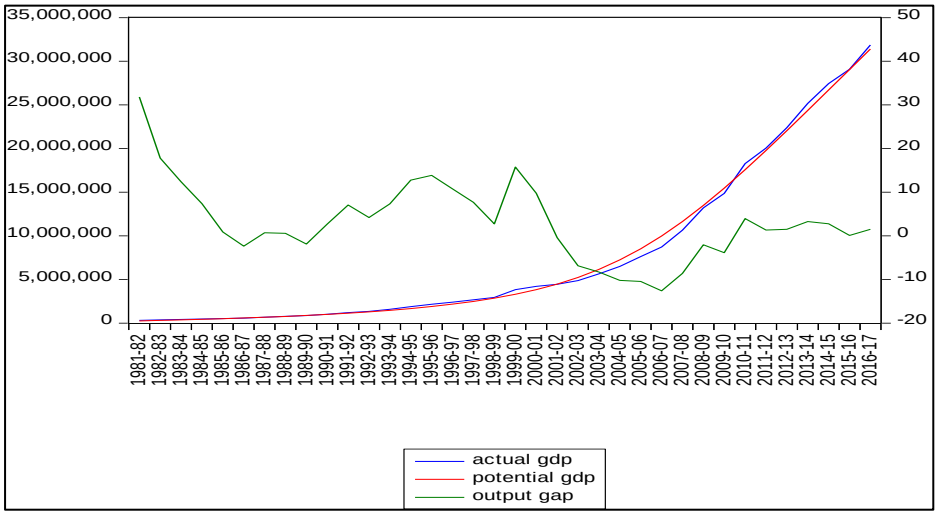
ii. GDP at constant factor cost of 1908-81

Table 4.2: GDP at Current Factor Cost

YEAR	AT CURRENT PRICES		
	ACTUAL	POTENTIAL	DEVIATION
2007-2008	10,637,772	11,641,137	-8.61
2008-2009	13,199,707	13,476,901	-2.05
2009-2010	14,866,996	15,465,118	-3.86
2010-2011	18,276,440	17,578,556	3.97
2011-2012	20,046,500	19,784,000	1.32

2012-2013	22,385,657	22,055,215	1.49

Source: Author's own estimation



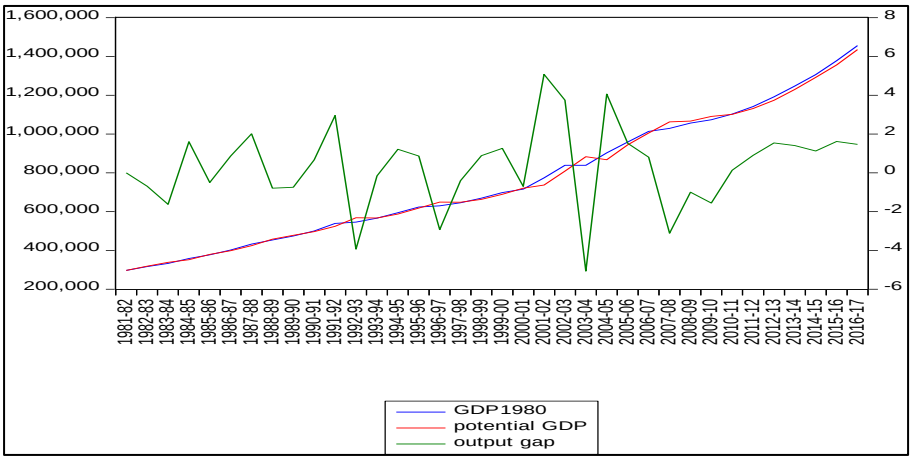
*Above variables are in rupee million

Figure 4.7: GDP at Current factor Cost (Source: Author's own estimation)

Table 4.3: GDP at constant price (1980-81)

YEAR	AT CONSTANT PRICE (1980-81)		
	ACTUAL	POTENTIAL	DEVIATION
2007-2008	10,29,139	10,622,19	-3.11
2008-2009	10,56,171	10,668,09	-0.99
2009-2010	10,731,41	10,901,19	-1.55
2010-2011	11,026,35	11,011,47	0.13
2011-2012	11,413,05	11,311,62	0.88
2012-2013	11,914,82	11,733,81	1.54

Source: Author's own estimation



*Above variables are in rupee million

Figure 4.8: GDP at constant prices (Source: Author's own estimation)

Figure 7a and 7b shows the cost of cost of default for current and constant prices for the sample period considered. Table 2a and 2b illustrates how actual GDP deviate from its potential GDP over the period 2007-2008 to 2011-2012 at current and constant prices. Global economic crisis caused output contraction not only during the crisis period but also in post immediate crisis period. It can be seen from the above tables that during the period of global crisis 2007-2008, the GDP contracted by 8.61% and 3.11% at current and constant prices. Likewise, the aggregate output loss as e result of crisis for the period 2007-2008 to 2009-2010 is observed to be 14.52% and 5.65% respectively. Therefore, we calculate the optimal level of reserves for Pakistan by taking into consideration the maximum ranges of output loss.

4.3.2 Estimation of probability of default:

Before the implementation of Johansen's Cointegration technique for estimating risk premium equation, we require some initial testing of the series in order to ensure I (1). For this purpose, we conducted a test of order of integration for each variable using Augmented Dickey-Fuller. This test ensures the accuracy regarding the unit root conclusion.

Table 4.4: Unit Root Test

VARIABLES	**ADF TEST STATISTICS (P-VALUES)** *LEVEL*	*1ST DIFFERENCE*
SPREAD $\left(\frac{1-i^f}{1+i^r}\right)$	0.7016	0.0000
VOLATILITY OF PORTFOLIO INVESTMENT $(vfpi_,)$	0.2038	0.0000
SHORT-TERM EXTERNAL DEBT TO RESERVES $\left(\frac{ed-st}{resv}\right)$	0.5257	0.0000
FISCAL DEFICIT TO GDP($\frac{fcd}{gdp}$ **)**	0.1122	0.0000

Source: Author's own estimation

Table 4.3.2.a illustrates that the level data for all variables was non-stationary as it can be observed that p-values of each variable is greater than 0.05 at level. However, stationarity is obtained at first difference where p-value of all variables is less than 0.05. It means that all variables are integrated of order one, I (1). This is basically a requirement for implementation of Johnsen Cointegration Technique.

Following the unit root testing, Johnsen cointegration testing is carried out for examining whether there is an existence of cointegrating equation or not.

Table 4.5: Johensen's Cointegration Technique

Hypothesized Number of Cointegrating Equations	Trace statistics	0.05 Critical Value	Probability	Significance at 5% level
None*	52.206	47.856	0.018	Yes
At most 1	22.746	29.797	0.258	
At most 2	9.932	15.494	0.286	
At most 3	2.998	3.841	0.083	

Source: Author's own estimation

Table 4 shows the results of trace test which indicates that there is an existence of 1 cointegrating equation at the 5% level. At None, the value of trace statistics is greater than the 0.05 critical value, illustrating that one linear combination exists between the variables. This linear combination means that all variables will not drift apart in long-run, despite of short-run deviations from the equilibrium levels.

In order to confirm the results of the Johansen's Trace test, we also present the results of the Maximum Eigenvalue Test in the table below:

Table 4.6: Johensen's Cointegration Technique

Hypothesized Number of Cointegrating Equations	Max-Eigenvalue statistics	0.05 Critical Value	Probability	Significance at 5% level
None*	29.495	27.584	0.028	Yes
At most 1	12.814	21.131	0.469	
At most 2	6.933	14.264	0.497	

At most 3	2.998	3.841	0.083	

Source: Author's own estimation

Table 5 shows the results of the Maximum Eigen value Test which illustrates that 1 cointegrating equation exist at 5% significance level. At None, the value of trace statistics is greater than the 0.05 critical value, portraying the presence of cointegrating equation. While, at most 1, At most 2 and At most 3, trace statistics value< 0.05 critical value, presenting the absence of cointegrating equation. However, the results of the Maximum Eigen value test confirming the trace test. Therefore, both of these tests confirm a cointegrating relationship over the sample period considered.

After establishing the cointegration relationship, we need to estimate the long-run coefficients of the cointegrating equations using Vector Error Correction Model. The long-run estimates of equation are given in table below:

Table 4.7: Result of Vector Error Correction Model

Spread	Constant	Volatility of portfolio investment	Short-term external debt to reserves	Fiscal deficit to GDP
	0.0248	-0.0068 (0.0133) [-0.5105]	13.3912 (0.3570) [-37.5110]	1.0555 (0.9071) [1.1636]

Source: Author's own estimation

Table 6 mentions the results obtained through vector error correction model which basically represents the speed of adjustment back towards equilibrium. The coefficients of the long-run cointegrating equation demonstrate that sted-resv and fcd-GDP present the theoretically expected signs but only sted-res is statistically significant at 5% level. This indicates that Pakistan's ability to meet its short-term obligations is an important determinant of risk premium.

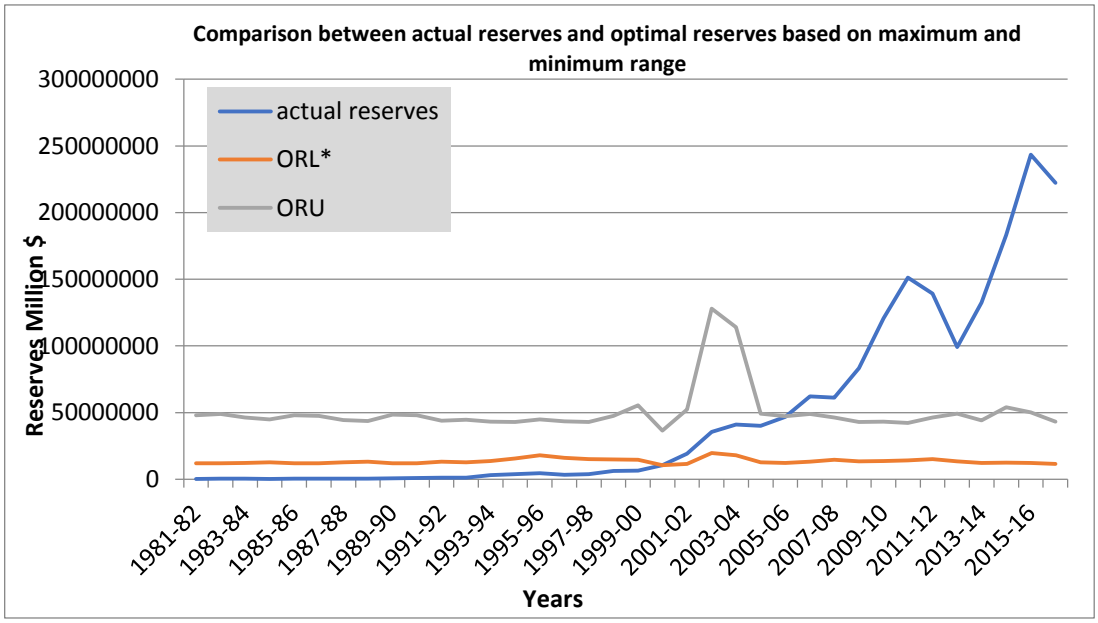
After estimating spread, we are now able to derive the absolute and marginal probabilities of default. The marginal probability is estimated as follows:

$$\frac{\partial \pi}{\partial R} = \pi_{rs} = -\pi(1-\pi)\frac{13.39}{R} < 0 \qquad (12)$$

Equation (12) indicates that a small increase in reserves leads towards negative change in probability of default, demonstrating a negative relationship between reserves and probability of default.

4.3.3 Optimal Reserves:

As we have estimated π, π_{rs}, $C_D$and r^{opp}, so by substituting the value of these four estimates in Eqn (4), the optimum level of reserves is derived. In order to compare the actual reserveswith optimal reserves, we simulated optimum reserves by considering the impact of



8.61% and 14.52% of output contraction for the period 1982-2017.

Figure 4.9.: Comparison B/W Actual Reserved and Simulated optimal reserves (Source: Author's own estimation)

The figure shows that from 1981-82 to 2002-03, the actual reserves holding is lower as that of optimum level of reserves considering output forgone of 8.61% and 14.52%. The reason could be that traditionally nations were not involved in massive reserves accumulation and so was the case of Pakistan. Since East Asian crisis, countries started to hold large stockpiles of reserves and this pattern was followed in Pakistan few years later. After 2004-05, we find

structural shift in actual reserves data, that is the result of SBP reforms, the increase in remittances and other capital inflows. These changes led to enormous reserve accumulation by the SBP. Although actual reserves were lower in period 2009-10-2011-13 as compared to previous periods due to global economic crisis but actual reserves were much higher than the optimum level.

4.3.4 Rolling Regression:

Rolling regression analysis was used to calculate the optimum level of reserves in order to determine whether calculated optimum reserves vary over time.Estimates of Eqn (10) were computed for 36 rolling windows (7 year).

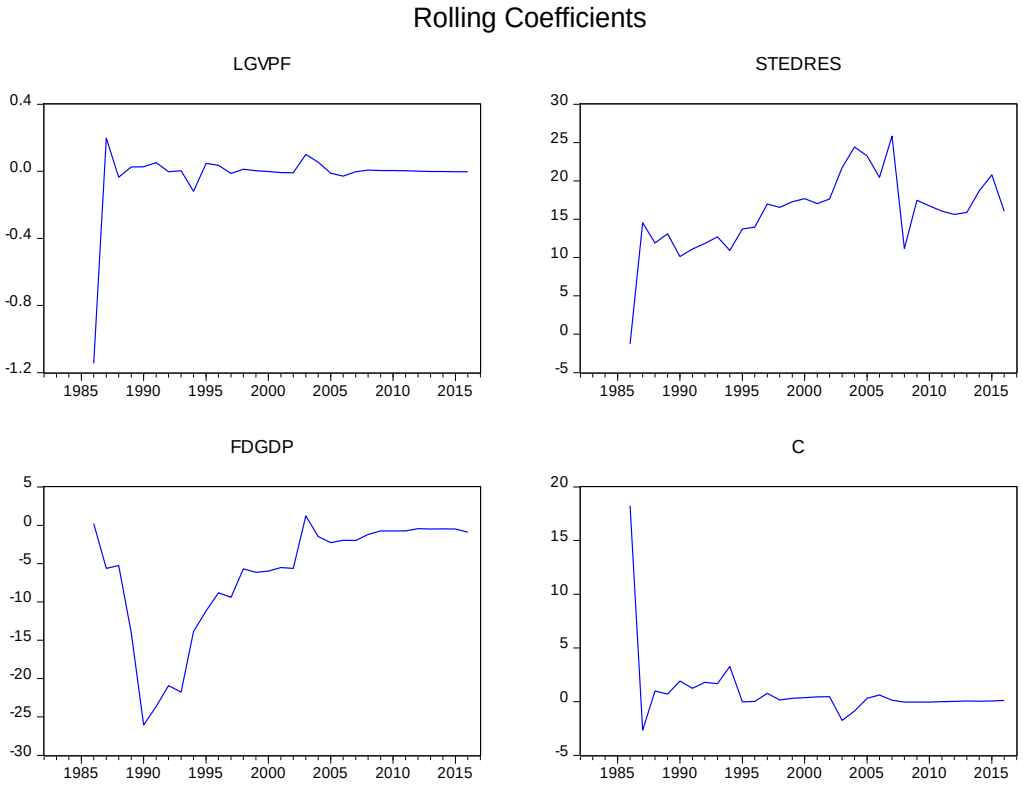


Figure: 4.10: Result of Rolling Regression (Source: Author's own estimation)

Above figure indicates the estimated rolling coefficients through implementing least square regression. The non-straight line reflects that the estimates of coefficient faced various changes over the period considered. Now we can derive marginal and absolute probabilities

of default using these estimates, and then by substituting these estimates in Eqn (4), the time varying optimal level of reserves can be calculated.

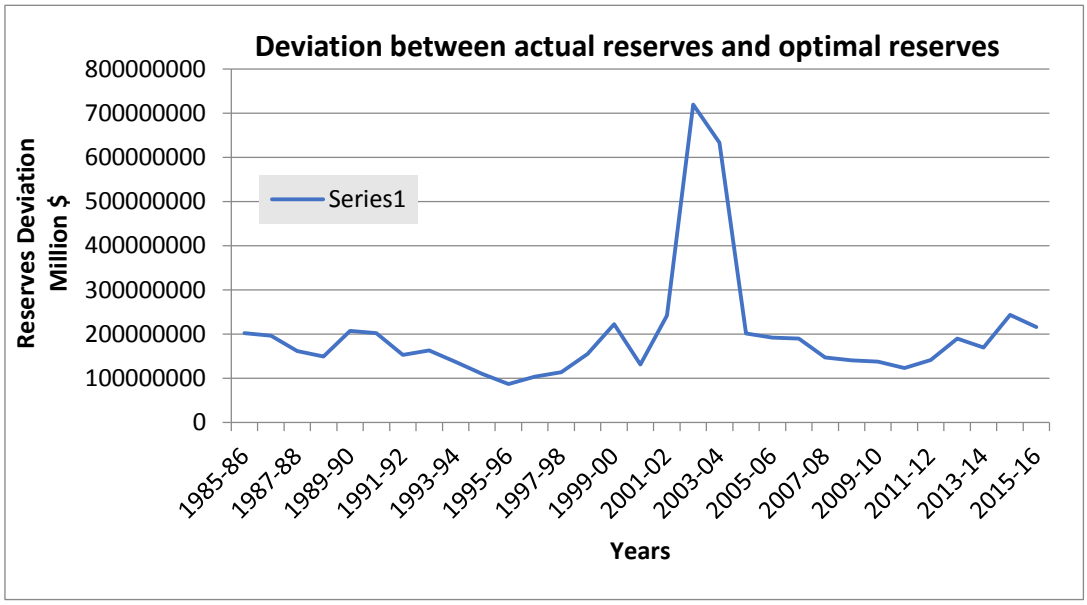


Figure 4.11: Deviation between actual reserves and simulated optimal Reserves (Source: Author's own estimation)

Figure 10 illustrates the difference between the time varying optimum level of reserves and the simulated optimum level of reserves calculated by employing two different ranges of output loss. It is observed that deviation is very low except for the time period 2000-01 to 2004-05. The significant increase in these years is likely because of reforms by central bank, the increase in remittances and other capital inflows.

CHAPTER 5

Conclusion and Policy Recommendations

5.1. Permeable

This chapter mentions the conclusion and policy recommendation. Section 5.1 summarizes the overall work done in this study. Section 5.2 provides the policy recommendations.

5.2. Conclusion

Using annually data, this study has tried to derive the optimal level of international reserves for Pakistan for period 1982-2017. For this purpose, the study employed reserves optimizing approach suggested by Ben-Bassat and Gottlieb (1992). The reserve optimizing approach requires central banks to minimise the total cost of holding reserves, which consist of the cost due to positive reserves and cost due to reserves depletion and their associated probabilities. The cost of holding reserves is defined as the alternative income forgone and here it is proxied by T-bills rate. Due to expansion of world trade, economies become more vulnerable to global disturbances which resultantly led to reserve depletion. The cost of reserve depletion is measured through output contraction by using H-P filter method. Our study found that maximum range of output contraction due to global economic crisis 2008 was 8.61%- 14.52%.

As we discussed earlier that global shocks affect the stock of external reserves and value of domestic currency, it means that every economy has a probability that such shocks will result in reserve depletion. By employing Johensen's Cointegration analysis, the study estimated risk premium equation in order to calculate probability of default. Results suggests that sted-res and fcd-gdp have theoretically expected relationship with risk premium but sted-res and vfpi are statistically significant at 5% level.

The study shows that simulated optimum reserves remains higher than actual reserves till 2004-05 and then in subsequent periods actual reserves are much higher than optimum reserves. Although after global crisis, level of actual reserve holdings declines but still remain higher than optimum level of reserves.

Finally, the study utilized Rolling Regression in order to determine whether calculated optimal reserves vary overtime. A comparison has been conducted between the time varying optimum level of reserves and the optimum level of reserves based on H-p filter and Johnsen's cointegration technique. Results illustrate that deviation is very low except for the time period 2000-01 to 2004-05.

5.3 Policy Recommendation

For a small open economy like Pakistan large stockpiles of reserves is necessary for the country's overall macroeconomic policies, for improving country's credit-worthiness, to pay debt obligations on time and to defend country in the event of sudden capital flights. Furthermore, reserves are increasingly considered as insurance against domestic weaknesses and external uncertainties. Accumulation of actual reserves is increasing at a faster rate since 2004-05 and it is much higher than that of optimum level of reserves. These accumulations are made irrespective of its effects on economy. However, there is overall economic cost involved in accumulating large amount of reserves. Pakistan, being a developing country require high investment in order to enhance economic growth so investing these reserves in productive sectors will help to achieve better returns. There is a dire need of focusing on the basic issues i.e. health, education and other economic problems. The cost of holding reserves is the investment that nations must forgo in order to accumulate reserves. Keeping in view these arguments, few recommendations are given with respect to reserves holding behaviour of developing countries and particularly for Pakistan. The indication of significant opportunity cost of holding reserves implies the existence of trade-off between adjustment

policies and reserve holding policy for the purpose of correcting disequilibrium in balance of payments. As a consequence, the marginal cost of holding reserves should be equated with its marginal benefits. This will help in the determination of true level of reserves. Reserves accumulation will be preferred in case where the marginal cost of holding reserves is smaller than its marginal benefits. Variations in balance of payment are the main reason of holding foreign reserves both in short-run and long-run. Therefore, authorities should try to minimise the imbalance in international accounts by taking measures such as improving the quality of exports, attracting foreign direct investment by providing friendly domestic investment environment, regular receipts of worker's remittances and persistently low prices in times of serious balance of payment deficits. All these measures will help in reducing the requirement for accumulating reserves. The state bank remained inactive in reserves management in the past. Therefore, appropriate steps should be taken in order to restructure management policies regarding reserves to enhance its performance.

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