



ANALYSIS OF THE DETERMINANTS OF FOREIGN EXCHANGE RESERVES IN SUB-SAHARAN AFRICA

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Abstract

Abundant literature has risen sharply over the years with regards to determinants of foreign exchange reserves and motives for holding the foreign exchange reserves due to the financial and currency crises that the world has experienced. This study examines the determinants of foreign exchange reserves using 19 Sub-Saharan Africa countries over the period 2000-2019 and applies the panel autoregressive distributed lag methodology. The empirical discussion is enriched by extending the Worrell (1976) framework of optimal foreign exchange reserves considering the role of the institutions and its effect on the flow of foreign exchange reserves across the selected countries. Results from the empirical analysis indicate that the main determinants of foreign exchange reserves in Sub-Saharan Africa are trade openness, broad money to GDP, inflation and exchange rate. With regards to the role of institutions, political stability and absence of terrorism, government effectiveness, control of corruption and voice and accountability affect reserves in the long run, while control of corruption and regulatory quality negatively affect reserves in the short run. Countries should therefore observe the above-mentioned macroeconomic indicators and quality of their institutions to increase their reserves and for the development of their economies.

Keywords: Sub-Saharan Africa, Foreign exchange reserves, Institutions, Heterogeneous panel.

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CHAPTER ONE

Introduction

1. Introduction

1.1 Background and Motivation

The accumulation of foreign exchange reserves has increased worldwide over the years. Foreign exchange reserves are “external assets that are available immediately and controlled by central banks to finance balance of payments needs, to intervene in foreign exchange markets and for other related purposes” (International Monetary Fund, 2013). The growing literature on foreign exchange reserves accumulation has been motivated by a series of financial and currency crises over the years.

Although the crises began in emerging markets, they spread across the globe, disrupting the daily operations of economies. These became a wake-up call for nations to think about financial backup during unforeseen circumstances. The lack of adequate reserves during the 2008 global financial crisis led to many countries falling into debts due to external borrowing, export trade declined, leading to contraction of Gross Domestic Product of trade-oriented countries and consequently depreciation of currencies and depletion of reserves (Dominguez, Hashimoto and Ito, 2011).

African countries have accumulated reserves over the years mainly from export earnings, aid, and foreign direct investment (Elhiraika and Ndikumana, 2007). Africa is endowed in natural resources such as oil, diamonds, copper, and uranium, through which countries export and earn revenues. Conventionally, by rule of thumb, central banks are expected to hold optimal level of reserves equal to at least three months of import cover, many countries have managed to exceed this threshold due to factors such as financial openness and trade (Rodrik, 2006).

As countries were exposed to financial crises, volatile commodity prices, and changes in exchange rate regimes, it became critical for monetary authorities to build reserves as insurance against unexpected shocks and to maintain price stability in their economies. Bahmani-Oskooee and Brown (2002) recognize that it is important for countries to hold reserves for

balance of payments imbalances, to defend exchange rates, to use as collateral when they want to borrow and to pay government obligations.

The ability of countries to maintain sufficient reserves makes the country attractive to foreign investors, which consequently improves investment and growth (Elhiraika and Ndikumana, 2007). This is important for the African continent which has unique challenges of shortage of investments, lack of trust in institutions and massive development needs (International Forum of Sovereign Wealth Funds and Franklin Templeton, 2021).

Moreover, institutional environment has a direct impact on business operations which may attract or deter foreign investments. Corruption, bureaucracy and rule of law are some important factors under the institutional environment that determine the flow of investment into the country (Ajayi, 2006). Consequently, it is critical for countries to understand the factors that increase their reserves so that they hold enough to use as insurance against uncertainties, hence the need for this study to examine the factors.

1.2 Problem Statement

Globalization and financial integration mean that through free trade, African countries can export their commodities such as oil and diamonds, pay for imports, thus exposure to fluctuations in capital inflows and outflows. Payment for imports means that African countries have to drawdown on their reserves, which reduces their stock of reserves. Reliance on commodity exports means there is uncertainty in revenues that minerals generate as they are exposed to trade shocks.

Potential to deplete reserves and chances of capital flights and sudden stops are a threat to the economies. The recent 2008 global financial crisis has exposed countries financial position as many had to resolve to external borrowing to meet their daily needs, which led to accumulation of debt. Previous research has identified some macro-economic indicators that affect the demand for reserves, but they have not provided insight on the role that institution in Africa affects accumulation of reserves. Trade openness, broad money, inflation, interest rates, exchange rate and exchange rate regime are some of the factors that have been found to influence demand for reserves.

The ineffectiveness of Governments in implementing set policies, the barriers to businesses by foreign companies in a country, corruption, and dysfunctional legal systems are likely to chase away potential investors, which is detrimental to the growth of the Sub-Saharan economies. Accordingly, this study proposes to explore factors that determine accumulation of reserves by investigating the role of institution, introducing it as a new variable in the study.

Investigating the macroeconomic factors relevant to Sub-Saharan Africa and the role of institution is critical since the continent is vulnerable to spillover effects of crisis from emerging and advanced economies, as well as prone to external shocks in relation to their commodity-export reliance. Subsequently, maintaining price and economic stability is one of the goals of the central banks, hence, investigating factors that affect the decrease and or increase in reserves is crucial for attainment of stability. A stable economy and adequate reserves put countries in the eyes of potential investors who need to put their money where its possible to run a sustainable investment which brings forth profits and economic growth.

Considering the vulnerability and potential failure of the financial system, shocks to trade, and presence of natural resources in many African countries, the importance of foreign reserves in Africa cannot be neglected. Therefore, for sustainable growth in Africa, and understanding factors that could cause economic instability, it is critical to study the factors that affect reserves.

1.3 Research Questions

- i. What are the factors that determine foreign exchange reserves in Sub-Saharan Africa?
- ii. What role does institution play on the flow of foreign exchange reserves in Sub-Saharan Africa?

1.4 Research Objectives

- i. To identify the factors that determine international reserves in Sub-Saharan Africa.

- ii. To examine the role of institution¹ on the flow of foreign exchange reserves in Sub-Saharan Africa.

1.5 Contribution of the Study

To date, evidence on the determinants of foreign exchange reserves has provided mixed results, with much focus on emerging economies and little attention given to the African region. Available literature on the subject has focused on single country analysis, and it was found that some countries are resource dependent, (oil-and-diamond exporting countries for example), others are in debts and others rely on aid. That is, empirical analysis has found that natural resources, debt, and other macroeconomic variables are the determinants of foreign exchange reserves.

Furthermore, panel data studies have been conducted, to understand the reasons behind hoarding of reserves which was linked to crises such as Asian crisis, and the global financial crisis which had negatively impacted the economies. However, majority of the studies have focused on emerging and developed economies. In Africa, two panel studies have been done to the best of my knowledge by Elhiraika and Ndikumana (2007) on sources, motivations and effects of reserve accumulation in 21 African countries and the other study for 10 Southern Africa countries by Sanusi, Meyer and Hassan (2019), who explored determinants of foreign exchange reserves.

Earlier studies focused on homogeneous panels without considering heterogeneity effects across countries and this may produce biased results. Thus, heterogeneous models produce better results compared to homogeneous panel. Therefore, this study explores the heterogeneity of the selected Sub-Saharan Africa countries. Motivation behind including the role of institution in Sub-Saharan Africa is due to its importance to foreign investors who need a stable, safe, and law-abiding countries to invest their time and resources and to policy makers who want development and progress in their economies. The countries in the region are mostly characterized by poor economic performance, political instability and poor social structures,

¹ For this study, institution is proxied by the indices from the World Governance Indicators.

which inspired the study to look at how much governance determines foreign exchange reserves which are a useful tool for macroeconomic stability.

The variable institution is interesting to the development and advancement of any country and has been neglected by studies which investigated the determinants of reserves at large. It is important to the body of research because the stability of country leadership and governance is crucial in forming meaningful relationships and investment partnerships which will help the many low income and less developed countries in Sub-Saharan Africa. Therefore, this study provides insight about sectors that could assist the selected countries to accumulate reserves to protect themselves against any potential crises, use for domestic infrastructure developments and to reduce dependence on aid.

1.6 Structure of the Study

The study has five chapters, with introduction as chapter one. Chapter two covers the literature review, chapter three specifies the model and description of data, chapter four is empirical analysis, and chapter five focuses on the conclusion and recommendations.

CHAPTER TWO

Literature Review

2. Introduction

The section discusses the theoretical and empirical literature that is relevant to the study. The literature is critiqued, and a summary of gaps identified in the literature is provided at the end of the section.

2.1 Theoretical Review

Theoretical models with regards to motives of holding foreign exchange reserves are the mercantilist and precautionary theories. Mercantilist theory states that countries hold foreign exchange reserves to maintain exchange rates, which ensures stability of foreign exchange. Countries with stable exchange rates are viewed as competitive in the global market as compared to countries whose exchange rates are volatile. Thus, accumulation of foreign exchange reserves is used to promote export-growth by preventing exchange rate appreciation, (Akamobi & Ugwunna, 2017).

Precautionary theory suggests that the motive for holding foreign exchange reserves is to constitute a buffer stock which boosts investor confidence thus reducing probability of crisis and for insurance against financial and currency crises. That is, reserves are held for investment purposes before crises happen, and for mitigating effects of the crises on the economy after it has occurred, (Akamobi & Ugwunna, 2017).

In other words, countries should have backup in case their exchange rate currencies do not perform well, which will severely affect trade and foreign reserves. Sudden stops in capital inflows and contractions in output due to crises are the precautionary reasons to hold reserves. This is because of the possibility that investors may away their investments, causing harsh economic recession hence the need for countries to accumulate foreign exchange reserves (Gereziher & Nuru, 2020).

The above mercantilist and precautionary theories reveal that due to globalization, countries are financially integrated and more open to trade and investments. However, this interaction though beneficial for growth of different economies, is risky as it exposes them to different

shocks whose effects are contagious. Policies aimed at achieving stability and economic growth therefore hold reserves for meeting their financial needs domestically, and externally, buffer against shocks, promoting export growth and for exchange rate management.

The empirical literature below reviews the studies that were done to understand the reasons behind different countries holding of reserves, factors that help accumulate reserves and the cost-benefit analysis of hoarding reserves.

2.2 Empirical Review

The study by Jena and Sethi (2021) used time series data and applied a robust autoregressive distributed lag (ARDL) methodology to investigate the determinants of foreign exchange reserves in Brazil observing period 1960-2018. Authors conclude that in the long-run, coefficients of current account, per capita GDP, domestic credit to private sector, trade and real interest rate are positive and significant factors to foreign exchange reserves whereas debt coefficient is negatively significant. Given the economy of Brazil as one of the largest economies in the world, the significance of the variables under the study is justified.

Gereziher and Nuru (2021) investigated determinants of foreign exchange reserves in Ethiopia with annual data since 1981 to 2017 using the autoregressive distributed lag approach. External debt, inflation and current account balance positively and significantly determine reserves while exchange rate significance is negative in the long run. Ethiopia follows a managed floating exchange rate system and thus a depreciation of the exchange rate boost export volumes increasing foreign reserves. The authors applied the ARDL methodology which is fit for a single country study, but have not considered adding population as one of the variables, given that Ethiopia is one of the largest countries in Africa.

Law, Soon and Ehigiamusoe (2021) investigated the nonlinear impact of institutional quality on international reserves for 67 countries (developing and developed) applying the two-step system of Generalized Method of Moments from 1996 to 2016. Their argument was that institutional quality has two impacts on international reserves in the sense that there is a U-inverted relationship: improving institutional quality has an initial reaction of motivating countries to hold more reserves, but once a certain threshold is reached, the relationship turns

negative, and the country will hold less reserves. Additionally, trade openness and financial openness coefficients are positive and significant while exchange rate volatility is significant and negatively affect international reserves. The authors have considered a Generalized Method of Moments for mixed countries (developing and developed). This could produce biased results on the outcomes of the research in the sense that some countries are more advanced than the others, and they face different economic problems. Inclusion of institutional quality is commendable given its importance in the growth of an economy.

Sanusi, Meyer and Hassan (2019) investigated the determinants of foreign exchange reserves in Southern Africa, using the Autoregressive Distributed Lag panel econometric model from 1990 to 2015. The results assert that exports, inflation, and exchange rate significantly and positively affect foreign reserves while imports have a significantly negative effect on reserves in the long run. In the short run, exchange rate is the only significant variable that confirms the hypothesis of the study that countries in Southern Africa hold foreign reserves to defend the external value of their currencies. The authors have managed to confirm the hypothesis about Southern African countries, who are more vulnerable to shocks due to their dependence on natural resources, their barriers to access to ports and their slow economic growth problems. However, they have not considered other problems like the quality of institution which is good for attracting foreign investment.

Panel data for 52 emerging and developed markets, for the period 2000-2013 were used by Cabezas and De Gregorio (2019) to examine the accumulation of reserves. To capture the impact of the global financial crisis, the data were separated into two sections: 2000-2008 before the crisis and 2009-2013 after the crisis. The findings reveal that terms of trade, comparative hoarding² and broad money to GDP significantly and positively determine reserve accumulation while opportunity cost (interest rate differential) reduces reserve holding before the financial crisis. Post-financial crisis, fixed exchange rate regimes³ significantly reduced reserve holding while volatility of trading partners' output had positive effects on reserves.

² Demand for reserves that are dependent on reserve holdings of other countries to avoid currency speculative attacks, (Cabezas & Gregorio, 2019)

³ Exchange rate regime: 1 = fixed exchange rate 0= otherwise

The effects of crises on economies cannot be undermined, and thus it is commendable for the authors to separate the post-crises and after-crises effects on the foreign exchange reserves of the selected economies.

Khomo, Mamba and Matsebula (2018) investigated determinants of foreign exchange reserves in Eswatini from 1990-2014 using ARDL approach. The results indicate that GDP per capita (economic growth) and exchange rate positively influence reserves, whereas the current account ratio to GDP and government expenditure negatively influence reserves in the long run. Thus, policy makers should focus on projects that increase economic growth seeing that trade and government expenditure have potential to deplete the reserves.

In analyzing the determinants of international reserves in West African states from 2005 to 2014, Ajayi and Olomola (2018) used the panel ARDL methodology. The findings indicate that in the short run, imports, and exchange rates (appreciation in the nominal exchange rate) negatively affect pooled reserves. Exports, population, and Gross Domestic Product have a significant positive effect on pooled reserves. However, the long run results reveal that only population and real GDP per capita are significant determinants of pooled reserves in the West Africa states and have a positive effect.

Akamobi and Ugwunna (2017) used Ordinary Least Squares technique to examine determinants of foreign exchange reserves in Nigeria from 1970 to 2013. Oil price and domestic credit coefficients are positive and statistically significant major determinants of foreign reserves. The results suggest that policy makers need to find other alternatives to oil because it is vulnerable to external shocks and avail more domestic credit to private sector so that investments can be carried out and bring more returns. The study is country specific hence the choice of variables like oil price, which is a significant factor to the growth of the Nigerian economy.

Dash, Shylajan and Dutta (2017) analyzed macroeconomic factors affecting foreign exchange reserves in India using quarterly data from 2001 to 2014. An autoregressive distributed lag model was applied, and it was found that short term external debt to GDP ratio positively and

significantly influences reserves while inflation negatively and significantly affects reserves in the long run. Exchange rate is the only significant factor in the short run, and it positively affects reserves. Thus, policy makers should focus on achieving stable inflation rate and intervene in foreign market exchange for export competitiveness to maintain a significant amount of foreign exchange reserves.

Examining the determinants of reserves in Bangladesh, Chowdhury, Uddin and Islam (2014) used annual time series data from 1972-2011 applying the ordinary least squares method. The results show that exchange rate, remittances, broad money supply, home interest rate, GDP per capita, and unit price index for imports and exports are statistically significant determinants of foreign exchange reserves. Remittances, GDP per capita and depreciation of exchange rate increase reserves whereas home interest rate, broad money supply and unit price index of imports and exports negatively affect the reserves.

Ordinary least squares based autoregressive distributed lag methodology has been applied by Shrestha and Wansi (2014) on 6 selected South East Asian countries for the period 1980-2011. Results of the study show that in 5 of the 6 countries, economic growth positively affects reserves, and it is significant. In addition, it is the only significant factor for Philippines.

The results for other factors and the rest of the countries are as follows: In Indonesia exchange rate volatility significantly and positively affects reserves. Capital flows increase reserves, while total trade negatively affects reserves in Malaysia. For Singapore, capital flows decrease reserves while total trade positively impacts reserves. Exchange rate volatility and capital flows have a negative impact on reserves, while export volatility increases reserves in Thailand. In Korea, capital flows and total trade positively affect reserves, while the effects of export volatility, economic growth and exchange rate volatility are negative.

Using a nonlinear approach to examine the determinants of international reserves, Delatte and Fouquau (2011) applied a Panel Smooth Transition Regression to selected 20 emerging economies from 1981 to 2004. The results of the studies conclude that the deterioration of the United States's balance of payments is the main reason for holding of reserves by emerging economies as they had to guard against depreciation of the currencies.

Sula (2011) utilized a quantile regression approach to estimate the determinants of the demand for international reserves in 108 developing countries for the period 1980-2007. The results of the regressions conclude that there is a cost to holding reserves as countries accumulate more and more reserves until they exceed a given threshold, thus suggesting countries should observe their reserves and be able to use them for other purposes. Trade openness, population, GDP per capita, and post Asian crisis dummy have a positive and significant effect on reserves.

Financial openness has mixed results on the quantile regression; the coefficients are significant and positive for the 10th, 25th and 50th quantiles and significant and negative for the 90th quantiles, implying that countries with a higher degree of financial openness hold less reserves than those with lower degree of openness.

Choi, Sharma and Strömquist (2009) examined how the relationship between net capital flows and reserve accumulation were affected by external financing for 36 emerging markets and 24 advanced countries using panel data methods for the period 1980-2005. It was found that emerging markets increased reserve accumulation after the 1997 Asian crisis shown by a positive coefficient of capital flows on reserves for the 2001-2005 dummy. The dummy for capital flows before the Asian crisis has a negative and significant effect for emerging markets while for advanced countries capital flows significantly reduce reserves for before and after the Asian crisis.

Nor, Azali and Law (2008) investigated the short-run and long-run demand for foreign exchange reserves in Malaysia employing ARDL approach for the period 1970-2004. The results show that real GDP per capita, imports to GDP ratio (propensity to import), volatility of export receipts, current account balance and short-term debt all had a significant impact on reserves in Malaysia. It was concluded that in Malaysia, current account surplus is important in increasing reserves and that reserves are held more for precautionary motive against future crisis.

Elhiraika and Ndikumana (2007) examined the sources, motivations, and effects of reserves accumulation in 21 selected African countries for the period 1975-2005. In the long-run, panel regression results show that exports and Gross Domestic Product growth significantly drive

demand for reserves in Africa and have positive effects. Therefore, it is critical for African countries pursue export-led growth to increase reserve holding.

Prabheesh, Malathy and Madhumathi (2007) investigated demand for foreign exchange reserves in India applying the cointegration approach using quarterly data from 1983:1-2005:1. It was found that broad money to GDP (capital account vulnerability) and import to GDP ratio (current account vulnerability) are the main determinants of demand for reserves in India. The two have a significant and positive effect, thus indicating holding of reserves for precautionary motives. That is, India holds reserves as insurance against potential capital flight and current account deficits. Reserves in India are negatively affected by interest differential, implying that there is an opportunity cost to accumulating reserves than putting them to use.

Asian countries have hoarded their foreign exchange reserves since they were hit by the Asian crisis (Aizenman and Marion, 2003). In investigating why Asian countries hold the largest share of global reserves, the authors used annual data for 125 developing countries from 1980-1996. They concluded that countries that have been exposed to crisis, face sovereign risk, and have high tax collections hold large amounts of reserves for precautionary reasons.

Using the monetarist approach to investigate the determinants of international reserves in Barbados by applying the ordinary least squares (OLS) method for the period 1972-1987, Coppin (1994), found that openness of the economy and monetary policy are significant factors in holding international reserves. Openness of the economy has a positive effect while monetary policy has a negative effect on reserves.

2.3 Summary of the gaps in the Literature Review

The literature reviewed above has mixed results on the determinants of foreign exchange reserves and the motives for holding them. The results agree that:

- i. Reserves are held for insurance purposes against future unforeseen crisis and to escape borrowing loans from financial institutions such as International Monetary Fund. Many central banks have accumulated reserves after their experiences with sudden stops of capital flows, capital flights, currency crises and the global financial crisis.

- ii. Reserves accumulate because of countries promoting export growth which in turn increases domestic income. Reserves are held to manage exchange rate, as countries with stable exchange rates are viewed as competitive in international markets.

The significance of external debt on reserves differs in the literature. The reserves are held to protect country with payment of debts as evidenced by positive effect of debt on reserves for Ethiopia, Malaysia, and India. However, for Brazil, debt negatively affects reserves. Variables such as exchange rates, exports, external debt, inflation, and openness to trade among others have been examined in single country studies and panel studies.

Most of the research conducted was single country studies, and panel studies which focused more on emerging economies and developed countries, with little attention given to research on Africa. The role of quality of institution has not been critically analyzed, except for a study by Law et.al (2021), who utilized the International Country Risk Guide index to represent institutional quality, which averaged indices of the components, thus leaving a gap to identify the effect of each component which this study pursues.

This study fills this gap, by examining the factors determining reserves in Sub-Saharan Africa, considering the role of quality of institutions, using the world governance indicators, and applying panel autoregressive distributed lag estimation technique.

CHAPTER THREE

Methodology and Data

3. Introduction

This section discusses the analytical framework of the study, specifies the model to be used and indicates different tests conducted. The section further states the data used in the study and its sources.

3.1 Analytical Framework of Foreign Exchange Reserves

Worrell (1976) developed a framework in relation to stock of foreign exchange reserves. The theory is that monetary authorities hold reserves to insure against shocks to balance of payments. Furthermore, despite the desire to guard against uncertainties, they do not want to incur unnecessary costs. The discussion postulates that there are costs associated with holding unto reserves. There is an opportunity cost to holding reserves instead of putting them to good use in the economy and adjustment costs defined as the effect of having to change domestic income and spending to be able to work without foreign resources which the economy is unable to purchase for the time being.

The adjustment costs can be affected by adjustment mechanisms such as external financing. International organizations such as the International Monetary Fund, other central banks and international banks can loan out credit to countries that would not want to adjust their domestic spending however, these mechanisms are costly as interests must be paid to the principal amount, leading to reduced future incomes. Furthermore, some conditions of loans are known before borrowing, while others are usually specified during the request process which brings uncertainty to estimations of adjustment costs.

The author has designed an exemplary model, where foreign resource deficiency (F) is defined as total earnings minus essential foreign inputs over any period. This is meant to explain a situation that even great economies where the use of foreign exchange is rationalized, there is always a possibility of foreign resource deficiency. The equations below give a guide using a period of five years:

$$X_5 = X_0 (1 + x)^5 \dots\dots(1)$$

$$M_0 = mY_0 \dots\dots\dots (2)$$

Where x , X_t , X_0 , are rate of growth of the earnings, earnings and known earnings in the base year, respectively. M_t is essential imports, M_0 is base year essential imports, m is growth rate of imports and Y_0 is base year income. Rate of growth of income is given by g , so;

$$Y_5 = Y_0 (1 + g)^5 \dots\dots\dots(3)$$

$$\text{This means then that } M_5 = mY_0 (1 + g)^5 \dots\dots\dots(4)$$

$$\text{Therefore } F_5 = (M_5 - X_5) = mY_0 (1 + g)^5 - X_0 (1 + x)^5 \dots\dots\dots (5),$$

summing this equation would give the maximum growth rate over the 5-year period. Taking the issue of opportunity and adjustment costs into consideration yields the equations below:

$$OC_1 = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{R_1} g e^{-z/2\sigma} dz, \dots\dots\dots(6)$$

Where OC_1 is opportunity cost of R_1 , R_1 is the expected level of reserves, $(R_1 - z)$ is left over reserves, and their opportunity cost is g . If z is greater than R_1 , there will be no reserves left in the country and thus, no opportunity cost incurred, however, calling for the country to make adjustments. If the cost of $(R_1 - z)$ of adjustment is r , then;

$$AC_1 = \frac{1}{\sqrt{2\pi}} \int_{R_1}^{\infty} r e^{-z/2\sigma} dz \dots\dots\dots(7);$$

where AC_1 is the adjustment cost. Total expected cost (TC_1) of R_1 level of reserves is given by the sum of the opportunity cost and adjustment cost.

To identify the optimum level of reserves, then a schedule should be drawn plotting the points (TC_1, R_1) . The minimum point of the schedule corresponds to the level of reserves which enables the least sacrifice of growth of an economy within existing economic structures. The assumption that countries make adjustments only when they have exhausted their reserves is unrealistic, and therefore this assumption is relaxed.

The exchange rate regime is also crucial in foreign exchange reserves and must be determined looking at the growth strategy of each economy. Thus, calculating the opportunity and adjustment costs changes regarding exchange rate changes. In a nutshell, the theory of foreign exchange reserves gives the idea that there is a cost-benefit analysis to holding the reserves

and the model gives suggestions to management to be on watch so that reserves do not harshly decrease.

The choice of determining reserves in a country is given by the macroeconomic relation of the country of interest. In the case of the Jamaican economy cited in the paper, the following were the chosen factors: export earnings, capital inflows from abroad, changes in money supply and government expenditure.

3.2 Model specification

This study adopts the Worrell (1976) framework in modeling the determinants of foreign exchange reserves. To extend this framework, we consider some macroeconomic fundamentals, quality of institutions in addition to the factors considered by the Worrell (1976) paper on the principal channels by which external forces influence domestic forces of the Sub-Saharan Africa economies. To this end, based on the understanding of macroeconomic relations in the country of which the analysis is being done, this study presents a simple determinant of foreign exchange reserves model below;

$$FR_{i,t} = \beta_1 FR_{i,t-1} + \beta_2 M2_{i,t} + \beta_3 INF_{i,t} + \beta_4 ER_{i,t} + \beta_5 TO_{i,t} + \beta_6 INST_{i,t} + \varepsilon_{i,t} \dots (8)$$

where, subscripts i , and t , are cross-section and time respectively, $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ and β_6 are coefficients of the variables and FR, M2, INF, ER, TO, INST are foreign exchange reserves, broad money to GDP, inflation, exchange rate, trade openness, and institution, respectively and ε_t is the error term.

3.3 Estimation Technique

3.3.1 Panel Unit Root Tests

The tests for stationarity is conducted before any data analysis is done. The panel unit roots tests to be done are Fisher (ADF and PP), Im-Perasan and Shin (IPS), and Levin, Lin & Chu (LLC) tests. The tests that are chosen differ in their advantage over the other, and their weakness are addressed by the other's strengths.

For instance, the LLC tests are estimated based on the assumption of a common panel unit root with identical autocorrelation coefficients (Levin, Lin and Chu, 2002). Alternatively, for the

IPS test the lagged dependent variable is used as a regressor while allowing heterogeneity on the lagged coefficient of the dependent variable (Sanusi, et al., 2019). Maddala and Wu (1999) observe that the advantage of the Fisher test above these two is that it allows for different lag selections in the ADF tests, and sample size of different samples does not affect the outcome.

The null hypothesis of the tests is that a unit root exists, and alternative is that there is no unit root. If the data is not stationary, then it will be differenced to see if they are stationary at first difference. Once data has been verified to be stationary, then cointegration tests are done to examine long run relationship between variables.

3.3.2 Panel Autoregressive Distributive Model

To find factors that determine the foreign exchange reserves in Sub-Saharan Africa, the main empirical estimation relies on the dynamic heterogeneous panel regression which is merged into the error correction model through the ARDL (p, q) model. The panel ARDL model is stated as:

$$\begin{aligned} \Delta FR_{it} = & \vartheta_{0i} + \sum_{j=1}^p \alpha_{ij} \Delta FR_{i,t-j} + \sum_{j=0}^q \beta_{ij} \Delta M2_{i,t-j} + \sum_{j=0}^m \phi_{ij} \Delta INF_{i,t-j} + \sum_{j=0}^r \varphi_{ij} \Delta ER_{i,t-j} + \\ & \sum_{j=0}^s \gamma_{ij} \Delta TO_{i,t-j} + \sum_{j=0}^u \partial_{ij} \Delta INS_{i,t-j} + \vartheta_{1i} FR_{i,t-1} + \vartheta_{2i} M2_{i,t-1} + \vartheta_{3i} INF_{i,t-1} + \\ & \vartheta_{4i} ER_{i,t-1} + \vartheta_{5i} TO_{i,t-1} + \vartheta_{6i} INS_{i,t-1} + \varepsilon_{it} \dots \dots \dots (9) \end{aligned}$$

where $i = 1, 2, 3, \dots, N$; $t = 1, 2, \dots, N$, FR, M2, INF, ER, TO, INST are foreign exchange reserves, broad money to GDP, inflation, exchange rate, trade openness, and institution, respectively and ε_t is the error term.

Δ is the first difference operator, p, q, m, r, s , and u , are the optimal lags on the first-differenced variables by some information criterion such as the Schwarz Information Criterion (SIC) and μ_i captures the specific effects. The long run coefficients for the intercept and the regressors are computed as:

$$\begin{aligned} \delta_{0i} = & -\frac{\vartheta_{0i}}{\vartheta_{1i}}, \delta_{1i} = -\frac{\vartheta_{2i}}{\vartheta_{1i}}, \delta_{2i} = -\frac{\vartheta_{3i}}{\vartheta_{1i}}, \delta_{3i} = -\frac{\vartheta_{4i}}{\vartheta_{1i}}, \delta_{4i} = -\frac{\vartheta_{5i}}{\vartheta_{1i}}, \text{ and } \delta_{5i} = \\ & -\frac{\vartheta_{6i}}{\vartheta_{1i}}, \text{ for broad money to GDP, inflation, exchange rate, trade openness, and institution,} \\ & \text{respectively, since it is assumed that } \Delta FR_{i,t-j} = \Delta M2_{i,t-j} = \Delta INF_{i,t-j} = \Delta ER_{i,t-j} = \end{aligned}$$

$\Delta TO_{i,t-j} = \Delta INS_{i,t-j} = 0$ in the long run. $\alpha_{ij}, \beta_{ij}, \phi_{ij}, \varphi_{ij}, \gamma_{ij}$, and θ_{ij} are the short-run coefficients.

The error correction term of equation (9) is specified as:

$$\begin{aligned} \Delta FR_{it} = & \vartheta_{0i} + \sum_{j=1}^p \alpha_{ij} \Delta FR_{i,t-j} + \sum_{j=0}^q \beta_{ij} \Delta M2_{i,t-j} + \sum_{j=0}^m \phi_{ij} \Delta INF_{i,t-j} \\ & + \sum_{j=0}^r \varphi_{ij} \Delta ER_{i,t-j} + \sum_{j=0}^s \gamma_{ij} \Delta TO_{i,t-j} \\ & + \sum_{j=0}^x \theta_{ij} \Delta INS_{i,t-j} + \rho_i ect_{i,t-1} + \mu_i + \varepsilon_{it} \dots \dots \dots (10) \end{aligned}$$

where the error correction term for each cross-section is defined as $ect_{i,t-1} = FR_{i,t-1} - \delta_{0i} - \delta_{1i} M2_{i,t-1} - \delta_{2i} INF_{i,t-1} - \delta_{3i} ER_{i,t-1} - \delta_{4i} TO_{i,t-1} - \delta_{5i} INS_{i,t-1}$.

The error correction term measures the adjustment speed along the time path of the variables to the long-run equilibrium. The coefficient of the error term, ρ_i , must be statistically significant, negative and less than one in absolute for the long-run relationship to exist among the variables. Its expected negative value indicates convergence, with a positive value suggesting a divergence from equilibrium. Furthermore, if the value exceeds one in absolute term, it suggests an over-adjustment which has no meaningful intuition.

The panel ARDL model in equation (9) is estimated using three different dynamic heterogeneous estimators which are the mean group (MG) developed by Pesaran and Smith (1995), the pooled mean group (PMG) developed by Pesaran et al. (1999), together with the dynamic fixed effects (DFE) estimator. They are each estimators of long-run equilibrium computed by the maximum likelihood and can account for heterogeneity in the relationship among underlying variables.

It important to note that, although Phillips and Hansen (1990) and Johansen (1995) posit that long-run relationships only exist when the variables which are cointegrated have the same

integration order, Pesaran and Shin (1999) argue for the ability of panel ARDL to handle variables that are all integrated of order zero $I(0)$ or one $I(1)$ or a mixture of both $I(0)$ and $I(1)$.

There are other attractive qualities of the panel ARDL model. First, being suitable for a panel with large cross sections (N) and time periods (T), or usually panel with $T > N$ dimension, it allows for the simultaneous estimation of both short- and long-run relationships. Second, it provides consistent estimates in the presence of endogeneity. According to Pesaran et al. (1999), the endogeneity bias is accounted for with the inclusion of the lags of the dependent and independent variables.

3.3.2.1 MG Estimator

The MG estimator proposed by Pesaran and Smith (1995) computes distinct regressions for each cross-section and then calculates the coefficients as the unweighted averages of the computed coefficients for the individual cross sections. This makes the coefficients to be heterogeneous, over both the short- and long-run. The performance of this estimator, however, hinges on the condition that both the cross sections (N) and time periods (T) of the panel must be adequately large. In cases of small N Favara (2003) notes that the estimator becomes sensitive to the presence of outliers and reduced model permutations.

3.3.2.2 PMG Estimator

The PMG estimator on the other hand, relies on the assumption that the long-run slope coefficients are homogeneous across the cross-sections, hence the idea of pooling. However, the short-run coefficients, including the error variances, intercepts, and error correction mechanisms, are allowed to differ across the cross-sections. The long-run homogeneity assumption is valid when there are sufficient grounds to believe the cross sections have similar long-run equilibrium. For the heterogeneous nature of the short-run coefficients, the adjustment process is allowed to be specific to each cross section since different economic agents (such as countries in this study) are affected by various factors including financial crises and other exogenous shocks, at least in the short-run.

3.3.2.3 DFE Estimator

The DFE estimator tends to be similar to the PMG estimator by restricting the long-run slope coefficients and error variances to be equal across all the cross sections. Also observing some features of the MG estimator, it imposes restrictions on the short-run coefficients and speed of adjustment. However, the intercepts are made to be heterogeneous across the cross sections. One main benefit of this estimator, as pointed out by Blackburne and Frank (2007) is that it provides an option for the estimation of a within-group correlation with the standard error. However, if the sample size is small, the estimator is vulnerable to simultaneous equation bias resulting from endogeneity.

3.3.2.4 Efficient model selection

The panel ARDL model in equation (9) is estimated using the MG, PMG and DFE estimators, after which the Hausman test is applied to see the presence of significant differences among their estimates. The model adjudged by the Hausman test as the most efficient is then fully paid attention to for discussion.

3.4 Data sources and description

The study constructs a panel dataset for nineteen selected African countries, for the period 2000 to 2019. Annual data utilized in this study is sourced from World Development Indicators and World Governance Indicators of the World Bank. The choice of time and the country depends on availability of data on the selected variables of interest.

The selected countries for the study are as follows; Angola, Burundi, Botswana, Republic of Congo, Cabo Verde, Gabon, Ghana, Equatorial Guinea, Kenya, Madagascar, Mauritius, Nigeria, Rwanda, Sudan, Eswatini, Seychelles, Chad, Tanzania, and South Africa.

Foreign exchange reserves are defined as holdings of monetary gold, special drawing rights, reserves of International Monetary Fund (IMF) members held by the IMF, and holdings of foreign exchange under the control of monetary authorities (World Bank, 2021). In this study, the foreign exchange reserves are the dependent variable. The reserves are in US Dollars. The independent variables of the study, based on surveyed literature are broad money to GDP, trade

openness, consumer price index is used as a proxy for inflation, and exchange rate. The study adds a new variable institution proxied by indices from the world governance indicators.

Inflation: measured by the consumer price index. It shows how much prices have changed to acquire a basket of goods and services. A negative sign is expected. Theoretically, when prices of goods and services rise sharply, the foreign exchange reserves reduce as they are used to increase money supply into the economy.

Exchange rate: is the official exchange rate determined by national authorities,(World Bank, 2021). It is in local currency units per US dollar. Depreciation of local currencies against the US Dollar are expected to weaken the local currencies thus reducing the reserves, while currency appreciation strengthens local currencies which supports an increase in reserves.

Trade openness: calculated as the sum of exports and imports relative to Gross Domestic Product. It measures the extent to which a country participates in the global trading market. A positive coefficient of trade openness is expected for countries where exports exceed imports, and a negative sign is expected for countries which import more than they export.

Broad money to GDP ratio: the sum of currency outside banks; demand deposits; time, savings, and foreign currency deposits of resident factors other than the central government ; bank and traveler's checks and other securities such as commercial paper,(World Bank, 2021). It measures financial sector depth.

Institution proxied by the six dimensions of governance; voice and accountability, government effectiveness, regulatory quality, rule of law, political stability and absence of violence/terrorism, and control of corruption. The estimates are approximately from -2.5 for weak governance to 2.5 for strong governance. The expected results are mixed, in the sense that the different dimensions of governance have diverse effects to reduce the reserves, say for example when the Governments fail to control corruption and the elite groups access the funds. On the other hand, strong political stability and effective government are expected to have a positive impact on reserves when they attract foreign investors into the economies.

- i. Voice and accountability: *the idea that citizens can vote their own governments, free to express themselves and the media is unrestricted.*

- ii. Government effectiveness: *the quality and independence of public services and civil services from political pressures, the ability to formulate and implement sound policies, and the trustworthiness of the governments to commit to them.*
- iii. Regulatory quality: *defines the capacity of the government to execute set policies and regulations that enhance growth of the private sector.*
- iv. Political stability and absence of violence/terrorism *is about perceptions of the possibility of political unrest and/or violence driven by politics, including terrorism.*
- v. Rule of law: *having confidence in the societal rules and abiding by them. In addition, the excellence of contract enforcement, property rights, the police, and the courts, together with the chances of crime and violence.*
- vi. Control of Corruption *is the ability of those in power to execute their duties against use of state resources for personal gain and own interests.*

The inclusion of institutional variable is to capture other economic effects and political environment towards accumulation of the reserves. This is reasonable to investigate because the stability of government, ability to implement proposed policies, freedom of expression and quality services affects investor's decision in choosing a country that they want to invest in, consequently affecting the accumulation of reserves.

Additionally, high scores of the indicators show good governance, whereas low and negative values show that there is need for improvement in the weak areas. When laws are enforced and the legal systems of an economy perform well, this assures investors that their rights are protected by the host country which makes it possible for them to safely get their profits of investment. The study adds each indicator one after the other to the main regression model to see the significance of each in relation to foreign exchange reserves.

CHAPTER FOUR

Empirical analysis

4.1 Preliminary analysis

The section discusses the statistical properties of the panel data used in the study. Descriptive statistics is followed by correlation matrix, where the relationship between the variables is observed. The data is checked for stationarity to verify that there are no variables integrated of order two because the panel ARDL methodology would then be not suitable for the study. Cointegration tests are then done to examine the existence of a long run relationship between the variables. The tables and the full descriptions of the properties are done below.

4.1.1 Descriptive statistics

Table 1 below reports the characteristics of the data, summarizes, and interprets the data for the selected variables of interest. The variables foreign reserves, exchange rate, trade openness, consumer price index (proxy for inflation), and broad money have been logged except for the world governance indicators (proxies for institution) to improve the robustness of the estimated model and for consistency of the residual.

Table 1: Descriptive statistics

Variables	Obs	Mean	Std.Dev	Minimum	Maximum
Foreign Reserves(FR)	380	20.996	1.875	15.918	24.732
Trade openness (TO)	380	4.212	0.730	0.198	5.721
Broad money to GDP(M2)	380	3.337	0.676	1.747	4.794
Exchange rate (ER)	380	4.527	2.220	-0.607	8.194
Inflation(INF)	380	4.537	0.550	1.068	7.204
Control of corruption(COC)	361	-0.549	0.742	-1.826	1.217
Govt Effectiveness(GE)	361	-0.545	0.719	-1.697	1.057
Political stability(POL)	361	-0.399	0.975	-2.665	1.282
Rule of law(ROL)	361	-0.521	0.734	-1.663	1.077
Regulatory Quality(RQ)	361	-0.453	0.712	-1.799	1.127
Voice & accountability(VA)	361	-0.521	0.871	-2.000	0.998

Note: *Obs*; number of observations, *Std.dev* is standard deviation.

From Table 1 above, it can be observed that on average, all the institutional variables are negative. This indicates that governance of the selected countries appears to be weak, which implies that formulation and implementation of policies by governments, effectiveness of service delivery, transparency, and respect of law by citizens still needs room for improvement. The minimum value for institution variables is -2.7 in political stability and absence of violence which is an outlier (indicators range from -2.5 to +2.5) is for Sudan due to the political unrest in the country.

For the maximum, the institution variables fluctuate around 1, with the highest value at 1.28 for political stability and absence of violence. This indicates that for the Sub-Saharan African countries, the governments work harder towards achieving stable political environments and to lessen war and conflicts which affect the development of countries and partnerships with global economy. It is not attractive to investors to put resources in a country that is not stable and there are no possibilities of gaining returns.

The average growth rate of foreign exchange reserves for the 20-year period of this study stood at 21 million which means on average reserves in Sub-Saharan Africa grows at a slower rate. The minimum value is USD 15.9million while the maximum is USD24.7 million. The standard deviation of 1.9 shows that foreign exchange reserves are the next volatile variable in the study following exchange rates. Exchange rate is the most volatile variable with the highest standard deviation of 2.2.

There is low variation between the mean and standard deviation of trade openness, broad money, and inflation. The variables show that on average, they have growth in the right direction to influence the economies of Sub-Saharan Africa. Overall, Sub-Saharan economies are diverse in their economic and political structures.

4.1.2 Correlation Analysis

Table 2: Correlation Matrix

LFR	LTO	LM2	LER	INF	COC	GE	POL	ROL	RQ	VA
-----	-----	-----	-----	-----	-----	----	-----	-----	----	----

LFR	1.000										
LTO	-0.050	1.000									
M2	0.178	0.191	1.000								
LER	-0.179	-0.094	-0.453	1.000							
INF	0.174	-0.363	0.113	0.108	1.000						
COC	0.125	0.266	0.633	-0.449	-0.073	1.000					
GE	0.233	0.271	0.774	-0.480	-0.067	0.915	1.000				
POL	0.050	0.590	0.534	-0.223	-0.030	0.702	0.711	1.000			
ROL	0.153	0.272	0.768	-0.421	-0.021	0.896	0.944	0.789	1.000		
RQ	0.253	0.234	0.739	-0.346	-0.006	0.819	0.913	0.677	0.917	1.000	
VA	0.309	0.240	0.792	-0.365	-0.040	0.726	0.854	0.618	0.866	0.870	1.000

Source: Author's calculations

Trade openness and exchange rate are negatively correlated with foreign exchange reserves, that is, increases in these variables leads to a decrease in the reserves. Since the values are closer to zero, they show a weaker relationship with the dependent variable (reserves). Broad money to GDP, inflation, and the institution variables have a positive correlation with reserves, meaning the variables increase together. The values are also closer to zero than one, so it can be concluded that the linear relationship between the variables and reserves is weak.

4.1.3 Unit Root Tests

The aim of this study is to examine the determinants of foreign exchange reserves in Sub-Saharan Africa, as well as the role that institutional quality plays in reserve accumulation. The study uses panel ARDL approach, and the data is first analyzed to investigate whether the variables are stationary or not, and verify that there are no I(2) variables in. The panel unit root tests used are the Im-Perasan and Shin (IPS), Fishers' Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP), Levin, Lin & Chu (LLC).

Table 3: Unit root tests

	IPS	FISHER-ADF	FISHER-PP	LLC	
Variable	W-statistic	Chi-Square	Chi-Square	t* statistic	Remark
FR	-3.746*** (0.000)	80.220*** (0.000)	70.470*** (0.001)	-7.246*** (0.000)	I(0)

TO	-9.893*** (0.000)	174.552*** (0.000)	242.812*** (0.000)	-12.097*** (0.000)	I(1)
INF	2.309 (0.990)	25.394 (0.942)	59.807** (0.014)	-6.382*** (0.000)	I(1)
M2	-7.429*** (0.000)	126.187*** (0.000)	233.890*** (0.000)	-7.833*** (0.000)	I(1)
ER	-7.105*** (0.000)	122.634*** (0.000)	165.406*** (0.000)	-8.615*** (0.000)	I(1)

*P-values are in parenthesis. ***, **, * indicate the levels of significance at 1%, 5% and 10% respectively.*

The results of the unit root tests indicate that foreign exchange reserves are stationary at level, therefore integrated of order zero at 5 percent level of significance. Broad money supply, trade openness and exchange rate are stationary after first differencing for all the unit root tests, therefore they are integrated of order one at 5 percent level of significance. Inflation is stationary at level for the LLC unit root test, but its stationary after first difference for all the other tests.

The data has been verified to be stationary and that there are no I (2) variables, then cointegration tests are done to examine long run relationship between variables. The study will use the Kao and Fisher cointegration tests.

4.1.4 Panel cointegration tests

Based on the preliminary results of unit roots tests, which showed that some variables are non-stationary, cointegration tests are done check whether the variables have long run relationship. The null hypothesis is that there is no cointegration, against the alternative that cointegration exists. The test was done for each of the models as shown in the table. The results of the Kao and Pedroni test are given below.

Table 4: Cointegration results

Variables/Test	Panel ADF-stat	Group PP-Stat	Kao test
<i>Model 1: fr,er,inf,trade,m2</i>	-3.791*** (0.000)	-2.696*** (0.004)	-4.086*** (0.000)
<i>Model 2: fr,er,inf,trade,m2,coc</i>	-1.445 (0.074)	-3.851*** (0.000)	-4.486*** (0.000)

<i>Model 3: fr,er,inf,trade,m2,ge</i>	-2.243** (0.012)	-2.853*** (0.002)	-4.511*** (0.000)
<i>Model 4: fr,er,inf,trade,m2,pol</i>	-3.125*** (0.001)	0.945 (0.828)	-4.674*** (0.000)
<i>Model 5: fr,er,inf,trade,m2,rol</i>	-0.591 (0.277)	-1.577* (0.057)	-4.402*** (0.00)
<i>Model 6: fr,er,inf,trade,m2,rq</i>	-1.558* (0.060)	-1.547* (0.061)	-4.526*** (0.000)
<i>Model 7: fr,er,inf,trade,m2,va</i>	-3.614*** (0.000)	-2.192** (0.142)	-4.629*** (0.000)

P-values are in parenthesis. ***, **, * indicate levels of significance at the 1%,5% and 10% respectively.

The results of the cointegration tests for model 1 reject the null hypothesis of no cointegration and therefore the conclusion is that a long relationship exists between the variables. Institution variables are added one after another to examine the long run relationship with the other variables. When adding control of corruption to the variables, the results show that there is cointegration between the variables, but the null hypothesis is not rejected for the Pedroni panel ADF test.

Government effectiveness, regulatory quality and voice and accountability tests all reject the null hypothesis of no cointegration and suggests that a long run relationship exists at the 1 percent,5 percent and 10 percent levels of significance. Rule of law and political and absence of violence fail to reject the null hypothesis for the panel ADF and group PP tests respectively, but they reject it for the other tests, hence a conclusion that there is a long run relationship between the variables. Overall, the results show that there exists a long run relationship between the variables.

4.2 Estimation results for Panel ARDL

The results of the unit root tests show that no variables are stationary after second differencing, which therefore qualifies the use of panel ARDL technique. The panel ARDL is estimated with the mean group, pooled mean group and dynamic fixed estimates whose results are presented

in seven columns (adding institution variables in succession) for tables 4.1 to 4.3. the columns are models 1-7 introduced in table 4 above.

Table 4.1: Panel ARDL results for Mean Group estimates

<i>Long-run</i>	1	2	3	4	5	6	7
	1.435	1.994	-3.631	1.413	4.230*	7.675*	-13.515
LTO	(1.051)	(2.281)	(22.048)	(1.877)	(2.199)	(4.010)	(9.210)
	1.567	0.966	11.498	3.843*	2.020	15.063*	17.500*
LM2	(1.626)	(4.131)	(37.331)	(2.300)	(1.543)	(8.732)	(8.765)
	-3.023	-5.016	2.975	-2.284	-5.460**	0.554	4.738
LER	(1.848)	(2.790)	(12.636)	(2.841)	(2.241)	(5.965)	(5.326)
	0.213	6.488	1.379	-1.434	1.479	12.835	-6.773
LINF	(1.368)	(7.377)	(14.361)	(2.200)	(1.660)	(13.636)	(6.543)
		3.001					
COC		(3.797)					
			46.368				
GE			(36.535)				
				-0.215)			
POL				(1.940)			
					0.192		
ROL					(1.013)		
						-5.349	
RQ						(6.625)	
							7.960
VA							(10.790)
<i>Short-run</i>							
	-0.142	-0.887	-0.800	-0.841	-1.241***	-0.713	-0.987
Δ TO	(0.279)	(0.477)	(0.565)	(0.527)	(0.478)	(0.551)	(0.528)
	0.322	-0.168	-0.093	-0.270	0.300	0.032	0.181
Δ M2	(0.434)	(0.442)	(0.538)	(0.457)	(0.557)	(0.494)	(0.720)
	1.283**	1.751*	1.409*	1.652*	2.017	1.108*	2.244
Δ ER	(0.655)	(0.868)	(0.851)	(0.908)	(0.913)	(0.653)	(1.297)
	-0.658	-3.901	4.706	-3.055	-3.378	-3.526	-1.893
Δ INF	(1.781)	(2.863)	(3.680)	(3.036)	(3.004)	(2.782)	(1.885)
		-0.538					
Δ COC		(0.342)					
			-0.692*				
Δ GE			(0.397)				
				0.046			
Δ POL				(0.207)			

					-0.538 (0.422)		
Δ ROL						-0.171 (0.319)	
Δ RQ							-0.577 (0.616)
Δ VA							
	-0.473*** (0.104)	-0.468*** (0.113)	-0.427*** (0.120)	-0.444*** (0.116)	-0.459*** (0.120)	-0.397*** (0.102)	-0.412*** (0.103)
ECT	18.547** (7.365)	4.885 (5.379)	7.372 (7.838)	12.553* (6.973)	12.046* (4.771)	5.324 (5.815)	10.327 (7.317)
Constant							

Note: the columns 1-7 are the estimated models explained in table 4 above. Standard errors are in parenthesis.

***, **, * indicate levels of significance at the 1%, 5% and 10% respectively.

Table 4.2 Panel ARDL results for Pooled Mean Group estimates

<i>Long-run</i>	1	2	3	4	5	6	7
	1.724*** (0.259)	2.473*** (0.336)	-6.276** (3.060)	1.139*** (0.180)	3.407*** (0.628)	4.867*** (0.524)	2.539*** (0.347)
LTO	0.844*** (0.306)	-0.699*** (0.251)	-19.644*** (7.478)	1.593*** (0.250)	-3.036*** (0.711)	-0.740** (0.328)	2.662*** (0.480)
LM2	-0.932** (0.448)	-1.016*** (0.147)	-12.766*** (3.909)	0.435 (0.269)	-8.188*** (1.229)	-1.568*** (0.356)	-2.701*** (0.688)
LER	3.77*** (0.406)	2.103*** (0.138)	20.327*** (6.677)	0.737*** (0.204)	9.909*** (1.159)	2.384*** (0.376)	6.602*** (0.724)
LINF		11.243*** (1.870)					
COC			-6.157** (2.681)				
GE				-3.497*** (0.674)			
POL					1.148 (0.724)		
ROL						29.069 (.)	
RQ							-4.597*** (0.754)
VA							
<i>Short-run</i>							
	0.013 (0.409)	-0.671*** (0.209)	0.091 (0.285)	0.063 (0.301)	-0.358 (0.265)	-0.822*** (0.240)	0.0622 (0.279)
Δ TO							

	0.853***	0.924***	0.974**	0.789***	0.904***	1.111***	0.381
$\Delta M2$	(0.299)	(0.284)	(0.392)	(0.281)	(0.325)	(0.332)	(0.345)
	-0.835**	0.048	-0.927**	-1.087**	-0.336	0.268	-1.029*
ΔER	(0.371)	(0.266)	(0.407)	(0.511)	(0.309)	(0.408)	(0.369)
	2.166*	0.780	1.294	1.785	2.304*	1.136	1.736
ΔINF	(1.152)	(0.692)	(1.249)	(1.754)	(1.157)	(1.137)	(0.944)
		-2.131***					
ΔCOC		(0.732)					
			-0.258				
ΔGE			(0.164)				
				0.233			
ΔPOL				(0.180)			
					0.269		
ΔROL					(0.382)		
						-5.769***	
ΔRQ						(1.585)	
							-0.464
ΔVA							(0.432)
	-0.091	-0.251***	-0.024	-0.006	-0.086	-0.195***	-0.278
ECT	(0.073)	(0.000)	(0.015)	(0.050)	(0.055)	(0.056)	(0.065)
	-0.697	2.307***	1.589	-0.232	0.414	-0.869	-0.994
Constant	(0.495)	(0.715)	(1.131)	(0.425)	(0.975)	(0.616)	(1.778)

Standard errors are in parenthesis. ***, **, * indicate levels of significance at the 1%, 5% and 10% respectively.

Table 4.3 Panel ARDL results for Dynamic Fixed Effects

<i>Long-run</i>	1	2	3	4	5	6	7
	0.940*	1.038*	1.046**	1.029**	1.077**	1.004**	1.000*
LTO	(0.429)	(0.443)	(0.447)	(0.420)	(0.447)	(0.458)	(0.433)
	-2.927**	-3.932***	-4.107***	-4.193***	-4.085***	-4.028***	-4.035***
LM2	(0.965)	(0.000)	(1.119)	(1.062)	(1.125)	(1.23)	(1.076)
	-1.625*	-0.367	-0.331	-0.491	-0.151	-0.200	-0.725
LER	(0.830)	(0.000)	(0.953)	(0.894)	(0.973)	(0.979)	(0.930)
	2.341***	1.042	1.028	1.103	0.825	0.871	1.256
LINF	(0.652)	(0.000)	(0.784)	(0.736)	(0.803)	(0.815)	(0.764)
		0.970					
COC		(0.762)					

GE			0.844 (0.875)				
POL				1.324** (0.565)			
ROL					0.656 (0.927)		
RQ						0.563 (0.864)	
VA							2.132* (0.957)
Short-run							
	0.122 (0.143)	-0.022 (0.132)	-0.020 (0.132)	-0.020 (0.131)	-0.022 (0.132)	-0.200 (0.132)	-0.020 (0.131)
ΔTO	0.841*** (0.242)	0.833*** (0.229)	0.884*** (0.230)	0.877*** (0.229)	0.850*** (0.230)	0.846*** (0.229)	0.928*** (0.229)
$\Delta M2$	-0.488 (0.292)	-0.169 (0.274)	-0.163 (0.276)	-0.157 (0.272)	-0.183 (0.275)	-0.180 (0.275)	0.151 (0.273)
ΔER	0.282 (0.471)	0.435 (0.528)	0.467 (0.532)	0.446 (0.526)	0.385 (0.532)	0.449 (0.539)	0.463 (0.526)
ΔINF		0.036 (0.222)					
ΔCOC			-0.042 (0.219)				
ΔGE				-0.081 (0.118)			
ΔPOL					0.211 (0.268)		
ΔROL						0.102 (0.196)	
ΔRQ							-0.249 (0.560)
ΔVA							
	-0.196*** (0.033)	-0.183*** (0.032)	-0.181*** (0.032)	-0.191*** (0.032)	-0.181*** (0.032)	-0.179*** (0.032)	-0.186*** (0.317)
ECT	4.674*** (0.947)	5.061*** (0.925)	5.067*** (0.931)	5.505*** (0.946)	5.030*** (0.944)	4.985*** (0.925)	5.454*** (0.943)
Constant							

Standard errors are in parenthesis. ***, **, * indicate levels of significance at the 1%, 5% and 10% respectively

The Hausman test was employed to determine the most efficient estimator, with a null hypothesis that the PMG is more efficient estimator than the MG estimator, at 5 percent level of significance. The second test compares the PMG and DFE and the last test compares MG to

DFE. Hausman test results are displayed in table 4.4, and results analysis follows afterwards based on the outcomes of the test.

Table 4.4 Hausman test

Hausman tests	1	2	3	4	5	6	7
	7.67	4.34	1.44	2.12	2.45	0.5	0.41
MG vs PMG	(0.105)	(0.501)	(0.920)	(0.833)	(0.785)	(0.974)	(0.995)
	6.27	10.07	1.02	-16.72	7.32	9.96	11.77
PMG vs DFE	(0.180)	(0.073)	(0.961)	(Inconclusive)	(0.198)	(0.041)	(0.038)
	0.20	0.08	0.02	0.05	0.08	0.04	0.02
DFE vs MG	(0.995)	(0.999)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)

Probability values are in parenthesis.

The results of the Hausman test show that comparing the MG and PMG, the probability value is greater than 5 percent for all the regression models, therefore PMG is preferred estimator over the MG. Comparing the PMG and DFE has mixed results. Models 1, 2,3, and 5 have probability value greater than the 5percent level of significance and therefore the results choose PMG as the best estimator. Models 6 and 7 show probabilities less than the 5 percent level of significance meaning the DFE is preferred. The results for the model 4, which incorporates government effectiveness are inconclusive for the PMG and DFE Hausman test.

The comparison of the DFE and MG estimates shows probability values greater than the 5 percent level of significance for all models, hence a conclusion that DFE is the preferred estimator. The Hausman test confirms that the PMG is most preferred over the other two, and therefore in interpreting results, the focus will be the PMG estimates as recommended by the Hausman test.

4.3 Discussion of results

Based on the outcomes of Hausman test, the results extensively discussed are for the PMG estimation. The discussion is in two parts to focus on long run and short run results separately.

Table 4.2 shows that in the long run, inflation is positive and the main determinant of foreign exchange reserves in Sub-Saharan Africa as the coefficients of the variable are all strongly significant across the seven models, at 1 percent level of significance. The results are consistent

with findings of Sanusi et al. (2019) who also found positive and significant effect of inflation on foreign reserves for Southern African countries.

In the case of the Sub-Saharan Africa countries, the positive relationship between foreign exchange reserves and inflation can be attributed to the objectives of central banks as they aim to maintain stable inflation in their economies. Maintaining price stability is key to central banks to boost economic activities in the country and hence the reason why as inflation increases, countries reserve increase so that they cushion the economy against the deterioration of the current account balance of payments.

Trade openness is positive and significant determinant of foreign exchange reserves in Sub-Saharan Africa for all models except one where government effectiveness is added. The results of positive impact are in line with studies which found evidence that openness of an economy to trade significantly increases reserves (Coppin, 1994; Jena and Sethi, 2021). The results of the six South East Asia selected countries by Shrestha and Wansi (2014) however show mixed outcome. Trade is positive and significant determinant of foreign exchange reserves in Singapore and Korea, while it is negative and significant for Malaysia.

In relation to the Sub-Saharan Africa countries, the positive impact trade openness to reserves could be due to the involvement of the countries in trading their commodities with developed economies and in exchange gain foreign currency. The negative relationship of trade openness when government effectiveness is involved possibly means that if government is not fully committed to implementation of formulated policies and there is poor service delivery (weak governance) , then taking part in global trade might not yield fruitful results. Therefore, an increase in trade openness and government effectiveness by 1% will cause a 6% decline in foreign exchange reserves of the Sub-Saharan African countries, all things held constant.

Exchange rate is negative and significant in six of the regressed models except for the model 4 which includes political stability and absence of terrorism. This insignificance in model 4, could be associated with economies where wars, conflicts and instability are more of a main concern to the leadership of countries and potential investors. If a country is not politically stable and there is possibility of terrorism/violence, then exchange rate is not effective in

accumulating reserves as potential investors and trade partners would not be willing to engage with such a country.

This outcome is inconsistent with the findings by Khomo et al. (2018) and Sanusi et al. (2019) who concluded that exchange rate is a positive and significant determinant of foreign exchange reserves in Eswatini and Southern Africa, respectively. The other six models where exchange rate is negative and significant, are supported by (Gereziher and Nuru, 2021). The consistent negative effect of exchange rate in the long run for the Sub-Saharan countries, could be associated with these countries holding onto foreign exchange reserves for currency defending purposes.

Broad money to GDP is significant to foreign exchange reserves across models. It is positive at 1 percent level of significance for models 1,4 and 7 and negative a 1 percent level of significance for models 2,3 and 5. Model 6 is negative and significant at 5 percent level of significance. The positive and significant impact of broad money to foreign exchange reserve accumulation is supported by findings of Cabezas and Gregorio (2019) when studying 52 emerging and developed markets. Sub-Saharan Africa countries with good banking sector are more likely to accumulate more reserves than those slacking behind in the financial development.

In examining the role of institution to the flow of foreign exchange reserves, the results show that control of corruption, political stability, and voice and accountability are significant at 1 percent level and government effectiveness is significant at 5 percent level of significance. The only positive determinant is control of corruption, which means that for Sub-Saharan Africa countries that put in place measures that fight against abuse of power for private gain will attract foreign investment and more trading partners to work on activities that will increase foreign exchange reserves holding. It has the highest positive coefficient amongst all the variables, which implies that in the long run, institution plays an important role in determining foreign exchange reserves.

Results in the short run, show that broad money to GDP is positive and significant across all models except model 7 with inclusion of voice and accountability. This suggests that countries hold onto reserves for protection against potential capital flight. Furthermore, the freedom of

expression, media, association, and ability of citizens to freely choose their government does not significantly influence foreign exchange reserves.

Exchange rate is negative and significant in the short run for four of the seven models and findings are supported by Gereziher and Nuru (2021) for the Ethiopia study, Olomola and Ajayi (2018) for the West African states and Sanusi et al. (2019) for the Southern Africa studies. The results suggest that Sub-Saharan countries accumulate foreign exchange reserves to defend their currencies. However, exchange rate is positive and significant in the short run for India as found by Dash et al. (2017), therefore contradicting this study.

Trade openness in the short run is significant and negative for two models at 1 percent level of significance, where control of corruption and regulatory quality are also negative and significant at the 1 percent level. The latter are the only two governance indicators that are significant in the short run. Their negative outcome implies that a 1% increase in control of corruption and regulatory quality cause foreign exchange reserves of Sub-Saharan African countries to fall by approximately 2% and 6% respectively, all else constant.

These results are not consistent with long run outcomes that control of corruption increases reserves. It could be that it takes time for the government to fully tackle issues against corruption, hence in the short term, reserves could be decreased by being spent on personal/private interests than serving the nation. As for regulatory quality, the results suggests that as governments improves on policies and promotes private sector development, they tap into foreign exchange reserves for domestic use. This implies that if Sub-Saharan African countries uses foreign exchange reserves to enhance the private sector, then their reserve holdings will decrease.

Inflation is positive across the models which is similar to long run outcomes, however, it is significant for two models in the short run at 10 percent level of significance, which suggests that in the short term, rising prices are significant to a certain degree in determining foreign exchange reserves.

The results of this study agree with the findings of the literatures (Cabezas & Gregorio, 2019; Sanusi, et al., 2019; Ajayi & Olomola, 2018) that indeed trade openness, broad money and inflation and exchange rate significantly determine foreign exchange reserves. Cabezas and

Gregorio (2019) found that broad money had a positive effect on foreign exchange reserves for the emerging economies before the 2009 global financial crisis. Depth of the financial sector in Sub-Saharan African countries is crucial to their accumulation of reserves as they need to be more open to stimulate savings, encourage efficient investments and have improved productivity in the economy.

Sanusi et al. (2019) found that in Southern Africa, inflation and exchange rate had significant impact on reserves, which is consistent with the results of this study as the variables are very significant across the regression, (with only one insignificant result for exchange rate out of seven). Ajayi and Olomola (2018) found that for the West African states, exchange rate had a significant and negative effect on reserves only in the short run which compares to four of the seven regression results of this study.

The error correction term is the speed of adjustment along the time path of the variables to the long-run equilibrium, it is negative across all models, which depicts the convergence of the variables in the long run. However, it is negative and statistically significant at 1 percent level of significance only for the two models which include control of corruption and regulatory quality. The coefficients (-0.25 and -0.20) indicate that about 25% and 20% respectively of this disequilibrium is corrected each year in the long run.

CHAPTER FIVE

Conclusion and Implication for policy

5.1 Introduction

This chapter summarizes findings of the study and concludes the analysis. The study aims at finding the factors that determine foreign exchange reserves in Sub-Saharan Africa and explores the role of institution in addition to the factors. Use of heterogeneous model to establish the findings is the new addition to the existing literature. The conclusion of the study is given below.

5.2 Summary and conclusion

The study articulates the determinants of foreign exchange reserves in Sub-Saharan Africa based on the framework developed by (Worrell, 1976). The framework discusses cost-benefit analysis of holding onto reserves, the economic variables associated with reserve holding and the optimum reserve holding. According to the author, foreign exchange reserves are one of the factors that influence the growth of an economy, and thus there is always a possibility of foreign exchange deficiency.

Worrell (1976) indicates that the variables that determine foreign exchange reserves are based on understanding the macroeconomic structure of the economy being analyzed. For the case of Jamaica economy, export earnings, capital inflows from abroad, money supply changes and government expenditure are the main factors affecting the reserves. Cost-benefit analysis provides guidance on the optimal level of reserves to hold, such that economies do not hold onto more reserves than necessary and miss out on developing sectors that are behind.

Following the Worrell's paper guide, this study augments the variables of choice based on the economic structure of the Sub-Saharan Africa and the peculiar nature and characteristics of countries under study. The study employs the panel autoregressive distributed lag technique on 19 selected countries for the period 2000 to 2019. Based on the structure of the Sub-Saharan economies and the problems they encounter; the study explores the role of institution on the flow of reserves and determines the other main factors that influence reserves in the region.

The findings of the study show that foreign exchange reserves in Sub-Saharan Africa are mainly determined by trade openness, broad money, inflation, exchange rate, control of corruption, government effectiveness, political stability and absence of terrorism, voice and

accountability and regulatory quality. Inflation coefficient is positive and significant at 1 percent level, across the seven models run indicating that it is an important component that economies in the region should carefully manage to have stability and adequate reserves, which is supported by findings of (Sanusi, Meyer and Hassan, 2019).

Trade openness significance is agreeable with Coppin (1994) and Jena and Sethi (2021) that there is a positive effect on reserves when economies are involved in global trade. Broad money positively affects reserves is similar to the panel study findings by (Cabezas and De Gregorio, 2019). The results of this paper for exchange rate are supported by Gereziher and Nuru (2021) but are inconsistent with the findings of (Khomo et al. 2018; Sanusi et al. 2019) whose effects were positive on reserves.

The effects of institution on the flow of Sub-Saharan Africa show that governance is crucial on how much reserves the economies gain, in the sense that improving the quality of institution has potential to attract investors and advance the growth of economies. Control of corruption variable is statistically significant in both the long run and short run, implying that this variable plays a critical role in increasing and decreasing investments into the economies.

5.3 Implication for policy

The study confirms the abundant literature that accumulation of reserves is crucial to guard against unexpected shocks, to use for loan repayments, attract foreign direct investors and grow partnerships. The countries in the Sub-Saharan Africa region are characterized by mixed exchange rate regimes, and from the study, exchange rate is a significant determinant of reserves. Therefore, it is crucial for each country to examine its exchange rate policy and observe its impact on reserves.

Additionally, most economies in the region are open, and thus based on the significance of trade openness, the countries are advised to focus on export-oriented projects to increase their foreign exchange earnings. Maintaining price stability is encouraged as most of the Sub-Saharan Africa countries are characterized by high inflation rates, and thus this study recommends for central bank authorities to engage in robust measures to ensure that consumers are protected against effects of high inflation.

Quality of institution in the region is extremely poor, therefore based on the significance of the world governance indicators, it is recommended that institutional quality be improved so that investors can have confidence to do businesses with the countries, thus attracting more foreign exchange, gain skills exchange and growth in the economies. Furthermore, governments must find solutions to conflicts and wars that rise due to hunger, unemployment, and low salaries amongst others that citizens face.

In a nutshell, countries should engage more in trade, employ exchange rate and inflation management policies, expand banking sectors, and improve the institutions to gain reserves, guard against unforeseen sudden stops, and balance of payments imbalances.

5.4 Limitation of the study

There is a problem of data availability for the Sub-Saharan Africa region, hence the study used 19 selected countries in the analysis.

5.5 Suggestions for future research

It is recommended that future studies may do an analysis in the region by introducing a different variable to the model such as capital flight. It is important to investigate in the Sub-Saharan African region as it has proven to be one of the ways foreign exchange earnings can be affected when investors decide overnight to end their businesses. Additionally, future research can consider the role of economic policy uncertainties from developed and emerging countries in the region.

Historical geo-political risk such as coup-De tat, terrorism attacks and xenophobia are prevalent across the Sub-Saharan African region, and this goes a long way in determining the cash balance of countries. All this factors, may be considered as a form of future research in determining foreign exchange reserves of Sub-Saharan Africa.

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Appendix

PANEL ARDL TABLES

Table 5: Main variables of the study

<i>Long-run</i>	MG	PMG	DFE
LTO	1.435 (1.051)	1.724*** (0.259)	0.940* (0.429)
LM2	1.567 (1.626)	0.844*** (0.306)	-2.927** (0.965)
LER	-3.023 (1.848)	-0.932** (0.448)	-1.625* (0.830)
LINF	0.213 (1.368)	3.77*** (0.406)	2.341*** (0.652)
<i>Short-run</i>			
Δ TO	-0.142 (0.279)	0.013 (0.409)	0.122 (0.143)
Δ M2	0.322 (0.434)	0.853*** (0.299)	0.841*** (0.242)
Δ ER	1.283** (0.655)	-0.835** (0.371)	-0.488 (0.292)
Δ INF	-0.658 (1.781)	2.166* (1.152)	0.282 (0.471)
ect	-0.473*** (0.104)	-0.091 (0.073)	-0.196*** (0.033)
constant	18.547** (7.365)	-0697 (0.495)	4.674*** (0.947)
Hausman test			
MG vs PMG	7.67	6.27	
Prob	0.105	0.180	
DFE vs MG			0.20
Prob			0.995

Log likelihood	14.087		
No.of.Obs	361		

Table 6: Model with corruption

<i>Long-run</i>	MG	PMG	DFE
LTO	1.994 (2.281)	2.473*** (0.336)	1.038* (0.443)
LM2	0.966 (4.131)	-0.699*** (0.251)	-3.932*** (0.000)
LER	-5.016 (2.790)	-1.016*** (0.147)	-0.367 (0.000)
LINF	6.488 (7.377)	2.103*** (0.138)	1.042 (0.000)
COC		11.243*** (1.870)	0.970 (0.762)
<i>Short-run</i>			
Δ TO	-0.887 (0.477)	-0.671*** (0.209)	-0.022 (0.132)
Δ M2	-0.168 (0.442)	0.924*** (0.284)	0.833*** (0.229)
Δ ER	1.751* (0.868)	0.048 (0.266)	-0.169 (0.274)
Δ INF	-3.901 (2.863)	0.780 (0.692)	0.435 (0.528)
COC	-0.538 (0.342)	-2.131*** (0.732)	0.036 (0.222)
ect	-0.468*** (0.113)	-0.251*** (0.000)	-0.183*** (0.032)
constant		2.307*** (0.715)	5.061*** (0.925)
Hausman test			
MG vs PMG	4.34	10.07	
Prob	0.501	0.073	
DFE vs MG			0.08
Prob			0.999
Log likelihood	72.835		

No.of.Obs	342		
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Table 7: Model with government effectiveness

Long-run	MG	PMG	DFE
LTO	-3.631 (22.048)	-6.276** (3.060)	1.046** (0.447)
LM2	11.498 (37.331)	-19.644*** (7.478)	-4.107*** (1.119)
LER	2.975 (12.636)	-12.766*** (3.909)	-0.331 (0.953)
LINF	1.379 (14.361)	20.327*** (6.677)	1.028 (0.784)
GE	46.368 (36.535)	-6.157** (2.681)	0.844 (0.875)
Short-run			
ΔTO	-0.800 (0.565)	0.091 (0.285)	-0.020 (0.132)
ΔM2	-0.093 (0.538)	0.974** (0.392)	0.884*** (0.230)
ΔER	1.409* (0.851)	-0.927** (0.407)	-0.163 (0.276)
ΔINF	4.706 (3.680)	1.294 (1.249)	0.467 (0.532)
GE	-0.692* (0.397)	-0.258 (0.164)	-0.042 (0.219)
ect	-0.427*** (0.120)	-0.024 (0.015)	-0.181*** (0.032)
constant	7.372 (7.838)	1.589 (1.131)	5.067*** (0.931)
Hausman test			
MG vs PMG	1.44	1.020	
Prob	0.920	0.961	
DFE vs MG			0.02
Prob			1.000
Log likelihood	94.186		
No.of.Obs	323		

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Table 8: Model with political stability

Long-run	MG	PMG	DFE
LTO	1.413 (1.877)	1.139*** (0.180)	1.029** (0.420)
LM2	3.843* (2.300)	1.593*** (0.250)	-4.193*** (1.062)
LER	-2.284 (2.841)	0.435 (0.269)	-0.491 (0.894)
LINF	-1.434 (2.200)	0.737*** (0.204)	1.103 (0.736)
POL	-0.215 (1.940)	-3.497*** (0.674)	1.324** (0.565)
SR			
ΔTO	-0.841 (0.527)	0.063 (0.301)	-0.020 (0.131)
ΔM2	-0.270 (0.457)	0.789*** (0.281)	0.877*** (0.229)
ΔER	1.652* (0.908)	-1.087** (0.511)	-0.157 (0.272)
ΔINF	-3.055 (3.036)	1.785 (1.754)	0.446 (0.526)
POL	0.046 (0.207)	0.233 (0.180)	-0.081 (0.118)
ect	-0.444*** (0.116)	-0.006 (0.050)	-0.191*** (0.032)
constant	12.553* (6.973)	-0.232 (0.425)	5.505*** (0.946)
Hausman test MG vs PMG	2.12	-16.720 model fails to meet asymptotic assumptions of the test	
Prob DFE vs MG	0.833		0.05
Prob			1.000

Log likelihood	85.748		
No.of.Obs	323		

Table 9: Model with Rule of law

Long-run	MG	PMG	DFE
LTO	4.230* (2.199) 2.020	3.407*** (0.628) -3.036***	1.077** (0.447) -4.085***
LM2	(1.543) -5.460**	(0.711) -8.188***	(1.125) -0.151
LER	(2.241) 1.479	(1.229) 9.909***	(0.973) 0.825
LINF	(1.660) 0.192	(1.159) 1.148	(0.803) 0.656
ROL	(1.013)	(0.724)	(0.927)
Short-run			
Δ TO	-1.241*** (0.478) 0.300	-0.358 (0.265) 0.904***	-0.022 (0.132) 0.850***
Δ M2	(0.557) 2.017	(0.325) -0.336	(0.230) -0.183
Δ ER	(0.913) -3.378	(0.309) 2.304*	(0.275) 0.385
Δ INF	(3.004) -0.538	(1.157) 0.269	(0.532) 0.211
ROL	(0.422) -0.459***	(0.382) -0.086	(0.268) -0.181***
ect	(0.120) 12.046*	(0.055) 0.414	(0.032) 5.030***
constant	(4.771)	(0.975)	(0.944)
Hausman test			
MG v PMG	2.45	7.320	
Prob	0.785	0.198	
DFE v MG			0.08
Prob			1.000
Log likelihood	97.355		
No.of.Obs	323		

Table 10: Model with regulatory quality

<i>Long-run</i>	MG	PMG	DFE
LTO	7.675* (4.010)	4.867*** (0.524)	1.004** (0.458)
LM2	15.063* (8.732)	-0.740** (0.328)	-4.028*** (1.23)
LER	0.554 (5.965)	-1.568*** (0.356)	-0.200 (0.979)
LINF	12.835 (13.636)	2.384*** (0.376)	0.871 (0.815)
RQ	-5.349 (6.625)	29.069 (.)	0.563 (0.864)
<i>Short-run</i>			
Δ TO	-0.713 (0.551)	-0.822*** (0.240)	-0.200 (0.132)
Δ M2	0.032 (0.494)	1.111*** (0.332)	0.846*** (0.229)
Δ ER	1.108* (0.653)	0.268 (0.408)	-0.180 (0.275)
Δ INF	-3.526 (2.782)	1.136 (1.137)	0.449 (0.539)
RQ	-0.171 (0.319)	-5.769*** (1.585)	0.102 (0.196)
ect	-0.397*** (0.102)	-0.195*** (0.056)	-0.179*** (0.032)
constant	5.324 (5.815)	-0.869 (0.616)	4.985*** (0.925)
Hausman test MG vs PMG	0.500	9.96	
Prob	0.974	0.041	
DFE vs MG			0.04
Prob			1.000
Log likelihood	69.808		

No.of.Obs	342		
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Table 11: Model with voice and accountability

Long-run	MG	PMG	DFE
LTO	-13.515 (9.210)	2.539*** (0.347)	1.000* (0.433)
LM2	17.500* (8.765)	2.662*** (0.480)	-4.035*** (1.076)
LER	4.738 (5.326)	2.701*** (0.688)	-0.725 (0.930)
LINF	-6.773 (6.543)	6.602*** (0.724)	1.256 (0.764)
VA	7.960 (10.790)	-4.597*** (0.754)	2.132* (0.957)
Short-run			
Δ TO	-0.987 (0.528)	0.0622 (0.279)	-0.020 (0.131)
Δ M2	0.181 (0.720)	0.381 (0.345)	0.928*** (0.229)
Δ ER	2.244 (1.297)	-1.029* (0.369)	0.151 (0.273)
Δ INF	-1.893 (1.885)	1.736 (0.944)	0.463 (0.526)
VA	-0.577 (0.616)	-0.464 (0.432)	-0.249 (0.560)
ect	-0.412*** (0.103)	-0.278 (0.065)	-0.186*** (0.317)
constant	10.327 (7.317)	-0.994 (1.778)	5.454*** (0.943)
Hausman test			
MG vs PMG	0.41	11.770	
Prob	0.995	0.038	
DFE vs MG			0.02
Prob			1.000
Log likelihood	98.795		
No.of.Obs	323		