Journal of Economic Cooperation and Development, **43**, 2 (2022), 161-190

The Impact of Foreign Reserves Accumulation on Macroeconomic Performance: A panel Analysis

Muhammad Riyadh Ghozali Lubis[1] and Sallahuddin Hassan[2]

ABSTRACT

This study analyzes the relationship between foreign reserves accumulation on export and foreign direct investment both short and long-run for the period of 1980-2019. The total reserves minus gold has been utilized in analyzing the impact of foreign reserves accumulation on export and foreign direct investment in 11 Asian-African countries, namely Bangladesh, Ghana, India, Indonesia, Kenya, Nigeria, Pakistan, Philippines, Sri Lanka, Tunisia, and South Africa. Variables such as export, foreign direct investment, and gross fixed capital formation are examined using three methods of analysis: ARDL/PMG method, FMOLS method, and DOLS method, and allow for common correlated effects. The PMG, FMOLS, and DOLS estimations, respectively, show that foreign reserves accumulation has a significant and positive impact on export and foreign direct investment.

ملخص

تحلل هذه الدراسة العلاقة بين تراكم الاحتياطيات الأجنبية على الصادرات والاستثمار الأجنبي المباشر على المدى القصير والطويل لفترة 1980-2019. وتم استخدام إجمالي الاحتياطيات ناقص الذهب في تحليل تأثير تراكم الاحتياطيات الأجنبية على الصادرات والاستثمار الأجنبي المباشر في 11 دولة آسيوية أفريقية، وهي بنغلاديش وغانا والهند وإندونيسيا وكينيا ونيجيريا وباكستان والفلبين وسريلانكا وتونس وجنوب أفريقيا. ويتم فحص المتغيرات مثل التصدير والاستثمار الأجنبي المباشر وتكوين رأس المال الثابت الإجمالي باستخدام ثلاث طرق للتحليل: طريقة لوحة الانحدار الذاتي للإبطاء الموزع (ARDL)/ المجموعة المتوسطة المجمعة (PMG)، وطريقة المربعات الصغرى المعدلة بالكامل (FMOLS)، وطريقة

[1] Department of Economics, Sultan Idris Education University, Tanjong Malim, Malaysia. Email: murigholisstar@gmail.com
[2] Department of Economics, Finance and Banking, Universiti Utara Malaysia, Sintok, Malaysia. Email: din636@uum.edu.my

المربعات الصغرى الديناميكية (DOLS)، وتسمح بالتأثيرات المترابطة الشائعة. وتظهر تقديرات PMG و FMOLS و DOLS، على التوالي، أن تراكم الاحتياطيات الأجنبية له تأثير هام وإيجابي على التصدير والاستثمار الأجنبي المباشر.

ABSTRAITE

Cette étude analyse la relation entre l'accumulation des réserves étrangères sur les exportations et les investissements directs étrangers à court et à long terme pour la période entre 1980-2019. Les réserves totales moins l'or ont été utilisées pour analyser l'impact de l'accumulation des réserves étrangères sur les exportations et les investissements directs étrangers dans 11 pays d'Asie et d'Afrique, à savoir le Bangladesh, le Ghana, l'Inde, l'Indonésie, le Kenya, le Nigeria, le Pakistan, les Philippines, le Sri Lanka, la Tunisie et l'Afrique du Sud. Les variables telles que l'exportation, l'investissement direct étranger et la formation brute de capital fixe sont examinées à l'aide de trois méthodes d'analyse : la méthode ARDL/PMG, la méthode FMOLS et la méthode DOLS, et tiennent compte des effets corrélés communs. Les estimations PMG, FMOLS et DOLS, respectivement, montrent que l'accumulation de réserves étrangères a un impact significatif et positif sur les exportations et les investissements directs étrangers.

Keywords: Panel data, export, FDI, foreign reserves accumulation, developing countries

JEL Classification: C23, F10, F23, F31, O50

1. Introduction

The persistent depreciation of foreign exchange rates and the accumulation of large foreign reserves have been considered crucial elements in fostering foreign trade and foreign direct investment, thereby achieving economic growth. A hefty foreign reserves accumulation is purposely to depreciates the real exchange rate for export promotion. In this context, the mechanism of export promotion is a profound argument for foreign reserves accumulation. Accumulating reserves depreciates the real exchange rate, which drives a shift in domestic production to the tradable sector. The foreign reserves accumulation will attract FDI into the tradable sector, which leads to higher productivity gain and economic growth. In addition, the foreign reserves accumulation has been regarded as a self-reliant economy, which by large foreign reserves holding can

finance the economy and mitigate external borrowing. In the long-run, support a country in minimizing the impacts of economic downturn and facing the volatility of international capital.

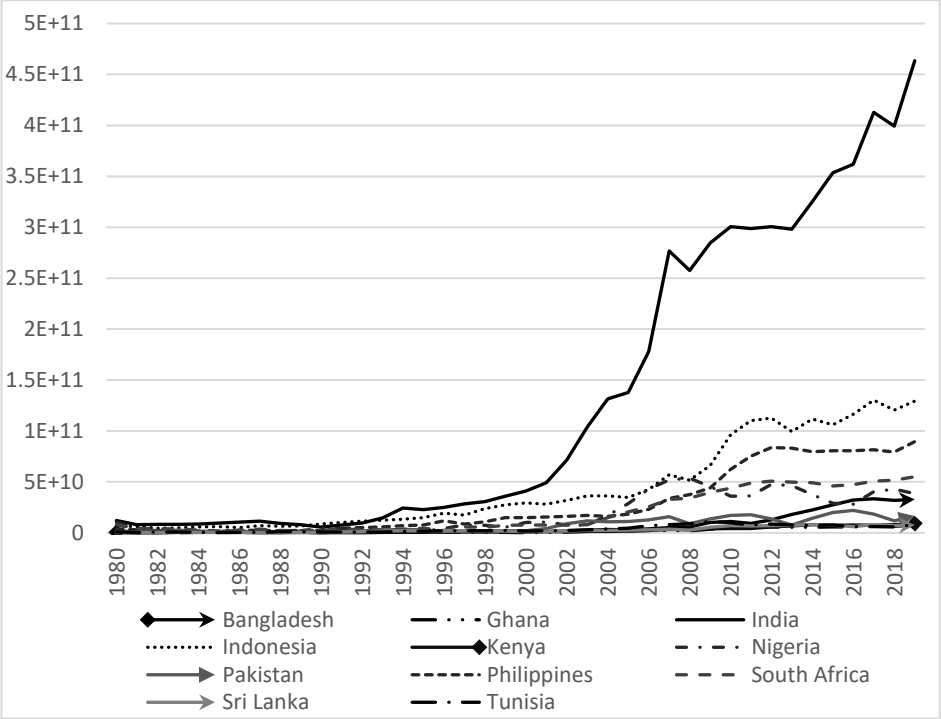
However, although all these arguments are well acknowledged, the social costs of holding foreign reserves remain the main argument for doubting foreign reserves accumulation in developing countries. This argument ties in with the cost borne on the economy. The cost bear from foreign reserves holding is due to non-interest payment on a large part of the foreign cash reserves and gold holdings. Thus, the good or bad for a country to accumulate foreign reserves depend on what a country has done with foreign reserves accumulation.

This paper begins the discussion with a brief overview of the selected countries. The selected countries are prominent in the world economy. The market and international institutions hold strong beliefs that the countries become some of the world's largest economies in the 21st century. Indonesia, India, and South Africa are known as the member of G20. Bangladesh, Pakistan, the Philippines, and Nigeria are members of the Next Eleven Countries.

In addition, Kenya is a major regional player in East Africa and one of the fastest-growing economies in Africa (World Bank, 2017). Ghana is one of the best trade destinations for foreign investment and trade in Africa and the fastest-growing economy in the world (World Bank, 2011). Sri Lanka is among the highest in terms of human development and social indicators in South Asia and favorably compared with other middle-income countries (World Bank, 2017). Tunisia is a rich country in human and physical capital and one of the fastest-growing and competitive economies in the Middle East and North Africa (MENA).

The statistics of foreign reserves accumulation, foreign trade, and FDI over the past four decades in developing countries are plotted in consecutive three figures. Figure 1 exhibits the trend of foreign reserves accumulation in 11 developing countries. India, Indonesia, and the Philippines are the countries with the hefty foreign reserves accumulation (FRA) compare to the other developing countries. South Africa showed an upward trend in FRA during 1980-2012. The FRA slightly decline in 2013 and 2015, then move a very slight increase during 2016-2019.

Figure 1: Foreign reserves accumulation minus gold
(in million USD, 1980-2019)



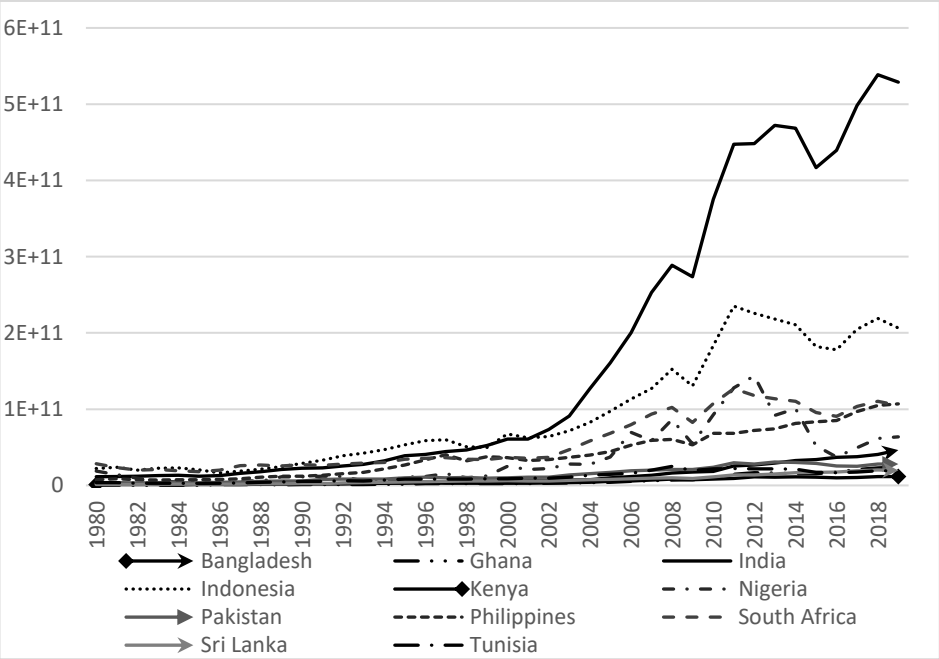
Source: World Bank Indicator Database (2021).

Additionally, Nigeria experienced increases in FRA in most of the years during 1980-2008. The FRA showed a downward trend since 2009, moving upward during 2016-2017, but declined in most recent years. Bangladesh recorded increases in FRA during 1980-2016 and quite static between 2017 and 2019. Pakistan experienced a shallow upward trend in FRA during 1980-2007 Bangladesh recorded stable increase in FRA during 1980-2016, and rather static between 2017 and 2019.

Figure 2 plots the export performance in the developing countries. India experienced an upward trend in export during 1980-2012. The export declined between 2013-2014, increased between 2015 and 2017, and decreased in 2018 and 2019. Indonesia recorded increasing exports during the period 1980-2010. Incidentally, South Africa has shown an export trend very similar to Indonesia during 2002-2019. South Africa experienced a shallow upward trend in export during 1980-1997, a slight

decrease in export in 1998 and 1999 and then a very slight increase in 2000 and 2001.

Figure 2: Export volume (in million USD, 1980-2019)



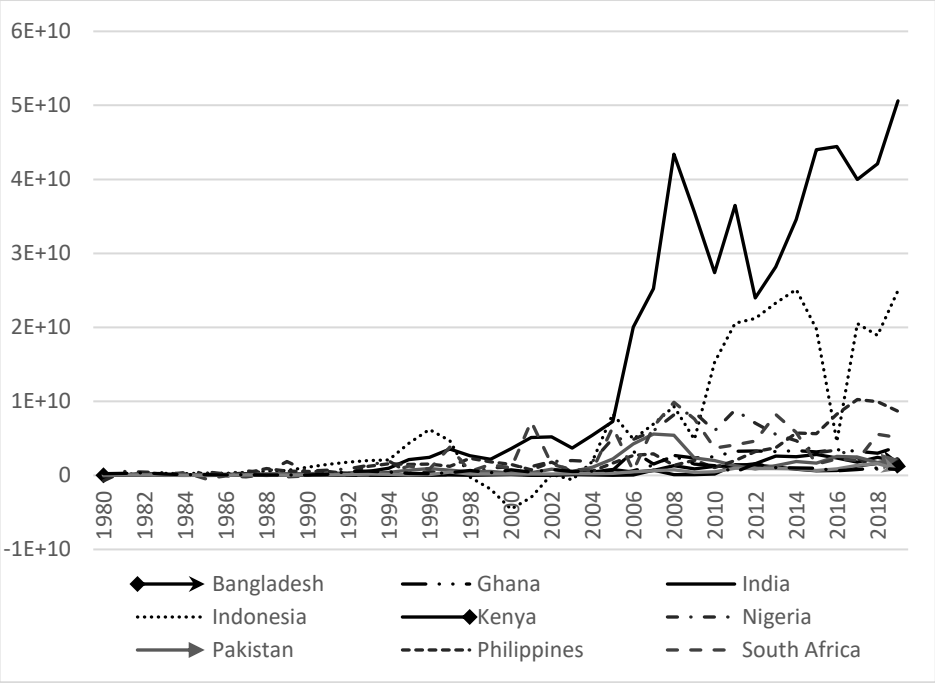
Source: World Bank Indicator Database (2021).

In addition, a slight upward trend in export was exhibited in Philippines over period 1980-2019. Nigeria recorded an increase in exports in most of the years during 1980-2006. Nigeria experienced export fluctuations in subsequent years, recording the highest increase in exports in 2012 and the lowest exports in 2016. Bangladesh showed a shallow upward trend in export during 1980-2019. Ghana and Sri Lanka also recorded slight increases in export during 1980-2010. Tunisia recorded a slight increase in export in most years during 1980-2008. The export declined slightly in 2009 and fluctuated at relatively low levels during 2010-2019. Kenya performed the lowest export among 11 developing countries during this period. Alongside the export expansion, the paper reveals the importance of FDI in developing countries.

Figure 3 presents the FDI in India and Indonesia was much higher than in other countries. India experienced an upward trend in FDI until 2008, decreased during 2009-2012, before moving up and reaching the highest

level in 2019. Indonesia recorded an upward trend in FDI during the 1980s and some years in the 1990s. The FDI decline to below zero levels from 1999 to 2001 before recovering to an upward trend in subsequent years. The FDI declined during 2014-2016, then increased upwards and reached its highest level in 2019. Nigeria experienced increases in FDI during 1980-2008. The fall in FDI started in 2009, increased slightly in 2010, and trended downwards between 2011 and 2019.

Figure 3: Foreign direct investment (in million USD, 1980-2019)



Source: World Bank Indicator Database (2021).

Furthermore, South Africa recorded ups and downs in the FDI during 1980-2019. The Philippines experienced an increasing trend in FDI over time but a slight decrease between 2017 and 2019. Ghana also recorded a shallow increase trend in FDI, quite similar to Bangladesh and Pakistan. Meanwhile, the FDI inflow in Tunisia and Sri Lanka recorded lower than others.

This study does also considers government spending on infrastructure development. The developing countries have liberalized their trade and FDI policies and pursued infrastructure development to support the

industrial sector and attract FDI inflow, and maximize the benefits of foreign presence in the domestic economy. Factors that affect human capital and capital investment are associated with economic capacity and growth. The effects of infrastructure development on economic activity and economic growth are well-reported in several studies (Barro, 1990; Agenor, 2006; Agenor & Moreno-Dodson, 2006).

Based on the pros-cons arguments discussed earlier and the countries' background, we undertake a further investigation on the impacts of foreign reserves accumulation on export and FDI in 11 Asia-Africa countries. This study is complementary to similar papers by providing new findings from a combination of Asia and African countries, as such analysis has been addressed intensely in the literature. Furthermore, in this paper, we postulate that the effects of foreign reserves accumulation on the macroeconomic performance indicators will provide some insights to explain expansion opportunities and economic growth. As the selected countries are most promising among developing countries and attractive for trade and FDI, they are interesting to be analyzed in seeing the contribution of foreign reserves accumulation on the economy.

The paper is structured as follows. Section 2 presents the literature review. Section 3 explains the data, model specification, and method of analysis. The empirical results of the study are discussed in Section 4. Lastly, Section 5 presents the conclusions and policy consideration can be implemented for the developing countries.

2. Literature Review

The conventional wisdom says that trade and FDI are the engines of economic growth. Highlighting the pivotal roles of foreign reserves accumulation, whether it is for a buffer for liquidity needs, smoothing of exchange rate volatility, and maintaining the countries' confidence level, the foreign reserves accumulation matters for the economy. The IMF (2004) emphasized the roles of foreign reserves accumulation is aimed to (1) facilitate the monetary and exchange rate policy and intervention (2) hedge the countries from external vulnerability by maintaining foreign currency liquidity to absorb shocks during economic downturns and crises or when access to borrowing limited, and (3) maintain a level of confidence to markets that a country can meet its external obligations. The points are related to each other and affect the performance of exports and

FDI. They are frequently highlighted in the literature, as will be discussed in this section.

The underlying justification for point (1) is that reserve accumulation depreciates the real exchange rate, stimulates international trade, and attracts foreign direct investment (FDI) inflows. In addition, foreign reserves holding allows the country to shield the economy from the balance payment instability. Dooley et al. (2003) stated that foreign reserves accumulation intended to protect the local industrial sector by interfering with imports and promoting exports. Aizenman and Lee (2005) viewed foreign reserves accumulation as an instrument for effective exchange rate management, such as maintaining a low exchange rate to promote international competitiveness and trade. Genberg et al. (2005) posited that the holding of foreign exchange reserves in Asian countries ties in directly with the US dollar intended to undervalue the exchange rate to foster export competitiveness. Benigno and Fornaro (2012) posited an increase in foreign reserves holding leads to real exchange rate depreciation, which fosters tradable sectors toward export expansion. Besides, Benigno and Fornaro (2012) argued that foreign reserves are used to internalize the externalities in tradable sectors and provide liquidity to the corporate sector during financial distress.

The importance of foreign reserves on export and FDI in developing countries has been identified in several empirical studies. Carvalho and Fry-McKibbin (2014) posited countries accumulate foreign reserves to support the export promotion strategies and promote capital and productivity capacity by influencing exchange rate and signaling relative economic strength. Similarly, Polterovich and Popov (2003) and Cruz and Kreisler (2008) found foreign reserves stimulate economic growth through capital productivity and aggregate demand. Furthermore, in regard to point (2), Matsumoto (2019) posited foreign reserves accumulation drives economic growth by attracting FDI inflows and minimizing the sudden stops often associated with private external debt and working capital financing. Additionally, the countries accumulate foreign reserves to get more liquidity in the event of a crisis that isolating them from the international capital markets and blocking the situation triggers the capital flights (Aizenman et al., 2004; Obstfeld et al., 2008).

The hefty foreign reserves permits a country to withstand the recurrent boom-bust cycles in capital inflow, as well as massive speculative and

capital flight. This idea relates foreign reserves accumulation directly to mitigate the sudden stops, capital flight, and exchange rate volatility. Catao and Milesi-Ferretti (2014) discussed that large foreign reserves holding minimizes the likelihood of external crises, which tend to occur in countries with a low foreign reserves accumulation. Most empirical studies conclude that the developing countries stockpile foreign exchange reserves to reduce the probability of falling into a crisis (Milesi-Ferretti & Razin, 2000; Calvo et al., 2008; Dominguez et al., 2011).

Finally, the stockpiling of large international reserves reflects the credibility of a country. Archer and Halliday (1998) identified the reasons why countries hold international reserve to include exchange rate targeting, foreign exchange market stability, credit worthiness, transaction buffer, exchange rate stability and emergency. By creating a credit worthiness through building up international reserve, the countries limit financial risk and minimize the impact of debt crisis. International reserve accumulation is proved to be growth-enhancing if only the debt flows are controlled. Assuming a self-reliance economy by mitigating debts (public and external debts), inducing higher level of international reserve is needed for boosting economic growth. It is because more debts would expose the country to volatile international capital and more international reserve will finance economic growth.

As external debt constitutes the profound source of economic financing in developing countries, debt is an instrument to finance infrastructure and public investment for fostering economic growth. However, in the long-run, the debt ties in with financial risks and debt crisis, not only in developed countries but also in developing countries. In this regard, mitigating debts is much wiser, and the hefty international reserve accumulation is much safer than borrowing. The large foreign reserves holding signalize creditworthiness and mitigate the external debt impact. Thus, it will attract more FDI. Elhiraika and Ndikumana (2007) believed that maintaining adequate reserves can boost investors' confidence and enhance investment and growth. Meanwhile, Cheng (2013) showed emerging market economies with a large stock of international reserves experience fast economic growth and suggested that holding reserves were part of economic catch-up strategies.

In case of financial distress, the foreign reserves serves as a veritable source of funds for external payments and liquidity to the trade sector.

The roles of foreign reserves accumulation in providing liquidity during crises amplify the positive impact of foreign reserves accumulation on growth. Taking some lessons from the previous economic downturns, the economists view that the accumulation of international reserves will be all the more significant. If the foreign reserves are treated as an isolated issue, trade and investment are difficult to generate and unlikely to achieve economic growth. The aforementioned has highlighted that the role of international reserve in coping with crisis and contingencies is in principle also to understand the key points linking foreign exchange reserves with trade, foreign direct investment, and economic growth.

3. Data and Methodology

3.1 Data

This study analyzes two main relationships in the long-run for a panel of eleven developing countries (N = 11) with annual data during 1980-2019 (T = 40). We analyze by using data from the World Bank Indicator. A set of variables are selected, and we define export (EXP) by the sum of export of goods and services. The foreign direct investment (FDI) represents the sum of investment flow into the host countries. We measure gross domestic product (GDP) by the sum of value added by all its producers. Meanwhile, foreign reserves accumulation (FRA) is measured by the total amount of foreign reserves minus gold. We represent infrastructure development (INFRA) by the gross fixed capital formation and defined by the sum of investment in infrastructure, investment in health, and investment in education, but not including labor costs. Our paper does not include gold holding but focuses on the total reserve minus gold to isolate the channel of the potential social effect on non-interest rates returns for gold holding. Each variable is measured in terms of the ratio of GDP as used in many empirical studies.

3.2 Model Specification

Panel data analysis is conducted to captures the information on both the intertemporal dynamics and individuality of the entities. i.e., to control unobservable characteristics and to give more reliable information (Baltagi and Kao, 2000; Hsiao, 2006). Based on Elhiraika and Ndikumana (2007), Fukuda and Kon (2010), and Matsumoto (2019), we construct two models for analyzing the impacts of foreign reserves accumulation on

export and foreign direct investment, respectively in the following equations.

$$EXP_{it} = \alpha_{0i} + \alpha_{1i}FRA_{it} + \alpha_{2i}FDI_{it} + \alpha_{3i}INFRA_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

$$FDI_{it} = \beta_{0i} + \beta_{1i}FRA_{it} + \beta_{2i}EXP_{it} + \beta_{3i}INFRA_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

In Equation [1], the dependent variable is export (EXP). The α_0 is a constant term, and α_1 to α_3 are estimated parameters in model, indicating foreign reserves accumulation (FRA), foreign direct investment (FDI), infrastructure development (INFRA) respectively. In Equation [2], the dependent variable is FDI. The β_0 is a constant term, and β_1 to β_3 are estimated parameters in model, indicating foreign reserves accumulation, export, and infrastructure development, respectively. The coefficients α_1, α_2, β_1, and β_2 are expected to indicate a positive sign. In each equation, i is a cross section data for countries concerned, t is a time series data, ε_{it} is the error term.

3.3 Estimation Procedure

The empirical study is carried out in three steps. We begin by performing the preliminary tests, such as stationary test and cointegration test. We then performed coefficients estimation by employing ARDL/PMG, FMOLS and DOLS methods.

3.3.1 Panel Stationary Test

We first conduct panel unit root tests before performing the model estimations. The test is carried out to avoid spurious regression, which may cause misleading results (Asteriou and Hall, 2007). According to Baltagi (2005), Levin, Lin, and Chu (hereafter LLC) and Im, Pesaran, and Shin (hereafter IPS) are the most efficient tests for stationarity for panel data analysis. This study conducts the panel root test using the IPS test, and the Akaike Info Criteria (AIC) is chosen for lag length selection. The IPS begins by defining a separate ADF regression for each cross-section with individual effects and no time trend, and specified as follows.

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{\rho_t} \beta_{tj} \Delta y_{i,t-j} + \delta_i + \varepsilon_{it} \quad (3)$$

Where $i = 1, \dots, N$ and $t = 1, \dots, T$. y_{it} is the dependent variable being tested. The Δ denotes first difference in the dependent variable. The α_i, ρ_i, and δ_i are the parameters. The ρ_t is the number of lags to be included in estimation and ε_{it} is the error term.

The IPS uses separate unit root tests for the N cross-section units. As the test is based on the Augmented Dickey-Fuller (ADF) and averaged across groups, after testing the separate ADF regressions, the average of the t-statistics for parameter ρ_i from the individual ADF regressions, $t_{iT}(\rho_i)$:

$$\bar{t}_{NT} = \frac{1}{N}\sum_{i=1}^{N} t_{iT}(\rho_i \beta_i) \qquad (4)$$

The $\bar{t}$ is then standardized and show that the standardized $\bar{t}$ statistic converges to the standard normal distribution as N and $T \to \infty$. Im, Pesaran and Shin (2003) assumed the cross-section dataset was balanced and $\bar{t}$ test has better performance when N and T were not too large. They proposed across-sectionally demeaned version of both tests to be applied in the case where the errors in varied regressions contain a common time specific component.

3.3.2 Cointegration Analysis

Once the order of stationary has been defined, we apply Pedroni's cointegration test. In principle, the cointegration analysis determines whether two or more variables are correlated for a specified period. The panel cointegration tests proposed by Pedroni (1999) consider heterogeneity by using specific parameters that are allowed to vary across individual members of the sample. Taking into account such heterogeneity constitutes an advantage because it is unrealistic to assume that the vectors of cointegration are identical among individuals on the panel. Pedroni test allows for individual member-specific fixed effects, deterministic trends and slope coefficients. The application of Pedroni's cointegration test requires first estimating of hypothesized long-run regression of the following form:

$$y_{i,t} = \alpha_i + \delta_{it} + \beta_{1i}x_{1i,t} + \beta_{2i}x_{2i,t} + \cdots + \beta_{Mi}x_{Mi,t} + \varepsilon_{i,t} \qquad (5)$$

for $i = 1, \dots, N$; $t = 1, \dots, T$; $m = 1, \dots M$, where N refers to the number of individual members in the panel; T refers to the number of observations

over time. In this equation, the $\alpha_i$is the member specific intercept or fixed effects parameter which varies across-sectional units. The δ_{it} is slope cooefficients and cross-section specific time effects.

Under the null hypothesis of no cointegration, the residual will be stationary at first differece. We shall obtain the residuals from Equation [6] and then test the residuals by running the following regression:

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + \sum_{j=1}^{p_i} \varphi_{ij} \Delta\varepsilon_{it-j} + v_{it} \qquad (6)$$

for each cross-section in the panel. Pedroni describes various methods of constructing statitics for testing for null hypothesis of no cointegration. Pedroni construct two tests for the null hypothesis for all cross-section, which he terms: (1) the within-dimension test or panel statistics test and (2) the between-dimension or group statistics test.

Pedroni (1999) defines three statistics $Z_{\hat{v},N,T}, Z_{\rho,N,T},$ and $Z_{tN,T}$ respectively, which are based on pooling the residuals along within-dimension of panel statistics and two statistics $\tilde{Z}_{\hat{\rho}N,T}$ and $\tilde{Z}_{\hat{t}N,T}$, which are based on pooling the residuals along between dimension or group statistics test. The asymptotic distribution of each of five statistic tests can be expressed in the following form:

$$\frac{X_{N,T} - \mu\sqrt{N}}{\sqrt{v}} \Longrightarrow N(0,1) \qquad (7)$$

where $X_{N,T}$ is the corresponding statistics from both panel statitics test and group statitics test, while μ and v are the mean and variance of each test respectively. They are provided in the original paper by Pedroni (1999). In summary, the panel v statistics diverges to positive infinity, which large positive values reject the null of no cointegration. The remaining statistics diverge to negative infinity, which large negative values reject the null hypothesis.

A total of eleven statistics with varying degree of properties are generated. In all cointegration tests, a long-run cointegration relationship is established when the p-values for two statitics tests are significant at 5% significance level. Therefore, if the majority of these values are significant then the null hypothesis is rejected, indicating there is cointegration

among variables in the models. Having found that all variables are cointegrated, the study then proceed with the model estimation.

3.3.3 Coefficients Estimation

As we are interested in general long-run elasticities, the pooled mean group (PMG) estimator developed by et al. (1999) is applied. Besides, we fulfill the requirement of panel ARDL/PMG estimation in our models: the balanced data panel and the widest panel dataset to satisfy the condition that the time dimension should be larger than the cross-section dimension ($T > N$).

According to Pirotte (1999), the pooled mean group estimator provides efficient long-run estimators of dynamic panel data models. Loayza and Ranciere (2006) viewed that the pooled mean group (PMG) estimator restricts the long-run slope coefficients to be the same across countries but allows the short-run coefficients (including the speed of adjustment) and the regression intercept to be country specific. The PMG estimator also generates consistent estimates of the mean of short-run coefficients across countries by taking the simple average of individual country coefficients. Based on Pesaran et al. (1999), we present Equation 1 and Equation 2 in error correction mechanism of autoregressive distributed lag ARDL.

$$\Delta EXP_i = \psi_i EXP_{i-1} + X_i\beta_i'(FRA_{it} - FDI_{it} - INFRA_{it}) + \sum_{j=1}^{\rho-1} \varphi_{ij}^{*}\, \Delta EXP_{i-j} + \sum_{j=0}^{q-1} \Delta X_{i-j}\, \vartheta_{ij}^{*\prime} \Delta FRA_{i-j} + \sum_{j=0}^{q-1} \Delta X_{i-j} \gamma_{ij}^{*\prime} \Delta FDI + \sum_{j=0}^{q-1} \Delta X_{i-j}\, \omega_{ij}^{*\prime} \Delta INFRA_{i-j} + D\mu_i + \varepsilon_{it} \quad (8)$$

$$\Delta FDI_i = \phi_i FDI_{i-1} + X_i\beta_i'(FRA_{it} - EXP_{it} - INFRA_{it}) + \sum_{j=1}^{\rho-1} \varphi_{ij}^{*}\, \Delta FDI_{i-j} + \sum_{j=0}^{q-1} \Delta X_{i-j}\, \vartheta_{ij}^{*\prime} \Delta FRA_{i-j} + \sum_{j=0}^{q-1} \Delta X_{i-j} \gamma_{ij}^{*\prime} \Delta EXP + \sum_{j=0}^{q-1} \Delta X_{i-j}\, \omega_{ij}^{*\prime} \Delta INFRA_{i-j} + D\mu_i + \varepsilon_{it} \quad (9)$$

With i and t representing cross-section units and the period respectively; The $\psi_i = (\psi_{i1}, \dots, \psi_{iT})'$ and $\phi_i = (\phi_{i1}, \dots, \phi_{iT})'$ respectively is a $T \times 1$ vector of observations on the dependent variable of the i-th cross-section unit; $\mathrm{X}_i = (x_{i1}, \dots, x_{iT})'$ is a $T \times k$ matrix of observations on the explanatory variables that vary both across group and time periods; $D = (d_1, \dots, d_T)'$ is a $T \times s$ matrix of observations on fixed explanatory

variables such as intercepts and time trends or those variables that vary over time; $y_{i,-j}$ and $\mathrm{X}_{i,-j}$ are j period lagged values of y_i and X_i; $\Delta y_i = y_i - y_{i,-1}$; $\Delta \mathrm{X}_i = \mathrm{X}_i - \mathrm{X}_{i,-1}$; $\Delta y_{i,-j}$ and $\Delta \mathrm{X}_{i,-j}$ are j period lagged values of Δy_i and $\Delta \mathrm{X}_i$; and $\varepsilon_i = (\varepsilon_{i1}, \ldots, \varepsilon_{iT})'$. The μ_i indicates the speed of adjustment parameter. The speed of adjustment parameter must be non-zero and less than 0, the $\mu_i = 0$ denotes there is no long-run relationship.

The PMG allows for heterogenous short-run dynamics and common long-run elasiticities based on the pooled mean-group estimator for dynamic heterogenous panel. Pesaran et al. (1999) constructed the PMG estimation technique which the slope parameters are assumed heterogeneous across the group and combine both pooling and averaging of the coefficients. In this respect, the intercept and slope parameters are homogenous in the long-run, and the error correction variances allow difference across the groups. The ARDL/PMG method observes the group specific error adjustment coefficient and short-run coefficient of the regressors. Specifically, Pesaran et al. (1999) assumed that (1) the error terms are serially uncorrelated and are distributed independently of the regressors, i.e., the explanatory variables can be treated as exogenous; (2) there is a long-run relationship between the dependent and explanatory variables; and (3) the long-run parameters are equal across countries.

Pesaran et al. (1999) proposes the Pooled Mean Group (PMG) and the Mean Group (MG) that allow for a certain degree of parameter heterogeneity in panel data regressions. We focus on the PMG estimator considers a lower degree of heterogeneity since it imposes homogeneity in the long-run coefficients while still allowing for heterogeneity in the short-run coefficients and the error variances. The PMG/MG estimator allows for long-run coefficient homogeneity over a single subset of regressors. The consistency and efficiency properties of the two estimators can be tested using a likelihood ratio test or Hausman test.

We also analyze the relationships by applying FMOLS and DOLS methods. It aims to strengthen the empirical findings of this study. In this regard, we attempt again to address the endogeneity and serial correlation that plausibly exist in the two relationship models developed. Phillips and Hansen (1990) viewed that the fully modified method and error-correction method allow consistent and efficient estimation of the

cointegration vectors in a finite sample, thus addressing serial correlation and endogeneity.

Later, Pedroni (1999) posited that the FMOLS allows consistent and efficient estimation of the cointegration vector, thus addresses the issues of endogeneity, simultaneity bias, and non-stationarity of the regressors. Meanwhile, the DOLS method as the parametric estimator accounts for lagged or the first difference term for controlling the endogenous problem (Saikkonen, 1991; Mark & Sul, 2002).

These approaches set out to deal with the issues of heterogeneity and endogeneity, which are the main concerns in a panel data model. By performing the methods, this study implicitly addresses such issues, thus presenting unbiased results. In sum, the consistency of the estimation results would show by ARDL/PMG, FMOLS, and DOLS methods, respectively, imply the robustness of the models in this analysis.

Pedroni (2000) stated that the FMOLS approach allows for the country-specific fixed effects to be heterogeneous while estimating long-run relationships. Based on Pedroni (2000), the estimator for the *i*-th panel data is given by Equation [10].

$$\hat{\beta}_{FMOLS} = \left[\sum_{i=1}^{N} \hat{\Omega}_{22i}^{2} \sum_{t=1}^{T} \left(x_{it} - \overline{\mathrm{x}}_{it}\right)^{2}\right]^{1} \left[\sum_{i=1}^{N} \hat{\Omega}_{11i}^{1} \hat{\Omega}_{22i}^{1} \left(\sum_{t=1}^{T} \left(x_{it} - \overline{x}_{i}\right) \hat{y}_{i,t} - T\hat{\gamma}_{i}\right)\right]$$

$$\hat{\varepsilon}_{it} = \varepsilon_{it} \widehat{\Omega}_{22i}^{1} \widehat{\Omega}_{21i} \qquad \hat{\gamma}_{i} = \hat{\Gamma}_{21i} + \widehat{\Omega}_{21i}^{0} \widehat{\Omega}_{22i}^{1} \widehat{\Omega}_{21i} \left(\hat{\Gamma}_{22i} + \widehat{\Omega}_{22i}^{0}\right) \qquad (10)$$

where matrix $\Omega_i = L_i L_i'$, L_i is the lower triangular decomposition of Ω_i. The covariance matrix can be decomposed as $\Omega_i = \Omega_i^0 + \Gamma_i + \Gamma_i$, where Ω_i^0 is the contemporaneous covariance matrix, and Γ_i is a weighted sum of autocovariance. Also, $\widehat{\Omega}_i^0$ denotes an appropriate estimator of Ω_i^0.

Pedroni (2000) emphasized that the main reasons for concern in estimating dynamic cointegrated panels are because the heterogeneity issues with differences in means among the individuals and differences in individuals' responses to short-run disturbances from cointegrating equilibrium. The FMOLS deals with these two issues by including into regression individual specific intercepts and by allowing serial correlation properties of the error processes to vary across individual members of the

panel. This enables point estimates for the panel group estimator can be interpreted as the mean value for the cointegrating vectors (Pedroni, 2000). Therefore, the test statistics constructed from the panel group estimator are designed to test the null hypothesis $H_0 : \beta_i = \beta_0$ for all i against the alternative hypothesis $H_A : \beta_i \neq \beta_0$, so that the values for β_1 are not constrained to be the same under the alternative hypothesis.

Finally, the panel DOLS introduced by Kao and Chiang (2000) have been applied in this study to consider fixed effects in the cointegrating regression models. Mark and Sul (2002) mentioned some properties of DOLS. It allows heterogeneity across individuals include individual-specific time trends, individual-specific fixed effects, and time-specific effects. Also, the estimator is fully parametric, computationally convenient, and more precise than the single equation estimator. Based on Kao and Chiang (2000), the estimator is written as follow.

$$Y_{it} = \alpha_i + \beta_i X_{it} + \sum_{j=-p_1}^{p_2} \delta_j \Delta Y_{it-j} + \sum_{j=-q_1}^{q_2} \gamma_j \Delta X_{it-j} + \varepsilon_{it} \qquad (11)$$

where p and q denotes the numbers of leads/lags typically chosen using some info criterion; δ_j and γ_j respectively is the coefficient of a lead or lag of first differenced explanatory variables.

$$\hat{\beta}_{DOLS} = \sum_{i=1}^{N} \left(\sum_{t=1}^{T} z_{it} z_{it}^{'} \right)^{-1} \qquad (12)$$

where $z_{it} = [x_{it} - \bar{x}_i, \Delta x_{i,\, t-q}, \ldots\ldots \Delta x_{i,\, t+q}]$ is 2 (q +1) × 1 vector of regressors.

The DOLS involves augmenting the cointegrating regression with lags and leads of so that the resulting cointegrating equation error term is orthogonal to the entire history of the stochastic regressor innovations. Thus, the DOLS estimation method provides a robust correction of endogeneity in the explanatory variables.

4. Empirical Results and Discussion

4.1 Stationary and Cointegration Analysis

Given the macroeconomic variables, the unit-roots for both constant and trend in the panel were tested by applying the Im, Pesaran, and Shin (IPS) test. All variables were tested by the null hypothesis of the existence of a

unit root. The results of the unit root are summarized in Table 1. The IPS test result indicates the presence of a unit root in the first differential for each variable.

Table 1: Panel Unit Root Test: Im, Pesaran, Shin (IPS)

Constant			**Constant + Trend**		
Variable	**Level**	**First Order Difference**	**Variable**	**Level**	**First Order Difference**
EXP	-0.774	-15.388*	EXP	-0.451	-13.524*
	(0.220)	(0.000)		(0.326)	(0.000)
FDI	-5.000*	-16.895*	FDI	-6.255*	-11.843*
	(0.000)	(0.000)		(0.000)	(0.000)
FRA	-1.486**	-13.043*	FRA	-3.272*	-10.263*
	(0.069)	(0.000)		(0.001)	(0.000)
INFRA	-0.978	-12.171*	INFRA	-2.704*	-10.750*
	(0.164)	(0.000)		(0.003)	(0.000)

Note: * and ** indicate rejection of the null hypothesis of no cointegration at one percent level and ten percent levels of significance, respectively.

Subsequently, the study investigates the long-run and short-run impact of foreign reserves accumulation on export and foreign direct investment, respectively. Lag length is selected on the principle of minimum Akaike information criterion (AIC). The long-run coefficients of respective model are exibited in Table 2. Concerning Equation 1, in constant level, we found that four out of seven statistics reject null hypothesis of no cointegration at one percent and five percent level of significance. This result indicates independent variables do hold cointegration in the long-run with respect to EXP.

Tabel 2: The Pedroni Panel Cointegration Test

Equation 1: EXP= FRA, FDI, INFRA			
Test	Constant	Test	Constant+Trend
Panel v-Statistic	-0.120	Panel v-Statistic	-1.632
Panel ρ-Statistic	-0.671	Panel ρ-Statistic	0.621
Panel t-Statistic	-1.724*	Panel t-Statistic	-0.987
Panel t-Statistic	-2.930*	Panel t-Statistic	-1.961*
Group ρ-Statistic	0.097	Group ρ-Statistic	1.117
Group t-Statistic	-1.332**	Group t-Statistic	-0.763
Group t-Statistic	-2.509*	Group t-Statistic	-1.714
Equation 2: FDI= FRA, EXP, INFRA			
Test	Constant	Test	Constant+Trend
Panel v-Statistic	-0.983	Panel v-Statistic	-1.294
Panel ρ-Statistic	-1.834*	Panel ρ-Statistic	-3.514*
Panel t-Statistic	-3.823*	Panel t-Statistic	-7.286*
Panel t-Statistic	-3.237*	Panel t-Statistic	-6.375*
Group ρ-Statistic	-3.258*	Group ρ-Statistic	-2.144*
Group t-Statistic	-6.451*	Group t-Statistic	-7.971*
Group t-Statistic	-5.450*	Group t-Statistic	-6.730*

Note: * and ** indicate rejection of the null hypothesis of no cointegration at one percent and five percent level of significance, respectively.

Also, the result of panel cointegation test in Equation 2 with constant level show that six out of seven statistics reject null hypothesis of no cointegration at one percent level of significance. The result shows that independent variables do hold cointegration in the long-run with respect to FDI. Since all the statitics conclude in favor of cointegration with constant level, we conclude that there is a long-run cointegration among our variables in 11 developing countries.

4.2 The Impact of Foreign Reserves Accumulation on Macroeconomic Performance

Given the stationary result and cointegration result, the panel ARDL/PMG method can be utilised to account for long-run and short-run relationships. Table 4 reports the estimates for ARDL/PMG method.

Tabel 4: ARDL/PMG Estimation Result

Dependent Variable: D(EXP)			
Selected Model: (2,2,2,2)			
Variable	**Coefficient**	**Std. Error**	**t-Stats**
Long-run Equation			
FRA	36.586*	10.804	3.386
FDI	1.448*	0.588	2.465
INFRA	0.710*	0.135	5.276
Short-run Equation			
C	0.437	0.539	0.810
ECT	-0.148*	0.038	-3.936
D(EXP(-1))	0.074	0.061	1.202
D(FRA)	24.084**	14.588	1.651
D(FRA(-1))	10.033	7.411	1.354
D(FDI)	0.313**	0.175	1.785
D(FDI(-1))	0.006	0.322	0.018
D(INFRA)	0.034	0.088	0.392
D(INFRA(-1))	-0.158	0.115	-1.376
Dependent Variable: D(FDI)			
Selected Model: (2,2,2,2)			
Variable	**Coefficient**	**Std. Error**	**t-Stats**
Long-run Equation			
FRA	7.037*	1.228	5.729
EXP	0.017**	0.009	1.848
INFRA	0.044*	0.013	3.467
Short-run Equation			
C	-0.472*	0.128	-3.679
ECT	-0.561*	0.089	-6.283
D(FDI(-1))	0.064	0.071	0.895
D(FRA)	3.257	3.819	0.853
D(FRA(-1))	-3.399**	1.802	-1.886
D(EXP)	0.033*	0.011	2.977
D(EXP(-1))	-0.017	0.018	-0.947
D(INFRA)	0.047**	0.028	1.669
D(INFRA(-1))	0.065*	0.031	2.111

The error correction terms (ECT) is negative and less than one. Based on the error correction result, the speed of adjustment of -0.148 from the first model implying a correction of 14.8% for the convergence in the long-

run. In the short-run, PMG estimator show significant positive result of foreign reserves accumulation on export ratio. The foreign direct investment ratio has a significant positive effect on export ratio. However, although infrastructure development has a positive sign as expected it is largely not significant. In the estimation, the ARDL/PMG method shows a positive long-run relationship of FRA, FDI, and INFRA with EXP.

The relationship between foreign reserves accumulation and foreign direct investment is another area analyzed in this study. Table 4 reports the estimates for ARDL/PMG method and shows a significant result that foreign reserves accumulation positively affects FDI. Also, the ARDL/PMG approach exhibits a significant positive effect of export and infrastructure development on FDI in the long-run. The error correction term has a significant negative sign and less than one. The ECT coefficient is -0.561, implying a moderate adjustment toward the long-run equilibrium. In the short-run, the estimation exhibits a significant negative impact of foreign reserves accumulation on FDI. The variable of export and infrastructure development respectively has a significant positive effect on FDI.

We proceed the coefficient estimation by applying the FMOLS and DOLS methods. In the estimation, both estimators show a significant positive relationship between FRA and EXP and between FDI and EXP in the long-run, while neither show a significant relationship between INFRA and EXP although INFRA have a positive sign as expected. The close values of long-run coefficients for all estimation confirm the robustness of the estimated results. Our coefficient estimation in Table 5 shows the variables of FRA, EXP, and INFRA are significant and positively affect FDI in the long run.

In sum, in our export model, the variables of the foreign reserves ratio and foreign direct investment ratio are positively associated with export in the long-run in all three versions of the pooled estimations, indicating that they are key determinants of export growth. Similarly, in our FDI model, the long-run impacts of foreign reserves accumulation, export, ad infrastructure development on FDI in ARDL/PMG estimation are in line with the results of the FMOLS and DOLS estimators.

Tabel 5: FMOLS/DOLS Estimation Results: Pooled Method

Equation 1							
FMOLS				**DOLS**			
Variable	Coefficient	Std. Error	t-Stats	Variable	Coefficient	Std. Error	t-Stats
FRA	48.779*(0.000)	10.341	4.717	FRA	47.672*(0.000)	13.334	3.575
FDI	1.320*(0.001)	0.390	3.381	FDI	1.176*(0.041)	0.572	2.058
INFRA	0.010 (0.901)	0.077	0.124	INFRA	0.151 (0.207)	0.120	1.264
R-squared			0.722	R-squared			0.776
Adj R-squared			0.714	Adj R-squared			0.691
Equation 2							
FMOLS				**DOLS**			
Variable	Coefficient	Std. Error	t-Stats	Variable	Coefficient	Std. Error	t-Stats
FRA	6.528*(0.003)	2.148	3.039	FRA	7.203*(0.010)	2.778	2.593
EXP	0.048*(0.003)	0.016	2.972	EXP	0.043*(0.043)	0.021	2.029
INFRA	0.036*(0.015)	0.015	2.436	INFRA	0.060*(0.008)	0.023	2.680
R-Squared			0.346	R-squared			0.505
Adj R-squared			0.326	Adj R-squared			0.316

Indeed, the 11 developing countries experienced depreciation in foreign exchange rates. Notwithstanding the exchange rate depreciation due to the acceleration in foreign reserves holding, this study shows foreign reserves accumulation has a positive effect on exports and FDI in developing countries. This result is in line with arguments in seeing foreign reserves accumulation as driven by a desire to maintain competitive exchange rates, fostering export and FDI and, hence, economic growth.

By providing a balanced panel dataset and a lengthy period of coverage, our empirical results complement the previous works for instance, Polterovich and Popov (2003), Fukuda and Kon (2010), and Matsumoto (2019). These studies favours the foreign reserves accumulation to achieve export growth, attract foreign direct investment, thus long-run economic growth. Polterovic and Popov (2003) for instance, concluded hefty foreign reserves accumulation undervalued the exhange rate and build the credibility of the government, which both attracts FDI. Fukuda and Kon (2010) shows foreign reserves accumulation expands the share of the exportable sector and fosters FDI in developing countries. Matsumoto (2019) summed that stockpiling foreign reserves depreciates the real exchange rate, which allows a shift towards the tradable sector and FDI, thus economic growth.

Our results may also have some interesting policy implications. Firstly, the countries concerned should consider putting in policy mechanisms for ensuring the positive contribution of FRA side by side that acceleration in foreign reserves accumulation does not bear the social cost to the economy. The developing countries need to take prudent considerations in addressing the social costs of holding international reserves, as are concluded in Rodrik (2006), Mezui and Duru (2013). Secondly, since the foreign reserves accumulation is measured by the total amount of foreign reserves (not include the gold holding), our results imply that foreign currencies reserves are more reliable to accumulate for setting up the precautionary motives of stockpiling foreign reserves.

5. Conclusion and Policy Implications

Having an economic background of a group of Asia-Africa countries, this study aims to analyze the impacts of foreign reserves accumulation on export and FDI over the past four decades. We applied panel ARDL/PMG approach with a constant term and both FMOLS and DOLS estimators

with pooled method. This paper concludes the existence of a robust and statistically significant long-run cointegrating relationship between foreign reserves accumulation and export and between foreign reserves accumulation and FDI. Following the empirical findings, we recommend a more in-depth study for a balanced panel dataset with more countries on the effectiveness of foreign reserves holding (only in the form of foreign currencies) rather than foreign currencies and gold holding.

References

Agenor, Pierre-Richard. and Moreno-Dodson, Blanca. (2006), "Public infrastructure and growth: New channels and policy implications," World Bank Policy Research Working Paper, No. 4064. The World Bank, Washington.

Agenor, Pierre-Richard. (2006), "A Theory of infrastructure-led development," Economics Discussion Paper, No. EDP-0640. The University of Manchester.

Aizenman, J., Lee, J. and Rhee, Y. (2004), "International reserves management and capital mobility in a volatile world: Policy considerations and a case study of Korea," NBER Working Paper, No. 10534. National Bureau of Economic Research, Massachusetts.

Aizenman, J. and Lee, J. (2005), "International reserves: precautionary vs percantilist views, theory and evidence," NBER Working Paper, No. 11366. National Bureau of Economic Research, Massachusetts.

Asteriou, D. and Hall, S. G. (2007). Applied econometrics: A modern approach. Revised edition. Hampshire: Palgrave Macmillan.

Baltagi, B. H. and Kao, C. (2000), "Nonstationary panels, cointegration panels and dynamic panels: A survey," Syracuse University Center for Policy Research Working Paper, No. 16, 1-44.

Baltagi, B. H. (2005). Econometric analysis of panel data. Third edition. England: John Wiley and Sons Ltd.

Barro, R. J. (1990), "Government spending in a simple model of endogeneous growth," *Journal of Political Economy*, 98(5), 103-125.

Benigno, G. and Fornaro, L. (2012), "Reserve accumulation, growth, and financial crisis," Centre for Economic Performance Discussion Paper, No. 1161. Centre for Economic Performance, London.

Bird, G. and Rajan, R. (2003), "Too much of a good thing? The adequacy of international reserve in the aftermath of crises," *World Economy*, 86, 873-91.

Calvo, G. A., Izquierdo, A. and Mejia, L. (2008), "Systemic sudden stops: The relevance of balance-sheet effects and financial integration," NBER Working Paper, No. 14026. National Bureau of Economic Research, Massachusetts.

Carvalho, P. and Fry-McKibbin, R. A. (2014), "Foreign reserves accumulation and the mercantilist motive hypothesis," CAMA Working Paper, No. 18/2014. The Centre for Applied Macroeconomic Analysis, Canberra.

Catao, L. A. and Milesi-Ferretti, G. M. (2014), "External liabilities and crises," *Journal of International Economics*, 94, 18-32.

Cheng, G. (2013), "A Growth perspective on foreign reserves accumulation," Banque de France Working Paper, No. 443. Banque de France, Paris.

Christopoulos, D. and Tsionas, E. M. (2004), "Financial development and economic growth: Evidence from panel unit root and cointegration tests," *Journal of Development Economics*, 73(1), 55-74.

Cruz, M. and Walters, B. (2006), "Is the accumulation of international reserves good for development," *Cambridge Journal of Economics*, 32(5), 665–681.

Dominguez, K. M. E., Hashimoto, Y. and Ito, T. (2011), "International reserves and the global financial crisis", NBER Working Paper, No. 17362. National Bureau of Economic Research, Massachusetts.

Dooley, M., Folkerts-Landau, D. and Garber, P. (2003), "An essay on the revived Bretton Woods system," NBER Working Paper, No. 9971. National Bureau of Economic Research, Massachusetts.

Elhiraika, A. and Ndikumana, L. (2007), "Reserve accumulation in African countries: Sources, motivations, and effects," UNECA Economic Conference, Nov. 15-17, 2017, Africa Development Bank, Addis Ababa.

Fukuda, S. and Kon, Y. (2010), "Macroeconomic impacts of foreign exchange reserve accumulation: Theory and international evidence," ADB Working Paper No. 197. Asian Development Bank, Manila.

Genberg, H., McCauley, R., Park, Y. C. and Persaud, A. (2005), "Official reserves and currency management in Asia: Myth, reality and the future," Centre for Economic Policy Research, London.

Hsiao, Cheng. (2006), "Panel data analysis: Advantages and challenges," IEPR Working Paper, No. 06.49. Institute of Economic Policy Research, University of Southern California.

Im, K. S., Pesaran, M. H. and Shin, Y. (2003), "Testing for unit roots in heterogeneous panels", *Journal of Econometrics*, 115, 53–74.

IMF. (2004). Guidelines for foreign reserves management. International Monetary Fund, Washington.

Kao, C. and Chiang, M. H. (2000), On the estimation and inference of a cointegrated regression in panel data, in Badi H. Baltagi, Thomas B. Fomby, & R. Carter Hill. (eds.) *Advances in Econometrics: Nonstationary Panels, Panel Cointegration and Dynamic Panels*. Elsevier: Amsterdam.

Loayza, N. V. and Ranciere, R. (2006), "Financial development, financial fragility, and growth," *Journal of Money, Credit and Banking*, 38(4), 1051-1076.

Mark, N. C. and Sul, D. (2002), "Cointegration vector estimation by panel DOLS and long-run money demand," NBER Technical Working Paper, No. 287. National Bureau of Economic Research, Massachusetts.

Matsumoto, H. (2019), "Foreign reserves accumulation, foreign direct investment, and economic growth," IMES Discussion Paper Series, No. 2019-E-4. Institute for Monetary and Economic Studies, Bank of Japan, Tokyo.

Mezui, C. and Duru, U. (2013), "Holding excess foreign reserves versus infrastructure finance: What should Africa do?," African Development Bank Working Paper, No. 178. African Development Bank, Tunis.

Milesi-Ferretti, G. M., and Razin. A. (1998), "Current Account Reversals and Currency Crises: Empirical Regularities," IMF Working Paper, No. WP/98/89. International Monetary Fund, Washington.

Obstfeld, M., Shambaugh, J. C. and Taylor, A. M. (2008), "Financial stability, the trilemma and international reserve," NBER Working Paper, No. 14217. National Bureau of Economic Research, Massachusetts.

Pedroni, P. (1999), "Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors," *Oxford Bulletin of Economics and Statistics*, 61, 653-670.

Pedroni, P. (2000), Fully modified OLS for heterogeous cointegrated panels, in Badi H. Baltagi, Thomas B. Fomby, & R. Carter Hill. (eds), *Advances in Econometrics: Nonstationary Panels, Panel Cointegration and Dynamic Panels*. Elsevier: Amsterdam.

Pesaran, M. H. and Shin, Y. (1995), An autoregressive distributed lag modeling approach to cointegration analysis, in Strom, S., Holly, A., and Diamond, P. (eds.), *Centennial Volume of Rangar Frisch*. Cambridge University Press: Cambridge.

Pesaran, M. H., Shin, Y. and Smith, R. P. (1999), "Pooled mean group estimation and dynamic heterogeneous panels", *Journal of the American Statistical Association*, 94(446), 621-634.

Phillips, P. C. B. and Hansen, B. E. (1990), "Statistical inference in instrumental variables regression with I(1) Processes", *Review of Economic Studies*, 57, 99-125.

Pirotte, A. (1999), "Convergence of the static estimation toward the long-run effects of dynamic panel data models," *Economics Letters*, 63(2), 151–158.

Polterovich, V. and Popov, V. (2003), "Accumulation of foreign exchange reserves and long-term growth," MPRA Paper, No. 20069. University Library of Munich, Germany.

Saikkonen, P. (1991), "Asymptotically efficient estimation of cointegration regressions," *Econometric Theory*, 7, 1-21.

Rodrik, D. (2006), "The Social cost of foreign exchange reserve," NBER Working Paper, No. 11952. National Bureau of Economic Research, Massachusetts.

World Bank. (2011), "Ghana looks to retool its economy as it reaches middle-income status," *Feature Story*, July 18, 2011. World Bank, Washington.

World Bank. (2017). World Bank List of Economies 2017. World Bank, Washington.

World Bank (2017). Overview. In The World Bank in Sri Lanka. October 11, 2017. World Bank, Washington.

World Bank. (2021), World development indicators 2021. Accessed 22, July 2021.