# Economic Growth in Sub-Saharan Africa

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**Abstract**

Determining how developed and developing countries' economies grow is always the key research in the field of international economics. Behind the economic growth are various factors which can promote or dampen this process. Our paper focuses on the development of Sub-Saharan African (SSA) economy. We choose foreign direct investment, external debt, exchange rate, and trade openness as our primary interests. By using both the fixed effect and system GMM model, we first find the effects of these four factors on the economic growth of SSA. Then, to build a more complete view on SSA economy, we also create two networks (based on different models), which clearly show the complex interrelationships among these factors.

# 1    Introduction

Exploring factors which promote sustainable economic growth in developing countries is a main topic faced by worldwide economists. Among numbers of factors, foreign direct investment (FDI) and external debt are the two most powerful ones that have either positive or negative impact on the development of vulnerable economies. In literature, scholars choose developing countries located in Asia, Africa, Central and South America to research on how FDI, external debt, and other potential factors play a role on the economic growth of these countries. Following this trend, we have strong interest on exploring the economy in Sub-Saharan Africa (SSA), whose sustainable growth is rapid in early 2000s. Based on previous literature, besides FDI and external debt, we also put trade openness and exchange rate into consideration. More importantly, we not only explore the effects of these four factors on economic growth, but also explore the interrelationships among them in order to provide a complete view on the development of economy in Sub-Saharan Africa.

Sub-Saharan Africa, by geographical definition, includes all African countries located in South of the Sahara. In total, there are 48 countries in this region and 33 of them are categorized as "least developed countries" by the United Nations. Also, about 1.14 billion of inhabitants living in SSA. This indicates that Sub-Saharan Africa is one of the poorest areas in the world.

However, "poor" and "less developed" do not imply that the economy in SSA is not worth focusing. Generally speaking, the economic growth in SSA is fast, promising, but also unstable and fragile. Explained by the data from International Monetary Fund (IMF)[1], the real GDP growth of 2004 to 2007 were 7.0, 6.2, 6.3, 6.7 percent, recorded in "Regional Economic Outlook 2008". We can observe that the growth speed is fairly fast. However, after 2008, when Global Financial Crisis was coming, the economy in SSA was seriously shocked and worsen. As IMF documented in 2009, "Demand for African exports and commodity export prices have fallen...Investor risk aversion have led to a reversal of portfolio inflows, less favorable conditions for trade finance, and could lower foreign direct investment..." Then, the real GDP growth in 2009 fell to 2.7 percent. The most interesting condition happened after 2009: the real GDP growth in 2010 was 5.4 percent, recorded by IMF in 2011. This shows that SSA economy has strong resilience and can recover well. Further evidence were shown by IMF in 2015: the average real GDP growth from 2011 to 2014 was about 5 percent.

Although we can see the strong resilience in SSA and the promising trend to recover growth rate to the level before Global Crisis, the fact in 2016 implied that the economy in SSA was fragile. As explained by IMF, "2016 was a difficult year for many countries, with regional growth dipping to 1.4 percent—the lowest level of growth in more than two decades. Most oil exporters were in recession, and conditions in other resource-intensive countries remained difficult." As a result, real GDP growth in 2006 dropped to 1.4 percent and SSA used three years to recover GDP growth to the level of 3 percent. Then walking into the recent COVID period, Sub-Saharan African countries faced the worst condition after the turn of the millennium: -3.0 percent GDP growth rate projected at the end of 2020. Even though the real number was -1.7 percent recorded in 2021 which was

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[1]All data from IMF can be found in *Regional Economic Outlook: Sub-Saharan Africa*, from 2008 to 2020. URL: https://www.imf.org/en/Publications/REO?sortby=Date&series=Sub-Saharan%20Africa&page=1

better than expected, no one could predict what will happen to SSA economy after the COVID.

Besides its fast growing GDP, Sub-Saharan African countries have another feature. It is one of the regions with the fastest growth of foreign direct investment. According to United Nations Conference on Trade and Development (2022), FDI inflows in Sub-Sahara Africa increased by 13% to $32 billion in 2018, reversing the global downward and the two-year downward trend. This large increase was resulted from the great inflows to South Africa, which is the second largest economy in Africa. On the other hand, Sub-Saharan African is also one of the regions with the highest external debt risk and the highest probability of debt crisis. Simply explained by data from World Bank (2022), total external debt stocks in 2010 was about 305 billion and it raised to 702 billion in 2020. In the other words, the debt to GNI ratio in SSA raised nearly 20 percentage points from 2010 to 2020 so that many SSA countries faced serious issue on paying debt services.

Under this background, it is worth exploring the determinants of the economic growth in SSA and their effects. In our paper, we choose foreign direct investment, external debt, exchange rate, and trade openness as our primary interests[2]. The empirical strategy we apply includes both fixed effect and system GMM model, which are used to determine the five-way linkages among these variables. The detailed descriptions of these two models are provided in Section 3.2. There are four main findings in our paper. First, there exists a bi-directional causal relationship between external debt and GDP in the fixed effect model, while in the system GMM model, the impact of GDP on external debt is not significant. Second, in the fixed effect model, there is a bi-directional causal relationship between FDI and GDP. Third, there is a bi-directional causal relationship between trade openness and GDP both in the fixed effect model and the system GMM model. Fourth, there is a bi-directional causal relationship between trade openness and exchange rate in the fixed effect model.

The rest of the paper is organized as follows. Section 2 is Literature Review while the data and empirical strategy are explained in Section 3. Section 4 are results and Section 5 concludes.

# 2 Literature Review

## 2.1 Foreign Direct Investment and Economic Growth

Theoretically speaking, the research on FDI and economic growth is generally based on neoclassical economic growth model and endogenous growth model. Firstly, according to neoclassical economic growth model, technical progress has a major influence on the long-run economic growth. Solow (1957) provides mathematical proof on the impact of technical changes on the aggregate production function. de Mello (1997) states that because technology is one of the main determinants of FDI, FDI stimulates more on the developing economy with newer technology. Secondly, the endogenous growth model emphasizes that economic growth is mainly from internal forces. Based on Romer (1986) and Lucas (1988), these internal forces contain human and physical capital accumulation as well as innovations (or technical changes). Since human capital and innovations are both important

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[2]the detailed description of these variables are in Data section

determinants of FDI, FDI inflows definitely promote economic growth.

In the empirical literature, a large number of papers focus on the relationship between foreign direct investment and economic growth. Many of them choose Sub-Saharan Africa because FDI has become the most important external finance source in many SSA countries. Joshua et al. (2021) show empirical evidence that FDI inflows, combined with other factors like financial aids, is useful in economic expansion in SSA countries. Asongu and Odhiambo (2020) apply novel element "information and communication technology" (ICT) into the relationship between FDI and economic growth in SSA countries. They find that ICT helps FDI generate positive net effects on three economic growth dynamics: GDP growth, real GDP and GDP per capita.

In addition, this FDI-Growth relationship also appears in other African economies. Kalai and Zghidi (2019) analyze the relationship between FDI and economic growth in fifteen Middle Eastern and North African countries. They find that FDI gives long-run support on economic growth in these countries. Gui-Diby (2014) examines this relationship in 50 African countries in different time periods: the relationship is negative from 1980 to 1994 and positive from 1995 to 2009.

Among these literature, scholars not only support the positive impact of FDI on economic growth, but also argue that there might be zero or adverse effect. Papers which support the zero effect suggest that FDI can play a role on economic growth only when there are other factors included. Borensztein et al. (1998) test FDI-growth relation in 69 developing countries and conclude that FDI promotes the economic growth only when the host country has "sufficient absorptive capability of the advanced technologies". For the adverse effect, Bornschier et al. (1978) state that in the short term, FDI and financial aid increase the economic growth rate; however in the long term, they decrease the rate.

## 2.2   External Debt and Economic Growth

Among the existing literature, the major perspective is that external debt has negative effect on economic growth, with the following three channels.

Firstly, the debt overhang channel. The definition of debt overhang in international economy is that a country which has excessive amount of debt cannot easily borrow more capital. Borensztein (1990) provides a clear description on debt overhang channel. He states that

> The debt overhang arises in a situation in which the debtor country benefits very little from the return to any additional investment because of debt service obligations. When foreign obligations cannot be fully met with existing resources and actual debt payments are determined by some negotiation process between the debtor country and its creditors, the amount of payments can become linked to the economic performance of the debtor country, with the consequence that at least part of the return to any increase in production would in fact be devoted to debt servicing.

The second channel is the idea of Debt Laffer Curve, which is given by Krugman (1988) under the context of debt overhang. Tatu (2014) provides a explanation of Debt Laffer Curve:

When a country accumulates too much debt, in other words when payment obligations exceed its ability to pay, payment obligations act as a marginal tax rate: if the state succeed to obtain better results than those expected, benefits will return to creditors and not to the state. In these circumstances, the government may be discouraged to improve economic performances because the benefits are going rather to creditors than to country.

The research by Pattillo et al. (2003) also applies the idea of Debt Laffer Curve. Authors explain that when debt accumulates excess a certain threshold, increases in debt will reduce expected debt repayment so that some amounts of debt have to be forgiven. This fact will "discourage private foreign investors from providing new financing, thus lowering capital accumulation."

The third channel is called import compression effect. Khan and Knight (1988) describe that many developing countries which have large debt burden tried to "compress imports to generate trade surpluses to service foreign debt." In addition, Mirakhor and Montiel (1987) provide evidence that after the debt crisis in 1980s, developing countries facing debt servicing problems improved their trade balances only by reducing imports but not increasing exports. This dependence on import compression consequently hinders countries' short and medium term of economic growth.

In the empirical works, Frimpong and Oteng-Abayie (2006) perform studies on external debt under Ghana and show that economic growth is positively related to external debt inflows. Also, Jayaraman and Lau (2009) confirm that for six major Pacific island countries, external debt is a good source which contributes to the economic growth. On the contrary, Manasseh et al. (2022) reveal that both external debt and its volatility have negative effects on economic growth in SSA countries. What's more, Butts (2009) explores the causality relationship between external debt and economic growth for 27 Latin American and Caribbean countries. The main finding is that economic growth granger-causes short-term external debt in 13 Latin American and Caribbean countries. Moreover, Shabbir (2013) examines the long-term external debt. The results indicate that in the long run, increasing external debt dampens the economic growth in the sample of 70 developing countries.

## 2.3   Exchange Rate and Economic Growth

In the international economics, nominal devaluation of currency is usually used as a tool to stabilize the foreign sector of an economy. Among the existing literature, scholars find that the effects of devaluation are mixed: there is expansionary effect which can stimulate economic growth but there is also contractionary effect which can reduce economic growth. Papers like Gylfason and Schmid (1983) describe expansionary effect as a way to improve the competitiveness and demand of domestics products, and then stimulate the production of domestic products, which will increase the economic growth of the country. On the other hand, papers like Upadhyaya (1999) describe contractionary effect as a way to increase the price of imported goods and thus adversely affect production and economic growth. Interestingly, the results in Edwards (1986) indicate that the devaluation in the short run has contractionary effect but turns to have an expansionary effect after one year. After that, there is no effect on aggregate output in the long run.

Under the setting of African countries, Joshua et al. (2020) find that 1 percent improvement on exchange rate will increase GDP by 0.19 percent in the long run, which is a large benefit for the economy of South Africa. Elbadawi et al. (2012) find that exchange rate overvaluation reduces sustained growth in Sub-Saharan Africa. Similarly, Ghura and Grennes (1993) perform time-series and cross section analysis to confirm the negative relationship between exchange rate misalignment and economic growth in 33 Sub-Saharan African countries.

## 2.4  Trade Openness and Economic Growth

The discussion about the relationship between trade openness and economic growth has lasted for a long time. However, in the theoretical side, there is not an affirmative and accurate answer. Basically, the traditional Ricardian-Heckscher-Ohlin theory in trade topic argues that trade openness only has impact on one time increase in output but no impact for long-run growth. However, endogenous growth theory realizes that in the long run, trade openness promotes technology changing and stimulates firms to develop their R&D sectors. As discussed in section 2.1, by neoclassical economic growth model, technical progress has large influence on the long run economic growth.

Because theories do not provide a conclusive answer and the prediction of this relationship is based on different country background, studies on trade openness and economic growth are mainly in empirical side. Tahir and Ali (2014) provide a clear summary on the effects of trade openness on economic growth in the empirical literature. The paper states that unless technical or methodological issues appear, there is no evidence that trade openness does harm to economic growth. In the other words, the existing literature enhances that there is a positive and robust relationship between trade openness and economic growth under various settings.

As a summary, Edwards (1998) performs empirical study using data from 93 countries. He concludes that for more open economies, the total factor productivity growth is much faster. This result is robust to different measures of trade openness and different estimation methods. Frankel and Romer (1999) use countries' geographical characteristics as an instrument variable to estimate the effect of trade on income and economic growth. They find that this effect is significant positive, large and robust. In addition, Berg and Krueger (2003) research on the effect of trade openness on poverty. By using various methods, they conclude that trade openness contributes greatly to economic growth. What's more, Bruckner and Lederman (2012) provide empirical results that 1 percent increase of trade openness induces 0.5 percent increase of growth in the short run and 0.8 percent increase in the long run.

## 2.5  Interrelationships

Besides the effects of FDI, external debt, exchange rate, and trade openness on economic growth, there are also a number of works on the interrelationship among these factors. Froot and Stein (1991) find that when the currency appreciates, the inflow of FDI will decrease; when the currency depreciates, the inflow of FDI will increase. This indicates the causal relation between exchange rate and FDI. In addition, Suliman et al. (2015) provide evidence that real exchange rate does

have influence on FDI inflows in SSA countries; however exchange rate does not have significant impact on FDI in China, as Khandare (2016) illustrates.

Furthermore, Kizilgol and Ipek (2014) study Turkish economy and find that in both long and short run, increase in trade openness has positive effects on external debt. Zaman et al. (2018) show that increasing trade openness positively influences FDI inflows in the long run in India, Iran and Pakistan countries. However, under Latin America, Ponce (2006) concludes that the relationship between trade openness and FDI is mixed because of the influence by some indirect linkages like real exchange and technical changes. So, at least in Latin America, the positive trade-FDI relation may not be accurate. Besides, according to Gantman and Dabos (2018), by using data including 101 countries, increasing trade openness leads to depreciation of real exchange rate, which is robust and significant.

# 3 Empirical Strategy

## 3.1 Data

Our data are all from World Bank (2022), World Development Indicator, which includes Economic growth (GDP, measured in current US$), Foreign direct investment, net inflows (measured in BoP, current US$), External debt stocks, total (measured in DOD, current US$), Official exchange rate (measured in LCU per US$, period average), and Trade openness (measured in % GDP). Because trade openness is measured in percent of GDP, we do one more treatment by multiplying it by GDP in order to get its real value. To determine the effect of each elements on economic growth, we set GDP as dependent variable and foreign direct investment (FDI), external debt (Edebt), exchange rate (ExRate), and trade openness (TradeOpen) as regressors. To determine their interrelationships, we set each of these four variables as dependent variable separately. We normalize all variables by transforming them into logarithm forms. The statistic summary is shown in Table 1 below. (LN_Edebt: log form of external debt, LN_ExRate: log form of exchange rate, LN_FDI: log form of foreign direct investment, LN_GDP: log form of GDP, LN_TradeOpen: log form of trade openness)

Table 1

| Statistic | N | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| LN_Edebt | 870 | 21.587 | 1.252 | 18.687 | 24.716 |
| LN_ExRate | 870 | 5.296 | 2.198 | −5.404 | 9.115 |
| LN_FDI | 870 | 23.060 | 0.073 | 22.956 | 23.659 |
| LN_GDP | 870 | 22.382 | 1.393 | 19.146 | 27.027 |
| LN_TradeOpen | 870 | 21.763 | 1.440 | 18.406 | 26.097 |

We also examine the geographical distribution of the data series across Sub-Saharan Africa

presented in Figure 1. It can be seen that South Africa has the highest 29-year average GDP of about US$0.26 trillion, followed by Nigeria of about US$0.21 trillion. Also, South Africa has the highest average total external debt of about US$76.91 billion, and trade openness. Somalia receives the highest average exchange rate of about 24804 local currency unit per US$. Nigeria has the highest average FDI of about $13.12 billion, followed by South Africa of $13.06 billion. Finally, Sourth Africa has the highest average trade openness of US$0.13 trillion, followed by Nigeria of about US$0.08 trillion.
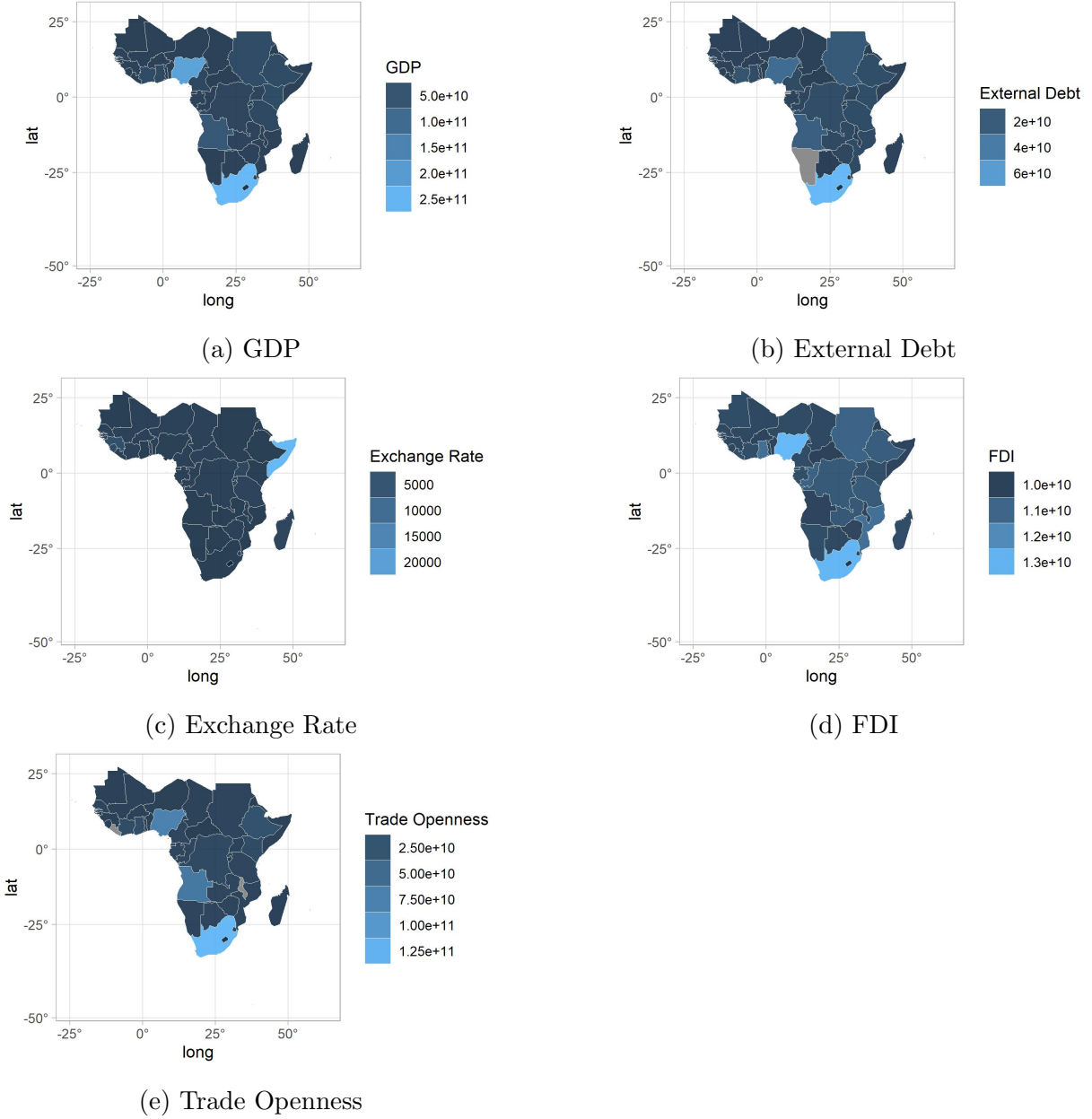


(a) GDP



(b) External Debt



(c) Exchange Rate



(d) FDI



(e) Trade Openness

Figure 1: The Geographic Distribution

## 3.2 Model

In this paper, we explore the five-way linkages among GDP, external debt, exchange rate, FDI, and trade openness for 30 Sub-Saharan Africa countries from 1990 to 2018. We adopt the logarithmic transformation of all variables to strengthen linearization trend of data and eliminate the heteroscedasticity. The linear expression of our model is as follows:

$$GDP = f(Edebt, ExRate, FDI, TradeOpen)$$

We use fixed effect model and system GMM to detect the interrelationship among these variables. The model specification of the fixed effect can be expressed as follows:

$$LN\_GDP_{it} = \alpha_i + \mu_t + \beta_1 LN\_Edebt_{it} + \beta_2 LN\_ExRate_{it} + \beta_3 LN\_FDI_{it} + \beta_4 LN\_TradeOpen_{it} + \epsilon_{it}$$

$$(1)$$

For other four equations, we use $LN\_Edebt_{it}$, $LN\_ExRate_{it}$, $LN\_FDI_{it}$, and $LN\_TradeOpen_{it}$ as dependent variables to make FE regressions. Moreover, the dynamic model used by System Generalized Method of Moments (system GMM) is as follows.

$$LN\_GDP_{it} = \alpha_i + \rho LN\_GDP_{i,t-1} + \beta_1 LN\_Edebt_{it} + \beta_2 LN\_ExRate_{it} + \beta_3 LN\_FDI_{it} + \beta_4 LN\_TradeOpen_{it} + \epsilon_{it}$$

$$(2)$$

For other four equations, we use $LN\_Edebt_{it}$, $LN\_ExRate_{it}$, $LN\_FDI_{it}$, and $LN\_TradeOpen_{it}$ as dependent variables to make system GMM regressions.

# 4 Results

## 4.1 Model Results

### 4.1.1 Economics Growth

Table 2: Regression Results

| | Dependent variable: | |
| --- | :---: | :---: |
| | lnGDP | |
| | *panel* | *panel* |
| | *linear* | *GMM* |
| | Fixed Effect | System GMM |
| | (1) | (2) |
| lag(LN_GDP, 1) | - | 0.773*** |
| | | (0.076) |
| LN_Edebt | 0.069*** | 0.061*** |
| | (0.016) | (0.016) |
| LN_ExRate | −0.005 | 0.004 |
| | (0.014) | (0.008) |
| LN_FDI | 1.249*** | 0.040** |
| | (0.142) | (0.019) |
| LN_TradeOpen | 0.356*** | 0.179*** |
| | (0.018) | (0.068) |
| $R^2$ | 0.455 | - |
| Year Dummies | Yes | - |
| Number of Country ID | 30 | 30 |

*Note:* $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01

In Table 2, we regard logarithmic transformation of GDP as dependent variable. The results from the two estimates show that external debt, FDI, and trade openness have positive and significant effects on economics growth. But the effect of exchange rate on economics growth is not significant. The positive impact of external debt reflects debt is a good source to improve economic growth. This outcome conforms to Jayaraman and Lau (2009). The impact of FDI in line with de Mello (1997) shows that the flow of investments into Sub-Saharan Africa has the positive effect on economic growth. The significantly positive parameter of trade openness represents that countries in Sub-Saharan Africa have potential benefits from globalization. This result allies with Tahir and Ali (2014).

### 4.1.2 External Debt

|  | *Dependent variable:* | |
|---|---|---|
|  | lnEDebt | |
|  | *panel* | *panel* |
|  | *linear* | *GMM* |
|  | Fixed Effect | System GMM |
|  | (1) | (2) |
| lag(LN_Edebt, 1) | - | 0.967*** |
|  |  | (0.016) |
| LN_GDP | 0.327*** | 0.056 |
|  | (0.076) | (0.039) |
| LN_ExRate | 0.002 | −0.003 |
|  | (0.031) | (0.002) |
| LN_FDI | −1.004*** | 0.004 |
|  | (0.322) | (0.008) |
| LN_TradeOpen | 0.025 | −0.023 |
|  | (0.048) | (0.035) |
| $R^2$ | 0.040 | - |
| Year Dummies | Yes | - |
| Number of Country ID | 30 | 30 |

| *Note:* | *p<0.1; **p<0.05; ***p<0.01 |
|---|---|

In Table 3, we regard logarithmic transformation of external debt as dependent variable. The results from the fixed effect model show that GDP has the significantly positive impact on external debt, while the trade openness negatively affects the external debt. The negative relationship shows the inflow of investments contributes negatively to external debt, which is consistent with Tanna et al. (2018).

### 4.1.3 Exchange Rate

Table 4: Regression Results

| | Dependent variable: | |
|---|---|---|
| | lnExRate | |
| | *panel* | *panel* |
| | *linear* | *GMM* |
| | Fixed Effect | System GMM |
| | (1) | (2) |
| lag(LN_ExRate, 1) | - | 0.949*** |
| | | (0.012) |
| LN_Edebt | 0.002 | 0.053*** |
| | (0.040) | (0.014) |
| LN_GDP | −0.030 | 0.020 |
| | (0.087) | (0.036) |
| LN_FDI | 3.165*** | 0.013 |
| | (0.349) | (0.009) |
| LN_TradeOpen | −0.093* | −0.072** |
| | (0.054) | (0.029) |
| $R^2$ | 0.099 | - |
| Year Dummies | Yes | - |
| Number of Country ID | 30 | 30 |

*Note:* $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01

In Table 4, we regard logarithmic transformation of exchange rate as dependent variable. The results from two estimates show that the impact of trade openness on exchange rate is significantly negative. This result show that when the level of trade openness decreases, exchange rate appreciates, which is consistent with Gantman and Dabos (2018). In the fixed effect model, it can be seen that the impact of FDI on exchange rate is positive, which is in accord with Kosteletou and Liargovas (2000) for Europe. In the system GMM model, the parameter of external debt is positive, which shows that a decreased level of external debt leads to a lower demand for currency needed and lower prices of foreign currency (Bunescu, 2014).

### 4.1.4 Foreign Direct Investment

Table 5: Regression Results

| | Dependent variable: | |
|---|---|---|
| | lnFDI | |
| | *panel* | *panel* |
| | *linear* | *GMM* |
| | Fixed Effect | System GMM |
| | (1) | (2) |
| lag(LN_FDI, 1) | - | 1.001*** |
| | | (0.002) |
| LN_Edebt | −0.012*** | −0.001 |
| | (0.004) | (0.001) |
| LN_ExRate | 0.029*** | −0.0005 |
| | (0.003) | (0.0005) |
| LN_GDP | 0.070*** | −0.003 |
| | (0.008) | (0.002) |
| LN_TradeOpen | 0.009* | 0.002 |
| | (0.005) | (0.001) |
| $R^2$ | 0.243 | - |
| Year Dummies | Yes | - |
| Number of Country ID | 30 | 30 |
| Note: | | *p<0.1; **p<0.05; ***p<0.01 |

In Table 5, we regard logarithmic transformation of FDI as dependent variable. The results from fixed effect model show that the impacts of exchange rate (Kosteletou and Liargovas (2000)) and GDP on FDI are positive. But the external debt has the negative impact on FDI showing that increasing foreign debt has destroyed foreign investors' vision, which is consistent with Ostadi and Ashja (2014). Moreover, the trade openness has the positive impact on FDI at the 10% significant level, which coincides with Zaman et al. (2018).

#### 4.1.5 Trade Openness

Table 6: Regression Results

| | Dependent variable: | |
| --- | --- | --- |
| | lnTradeOpen | |
| | *panel* | *panel* |
| | *linear* | *GMM* |
| | Fixed Effect | System GMM |
| | (1) | (2) |
| lag(LN_TradeOpen, 1) | - | 0.603*** |
| | | (0.092) |
| LN_Edebt | 0.014 | −0.057 |
| | (0.026) | (0.040) |
| LN_ExRate | −0.040* | −0.007 |
| | (0.023) | (0.019) |
| LN_FDI | 0.405* | 0.010 |
| | (0.239) | (0.030) |
| LN_GDP | 0.921*** | 0.432*** |
| | (0.046) | (0.095) |
| $R^2$ | 0.393 | - |
| Year Dummies | Yes | - |
| Number of Country ID | 30 | 30 |

*Note:* $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01

In Table 6, we regard logarithmic transformation of trade openness as dependent variable. The results from two estimates show the impact of GDP on trade openness is significantly positive. In the fixed effect model, exchange rate has negative effect on trade openness, which shows that exchange rate appreciates, domestic products become more expensive for the rest of the world, and therefore their demand decrease (Gantman and Dabos, 2018).

## 4.2 Robust Test

Table 7: Arellano-Bond Test

| Dependent Variable | z | Order | p-value |
|---|---|---|---|
| LN_GDP | 0.887 | 2 | 0.375 |
| LN_Edebt | 0.609 | 2 | 0.543 |
| LN_ExRate | 0.811 | 2 | 0.417 |
| LN_FDI | 1.390 | 2 | 0.165 |
| LN_TradeOpen | 0.122 | 2 | 0.903 |

In Table 7, we make the Arellano-Bond test to check the auto-correlation of disturbance term. The results show that we cannot reject the hypothesis there is no auto-correlation in the second order of disturbance term at 10% significance level. Thus, the parameters of system GMM above are not biased.

Table 8: Sargan Test

| Dependent Variable | chisq | p-value |
|---|---|---|
| LN_GDP | 29.025 | 0.568 |
| LN_Edebt | 27.601 | 0.642 |
| LN_ExRate | 29.137 | 0.562 |
| LN_FDI | 26.621 | 0.691 |
| LN_TradeOpen | 27.443 | 0.650 |

In Table 8, we use the Sargan test to check whether the instrumental variables are over-identified. The results show that we cannot reject the hypothesis that overidentifying restrictions are valid at 10% significance level. Thus, the parameters of system GMM above are not biased.

# 5 Conclusion



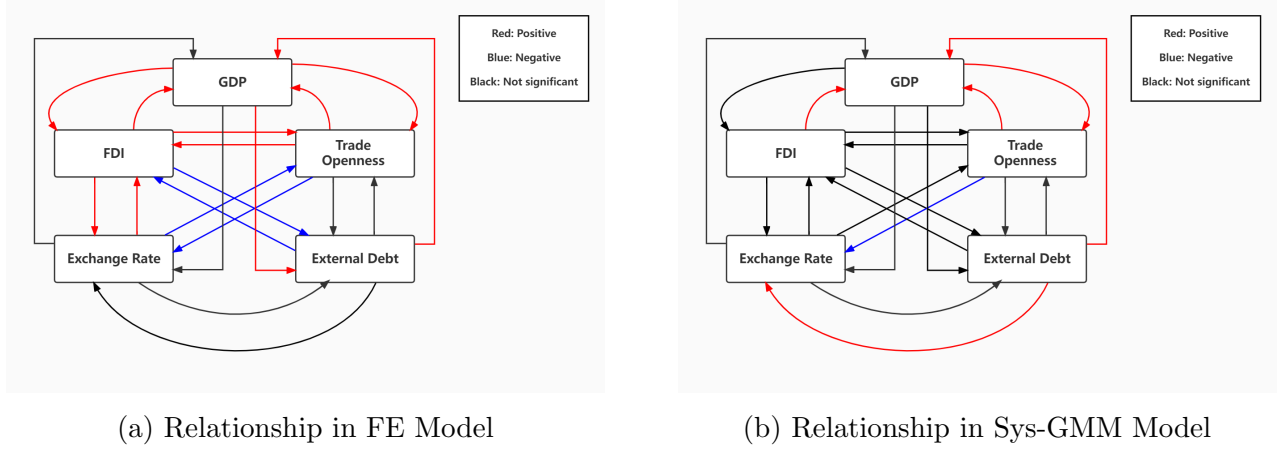(a) Relationship in FE Model         (b) Relationship in Sys-GMM Model

Figure 2: Summary Relationship

We conclude the relationships among all the variable in Figure 2. The red line represents significantly positive impact, while the blue line represents significantly negative impact. The black line means there is no significant impact. According to the overall results, four conclusions can be made.

First, there exists a bi-directional causal relationship between external debt and GDP in the fixed effect model, while in the system GMM model, the impact of GDP on external debt is not significant. When a country desires to improve economic growth, it tends to increase external debt for three reasons: first, the lack of sufficient savings for development requires the introduction of foreign funds to supplement savings; second, in the case of a sustained trade deficit, the net inflow of capital will be used to make up the foreign exchange gap and maintain the balance of payments; third, to achieve the goal of improving international competitiveness, introduce advanced foreign technology and equipment and improve product quality. Thus, the impact of external debt on GDP is positive.

Second, in the fixed effect model, there is a bi-directional causal relationship between FDI and GDP. In the system GMM model, the impact of GDP on FDI is not significant. For one reason, FDI contributes to economic growth by absorbing the advanced technologies. For the other reason, when the economic growth shows a stable and upward trend, foreign countries would like to regard this as a signal of safe conditions to invest directly. Thus, these two variables have positive relationships.

Third, there is a bi-directional causal relationship between trade openness and GDP both in the fixed effect model and the system GMM model. It can be seen that trade openness can potentially enhance economic growth by providing access to goods and services, achieving efficiency in the allocation of resources and improving total factor productivity through technology diffusion and knowledge dissemination. The results show that one country can increase economic growth by promoting trade openness.

Fourth, there is a bi-directional causal relationship between trade openness and exchange rate

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in the fixed effect model. In the system GMM model, the impact of exchange rate on trade openness is not significant. The possible explanation of the relationship between trade openness and exchange rate is that when the real effective exchange rate appreciates, domestic products become more expensive for the rest of the world, and therefore their demand decreases. Thus, our findings suggest that increasing overall trade volume is instrumental in achieving a competitive exchange rate.

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