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Quantifying Financial Development

A Panel Study on the Individual and Combined Effects of Remittances, Trade openness and Regulatory quality in Emerging Economies

MSc Research Project

FinTech

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Quantifying Financial Development

A Panel study on the Individual and Combined Effects of Remittances, Trade openness and Regulatory quality in Emerging Economies.

Cassandra Ezechukwu

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Abstract

This paper investigates the individual and combined influence of an economy's trade openness, remittances and regulatory quality as determinants of financial development. The research, which focused on studying specifically the effects from emerging economies, presents evidence from 50 developing countries for the periods 1998 - 2017. In conducting this study, panel analysis approach is applied where pooled OLS, fixed effects and random effects models are developed after which a panel Hausman test selects the fixed effects as the optimal model. The advantage and rationale for using this approach was to account for unobserved heterogeneity in the model i.e. obtaining valid statistical inferences in instances where other relevant variables that are correlated but unobserved by the model may exist. The results show that for every 10% increase in trade openness there will be a corresponding 0.7% approximate increase in financial development, while implementing policies that improve the quality of regulation by one unit will advance financial sector development by 3.3%. Conversely, for every year on increase in remittance figures, it is expected that there will be a drop in financial development and by a margin of approximately 0.5%. This empirical evidence therefore reveals that while financial sector development can be significantly improved by better trade openness and improved regulatory quality, large inward remittances will have an adverse effect and are insignificant. Additionally, the selection of the fixed effects model sheds light to the existence of homogeneity which means the effects are uniform across developing countries.

1 Introduction

The relationship between Financial Development (FD) and economic growth continues to be a significant topic within econometric studies. Interestingly, more empirical studies are making a case for the consensus with regards to the direction of causality between these two economic indicators and characterizing FD as an important mechanism for long-run economic growth (Mesagan, Olunkwa and Yusuf, 2018; Shahbaz, Naeem, Ahad and Tahir, 2018; Škare, Sinković and Porada-Rochoń, 2019). The International Monetary Fund (IMF) describes financial development as a term that relates to the depth, access and efficiency of a country's financial institutions and financial market[1]. Although FD is observed to be a robust indicator of an economy's potential growth, as highlighted in the literature review below, there is still a compelling case for understanding its observable and unobservable determinants. However, an exploration of the individual determinants of FD is rarely discussed, with

[1] https://data.imf.org/?sk=F8032E80-B36C-43B1-AC26-493C5B1CD33B&sId=1480712464593

few studies assessing those economic attributes which can significantly impact the level of financial development in an economy.

Thus, this study proposes to analyse the FD levels of developing countries using remittance, trade openness and regulatory quality data. A justification of the chosen indicators is provided below in **Section 1.4**.

1.1 Background and Motivation

Prasad (2010) is of the view that any economy which has an FD agenda will focus on reinforcing its banking system and broadening its capital and derivatives markets either through financial technologies, innovations or sound governing. Another viewpoint from Mesagan *et al*. (2018) claims that the adequate utilization of investments and domestic savings leads to an efficient financial sector. On the flip side, findings from the research by Mlachila *et al.* (2016) show that financial sector development in an economy will not only be propelled by financial institutions and their activities but also by the activities of non-financial institutions.

Although there is existing literature surrounding the significance of FD in econometric analysis, there are current limitations around utilizing FD as an econometric indicator considering its determinants are still vague. Development in any area will always have multidimensional features and utilizing only fixed measures of the financial sector such as financial institutions, markets and products, may not capture all aspects of financial development (Olarewaju, Akinola and Yearwood, 2018). Since the financial sector of a country is comprised of a variety of elements, these measures can only serve as a rough estimate. Moreover, policy makers in any economy are steadily interested in development activities that will advance their financial sector. They do this in order to gauge strategies that will attract international institutions and investors.

There is ongoing research in the area of FD, however where some have focused on just one country or a continent, others have not accounted for the progressive features of the financial sector. As an economic indicator, FD has also been studied in relation to its association with foreign direct investments, natural resource, remittances, investments, central banking activities amongst others (Karikari, Mensah and Harvey, 2016; Muyambiri and Odhiambo, 2018; Nkoa, 2018; Shahbaz *et al.*, 2018; Tayssir and Feryel, 2018).

1.2 Research Question

Following the outline of the motivation for this study, the key research question can be coined as;
Using a panel study, with what significance can remittances, trade openness and regulatory quality individually and collectively explain financial development in developing countries?

1.3 Objectives

- This research primarily aims to be an investigative study into probable determinants of FD. The main objective is to contribute to the existing literature on determinants of FD. It achieves this by analyzing data on trade openness, remittances and regulatory quality for a segmentation of countries; this segment being developing countries.
- In conducting this research, a combination of qualitative and quantitative methodologies is employed. A prior qualitative research is conducted where the objective is to gain insights from existing literature on conceivable determinants of development, while the objective of the follow-up quantitative study is to apply a panel analysis approach to determine fixed/random effects and significance of the determinants. The aim is to draw accurate conclusions that will guide policy maker's decision activities.

- Another objective of the research is to prepare the data by developing a quality dataset that will be used subsequently for the analysis. The panel data was formed in which individualities of the entities (i.e. countries) are recorded over time.

1.4 Justification

In selecting the indicators and methodology for this study, a prior exploratory research on existing literature was conducted. This approach was chosen to uniquely interpret and identify insights from previous influential studies, to understand the attributes of FD in the wider context, as well as to proffer improvements on research methodologies. Moreover, it is important to outline the link between the chosen variables and FD.

1.4.1 Determinants

REMITTANCES – Developing economies are seeing a gradual increase in remittance inflows and this can likely be attributed to globalization (Olarewaju *et al*., 2018). Remittances are considered as transfers of monies from a foreign worker or migrant back to an individual or institution in their home country. These can be considered as financial inflows. These inflows can be taken as a measure of a country's stable source of foreign finance and foreign exchange earnings which can be attributed to growth and development.

Some economists have investigated the remittance and FD nexus. The study by Khalid, Rabi and Walliullah (2011) for a developing country, Pakistan, found that remittances increased when the financial system is efficient and when financial deepening occurs. Javid, Umaima and Qayyum (2012) also studied the relationship between remittances and economic growth in the same country, and found positive and significant influence.

Sekantsi (2018) reports on the international remittance market in Lesotho where he highlights how remittance-dependent Lesotho has become. He attributes the increase to Lesotho's GDP as a result of the large migrant community sending inward remittances and that despite the decline in inflows in recent years, it still accounts for a major share of the GDP. Meanwhile in South Asia, remittances in conjunction with economic growth have shown that there is a positive and significant impact on FD, however this is only in the long-run (Rehman, 2018).

The link between remittances and FD can be described as a need for the recipient to improve financial services to its residents. To explain simply, as more money is being sent by the migrants, financial institutions will want to create and improve channels through which individuals can receive these transfers. Effectively this should make individuals adopt the financial services that will grant them access to these funds. Fromentin (2018) supports this claim and states that receiving remittances gradually exposes residents of the country to the formal financial sector and financial institution services.

TRADE OPENNESS – Trade openness is a popularly discussed indicator as an enhancement of FD. As discussed in the paper by Khoutem (2015), FD and trade openness interact through multiple channels. An economy's trade openness can be seen as the willingness to engage in international trade. In financial terms, it can be stated as the sum of exports and imports as a percentage of GDP.

Trade openness is actually vital for FD in Sub-Saharan African countries with better institutional quality since openness may also lead to increased vulnerabilities to shocks (David, Mlachila and Moheeput, 2014). Also, the study undertaken by Nabila and Zakir (2014) on the trade openness-financial development nexus showed that trade openness had an impact on FD in all countries analysed while Ehigiamusoe and Lean (2018) concluded that a tripartite relationship exists between trade openness, FD and economic growth.

The presence of an efficient open and international trade can be very influential in an economy. However, despite the existing studies on the impact of an economy's trade openness, it is still not conclusive. For example, Asongu (2010) did not note a significant impact of trade openness on FD while Menyah, Nazlioglu and Wolde-Rufael (2014) are of the opinion that there is limited support for the finance and trade led growth in an economy. This motivated the inclusion in this study to draw conclusive results for a developing country.

REGULATORY QUALITY – For most econometric measures to perform optimally, governments need to ensure sound policies are in place and it is essential that they are maintained. This is how the regulatory quality of an economy comes into the equation. The world bank defines regulatory quality as a method to determine a governments ability to enforce thorough and well planned regulations that promote development within the economy[2].

Empirical researches on FD and regulatory quality are not many, however there are researches that can be attributed to this. From Pasiouras, Tanna and Zopounidis (2009), they focus on banking efficiency and how regulatory frameworks can make an impact. The evidence provided showed that profit efficiency of banks is increased when sound banking regulations that will invariably lead to market discipline are enforced. In addition, the study found that placing restrictions on banking activities will lead to an improved profit efficiency but a reduced cost efficiency. Another study by Haider (2012) provided a robust claim that regulatory reforms are beneficial for enhancing economic growth as on average, each reform results in an estimated 0.15% increase in the economy's GDP. According to the IMFs staff discussion notes, FD can be promoted by establishing a strong regulatory and supervisory environment (Svirydzenka, 2016). This in no way means stricter regulations but rather better enforcement of existing regulations (Sahay *et al.*, 2015).

1.4.2 Panel Data Analysis

According to Hsiao (2007), panel data estimates improve the efficiency of econometric estimates. Usually, datasets employed for exploratory studies can be distinguished by three types; timeseries data, cross sectional data and panel data. While timeseries data contain data for a single entity collected at multiple time periods, and cross sectional data contains data for different entities where the ordering does not matter, panel data combines the two creating two dimensions; a cross-sectional dimension and a timeseries dimension. The author also alludes to the growing prominence of panel data for econometric analysis. This effectively provides more informative data and efficiency, subsequently providing variability and less collinearity among the variables[3].

The advantage and rationale for using panel data analysis methods is to allow the model to control and account for unobserved variables. This is good for obtaining valid statistical inferences in instances where there may exist other relevant variables that are correlated but unobserved by the model. More so, as panel estimation techniques consider the cross sections to be heterogeneous, it controls the issue of heterogeneity thus facilitating unbiased estimations (Baltagi, 2001). It is also a better estimation method to apply when studying the duration of economic states and the dynamics of change over time.

The remainder of this paper has the following sections; the related work section presents the academic literature where a critical and comparative analysis is conducted on similar works presented in this research domain; the methodology section which provides details of the research procedure, data

[2] https://info.worldbank.org/governance/wgi/
[3] Advantage of Panel Data Regression Economics Essay Chapter 3

collected, methods applied, as well as evaluation techniques; the model specification which shows the breakdown of the functionality of the methods to be applied; the implementation section which describes the step-by-step process to achieve the results; the comprehensive evaluation and in-depth discussion of results section and finally the conclusion and future work which summarizes the paper, highlights limitations encountered in the study and identifies gaps that were not addressed in the scope of work and will need further revision.

2 Related Work

2.1 The Stimulating Role of Financial Development

FD in an economy is an important element to monitor as it can influence the impact of a financial crisis should one arise. It is believed that financially developed countries were able to recover from the 2008 global financial crisis quicker than less financially developed countries (Naudé, 2009). In the same way, Demirgüç-Kunt and Huizinga (2000) presents evidence showing FD's influence on banking sector performance and stating that richer countries have more active financial intermediaries. According to their study, the greater the development of a country's intermediaries in the financial sector, the tougher is the competition, the greater is the efficiency, and the lower are the banks margins and profits.

Other empirical studies regard FD as a stable indicator for economic growth and stability. For instance, in Asteriou and Spanos (2019) paper, the authors analyse data from countries in the European Union for three crucial economic periods; before, during and after the financial crisis. They find that FD positively impacted economic growth but only in the period before the crisis. They employ panel analysis technique which is similar to the objective of this research. Their work is beneficial in the sense that they aimed to highlight FD in an economy under different market conditions. However, one significant drawback was in their proxy for FD, annual percentage growth rate of Gross Domestic Product. This is not a popularly discussed proxy for FD. Other researchers such as Škare *et al.* (2019), who concludes that development activities in the financial sector can stimulate economic growth and Alexiou, Vogiazas and Nellis (2018) who highlight the benefits of a high performing financial sector in an economy also support the FD and economic growth nexus.

FD and investment relationship is another area that has had significant amount of seminal studies such as research from Asongu (2014), Huang (2011) and Nazlioglu, Yalama and Aslan (2009). An empirical study that attempts to capture the vastness of the financial sector is that from Nkoa (2018). In the paper's analysis of the impact of FD on Foreign Direct Investments (FDI) for 52 African countries, the author employs six economic variables to account for FD. The findings show a positive influence of FD on FDI for countries with and without a financial market as well as a need for African countries to reinvest in their financial markets (Nkoa, 2018). This claim is supported by Muyambiri and Odhiambo (2018) who find a bidirectional Granger-causal relationship exists between FD and investment in the short run but Ganiyu, Abidemi and Enitan (2018) oppose this finding stating that FD does not aid FDI inflows, rather FDI encourages FD. Nkoa (2018) study is significant as they have clearly taken into consideration the depth of a financial system by employing more than one proxy, however, a significant suggested improvement would be for further investigation into the individual influences of these variables used.

Other notable empirical studies highlighting the causative role of FD are from Ogbeide, Kanwanye and Kadiri (2016) whose research show that both FD and resource dependency matter when navigating unemployment dynamics; Mesagan *et al.* (2018), who find that FD has a positive but insignificant impact on manufacturing sector performance in Nigeria; and Ndjokou and Mbassi (2018) who find that FD positively impacts the cyclicality of monetary policies in Sub-Saharan Africa thereby enabling the advancement from pro-cyclical monetary policies to counter-cyclical ones.

2.2 Determinants of FD

What is still unclear from literature is "*what determines financial sector development?"* A number of empirical studies have made significant attempts to answer the question and some of them are discussed in this section.

Using panel data analysis, Raza, Shahzadi and Akram (2014), investigates the determinants of FD in both developed and developing countries. The role of each variable in the study is then estimated by the fixed effect model which indicates that the domestic credit to private sector in the countries analysed largely depends on population growth, real GDP growth, (trade openness, net foreign direct investment, government spending) as a percentage of GDP and share of agriculture sector in GDP. The study does not justify how these indicators are chosen, however, the results are clear in the sense that the demand and supply of credit to the private sector guarantees FD.

The study on how a country's central banking activities affect their FD level is carried out by Tayssir and Feryel (2018). Usually, the aim of central bank polices is to induce financial sector development, promote financial inclusion and align financial system goals (Tayssir and Feryel, 2018). Their findings show that certain characteristics of central banks such as legal, real independence, and transparency play an important role in improving FD levels. The merit of their research is in their comparative analysis, where they create econometric models for three groups of countries; developing, emerging and developed countries.

Another panel study takes into consideration institutional conditions as a link to FD. Cherif and Dreger (2016) show that institutional conditions positively influence banking sector and stock market development respectively. To be specific, corruption, law and order all have a significant impact on stock market development whereas in the banking sector just corruption plays the most significant role. Trade openness is vital across both sectors for FD and should be a key policy priority. The study's limitation was its focus on just the Middle East and North Africa (MENA) region.

There are certain challenges faced when developing policies in emerging financial markets and one example is the development of a regulatory environment that facilitates FD and innovation within the bounds of set policies. Prasad's (2010) paper discusses these challenges for developing economies, highlighting the complexities involved and its long term effect on financial stability, inclusion and development. The paper goes further to discuss that cross-border regulations will impact development and the overall strength of the financial sector. Voghouei, Azali and Jamali (2011) provide literature to support this notion. In their survey of the determinants of FD, they discuss how the effectiveness of an economy's legal system will spur FD. Hence a country's legal system should be adaptable to the fluctuating demands of their financial markets and institutions. From their research a path diagram presenting determinants of FD levels is constructed as shown in Figure 1;

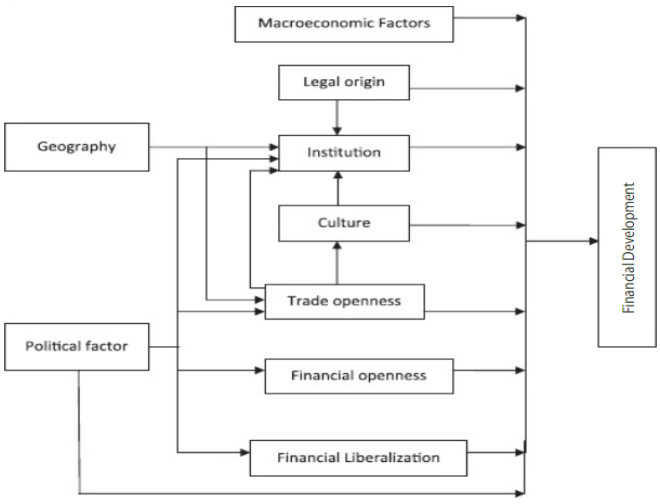

Figure 1: Determinants of FD *(Source: Voghouei et al., 2011)*

The IMF, in their construction of an FD index, are tasked with understanding the multidimensional processes of FD and the multifaceted features of a financial system. To combat the inadequacy of using a single sole proxy for FD, they construct a single composite index from a combination of perceived depth (size and liquidity of markets), access (ability of individuals and companies to access financial services), and efficiency (ability of institutions to provide financial services at low cost and with sustainable revenues) (Svirydzenka, 2016).

Although this index has created a comprehensive assessment of the perceived FD level of an economy, one limitation to highlight is that these indicators (depth, access and efficiency) can be seen as characteristics of a financial system and not necessarily its drivers. A graphic description of their model is shown below;

Figure 2 *(Source: IMF[1])*

2.3 Proxies for FD

Shown below is a table of relevant literatures and their proxies for FD in their research.

Table 1: FD Proxies

Research topic	Author	Methodology	FD Proxy
Revisiting the Determinants of Unemployment in Nigeria: Do Resource Dependence and Financial Development Matter?	Ogbeide *et al.* (2016)	Error correction model (ECM) with ordinary least squares (OLS)	credit to private sector by banks as a percentage of GDP
The relationship between financial development and economic growth during the recent crisis: Evidence from the EU	Asteriou and Spanos (2019)	Panel data analysis (fixed effects) on 26 European union countries	annual percentage growth rate of GDP
Determinants of foreign direct investment in Africa: An analysis of the impact of financial development	Nkoa (2018)	Generalized method of moments on 52 African countries	credit to private sector by banks as a percentage of GDP
Exploring the Determinants of Financial Development	Raza *et al.* (2014)	Panel data analysis on 27 developed and 30 developing countries	credit to private sector by banks as a percentage of GDP
Do remittances promote financial development in Africa?	Karikari *et al.* (2016)	Panel data analysis and Vector Error Correction Model method on 50 African Countries	Money supply, bank deposit and credit to private sector by banks as a percentage of GDP
Measuring financial development in India: A PCA approach	Lenka (2015)	Principal Component Analysis on timeseries data for India	Authors computation of financial depth index from 15 indicators

3 Research Methodology

This chapter provides a detailed description of the data and methods to be utilized in this study and the motivation for its selection.

3.1 Data

The empirical analysis uses annual data for 50 developing countries (N=50) over the period 1998 to 2017 (T=20). Due to the limited availability of the data for all developing countries and the quest to maintain a balanced panel dataset, only those developing countries with data available for the specified time periods are collected. However, it is ensured that these countries span across multiple continents.

Panel data, unlike the more common cross-section and time series data, allows controlling for unobservable heterogeneity through individual (Country) effect (Pandey, 2007).

The dataset is constructed from a number of sources;

- The list of developing countries is from the IMF's world economic outlook database[4]
- The variables under analysis are all soured from The Global Economy site whose main sources are the World Bank, the IMF, the United Nations, and the World Economic Forum[5]
- FD's broad measure (broken down into Financial Institutions and Financial Markets) is extracted from IMFs database[6]

3.1.1 Dependent Variable

The dependent variable this study sought to explain is Financial Development (FD). Following existing literature, the credit to private sector by Banks is applied in this thesis as the proxy for FD.

The private sector credit as a percentage of GDP is the domestic credit, in term of financial resources, provided by banks and other depository institutions to the private sector. This domestic credit can be loans, trade credits or securities. This dependent variable is essential in explaining the degree of access to credit and as shown by literature, facilitates increased innovation activities (Nkoa 2018). Used by Ehigiamusoe and Lean (2018), Ogbeide *et al.* (2016) and more of the studies highlighted in this proposal as their proxy for FD.

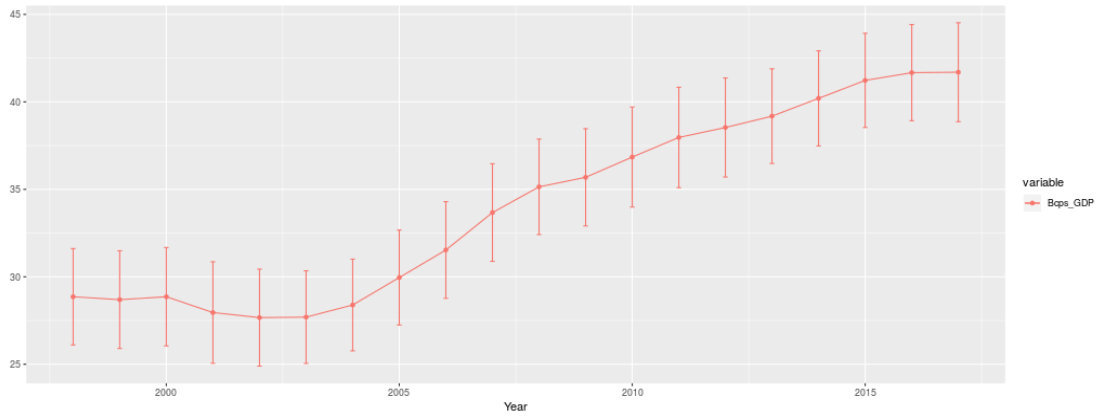

Figure 3: Time trend graph for Independent Variable

Source: Authors computation; data derived by the global economy from World Bank

[4] https://www.imf.org/external/pubs/ft/weo/2018/02/weodata/groups.htm
[5] https://www.theglobaleconomy.com/
[6] https://data.imf.org/?sk=F8032E80-B36C-43B1-AC26-493C5B1CD33B

3.1.2 Independent Variables

As the foundation of the independent variables has been discussed in the justification in **Chapter 1: Section 1.4** of the paper, **Table 2** below presents an outlay of these variables. The inclusion of these variables is based on sound academic, theoretical and empirical foundations of research. The variables are chosen to investigate their ability to create an unconventional measurement model for FD. The multidimensionality of a financial sector is accounted for in the model by incorporating two main components of the FD index created by the IMF; financial institutions and financial markets

Table 2: Independent Variables

Variable	Definition and Measurement
DETERMINANTS	
Remittances	In million USD – financial inflows
Trade Openness	In percentages – exports plus imports as a percentage of GDP
Regulatory Quality	In points (-2.5 weak – 2.5 strong) – measured ability of a government to create sound policies that will advance the financial sector
OTHER	
Financial Institutions	Broad based descriptor of FD for banking and nonbanking institutions
Financial Markets	Broad based descriptor of FD for stock and bond markets

3.2 Analysis

The empirical study follows the Cross Industry Standard Process For Data Mining (CRISP-DM) approach for a quantitative data analysis project[7]. The introductory section of this paper – **Chapters 1 and 2** – as well as the description table – **Table 3** below, covers the business and data understanding which are the first two steps in the CRISP-DM approach. The following sections highlight the remaining steps.

3.2.1 Data Preparation

One of the objectives outlined in this study is to construct and model a panel dataset. Panel data efficiently controls heterogeneity of cross section units – in this study's case, countries – over time. A panel dataset will always be comprised of at least two dimensions; a cross sectional dimension and a timeseries dimension.

As the dataset was formed from multiple sources and not sourced as a whole, formation was first carried out using Microsoft Excel. Hence most of the data wrangling and cleaning is conducted in Excel. Prior to the formation, each developing country listed by the IMF was reviewed for data availability. The goal of this was to ensure a balanced panel dataset was formed as such countries without available data across sections and years were not considered in the models.

3.2.2 Modelling

Panel data estimation models will be used to capture effects of the independent variables on the FD function. Baltagi (2001) stated that panel data estimation is better to identify and measure effects of

[7] https://www.ibm.com/support/knowledgecenter/en/SS3RA7_15.0.0/com.ibm.spss.crispdm.help/crisp_overview.htm

independent variables on dependent variables when compared to pure cross-section and timeseries methods used on cross-section and timeseries data. There are three panel data estimation models used in this study.

1.) Pooled Ordinary Least Square

This estimation technique is most efficient and produces consistent parameter estimate when cross-sectional or time specific effect does not exist (Park, 2011). It additionally will not consider heterogeneity across countries or across years and so becomes biased if there is endogeneity issues (Majeed and Ayub, 2018). This simple means it will not consider the data as panel data. However, Khan and Majeed (2018) consider the pooled OLS estimation technique to be one of the more efficient techniques of panel datasets analysis.

2.) Fixed Effect, FE

Also known as the within estimator, it is used in efficiently analysing the impact from variables that have variation across time (Torres-Reyna, 2007). FE explores the relationship between independent and dependent variables within an entity (in this case country). This model is so designed to study the causes of changes to an entity (country). It assumes that there could be possible bias in the variables and so removes the effect of time-invariant characteristics so that the net effect of the predictors on the outcome variable can be accessed. (Songwathana, 2018) has considered it to be better at modelling cases of unobserved individual and time effects.

3.) Random Effect, RE

Also known as the random intercept, error component or pooling model, it is useful in cases where differences across entities is believed to have some influence on the dependent variable. These differences across entities is believed to be random and uncorrelated with the explanatory variables in the model. It also allows for time invariant variables unlike the fixed effect model. RE additionally accommodates generalization of inferences beyond the sample used in the model. As stated earlier, Pooled OLS can be used to derive unbiased and consistent estimates of parameters even when time constant attributes are present, but random effects will be more efficient (Torres-Reyna, 2007).

3.2.3 Evaluation and Model Selection

Following the model development, the next phase will be to evaluate the models. The F test is used to evaluate the FE models where the null hypotheses is that the dummy parameters are all zero while the LM test is used to evaluate the RE models and the null hypotheses is that individual or time specific variance components are zero. The results are discussed fully in the evaluation section – **Chapter 6**.

The panel Hausman test is a test for the statistical significance of the difference between the coefficient estimates obtained by FE and the RE models[8]. It is the standard procedure used in empirical panel data analysis to select the best model out of either the fixed effects and random effects. It tests that the RE estimate is insignificantly different from the unbiased FE estimate. So under the null hypothesis, the RE estimates are efficient and consistent, and FE estimates are inefficient. While for the alternative hypothesis, the FE estimates are better and are chosen over the RE.

[8] https://towardsdatascience.com/understanding-panel-data-regression-c24cd6c5151e

4 Model Specification

The overall model specification for this study is shown as;

$$\boldsymbol{Bcps\_GDP_{it} = f(REM_{it}, TO_{it}, RegQuality_{it})} \quad \textbf{(1)}$$

Where Bcps_GDP is the credit to private sector by Banks as % of GDP, REM = remittances, TO = trade openness and RegQuality = regulatory quality. i and t = indices for cross-sections (individual countries) and time periods respectively.

Following Baltagi (2001), the general panel regression is presented as;

$$\boldsymbol{Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}} \quad \textbf{(2)}$$

Where *Yit* is the dependent variable at i-entity and t-time, *Xit* is the independent variable at i-entity and t-time, α is the unknown intercept, β is the coefficient for that independent variable, and eit is the error term in the model.

4.1 Pooled OLS

Model A

$$\boldsymbol{Bcps\_GDP_{it} = \alpha + \beta_1 REM_{it} + \beta_2 TO_{it} + \beta_3 RegQuality_{it} + \beta_4 FI_{it} + \beta_5 FM_{it} + \varepsilon_{it}} \quad \textbf{(3)}$$

Key assumption – Cross-sections in the panel data do not have unique attributes and no universal effects across time. The regressors should be uncorrelated with the error term.

4.2 Fixed Effect, FE

Model B

$$\boldsymbol{Bcps\_GDP_{it} = \alpha_i + \beta_1 REM_{it} + \beta_2 TO_{it} + \beta_3 RegQuality_{it} + \beta_4 FI_{it} + \beta_5 FM_{it} + \varepsilon_{it}} \quad \textbf{(4)}$$

In equation 4, FD in country i of the year t is regressed on an intercept (α) (unlike in pooled OLS where it is constant term), and other independent variables that is being investigated to impact FD.
Key assumption – Cross-sections have unique attributes that show no variation across time and may or may not be correlated with the dependent variables.

4.3 Random Effect, RE

Model C

$$\boldsymbol{Bcps\_GDP_{it} = \alpha_0 + \beta_1 REM_{it} + \beta_2 TO_{it} + \beta_3 RegQuality_{it} + \beta_4 FI_{it} + \beta_5 FM_{it} + (\mu_i + \varepsilon_{it})} \quad \textbf{(5)}$$

In equation 5 and unlike in FE, intercept (α) is constant for each entity. Also, the error term is randomly distributed across entities or time periods as denoted by the μi which is a random effect not included in the regression.
Key assumption – Cross sections have unique and time constant attributes that have no correlation with the individual regressors.

5 Implementation

5.1 Data Pre-processing

There are two types of panel dataset; balanced and unbalanced panel data. The study chose to model a balanced panel dataset and so all time periods have to be accounted for, for each country chosen. Data was transformed in multiple ways and analysed to see which produced better result. Any country with missing values were removed entirely from the model. The final transformation method included recording a zero score for regulatory quality points in the years 1999 and 2001 as values were not recorded for those two years in all countries and appending the 2016 records for 2017 for FI and FM as 2017 data was unavailable at the time of the analysis. The final model contained a panel of 50 countries for the years 1998-2017 (20 years).

5.2 Data Understanding and Visualization

To run visualization plots of the panel data, ExPanD was used. ExPandD is a web based application built on the R package, Shiny, for exploratory panel data visualizations[9]. The distribution plots for each of the variables is then computed in R where it is found that remittance is extremely skewed and so the logarithm of remittances, Log(REM), is used throughout the modelling.

A table of the descriptive statistics and correlation matrix is shown below.

Table 3: Descriptive Statistics

Variable	N = Countries	Mean	Min	Std. dev.	Median	Max
Bcps_GDP	50	34.071	1.520	20.065	31.145	94.730
Remittances	50	3137.204	0.75	7419.731	956.9	66831.61
TradeOpeness	50	74.854	16.44	32.48	71.47	206.77
Reg_Quality	50	-0.931	-1.77	0.519	-0.145	1.050
FI	50	0.341	0.079	0.137	0.320	0.698
FM	50	0.126	0.000	0.156	0.041	0.631

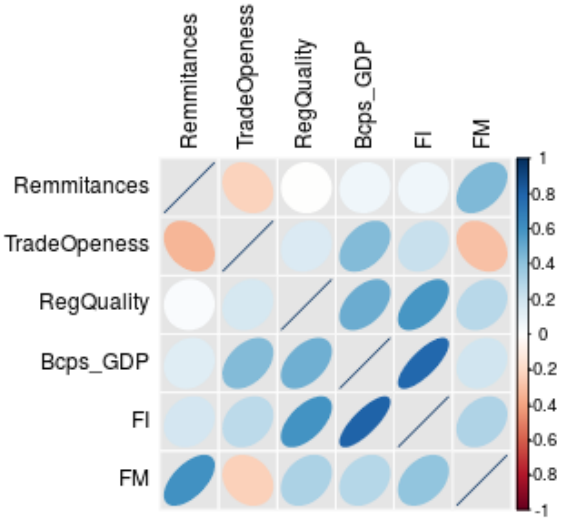

Figure 4: Correlation Matrix of Variables *(Source: Authors Computation from ExPanD)*

[9] https://jgassen.shinyapps.io/expand/

5.3 Modelling

The modelling was implemented in R on the R studio platform. The PLM package is installed to carry out the analysis. The data is then set to panel data, using the pdata.frame() function. This allows R to recognise it as a panel during the analysis. The three estimation models discussed in the methodology are subsequently run on the data.

To evaluate each of the models, F test is conducted for FE and LM test is conducted for RE. In R this is specified by using pFtest() and plmtest() function respectively. The models are both verified to be appropriate from the tests and so the Pooled OLS becomes the least qualified and is discarded.

The better model between the FE and RE model is decided by conducting a Hausman test. The phtest() function is used for this where the arguments in the function are the FE and RE models developed.

5.3.1 Hausman Test Specification

H_0: Corr (a_i, X_j) = 0

This specifies the correlation between individual effects and explanatory variables. If null hypothesis is not rejected RE is favoured over FE.

Shown below is a visual representation of the modelling process conducted.

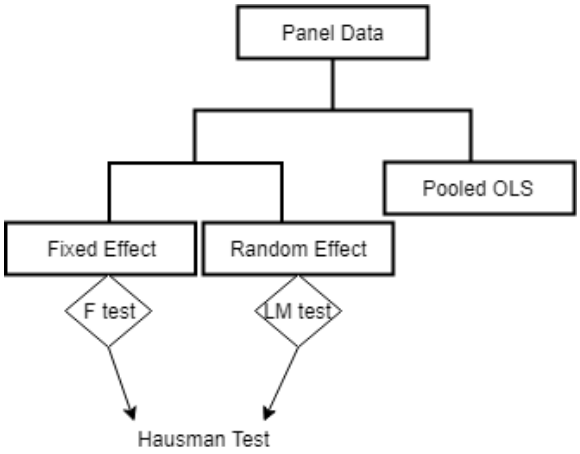

Figure 5: Static Panel Methodology Implementation *(Source: Author's Diagram)*

5.4 Model and Data Diagnostics

A series of standard tests are conducted to check assumptions of panel methodology and ensure results are unbiased

i. Test for multicollinearity – Using the correlation plot for the panel data, multicollinearity is not detected (See **Figure 4** above).

ii. Test for Cross Sectional Dependence – This is conducted using the Pasaran CD test where the null hypothesis is that there is no cross sectional dependence. Cross sectional dependence is not detected as p-value is greater than 0.05. However, according to Baltagi (2001), cross-sectional dependence is not much of a problem in micro panels (where N > T) N being entities and T being time periods. The panel data used in this study fits the description.

iii. Test for stationarity – Using the Augumented Dickey-Fuller Test, adf.test(), the null hypothesis is that the series is non-stationary and therefore has a unit root. From the test, the series show stationarity as p-value was less than 0.05.

iv. Test for Heteroscedasticity – Using the Breusch-Pagan test, bptest(), where the null hypothesis is homoscedasticity. Heteroscedasticity is detected and so a robust covariance matrix is used to control for this in the model and results are provided.

6 Evaluation

Shown below are the summary results from the three models;

Table 4: Summary Results of Pooled OLS, FE and RE

	POOLED OLS		**FIXED EFFECT**		**RANDOM EFFECT**	
Variables	Coefficient (Std. Err)	t-stat	Coefficient (Std. Err)	t-stat	Coefficient (Std. Err)	z-stat
Remittance	0.91*** (0.203)	4.463	-0.53 (0.346)	-1.544	-0.42 (0.306)	-1.377
TradeOpeness	0.19*** (0.012)	15.35	0.07*** (0.017)	3.933	0.08*** (0.016)	5.332
Reg_Quality	1.55’ (0.860)	1.801	3.302*** (0.888)	3.718	3.23*** (0.861)	3.753
FI	98.54*** (3.374)	29.21	103.6*** (4.317)	23.99	102.4*** (3.983)	25.71
FM	2.59 (2.959)	0.874	16.08** (5.205)	3.090	11.96** (4.504)	2.655
Intercept	-19.67*** (1.903)	-10.34			-5.35* (2.418)	-2.212
R^2	0.69		0.50		0.52	
F-Statistic	443.5		190.031			
Chisq					1068.9	
Theta					0.831	
N of Countries	50		50		50	
Observations	1000		1000		1000	

Significance codes: ***0.1%, **1%, *5%, ‘10%

Table 4 presents the overall results for the three Models. In the pooled OLS method, remittance, trade openness and regulatory quality show a positive and significant effect on the output of FD, however the significance is much lower (at the 10% significance level) for regulatory quality. While remittances and trade openness are high at the 0.1% significance levels. This results however varied from the fixed and random effects.

For the FE model, trade openness and regulatory quality show a positive and significant effect on the output of FD (both at the 0.1% significance levels), however remittances produced a negative and insignificant estimate.

Similarly, the RE model shows that trade openness and regulatory quality both have positive and significant effects on FD while remittances negatively impacts the output and is also insignificant to the model.

For all three models, f-statistics is also significant as it reports probability of less than 5% which shows the models are appropriate.

As model validation and the Hausman test is conducted subsequently to pick the best model since there are mixed effects, the result of only that model is discussed fully in **Section 6.4** of the report.

6.1 Model Validation

To validate panel models, there are specific tests to carry out on the models developed. **Table 5** below shows the methods applied.

Table 5: FE and RE Model Evaluation

Fixed Effects		Random Effects	
Method	**p-value**	**Method**	**p-value**
F test for Individual Effects	< 2.2e -16	**Lagrange Multiplier (LM) Test**	< 2.2e - 16

For the FE evaluation result, the small p-value suggest rejection of the null hypotheses of no fixed effect therefore there are significant time-invariant effects (i.e. the fixed effects model is appropriate).

For the RE evaluation results, the small p-value also suggest rejection of the null hypotheses of zero variance in individual-specific errors. Therefore, there is heterogeneity among individuals. This implies that there is significant difference across cross sectional units and hence the RE model is appropriate.

Following the model specification for a panel analysis study, since both the FE and RE are appropriate models, we discard the pooled OLS and conduct a Hausman test to select the best model.

6.2 Panel Hausman Test

Table 6

Method	p-value
Hausman Test to choose between FE and RE	0.004739

The p-value of less than 0.05 suggest rejection of the null hypotheses of individual random effects being exogenous. Hence the fixed effect method is the better solution for our model. A discussion on this result is provided in **Section 6.4**.

6.3 Model Assumptions

The test for multicollinearity was analysed from the plot of the correlation matrix where strong multicollinearity between variables is not detected (see Figure 4). The other tests results are provided below.

6.3.1 Test for Cross-sectional dependence

Table 7

Method	p-value
Pesaran CD test for cross-sectional dependence in panels	0.9869

The p-value suggests the null hypotheses of no cross-sectional dependence is not rejected. Therefore, there is no cross-sectional dependence. However, according to Baltagi (2001), cross-sectional dependence is also not much of a problem in micro panels (where N > T) N being entities(countries) and T being time periods. The panel data used in this study fits the description.

6.3.2 Test for Stationarity

Table 8: ADF Test Result

Method	p-value
Augmented Dickey Fuller Test	0.01

The p-value of 0.01 allows for rejection of the null hypotheses of non-stationarity. Hence the panel does not have a unit root and is therefore stationary.

6.3.3 Test for Heteroscedasticity

Table 9: Heteroscedasticity Test Result

Method	p-value
Breusch-Pagan Test	<2.2e-16

Heteroscedasticity is detected as the null hypotheses of homoscedasticity is not rejected, so it is controlled by using a robust covariance matrix. This is performed on just the fixed effects model as it is the best model. Table 10 shows the adjusted results after controlling for heteroscedasticity.

Table 10: Results after Controlling for Heteroscedasticity in the Model

Variables	Coefficient (std. err)	t-stat
Remittances	-0.53 (0.93)	-0.575
TradeOpeness	0.07* (0.03)	1.973
RegQuality	3.30’ (1.74)	1.899

Although significance levels are lower than initially reported, however the coefficients remain the same from the initial results.

6.4 Discussion

This discussion is based on the result of our panel Hausman test which selects the fixed effects model as the most appropriate model for this study.

6.4.1 Individual effects

The financial sector as we know it caters to a lot of other sectors in any economy and is propelled by a vast number of factors both intra (from the activities within an economy) and inter (from the activities of one economy with other economies). For this reason, investigating remittances, trade openness and regulatory quality as determinants of FD is conducted.

As highlighted above trade openness and regulatory quality show positive and significant effects on the output of FD. To be specific, if the level of trade openness increases in a year by 10% there will be a corresponding increase of approximately 0.7% in FD. This is on par with findings from David *et al* (2014) and Ehigiamusoe and Lean (2018) whose work show that trade openness is vital for FD. The analysis highlights how the presence of open and international trade can be very influential in

an economy. Controlling for heteroscedasticity in the model, trade openness still results in a positive effect although significance is a little lower at the 5% level.

The quality of an economy's regulatory sector is very influential not just for financial development and growth, but shows how well policies are implemented. In the long run this can be favorable for maintaining relationships with other countries. The FE estimates show that for every one-unit increase in the regulatory point of a developing economy, FD will increase by 3.3%. Similar to trade openness when heteroscedasticity is controlled, a positive influence is still found but lower significance at the 10% level.

In contrast, remittances have shown a negative effect. It is expected that as money is sent into developing economies, either through migrants or trade deals, the development of the financial sector should be boosted by these activities and be propelled to develop more channels to receive these funds. This is not so for all developing countries from this study's model. For every year on increase in remittance figures, it is expected that this will take a toll on the level of FD and by a margin of approximately 0.5%. It is also insignificant to the model as its large p-value suggests that changes in remittances are not associated with changes in FD. This is similar to results from Karikari *et al.* (2016) who also find a negative impact and low significance between remittance and credit to the private sector but contradicts Javid *et al*. (2012) who sees the significance and importance of remittances for growth in their study. It could be that even though developing countries take remittances largely as a source of foreign capital and investments it could have adverse effects in the long run. Karikari *et al.* (2016) alluded to this fact by stating the risk involved with high remittances. They discuss that households in developing economies can become highly remittance dependent and subsequently abandon the labour market thereby slowing economic growth. The empirical analysis also shows a negative relationship in particular with trade openness and this could be because it also leads to reduced exports.

6.4.2 Combined Effects

Although both the random and fixed effects models were validated to be appropriate thereby creating mixed effects, the FE model proved to be the most significant of the models. This model primarily focused on exploring the relationship between the determinants and FD within the countries under study. Under the FE models, the unobserved elements are correlated with FD levels across countries. It controls for the fact that there are probably differences between the countries that will impact their level of FD other than those under study. Additionally, the FE model will have an intercept for each country. The validity of FE models is consistent and supported by Balazsi *et al* (2015).

Isolating the fixed effects in the model, the analysis then highlights the intercept of each country. The study finds that on average there are more countries with negative estimates which means that they will have lower FD (See **Appendix A** for list of countries and estimates). Delving further into the estimates of the countries, the study subsequently finds that developing countries in Europe are most likely to record lower FD values as all but one country had negative estimates. Countries located in America, Africa and Asia have a better chance of maintaining higher FD levels from the model. This is because they each had at least 4 countries with positive estimates, although the negatives were still more. It could be because of factors such as proximity to each other and size. For example, Honduras, El Salvador, Nicaragua and Belize are all in close proximity with each other and by population and land mass are not big countries, yet they all recorded positive values in the model. While Morocco is an African country in close proximity to developed European countries (Spain and France) and this could make substantial impact in their cross-country activities which may explain their positive FD value.

The above explanation on the findings have been used to further interpret the results of the analysis. The main drawback of the fixed effects is that it explains the effects of the determinants on the countries independent of time.

7 Conclusion and Future Work

For developing countries, the focus will usually be on trying to attain a level of economic growth that will boost their economy in the long run. As such several measures are driven simultaneously to spur growth and one of such is the development of the financial sector. Remittances, trade openness and the quality of regulations all exert different effects and significance on FD levels in developing countries. The motivation for this research was to investigate determinants of FD with a focus on developing countries because FD is used by many researchers as an indicator to measure economic growth. By selecting the Fixed Effects model after the model evaluation process, the true significance of the results shows that while developing countries may be differ considering their emerging markets status and activities, the influence of the determinants will be uniform across them. The results show economic verification of the significance of efficient trade openness and improved regulatory quality for financial sector development with trade openness having the most significance. This is so even after controlling for heteroscedasticity in the model. However, remittance proved to be insignificant and will have a negative impact and this is similar to findings from (Karikari *et al.,* 2016).

Collectively the results also show that there are more countries with lower FD values than high FD values using this model. Developing countries in Europe were most likely to record lower FD values while countries located in America, Africa and Asia have a better chance of maintaining higher FD.

As for policy implications, the study suggests that for enabling financial sector development, governments have to undertake measures that will increase international trade with both neighboring and already developed countries. This could be through the provision of policies that are attractive to other trade countries and enabling digital access for e-commerce activities. Additionally, policy makers are shown that stable regulations that are well enforced are significant for developing countries especially as it shows growth and how well they implement and adhere to regulations. Besides enforcing good policies, governments should ensure that regulations are favoring and not hindering interaction with international markets. As remittance was deemed to have a negative effect, one way to correct this is to advice policy makers to create attractive ways and channels for remittance-dependent households to invest back into the financial sector.

7.1 Future Work

The development of a financial sector can be made efficient by better trade openness and improved regulatory quality, however, these will not be the only factors. There may be other alternative measures and so future study will be focused towards modelling these undocumented measures in an economy.

It is important to highlight that the limitation of this study is in its sampling of just 50 developing countries due to data availability and application of methods that suit a balanced dataset. Future work will look into methodologies and techniques to model an unbalanced dataset so as to account for more countries and time periods. Applying dynamic panel methods to the panel data will also be looked into to ascertain robustness of results.

Finally, the model was built on just data for developing countries. It could be that developed countries will have a different pattern to financial development and may not exhibit fixed effects because of their established and well-formed economic activities. Future work will aim to understand as well the effects on a model with developed countries.

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APPENDIX A

Countries and coefficients.

Country	Coefficient
Albania	-11.9342864
Antigua and Barbuda	-5.7035866
Argentina	-25.0830966

Country	Coefficient
Guinea	-8.8503248
Guyana	0.3056791
Haiti	-1.0837286

Azerbaijan	-11.0488014
Bangladesh	9.0391062
Belarus	-9.1038717
Belize	7.0487130
Benin	-9.1924100
Bolivia	12.1589871
Bosnia and Herzegovina	1.5508088
Brazil	-20.3371157
Cambodia	4.8950726
Cameroon	-7.3514965
Cape Verde	2.9796908
Colombia	-13.6760272
Costa Rica	-5.2755333
Croatia	-10.4695854
Dominic Republic	-3.9623254
Dominica	-2.7353896
Ecuador	-5.2351212
Egypt	7.6905932
El Salvador	8.6421646
Georgia	-7.6826614
Grenada	4.3955766
Guatemala	-11.1473547

Honduras	7.9572813
India	4.2306504
Indonesia	-9.6880042
Jamaica	-14.6375587
Jordan	14.8847947
Malawi	-8.1265856
Mexico	-26.5456122
Morocco	6.1785610
Namibia	-23.7316839
Nicaragua	-1.2263080
Pakistan	-7.4335585
Panama	14.8540104
Paraguay	2.6688212
Peru	-5.7129891
Philippines	-5.2938396
Poland	-24.1803017
Sierra Leone	-9.1307718
Sri Lanka	-3.8869128
Sudan	-3.8133377
Tunisia	9.9121571
Turkey	-9.6655925
Uganda	-7.6186681