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FULL LENGTH RESEARCH ARTICLE (OPEN ACCESS)

FINANCE-GROWTH NEXUS IN GHANA: *TESTING FOUR COMPETING THEORIES*

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ABSTRACT

Purpose/Objective

The principal purpose of the study was to empirically ascertain whether or not any of the four competing theories explaining the finance-growth nexus could be confirmed in the Ghanaian context.

Paradigm/ Design/ Methodology/ Approach

The study utilized an objectivist ontological paradigm, a positivist epistemological viewpoint, and sound axiological (ethical) principles in collecting the data used for the analysis. A quantitative research design was applied to mainly secondary data representing the various proxies of financial development and economic growth that were collected from the websites of the Finance Ministry (MoF), Ghana Statistical Services (GSS), African Development Bank (AfDB), Bank of Ghana (BoG), and the World Bank Development Indicators (WDI). The data were annual time series data spanning the period 1960–2019, capturing both the pre- and post-economic reform and structural adjustment program periods for Ghana. The data was analyzed using descriptive statistics, trend lines and inferential statistics. Individual unit root tests were performed using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The Johansen System Cointegration test was also carried out to test for the presence of a matrix of cointegrating relationships between the variables. Empirical models were specified to test the four main theories, namely, the finance-led growth theory, growth-led finance theory, mutual impact/feedback hypothesis, and no-causal relationship theory. The model parameters were estimated using *the Fully Modified Ordinary Least Squares (FMOLS) technique.* The FMOLS model was employed to analyze the short-term nexus between financial sector development and economic growth. The robustness of the FMOLS estimates in terms of the consistency of the statistical significance and effects of the parameter estimates were checked using the *Canonical Cointegration Regression (CCR)* model. The Vector Error Correction Model (VECM) was also further applied to analyze the short-run and long-haul dynamic link between financial development variables and economic growth. Additional VECM diagnostic tests were performed which were mainly graphical analyses of VECM Residuals, Error Correction Term and Impulse Response Functions to ensure robustness of the VECM results. The simple pairwise Granger causality test was also exercised to ascertain the direction of causality between economic growth and financial sector development indicators. The analysis was performed using Econometrics Views (EVIEWS 10.0) and GRETL statistical software packages.

Findings

The findings are as follows: Firstly, the *Finance-led growth theory* is strongly corroborated in Ghana with reference to the following variables: *(i) Stock market development and economic growth; (ii) Efficiency of the financial sector and economic growth; and; (iii) Financial sector activity and economic growth.* Secondly, the *Growth-led finance theory* is slightly substantiated in Ghana only in relation to financial inclusion and economic growth. Thirdly, the *Mutual Impact or feedback hypothesis* is marginally authenticated in Ghana in connection with financial innovation and economic growth; and; fourthly, *the No-Causal Relationship theory* is vaguely verified in Ghana only with respect to financial liberalization and economic growth.

Originality/ Value

The main value of this study is the identification of the finance-growth theory is the most generous theory that accounts for the interconnection between financial sector development and economic growth in Ghana since it can explicate the union between economic growth and a majority of the financial sector development variables such as stock market development, efficiency of the financial sector, and financial sector activity. Additionally, the study slightly confirms the *Growth-led finance theory* in Ghana only in relation to financial inclusion and economic growth. Moreover, the study marginally endorses the *Mutual Impact or feedback hypothesis* in Ghana but this is only as regards the tight liaison between financial innovation and economic growth. Finally, the study vaguely corroborates *the No-Causal Relationship theory* in Ghana only with respect to financial liberalization and economic growth.

Key words: *Finance, Economic growth, nexus.*

1. INTRODUCTION

1.1Background of Study

A careful analysis of the literature on financial economics will expose a very interesting and topical issue concerning the connection between the development of the financial sector and economic advancement. Very often captioned in the literature with such expressions as "finance-growth nexus" or "growth-finance nexus", these two expressions reflect a cluster of opposed schools of thoughts, ideas, and theories regarding the exact nature of the dynamic synchronicity between finance and economic growth. Although there is no universal consensus on the exact nature of the relationship between finance and growth, there are four major competing theories or schools of thought to consider whenever the analysis is conducted on the relationship between financial growth and economic development. These theories are the *"finance-led growth theory"*, *"growth-led finance theory"*, *"mutual feedback/ impact theory"* and *"no-causal relationship theory"*.

The first theory (finance-led growth theory) was initially promulgated by Schumpeter (1911) **[110]** and subsequently developed by Goldsmith (1969) **[45]**, McKinnon (1973) **[85]**, and Levine (1997) **[76]**. However, Demirguc-Kunt (2006) **[34]**, inspired by the initial works of Schumpeter (1911) **[110]**, Goldsmith (1969) **[45]**, McKinnon (1973) **[85]** and Levine (1997) **[76]** extended the theory by positing a well-working financial framework as one of the key underpinnings of sustainable economic growth. He contended that advancements in the financial industry was a critical precursor to economic growth and further asserted that finance influences development by stimulating technological innovation, savings, and investment (Demirguc-Kunt, 2006) **[36]**. In essence, therefore, the finance-led growth perspective argues that critical developments and improvements in the financial sector are key drivers of economic growth (Goldsmith, 1969; Levine, 1997; McKinnon, 1973; Schumpeter, 1911). **[45, 76, 85, 110]**.

The second theory, the Growth-led finance theory argues that economic development is the key antecedent of financial sector improvement. The preachers of the second school of thought, (i.e., the Neoclassical scholars), assert that finance is certifiably not an essential wellspring of development (Lucas, 1988) **[80]**. Lucas (1988) **[80]**, a strong believer in the "Growth-led finance theory" has, however, critiqued the "finance-led growth theory" by alluding to an over-emphasis of the true linkage between finance and economic growth (Christopoulos & Tsionas, 2004) **[32]**. Accordingly, other scholars postulated a converse correlation between growth and finance. **[1]**

The findings on a positive finance-growth relationship disagree with the view of a converse linkage between the two variables, and this further confounds the argument. In lieu of this, some authors have argued for a bi-directional connection between finance and growth. Known as the theory of mutual feedback/impact, this viewpoint postulates a contemporaneous association between

[1] (For example see the works of Singh, 1997; Ayadi, Arbak, Naceur, & De Groen, 2015; Andersen & Tarp, 2003; Ductor & Grechyna, 2015). However, in the ongoing past, various investigations have concurred that finance positively influences economic growth (See, Pradhan, Arvin, Hall & Nair, 2016; King & Levine, 1993a, 1993b; Samargandi, Fidrmuc & Ghosh, 2014; Muhammad, Islam & Marashdeh, 2016; Beck, Levine, & Loayza, 2000; Durusu-Ciftci, Ispir, & Yetkiner, 2017; Herwartz & Walle, 2014; Christopoulos & Tsionas, 2004; Jedidia, Boujelbène, & Helali, 2014; Khan & Senhadji, 2000; Levine, 1997; Uddin, Sjö & Shahbaz, 2013; Zhang, Wang & Wang, 2012).

finance and growth. In other words, economic growth propels financial development and financial development stimulates economic growth [2].

The fourth and final theory is the non-causal relationship concept, which suggests that economic growth and financial development are unrelated (Graff, 1999; Lucas, 1988). [46,80].

The above arguments indicate the lack of fundamental consensus among scholars on the connection between finance and growth. Against this milieu, this research is being conducted to explore the finance-growth nexus in Ghana by specifically undertaking a macro-econometric review of the four competing theories, namely, finance-led growth, Growth-led finance, mutual impact, and non-causal relationship hypotheses.

1.2 Purpose of the Study

The main purpose of the study is to empirically ascertain whether or not any of the four theories explaining the finance-growth nexus could be confirmed in the Ghanaian context.

1.3 Objectives of the Study

The central goal of the study is to conduct a macro-econometric analysis to test which of the four theories, namely financial-led growth, Growth-led finance, mutual impact, and no-causal relationship theories, could account for the finance-growth linkage in Ghana.

Specifically, the study would seek to confirm or reject the:

i. Finance-led growth theory in Ghana by analyzing the short- and long-run unidirectional causal impacts of financial sector development variables on economic growth.
ii. Growth-led finance theory in Ghana by analyzing the short- and long-run unidirectional causal impacts of economic growth on financial sector development variables.
iii. Mutual feedback theory in Ghana by analyzing the short- and long-run bi-directional causal impacts of financial sector development variables on economic growth and vice-versa.
iv. No-causal relationship theory in Ghana by analyzing the short- and long-run macro-dynamic impacts of financial sector development variables on economic growth and vice-versa.

1.4 Research Questions

The study would seek to address the following research questions;

Research Question 1

1. Can the finance-led growth theory be confirmed in Ghana because financial sector development variables exert some statistically significant short- and long-run unidirectional causal impacts on economic growth?

Research Question 2

2. Can the Growth-led finance theory be confirmed in Ghana because economic growth exerts some statistically significant short- and long-run unidirectional causal impacts on financial sector development variables?

[2] (For instance refer to Demetriades & Hussein, 1996; Luintel & Khan, 1999; Al-Yousif, 2002; Calderon & Liu, 2003; Abu-Bader & Abu-Quan, 2008; Wolde-Rufael, 2009; Bangake & Eggoh, 2011; Kar et al., 2011).

Research Question 3

3. Can the mutual feedback theory be confirmed in Ghana because financial sector development variables exert some statistically significant short- and long-run bi-directional causal impacts on economic growth variables and/or vice-versa?

Research Question 4

4. Can the no-causal relationship theory be confirmed in Ghana because financial sector development variables exert no statistically significant short- and long-run causal impacts on economic growth variables and vice-versa?

1.5 Contribution of the Study

This paper makes several contributions. Firstly, the results of the research serve as an invaluable academic guide or reference material for potential studies on the finance-growth linkage in Ghana. Secondly, the conclusions of the study could also be constructive to policymakers such as the Bank of Ghana (BoG) as its outcomes and recommendations could influence fiscal and monetary policy. Thirdly, the Managements of Ghanaian banking and financial institutions in the country's financial services sector could also profit from the findings of this study, as it would assist them to further grasp the link between the development of the financial system and economic growth.

Additionally, this paper offers some momentous inputs to both the theoretical and empirical literature on the finance-growth linkage. The foremost contribution is the identification of the finance-growth theory is the most generous theory that accounts for the interconnection between financial sector development and economic growth in Ghana since it can explicate the union between economic growth and a majority of the financial sector development variables such as stock market development, efficiency/inefficiency of the financial sector, and financial sector activity. The implications for this finding to the finance-growth literature are as follows. Firstly, the development of the financial sector is antecedent to economic growth. In particular, stock market development, improvements in financial sector efficiency in allocating surplus funds to deficit units, and general enhancements in the operational activities and financial services delivery quality could heighten economic growth in Ghana. Therefore, this study encourages the development of the stock market but draws the attention of policymakers to the fact that there are currently some inefficiencies in stock market activities that may be undermining economic growth in Ghana. Furthermore, the paper highlights the crucial need for the BoG and Managements of banks and other financial institutions to implement policies that minimize their operational inefficiencies and amplify operational effectiveness via improved financial services quality.

It is important to note, however, that this paper does not only have something to say about the finance-growth theory; there are a few points to note regarding the other competing theories. Concerning these theories, this study somewhat confirms the *Growth-led finance theory* in Ghana only in relation to financial inclusion and economic growth. The paper, therefore, draws the attention of policymakers and managers of financial institutions to the need to strive toward enhancing the coverage of financial inclusion across the country by extending financial services to the poor and marginalized in society. As more of the marginalized in society begin to get included in the financial revolution and benefit from financial technologies such as mobile money services etc., economic activities would be drastically enriched which would also positively uplift the advancement of the financial sector.

Moreover, the study marginally endorses the *Mutual Impact or feedback hypothesis* in Ghana but this is only as regards the tight liaison between financial innovation and economic growth. This denotes that financial innovation augments economic growth and economic development triggers more financial innovation. Hence, the Managements of Ghanaian Banks are admonished to invest more in research and development activities that target the development of financial technologies that enrich banking operations and make life easier for customers. In this regard, banks need to multiply the number of Automated Teller Machines (ATMs) across the country to allow more customers to benefit from this technology. When this done economic activities would be optimistically boosted which would, in turn, convalesce financial services quality delivery.

Finally, the study vaguely corroborates *the No-Causal Relationship theory* in Ghana only with respect to financial liberalization and economic growth. This finding insinuates that the liberalization of the financial sector does not, at least in the short-haul, have a substantial correspondence with economic growth and vice-versa. However, financial liberalization was found to hurt economic growth in the long-term. This study, thus, cautions the Bank of Ghana against the "over-liberalization" of the financial sector.

1.6 Scope and Organization of the Paper

Theoretically, this paper is limited only to the four theories on the finance- growth nexus, namely, finance-led growth, growth-led finance, mutual impact, and no-causal relationship. Geographically, the study only examines the finance-economic growth connection by focusing on Ghana. This implies that the results of the research are not generalizable to other situations. Methodologically, the study relies only on secondary data and uses statistical/econometric models to analyse the association between financial development and economic advancement. Since the research design is non-experimental, ex-post-facto, the observed association between the development variables of the financial sector and economic growth must be considered from the perspective of statistical correlation, not actual causation – something that can only be accomplished when the more rigorous experimental design is used.

The paper is organized into five chapters. Section one is the *Introduction* and will cover topics such as the background of the study, purpose of the study, aims/objectives, research questions, contributions of the paper, and scope and organization of the paper. Section two is the *Literature Review* which offers more detailed information on all relevant conceptual, historical, theoretical, and empirical issues about the development of the financial sector and economic growth in Ghana. Section three would provide an overview of the *methodology* used by the researcher to achieve the study objectives. It includes research design, data sources, data collection, and analysis techniques. Section four introduces and addresses the actual *findings and results* of the research by situating them in the appropriate empiric literature. Section five shall provide the *summary, conclusions*, and *recommendations* for policy action and *further research*.

2. LITERATURE REVIEW

2.1 Conceptual and Theoretical Review

This section has two main parts. The first part reviews the concepts and theories of economic growth. The second part looks at the four theories explaining the finance-growth nexus.

2.1.1 Concept of Economic Growth

The concept of economic growth, according to Habane (2012) [48], alludes to an upsurge in the overall yield or total output delivered by a country. It contains an expansion in the capacity of an economy to create products and services, analyzed after some time. It is realized whenever resources are rearranged to give more value. It is mostly measured in real terms, which is adjusted for inflation, or in nominal terms which includes inflation (Habane 2012) [48]. Often measured in monetary units, the term economic growth is also influenced by some factors such as measurements of economic growth determinants of per capita Gross Domestic Product (GDP) growth.

2.1.2 Models and Theories of Economic Growth

Models of economic growth insinuate different speculations and scientific portrayals and plans for the possibility of economic and financial development found in the empirical literature. There are two significant models and speculations of economic growth found in the literature, namely, the; *1) Neoclassical Economic Growth Theory (Solow-Swan model);* and 2) *Endogenous Growth Theory*. However, due to the page limitations imposed upon this long essay, we discuss below, only the *Neoclassical Economic Growth Theory (Solow-Swan model).*

2.1.3 Neoclassical Economic Growth Theory (Solow-Swan Model)

The Solow-Swan model is usually regarded as the Neoclassical model of economic development. It was initially created by two researchers, Robert Solow and Trevor Swan during the 1950s. The model hypothesizes that there are low returns to capital and work (labor). As per the model, capital accumulates through venture or investment, yet its amount or stock persistently diminishes because of devaluation (depreciation). Due to the unavoidable losses to capital, increments in capital/laborer combined with the nonappearance of innovative advancement causes financial yield/worker to in the long-run arrive at a point where capital for every worker and monetary yield/laborer will stay unaltered because yearly capital investments are precisely equal to yearly devaluation/depreciation. This circumstance, as indicated by the model, is known as 'steady-state' (Solow 1956; Swan 1956). [114, 116].

Further, the Solow-Swan model attests that increments in productive efficiency that come through innovative headways would yield expansion in yield/worker regardless of whether the monetary framework is inside the steady-state. Yield/Worker could also blast at a related consistent state when productiveness is stretched out at a steady rate. Thusly, monetary blast, as per the model, can happen either by expanding the portion of GDP contributed or through innovative advancement. In any case, regardless of the level of GDP contributed, capital/worker sometimes meets the enduring state, to such an extent that the development pace of yield/worker is chosen most successfully with the guide of the pace of technological advancement. In this way, in a worldwide period where innovation is accessible to all nations and advancing at a relentless rate, all nations have the indistinguishable steady-state pace of economic growth. Regardless of the way that every nation has a remarkable degree of GDP/worker controlled by utilizing the level of

GDP it contributes, all nations, with regards to the hypothesis, have a similar pace of economic growth.

One characteristic presumption of the Solow-Swan model is that rich nations are those that have contributed a high level of GDP for quite a while and that ruined nations can develop to be rich through expanding the extent of GDP they contribute as time goes on. A basic forecast of the Neoclassical model, generally borne out of the information and records, is that of conditional convergence; the idea that poor nations will become speedier and seize up with rich countries so far as they have comparative investment (and saving) rates and access to a similar innovation (Solow 1956; Swan 1956; Easterly 2001). **[114, 116, 40]**.

Also, the Solow-Swan model is considered an "exogenous" form of economic growth since it does not clarify why nations put various portions of GDP in capital nor why innovation inevitably improves after some time. Then again, the pace of investment and the rate of innovative advancement are thought to be exogenous. The estimation of the model, in this way, lies in the way that it predicts the patterns of economic growth once these two rates are determined. A noteworthy constraint of the model lies in its inability to represent the determinants of these rates (Easterly 2001) **[40]**.

It should be referenced, notwithstanding, that even though the investment rate in the Solow-Swan model is exogenous, underneath specific conditions the model verifiably represents convergence in investment rates crosswise over countries. In a worldwide monetary framework with a worldwide money related capital market, fiscal and budgetary capital streams to the countries that offer the greatest earnings on financial investments. In the Solow-Swan model, nations having a lot lesser capital/laborer (financially impoverished countries) have a higher return on investment because of the consistent losses to capital. Therefore, capital/worker and yield/worker in a worldwide monetary capital market need to meet to an indistinguishable level in all nations.

Be that as it may, because of the way that truly financial capital has not streamed to the countries with the less capital/worker, the essential Solow-Swan model has an applied shortcoming. Beginning during the 1990s, this shortcoming has been tended to by methods for including extra factors to the model which can clarify why a couple of nations are significantly less compelling than others and, subsequently, do never again allure streams of world money related capital despite the way that they have considerably less (physical) capital/laborer (Solow 1956; Swan 1956; Easterly 2001). **[114, 116, 40]**.

2.1.4 Mathematical Formulations of the Solow-Swan model

The Solow-Swan model is a hypothesis of how economic growth (GDP per worker) is accomplished through the aggregation of capital. Its fundamental foundations are as follows:

i. Production function (GDP relies upon technological innovation, work/labor, and physical capital)
ii. Capital accumulation equation (change in net capital stock is equivalent to gross investments [=savings] less devaluation/depreciation) (Solow 1956; Swan 1956; Easterly 2001). **[114, 116, 40]**.

1. Solow-Swan Equations

Solow-Swan investigates how these two conditions communicate. Y and K are endogenous factors; s, δ and growth rate of L as well as A, are exogenous (parameters). The result relies upon the precise useful type of production function, and parameter estimates (Solow 1956; Swan 1956; Easterly 2001). **[114, 116, 40]**.

The Solow-Swan equations are depicted and explained below:

$$Y = Af(K, L) \quad \text{(production function)} \qquad \text{.....(2.1)}$$

Y = GDP, A = technology,

K = capital, L = labour

$$\frac{dK}{dt} = sY - \delta K \quad \text{(capital accumulation equation)} \qquad \text{.....(2.2)}$$

s = proportion of GDP saved $(0 < s < 1)$

δ = depreciation rate (as proportion) $(0 < \delta < 1)$

Robert Solow and Trevor Swan analyzed how these two equations interact. Y and K are endogenous variables;s, δ, and growth rate of L and/or A are exogenous (parameters). The outcome depends on the exact functional form of the production function, and parameter values (Solow 1956; Swan 1956; Easterly 2001). **[114, 116, 40]**.

2. *Neoclassical Production Functions*

Solow-Swan assumes (Solow 1956; Swan 1956; Easterly 2001) **[114, 116, 40]**:

a) Diminishing returns to capital or labor (the 'law' of diminishing returns), and
b) Constant returns to scale (e.g. doubling K and L, doubles Y).

For example, the Cobb-Douglas production function

$$Y = AK^{\alpha}L^{1-\alpha} \qquad \text{where } 0 < \alpha < 1$$

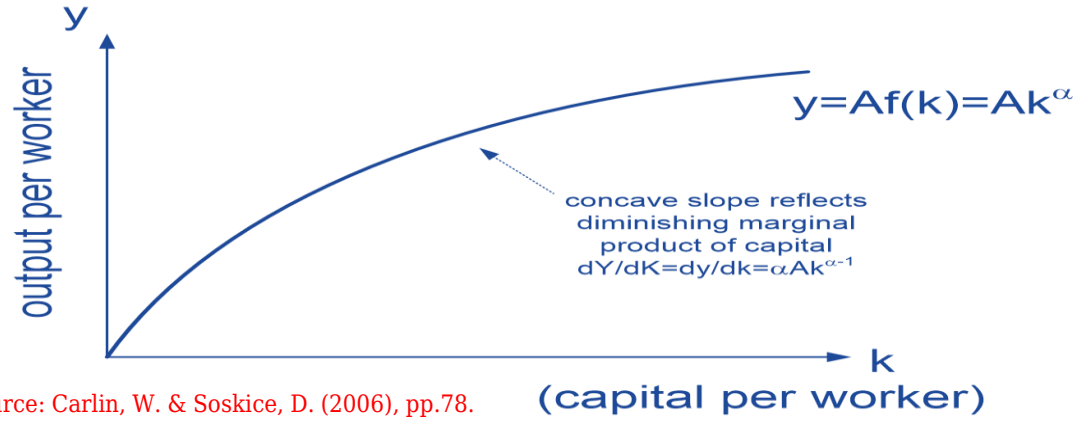
$$y = \frac{Y}{L} = \frac{AK^{\alpha}L^{1-\alpha}}{L} = \frac{AK^{\alpha}}{L^{\alpha}} = A\left(\frac{K}{L}\right)^{\alpha} = Ak^{\alpha} \qquad \text{.....(2.3)}$$

Hence, we now have y = output (GDP) per worker as a function of a capital to labor ratio (k).

3. *The Link Between GDP Per Worker (y) and Capital Per Worker (k)*

If we assume A and L to be constant (no technology growth or labor force growth), the relationship between output per worker and capital per worker could be described by the graph below (Solow 1956; Swan 1956; Easterly 2001): **[114, 116, 40]**.

Figure 2.3: Graph of Output per Worker against Capital per Worker (No Depreciation & Savings)



Source: Carlin, W. & Soskice, D. (2006), pp.78.

4. *Accumulation Equation*

If A and L are constant, it can be demonstrated that the accumulation equation is:

$$\frac{\partial k}{\partial t} = sy - \delta k \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.4)$$

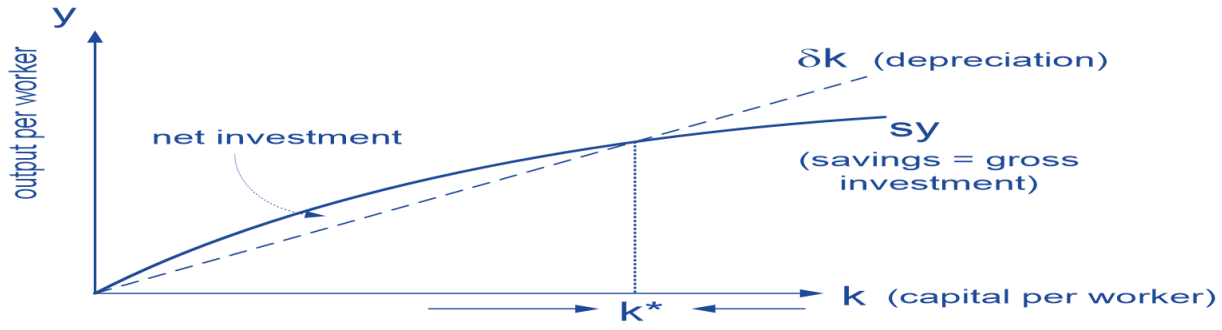
Diving through by L yields, $\frac{\partial k}{\partial t}/L = sy - \delta k$. Also, note that, $\frac{\partial k}{\partial t} = d\left(\frac{K}{L}\right)/dt = \frac{\partial k}{\partial t}/L$, since L is constant.

Equation 2.4 above is a differential equation. In words, the change in the capital- to- labor ratio over time = investment (saving) per worker *minus* depreciation per worker. Any positive change in k will increase y and generate economic growth. Growth will stop if $dk/dt=0$ (Solow 1956; Swan 1956; Easterly 2001) **[114, 116, 40]**.

5. *Graphical Analysis of the Accumulation Equation*

A graphical analysis of the accumulation equation $\frac{\partial k}{\partial t} = sy - \delta k$ where s and δ are constants is shown below (Swan 1956; Easterly 2001) **[116, 40]**. According to the graph, output per worker increases with capital per worker until the equilibrium point (k*) where savings equals gross investment **(Figure 2.4).**

Figure 2.4: Graph of Output per Worker against Capital per Worker (Depreciation & Savings)



Source: Carlin, W & Soskice D (2006), pp.81.

2.2 Finance-Growth Nexus Theories

This section presents the four competing finance-growth nexus theories, namely, *1) Finance-led Growth Theory; 2) Growth-led Finance Theory; 3) Mutual Feedback Theory;* and; *4) No Casual Relationship Theory.*

1. Finance -Led Growth Theory

The theoretical literature suggests that there are four possibilities regarding the causal relationship between financial development and economic growth (Apergis, Filippidis & Economidou, 2007). **[18]**. The first hypothesis, called the supply-leading response hypothesis, argues that financial development causes economic growth (Schumpeter, 1911, McKinnon, 1973; Shaw, 1973). **[110, 84, 111]**. This "supply-leading" relationship between financial and economic developments is a "finance-led growth theory" argues that the existence of the financial sector, as

well-functioning financial intermediations in channeling the limited resources from surplus units to deficit units would provide efficient allocation of resources thereby leading the other economic sectors in their growth process. Indeed, several studies have argued that the development of the financial sector has significantly promoted economic development (Schumpeter, 1911; Levine, Loayza & Beck, 2000). [110, 76]. **[Figure 2.5].**

Figure 2.5: Conceptual Model of Finance-Led-Growth Theory

Authors' (2020). Conceptualization based on Literature Review.

2. Growth –Led Finance Theory

The second hypothesis called the demand-following response hypothesis posits that economic growth
causes financial development. It argues that the development of the real sector stimulates demand for financial services that are passively met by the introduction of new financial institutions (Odhiambo, 2010) [87]. Also known as the "Growth-led finance" hypothesis, this hypothesis states that high economic growth may create demand for certain financial instruments and arrangements and the financial markets are effectively responding to these demands and changes. In other words, this hypothesis suggests a "demand following" relationship between financial and economic developments. The impact of economic growth on financial development has been documented in Robinson (1952) [100] and Romer (1990) [103], among others. **[Figure 2.6].**

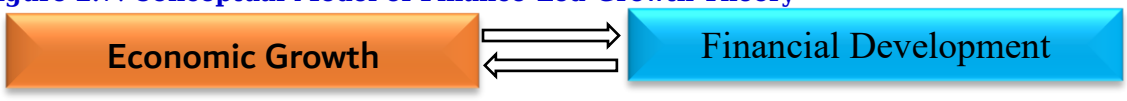
Figure 2.6: Conceptual Model of Finance-Led-Growth Theory

Authors' (2020). Conceptualization based on Literature Review.

3. Mutual Feedback Theory

The third hypothesis is the mutual impact or "feedback" hypothesis, which argues that there is a bi-directional causal relationship between finance and growth (Demetriades & Hussein, 1996; Greenwood & Smith, 1997) [35, 47]. The "feedback" hypothesis asserts that a country with a well-developed financial system could promote high economic expansion through technological changes, product, and service innovation (Schumpeter, 1911). [110] This, in turn, will create a high demand for financial arrangements and services (Levine, 1997). [72] As banking institutions, effectively respond to these demands, these changes will ultimately stimulate higher economic performance. Therefore, both financial development and economic growth are interdependent and their relationship could lead to feedback causality. **[Figure 2.7].**

Figure 2.7: Conceptual Model of Finance-Led-Growth Theory



Authors' (2020). Conceptualization based on Literature Review.

4. No-Causal Relationship Theory

The fourth hypothesis is the "no-causal relationship hypothesis", which argues that there is a no-causal relationship between financial development and economic growth (Graff, 1999; Lucas 1988). [46, 80] In particular, Lucas (1988) [80] rejects the existence of a finance-growth relationship, arguing, "economists badly overstress the role of finance in economic growth." **[Figure 2.8].**

Figure 2.8: Conceptual Model of Finance-Led-Growth Theory

Authors' (2020). Conceptualization based on Literature Review.

2.3 Empirical Literature Review

There are two main strands of studies concerning financial sector development and economic growth found in the literature that has yielded mixed findings. The first group is cross-country studies, some of which have been done across various countries in Africa exploring some aspects of the *link between finance and growth* [3], *law–finance–growth* (Huang & Yeung, 2018) [55], *financial sector development and international trade* (Sare, 2019) [109], and *nonlinearities in financial development- economic growth nexus* (Ibrahim & Alagidede, 2018) [57].

Other analogous researches have been done in Asia on the finance-growth nexus [4]. Furthermore, some of the previous cross -country studies have been done in other continents such as *Europe* [5], while others were conducted in *South America* [6] and *North America* [7].

The second group of studies on the finance-growth nexus is the country-specific studies that investigated various topics and themes directly or indirectly related to financial development and economic growth. For instance, in *Ghana*, Anokye, and Frimpong (2010) [17] examined whether financial sector development has 'caused' economic growth and investment in Ghana between 1970 and 2007. Ofori-Abebrese, Pickson, and Diabah (2017) [84] investigated the relationship and the causal direction between financial development and economic growth in *Ghana*, while Yeboah (2011) [117] analyzed the relationship between financial sector development and economic growth in *Ghana* using time-series data from 1980-2009. Others such as Anokye (2016) [16] looked at stock market development and economic growth in *Ghana* from 1991-2014, while Adu et al. (2013) [3]. examined the long-run growth effects of financial development in *Ghana*. Adusei (2013) [4] analyzed the relationship between economic growth and financial development using annual time-series data covering the period 1971-2010, while Sackey and Nkrumah (2012) [104] investigated

[3] (See, Haber, 2008; Fosu, 2013; Bist, 2018; Al-Zubi, Al-Rjoub & Abu-Mhareb, 2006).
[4] (e.g., Tarihi, & Tarihi, 2019; Estrada, Park & Ramayandi, 2010; Chee-Keong Choong & Chan, 2010; Reid, 2010; Akimov, Wijeweera & Dollery, 2006; Asghar & Hussain, 2014).
[5] (Refer to, Bongini, Iwanicz-Drozdowska, Smaga, & Witkowski, 2017; Amaral & Corbae, 2017; Fanta, 2015; Yilmazkuday, 2011; Agiropoulos, Karkalakos & Polemis, 2019; Hamdi, Hakimi & Sbia, 2017; Popov, 2017; Saqib, 2015; Marwa & Zhanje, 2017).
[6] (For example, Aizenman, Jinjarak & Park, 2015; Silva, Tabak & Laiz, 2019).
[7] (For instance, e.g., Levine, 2005; Jayaratnc & Strahan, 1996; Levine,1996; Becsi & Wang, 1997).

the causal connection between financial sector development and economic growth in *Ghana* using a quarterly time-series set of data over a ten-year period (2000 – 2009).

Other studies conducted within the Ghanaian context include that of Manu (2017) **[82]**, who examined the effect of stock market performance on economic growth in *Ghana* for the period 1990 to 2015, and Takyi and Obeng (2013) **[117]**, who studied the determinants of financial development in *Ghana* using quarterly data from 1988 to 2010.

Other previous empirical researches have been conducted by other scholars both in specific African countries and across other nations of the world regarding that the finance-growth nexus. For instance, there are studies in *Nigeria* **[8]**, *Sierra Leone* (e.g., Kargbo & Adamu, n.d) **[67]**, *South Africa* (Adusei, 2018) **[5]**, *Cameroon* (e.g., Puatwoe & Piabuo, 2017) **[98]**, *Brunei* (Alliasim, 2018) **[10]**, *Malaysia* (Ismail, Ab-Rahim, & Pei-Chin, 2019) **[58]**, *Nepal* (Bist, & Bista, 2018) **[27]**, *Russia* (Ono, 2017) **[91]**, *Germany* (Huang, 2010) **[56]**; *UK* (Trew, 2006) **[119]**; *Italy* (Vaona, 2006) **[121]**, and the *Netherlands* (Bijlsma, Kool & Non, 2018) **[26]**.

Studies also exist supporting the finance-led growth theory that generally found a unidirectional causality from financial development to economic growth **[9]**

Moreover, other empirical researches are available that seems to confirm the Growth-led finance theory by reporting a unidirectional causality from economic growth to financial sector development (e.g. Liang & Teng, 2006; Odhiambo, 2008; Adeyeye et al., 2015). **[79, 88, 2]**.

Additionally, there are a few studies in existence that confirm the mutual impact or feedback hypothesis by reporting a bi-directional causal linkage between finance and growth**[10]**

And there are also very few studies that seem to support the no-causal relationship hypothesis (e.g., Graff, 1999; Lucas, 1988). **[46,80]**.

Therefore, it is very obvious that there is no universal agreement on the connection between finance and growth as most of the empirical and theoretical works yielded inconclusive results. Furthermore, there is no single cross-country or country-specific study that analyzed the finance-growth nexus by performing macro-econometric testing of the four competing theories accounting for the finance-growth nexus (i.e., finance-led growth, Growth-led finance, mutual impact, and no-causal relationship). Hence, the conduct of this study is empirically justified as it is likely to be the first conducted in Ghana that analyzes the finance-growth relationship by testing its theoretical foundations using the four main competing theories found in the financial economics literature.

[8] (e.g. Oyebowale & Karley, 2018; Olaniran, 2018; Nkoro & Uko, 2013; Ogbonna, Uwajumogu., Chijioke & Agu, 2013).

[9](See, Jung, 1986; Ahmed & Ansari, 1998; Darrat, 1999; Xu, 2000; Fase & Abma, 2003; Christopoulos & Tsionas, 2004; Yang & Yi, 2008; Colombage, 2009; Hsueh et al., 2013).

[10] (Refer to, Demetriades & Hussein, 1996; Luintel & Khan, 1999; Al-Yousif, 2002; Calderon & Liu, 2003; Abu-Bader & Abu-Quan, 2008; Wolde-Rufael, 2009; Bangake & Eggoh, 2011; Kar et al., 2011).

3. METHODOLOGY

3.1 Research Paradigm

A research paradigm is a collection of values, opinions, concepts, and actions that, especially in an academic context, are a way for society to perceive a reality that represents them. In other words, a research or study paradigm is comprised of simple assumptions about how the world is perceived, which then serves as a foundation for reasoning that controls the researcher's conduct (Asamoah, 2015) [19]. In current scientific understanding, research paradigms involve the dimensions of ontology and epistemology (Laughlin 1995; Saunders, Lewis & Thornhill, 2009) [70, 106]. Ontology refers to the essence of knowledge while epistemology is related to the development of knowledge.

Ontology is the perspective of one's understanding of reality. Ontology may be disassembled into objectivism or subjectivism. Proponents of objectivism claim that an individual should recognize that the essence of reality is objective and independent of social agents and their perceptions of it, and proponents of it are either objectivist (Saunders et al., 2009) [106] or realist (Laughlin 1995) [70].
A subjectivist or nominalist, conversely, argues that nature relies on social forces and claims that people relate to social phenomena. Objectivism emphasizes the importance of exploring the quintessence of communication among entities within their constituents. Since this research thesis aims to analyze the micro-dynamic connection between financial development and economic growth, the objectivistic view is adopted.

The second theory, epistemology, is the qualities accompanying the values on the path to producing, knowing, and utilizing the evidence that is considered reasonable and true. This also includes the mechanism by which supposed information is gained. A positivist viewpoint assumes facts separate from the interpretations of the researcher and devoid of external factors and pressures which drive human behavior. On the other hand, an interpretative approach supports the researcher's desire to thoroughly examine individual behavior, because behaviors can be prejudiced by the interpretations behind them.

This fundamental philosophical assumption of this paper, therefore, is not only that truth can be measured but also it can be exploited to generalize and forecast to some degree the effects of such observation. In this study, objectivist and positivist paradigms are relevant, since the thesis attempts to study the nexus between financial development and economic growth.

Two more fundamental concepts influence the way truth is studied and they are axiology and methodology. The former is concerned with ethics, encompassing the positions of principles in the research and the stance of the scholar on the subject under review. The latter alludes to the design, approach, and techniques employed by the researcher in achieving the objectives of the study.

3.2 Research Design

Quantitative analysis requires mathematical methods to quantify and scrutinize the collaboration among remote variables (Yilmazkuday, 2013) [127]. This is harmonious with the aim of this study to analyze the macro-dynamic linkage between financial sector development and economic growth in Ghana. Therefore, this analysis utilizes evidence from time-series. This indicates the chosen sample was analyzed over many years. It varies from cross-sectional analysis, where for a single

year multiple variables are analyzed. We may detect some causal blueprints and parallels in the set of data using time-series data.

3.3 Data Sources and Collection

Data are characteristics or knowledge obtained through observation (Asamoah, 2015) [19]. In a more formal context, data is a collection of values of qualitative or quantitative variables for one or more entities or objects, whereas a datum (the singular of data) is a single value of a single variable (Saunders et al., 2009; Asamoah, 2015) [106, 19].

This research applied secondary information that is mixed in nature (quantitative and qualitative). Secondary data refers to data obtained on established government or institutional websites or databases by anyone other than the user and usually readily available. This varies from the primary data that the investigator typically obtains during the study period by questionnaire administrations or interviews (Asamoah, 2015; Saunders et al., 2009) [19, 106]. Quantitative data contains data that comes in number and figure forms and is usually calibrated, collected, documented, evaluated, visualized using graphs, charts, or other analytical methods. In conjunction, qualitative data refers to data that often comes in the configurations of texts, photographs, or other non-numeric formats (Asamoah, 2015) [19].

All the secondary, qualitative data applied in this research were gathered from journal articles, books, theses, and other online publications, and mostly came in text formats. Secondary, quantitative data, in particular, the various proxies of financial development and economic growth were all collected from the websites of the Finance Ministry (MoF), Ghana Statistical Services (GSS), African Development Bank (AfDB), Bank of Ghana (BoG), and the World Bank Development Indicators (WDI). The data are all annual time-series data spanning the period 1960–2019, capturing both the pre-and post-economic reform and structural adjustment program periods for Ghana.

3.4 Data Analysis Methods

The data analysis procedure is described as follows:

3.4.1 Descriptive Statistics

Descriptive Statistics mainly the Mean, Median, Maximum and Minimum values, Standard Deviation, Skewness, Kurtosis, Jarque-Bera statistic (and its probability value), the Sum of data observations, the Sum Squared Deviations, and the total number of Observations are exploited to illustrate the data set for all the variables.

3.4.2 Descriptive Charts: Trend Lines

Before conducting the unit root tests, it is necessary to observe the line graphs of all the variables to ascertain whether or not they have a constant, linear, quadratic, or polynomial trend specified by the generalized equations:

$$X_t = k + \varphi T^n$$

Where;

i. *Constant trend* occurs at $T = 0$
ii. *Linear Trend* ($T \neq 0$, n = 1)

iii. *Quadratic Trend* ($T \neq 0$, n = 2)
iv. *Cubic Trend* ($T \neq 0$, n = 3)
v. *Polynomial Trend* ($T \neq 0$, n > 3), $0 \leq \varphi \leq 1$

Therefore, the trend lines of all parameters are plotted and visually scrutinized to aid in the performance of unit root tests based on the correct assumption of the empirical distribution of the trend lines.

3.4.3 Individual Unit Root Tests

After recognizing the fundamental trend behind each variable sequence, Group Unit Root Checks are conducted on the data series by selecting any one of the three Augmented Dickey-Fuller (ADF) test models that are compatible with the trend lines found on each variable.

There are three models of the ADF test specified as follows:

$$\Delta Y_t = \beta_1 + \varphi Y_{t-1} + \alpha_i + \epsilon_t \quad \text{.....(3.1)} \qquad \text{Intercept Only}$$

$$\Delta Y_t = \beta_1 + \beta_2 t + \varphi Y_{t-1} + \alpha_i + \epsilon_t \quad \text{.....(3.2)} \qquad \text{Trend \& Intercept Only}$$

$$\Delta Y_t = \varphi Y_{t-1} + \alpha_i + \epsilon_t \quad \text{.....(3.3)} \qquad \text{No Trend, No Intercept}$$

The assessment of how or not the unit root can be based on the intercept only, trend and intercept only or no trend, no intercept assumptions is achieved through a visual analysis of the multiple trend lines of the data series.

The individual Unit Root Analysis was conducted on all the variables using the Augmented Dickey-Fuller and Philip Perron Tests.

The ADF test involves estimating Hamilton's (1994) [52] equation:

$$\Delta y_t = \alpha + \beta t + \rho y_{t-1} + \sum_{j=1}^{k} \gamma_j \Delta y_{t-j} + \varepsilon_t; \quad t = 1, \ldots, T \quad \text{.....(3.4)}$$

Where; T is the length of the sample, t is a time trend, and k is the length of the lag in the dependent variable. The selection of this parameter is rendered using the Akaike Information Criterion (AIC) modified by Ng and Perron (2001) [11].

The standard ADF test is conducted to gauge the degree of integration of the variables and to ascertain whether or not the data series are stationary.

The Phillips-Perron (PP) tests are similar to the Dickey-Fuller test and enable us to understand that the ADF test for autocorrelation between error terms using non-parametric (i.e. outside the regression framework) approaches. However, the vital values for the PP tests have the same distribution as the Augmented Dickey-Fuller statistic. The lag lengths of the ADF tests are chosen automatically based on the Schwarz Information Criterion (SIC). The spectral estimation

[11] For a comprehensive discussion see, Ng, S., & Perron, P. (2001). Lag Length Selection and the Construction of Unit Root Tests with Good Size and Power. *Econometrica*, 69, 1519–1554.

procedure for the PP tests is based on the Bartlett kernel to allow for the possible residual correlation, the bandwidth of which is automatically chosen depending on the Newey-West bandwidth.

3.4.4 Cointegration Tests

A cointegration test is employed to appraise if there is a long-term association between different time-series. Formed by Engle and Granger (1987), [41] the cointegration experiments describe situations in which two or more non-stationary time-series are coupled together in such a manner that they cannot deviate from long-term equilibrium.

Johansen System Cointegration Tests

Once the unit root tests have suggested the likely existence of cointegration, a formal cointegration test is performed.

Consider a Vector Autoregression (VAR) of order p :

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + B x_t + \epsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.5)$$

Where y_t is a $k - vector$ of non-stationary I(1) variables, x_t is a $d - vector$of deterministic variables, and ϵ_t is a vector of innovations. We may rewrite this Vector Autoregression (VAR) as:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + B x_t + \epsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.6)$$

where:

$$\Pi = \sum_{i=1}^{p} A_i - I, \qquad \Gamma_i = -\sum_{j=i+1}^{p} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.7)$$

Granger's representation theorem asserts that if the coefficient matrix $\prod = \alpha\beta'$ and $\beta' y_t$ is I(0). r is the number of cointegrating relations (the cointegrating rank) and each column of β is the cointegrating vector. The elements of α are known as the adjustment parameters in the Vector Error Correction (VEC) model. Johansen's method is to estimate the $\prod$ matrix from an unrestricted VAR to test whether we can reject the restrictions implied by the reduced rank $\prod$.

3.4.5 Empirical Model Specifications

Based on the empirical studies on finance and growth nexus [12] the model equations **3.8** and **3.9** below are specified to test the finance-led growth theory and the Growth-led finance theory, respectively:

[12] (Beck et al., 2000; Christopoulos & Tsionas, 2004; Khan & Senhadji, 2000; Levine et al., 2000)

$$Y_t = \beta_0 + \beta_i \sum_{i=1}^{m} Z_t + \beta_k \sum_{k=1}^{n} FD_t + \varepsilon_{1t} \dots\dots\dots\dots\dots (3.8)$$

$$FD_t = \beta_0 + \beta_i \sum_{i=1}^{m} Z_t + \beta_k \sum_{k=1}^{n} Y_t + \varepsilon_{2t} \dots\dots\dots\dots\dots (3.9)$$

Both the **equations (3.1** and **3.2)** are considered to be long-run or equilibrium relations.

Where

The subscript t represents the year,

$\boldsymbol{\beta_i \dots \beta_m}$ are the slope parameters for the control variables $\boldsymbol{Z_t}$

$\boldsymbol{\beta_k \dots \beta_n}$ are the slope coefficients for the Financial Development Variables $\boldsymbol{FD_t}$

3.4.6 Estimating Model Parameters

The parameters indicated in **equations 3.8 and 3.9** above are estimated using the Fully Modified Ordinary Least Squares (FMOLS). A brief theoretical description of the FMOLS is presented below.

1. ***The Fully Modified Ordinary Least Squares (FMOLS)***

Cogitate the dimensional time-series vector process, (y_t, X_t') with cointegrating equation

$$y_t = X_t'\beta + D_{1t}'\gamma_1 + u_{1t} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.10)$$

Where: $D_t = (D1_t', D2_t')$ are deterministic trend regressors and the stochastic regressors are governed by the system of equations:

$$\begin{aligned} X_t &= \Gamma_{21}' D_{1t} + \Gamma_{22}' D_{2t} + \epsilon_{2t} \\ \Delta\epsilon_{2t} &= u_{2t} \end{aligned} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.11)$$

Phillips and Hansen (1990) [95] propose a semi-parametric solution that uses the problem of cointegrating equations and stochastic regressors to remove the problem induced by the longer-term interaction. The resulting Fully Modified Ordinary Least Squares (OLS) (FMOLS) is asymptotically impartial and has fully successful combinations of regular asymptotics, which make standard residual tests with asymptotic statistical inference from Chi-square. In the FMOLS estimator, the symmetric and single-siding residual covariance matrices are approximate estimates.

Let $\hat{u}_{1t}$ be the residuals derived after conjecturing **Equation (3.10)**. The $\hat{u}_{2t}$ may be obtained indirectly as $\hat{u}_{2t} = \Delta\hat{\epsilon}_{2t}$ from the levels regressions.

$$X_t = \hat{\Gamma}_{21} D_{1t} + \hat{\Gamma}_{22} D_{2t} + \Delta\hat{\epsilon}_{2t} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.12)$$

or directly from the difference regressions

$$\Delta X_t = \hat{\Gamma}_{2\acute{1}}\Delta D_{1t} + \hat{\Gamma}_{2\acute{2}}\Delta D_{2t} + \hat{u}_{2t} \dots\dots\dots\dots\dots\dots\dots\dots (3.13)$$

Let $\hat{\Omega}$ and $\hat{\Lambda}$ be the long-haul covariance matrices processed using the residuals $\hat{u}_t = (\widehat{u_{1t}}, \widehat{u_{2t}})'$.

Then we may delineate the modified data $y_t^+ = y_t - \hat{\omega}_{12}\hat{\Omega}_{22}^{-1}\hat{u}_2 \dots\dots\dots\dots (3.14)$

and an estimated bias correction term

$$\hat{\lambda}_{12}^+ = \hat{\lambda}_{12} - \hat{\omega}_{12}\hat{\Omega}_{22}^{-1}\hat{u}_2 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.15)$$

The FMOLS estimator is given by

$$\hat{\theta} = \begin{bmatrix}\beta \\ \widehat{\gamma_1}\end{bmatrix} = \left(\sum_{t=2}^{T} Z_t\, Z_{\acute{t}}\right)^{-1}\left(\sum_{t=2}^{T} Z_t\, y_t^+ - T\begin{bmatrix}\hat{\lambda}_{1\acute{2}}^+ \\ 0\end{bmatrix}\right) \dots\dots\dots (3.16)$$

Where; $Z_t = (X_t', D_t')'$. The methodology to the computation of the FMOLS is the development of long-haul covariance matrix estimators $\hat{\Omega}$ and $\hat{\Lambda}$. Before discussing the possible options for measuring $\hat{\Omega}$ and $\hat{\Lambda}$, the scalar estimator would be helpful to describe as

$$\hat{\omega}_{1.2} = \hat{\omega}_{11} - \hat{\omega}_{12}\hat{\omega}_{22}^{-1}\hat{\omega}_{21} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.17)$$

Which can be deciphered as the expected long-haul variance of u_{1t}conditional on u_{2t}. If required, a degree-of-freedom correction can be added to $\hat{\omega}_{1.2}$. Hansen (1992a) [51] demonstrates the Wald statistic for the null hypothesis $R\theta = r$.

$$W = \left(R\hat{\theta} - r\right)'\left(RV(\hat{\theta})\acute{R}\right)^{-1}\left(R\hat{\theta} - r\right) \dots\dots\dots\dots\dots\dots\dots (3.18)$$

With

$$V\hat{\theta} = \hat{\omega}_{1.2}\left(\sum_{t=2}^{T} Z_t\, Z_t'\right)^{-1} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.19)$$

has an asymptotic χ_g^2 -distribution, where g is the number of restrictions imposed by R.

2. The Justification for Using the FMOLS

To examine the long-lasting rapport between financial and economic time-series parameters that unveil cointegration (Adusei, 2013) [4], the Fully Modified Ordinary Least Squares (FMOLS) estimator is engaged. Borrowed from Phillips and Hansen (1990) [95], FMOLS exploits kernel estimators of the nuisance variables that manipulate the OLS estimator's asymptotic distribution. When viewed through the lenses of Phillip and Hansen (1990) [95], the FMOLS achieves asymptotic efficiency by tweaking least squares to account for serial correlation effects and endogeneity tests in regressors arising from the presence of cointegrating relationships. The proficiency of the FMOLS estimator lies in its capacity to employ several kernel functions, examples of which are depicted below (Andrews, 1991) [15]:

$$\text{Truncated:} \quad k_{TR}(x) = \begin{cases} 1 & \text{for } |x| \leqslant 1, \\ 0 & \text{otherwise,} \end{cases}$$

$$\text{Bartlett:} \quad k_{BT}(x) = \begin{cases} 1 - |x| & \text{for } |x| \leqslant 1, \\ 0 & \text{otherwise,} \end{cases}$$

$$\text{Parzen:} \quad k_{PR}(x) = \begin{cases} 1 - 6x^2 + 6|x|^3 & \text{for } 0 \leqslant |x| \leqslant 1/2, \\ 2(1 - |x|)^3 & \text{for } 1/2 \leqslant |x| \leqslant 1, \\ 0 & \text{otherwise} \end{cases}$$

$$\text{Tukey-Hanning:} \quad k_{TH}(x) = \begin{cases} (1 + \cos(\pi x))/2 & \text{for } |x| \leqslant 1, \\ 0 & \text{otherwise,} \end{cases}$$

$$\text{Quadratic Spectral:} \quad k_{QS}(x) = \frac{25}{12\pi^2 x^2}\left(\frac{\sin(6\pi x/5)}{6\pi x/5} - \cos(6\pi x/5)\right).$$

The estimates of the FMOLS parameters as well as their corresponding p-values and t-statistics permit the researcher to analyse the short-run link between financial sector development and economic growth in Ghana. The R-squared statistical data were used to assess the general suitability for the data distribution of the FMOLS model.

3.4.7 Robustness Checks of the FMOLS Estimates

The robustness of the findings, in terms of the consistency of the statistical significance and effects of the parameter estimates, are checked using Canonical Cointegration Regression (CCR) model. It is universally acknowledged that the ordinary least square (static OLS) approximation of the cointegrating vector (3.10) is unswerving and congregates at a speed faster than that of the norms when cointegrated (Hamilton, 1994) [52]. A big shortcoming concerning static OLS (SOLS) is that estimates have an asymptotic distribution, which generally consists of non-Gaussian asymmetry, asymptotic bias, and which is indicative of non-scalar nuisances. Since orthodox methods of research are not right unless major amendments are made, SOLS is generally not endorsed if an inference is made on the cointegrating vector.

The panicking asymptotic distribution of SOLS is constructed on a long-term collaboration between regressors and equation errors, and the cross-relation between equations and regressors. The novel uncomplicated strategy for an asymptotically efficient estimator that jettisons feedback in the cointegrating process was introduced by Saikkonen (1992) [105] and Stock and Watson (1993) [115].

The above problems encountered when using the SOLS model can be handled effectively with the Canonical Cointegrating Regression (CCR) model.

Developed by Park (1992) [93], the Canonical Cointegrating Regression (CCR) is closely related to FMOLS, but it, instead, employs stationary transformations of the (y_{1t}, X_t') data to obtain least squares
estimates to remove the long-run dependence between the cointegrating equation and stochastic regressors innovations. Like FMOLS, CCR estimates follow a mixture of a normal distribution that is free of non-scalar nuisance parameters and permits asymptotic Chi-square testing. As in FMOLS, the first step in CCR is to obtain estimates of the innovations $\alpha_t = (\alpha_{1t}, \alpha_{2t}')'$ and corresponding consistent estimates of the long-run covariance matrices $\hat{\Omega}$ and $\hat{\Lambda}$. Unlike FMOLS, CCR also requires a consistent estimator of the contemporaneous covariance matrix $\hat{\Sigma}$. Following

Park, we extract the columns of $\hat{\Lambda}$ corresponding to the one-sided long-run covariance matrix of $\widehat{u_t}$ and (the levels and lags of) $\widehat{u_{2t}}$.

$$\hat{\Lambda}_2 = \begin{bmatrix} \hat{\Lambda}_{12} \\ \hat{\Lambda}_{22} \end{bmatrix} \quad \text{.....(3.20)}$$

And transform (y_{1t}, X_t') using

$$X_t^* = X_t - (\hat{\Sigma}^{-1}\hat{\Lambda}_2)' \hat{u}_t$$

$$y_t^* = y_t - \left(\hat{\Sigma}^{-1}\hat{\Lambda}_2 \hat{\beta} + \begin{bmatrix} 0 \\ \hat{\Omega}_{22}^{-1}\hat{\omega}_{21} \end{bmatrix} \right)' \hat{u}_t \quad \text{.....(3.21)}$$

Where the $\hat{\beta}$ are estimates of the cointegrating equation coefficients, typically the SOLS estimates used to obtain the residuals $\widehat{u_{1t}}$.

The CCR estimator is defined as ordinary least squares applied to the transformed data

$$\begin{bmatrix} \beta \\ \hat{\gamma}_1 \end{bmatrix} = \left(\sum_{t=1}^{T} Z_t^* Z_t^{*\prime} \right)^{-1} \sum_{t=1}^{T} Z_t^* y_t^* \quad \text{.....(3.22)}$$

where $Z_t^* = (Z_t^{*\prime}, D_{1t}')'$.

Park shows that the CCR transformations asymptotically eliminate the endogeneity caused by the long-run correlation of the cointegrating equation errors and the stochastic regressors innovations, and simultaneously correct for asymptotic bias resulting from the contemporaneous correlation between the regression and stochastic regressor errors. Estimates based on the CCR are therefore fully efficient and have the same unbiased, mixture normal asymptotics as FMOLS.

3.4.8 The Vector Error Correction Model (VECM)

Engle and Granger (1987) [41] argued that if two variables are cointegrated, then, the first variable may Granger cause the second variable, the second variable may Granger cause the first variable or each variable may Granger- cause another variable. This study, therefore, tests Granger-causality between financial development and economic growth using the Vector Error Correction Model (VECM) approach. This model has an advantage over the simple Granger-causality test in that the VECM approach enables us to find both long-run and short-run causalities. The VECM is represented as:

$$\Delta Y_t = a + \sum_{j=1}^{p} \psi_{1i} \Delta Y_{t-1} + \sum_{j=0}^{q} \psi_{2j} \Delta Y_{t-j} + \sum_{k=0}^{r} \psi_{3k} \Delta Z_{t-i} + \sum_{u=0}^{m} \psi_{4u} \Delta FD_{t-u} + \psi_m ECT_{t-1} + \varepsilon_{5t} \quad \text{.....(3.23)}$$

$$FD_t = \theta + \sum_{u=0}^{m} \beta_{1i}\,\Delta FD_{t-1} + \sum_{j=0}^{q} \beta_{2j}\,\Delta Y_{t-j} + \sum_{k=0}^{r} \beta_{3k}\Delta Z_t + \beta_m\,ECT_{t-1} + \varepsilon_{6t} \ldots\ldots\ldots\ldots (3.24)$$

Where;

a, θ =constant/autonomous terms; Δ denotes difference operator and ε_t is the stochastic error term, and ECT_{t-1} is the lagged value of the error correction term (ECT).

Y_t is real output (proxied by real GDP per capita);

$Z_t = [L_t, K_t, GE_t, OpenFDI_t, INF_t]$, representing a vector of macroeconomic control variables of economic growth such that;

L_t – labor force/employment level;

K_t – Capital stock (proxied by real gross fixed capital formation to GDP ratio);

GE_t –real gross government expenditure (proxied by general government final consumption expenditure to GDP ratio);

$OpenFDI_t$ –Country's openness to investments (proxied by the ratio of Foreign Direct Investment (FDI) inflows to GDP);

INF_t – measured using Consumer Price Index (CPI)

$[FD_t = FINLIB_t, StockMakDev_t, BankSecDev_t]$

FD_t denotes a vector of proxies for financial development comprising[13];

- **i.** $FINLIB_t$ – Financial liberalization policy implementation which assumes the value 1 for the period 1988–2019 (the period for the launch and implementation of Financial Structural Adjustment Program (FINSAP); and 0 before 1988 (1961–1987);
- **ii.** $StockMakDev_t$ = Stock market Development, measured as stocks traded as a percentage of GDP; and
- **iii.** $BankSecDev_t = [FSActivity_t\ FSSize_t\ FSDepth_t\ FSEfficiency_t]$

Where; $BankSecDev_t$ =Banking Sector Development *measured* using the following;

- ❖ $FSActivity_t$ –*The activity of the financial sector* proxied using Domestic credit to the private sector to GDP ratio.
- ❖ $FSEfficiency_t$ –*The efficiency of the financial sector* measured using the interest rate margin *(INT),* which measures the difference between deposit and lending rates in the banking market is used to measure the efficiency of the sector.
- ❖ $FinInnov_t$-Innovation of the financial sector is measured using the total number of Automated Teller Machines (ATMs) across the country.
- ❖ $FinInclus_t$-Financial sector inclusion is measured using the total number of mobile money customers.

[13] Financial Development (FD) is measured as the vector/algebraic sum of the values for its individual proxies namely, Financial liberalization, Stock market Development and Banking sector development variables.

The short-run causality from financial development to economic growth is tested by **H0: $\psi_{4u} = 0$** as shown in **equation 3.23**. Similarly, the short-run causality from economic growth to financial development is tested by **H0: $\beta_{2j} = 0$** as shown in **equation 3.24**.

The error correction term **(ECT)** indicates both long-run causality and the speed of adjustment. A very important point to note is whether $\psi_{4u} \neq 0$ and $\beta_{2j} \neq 0$. If this is not the case, the cointegration findings would not be reliable.

3.4.9 Additional VECM Diagnostic Tests

Additional graphical analyses are performed on the VECM Residuals, Error Correction Term and Impulse Response Functions to ensure the robustness of the findings.

3.4.10 The Simple Granger-Causality Test

The simple pairwise Granger-causality test is used to ascertain the direction of causality between economic growth and financial sector development. For two variables y and x, the Granger-causality test requires the following regression is estimated (Granger, 1987):

$$y_t = \alpha_0 + \sum_{i=1}^{m} \alpha_0 x_{t-i} + \sum_{i=1}^{m} \beta_0 y_{t-i} + u_{1t} \quad \text{.....(3.25)}$$

$$x_t = \beta_0 + \sum_{i=1}^{m} \lambda_i y_{t-1} + \sum_{i=1}^{m} \delta_i x_{t-1} + u_{2t} \quad \text{... ... ... (3.26)}$$

y_t represents the data series for the dependent variable at time t (Economic Growth)

x_t represents the values of the independent (Financial development) and/or control variables at a time, t. In general, if *x significantly* impacts *y*, then *x* Granger causes *y*, and the changes in *x always precede* changes in *y*. The inclusion of the past or lagged values of *x (i.e.* x_{t-1} *and* x_{t-i}*) and y (i.e.,* y_{t-1} *and* y_{t-i}*)* significantly enhances the explanatory power of the regression model.

The decision regarding whether or not there exists Granger-causality between financial sector development and economic growth is ascertained using the F test. The calculated F value is attained by the following recipe:

$$F = (n-k)\frac{RSS_R - RSS_{UR}}{m(RSS_{UR})} \quad \text{... ... ...(3.27)}$$

Where:

RSS_R dan RSS_{UR} = consecutive values are the Residual Sum of Squares in the restricted and unrestricted equation.

n = number of observations; m= number of lags; k= the number of variables estimated in the unrestricted equation

If the F- and the p-values are smaller than the crucial values of 0.05 or 0.10, it insinuates a unidirectional or bi-directional causality between finance and growth. The lag selection is done using Schwarz Information Criteria.

3.4.11 Estimation Software

The collected data shall be analyzed using Econometrics Views (EVIEWS 10.0) and GRETL statistical software packages.

4. RESULTS, FINDINGS AND DISCUSSIONS

4.1 Results

4.1.1 Descriptive Statistics

From **Table 4.1(a)** below, the mean value of Y in Ghana between 1960 and 2019 was 73.52320. The maximum value was 154.5470. The minimum value was 58.56428. The value of the standard deviation was 26.000607. The value of skewness was 2.000607 and the value of kurtosis was 5.592564. This establishes a data distribution that is skewed to the right, positive, and leptokurtic with a higher peak than the normal distribution. The average value of L in the years 1960 to 2019 in Ghana was 54.08024 with a maximum value of 58.28154 and a minimum value of 51.32793. The standard deviation value was also 2.198326. The value of skewness was 0.474026 and the value of kurtosis was 1.933965. This reveals a data distribution that is skewed moderately to the right and platykurtic with thinner tails. Also, the average value of K recorded in Ghana from 1960 to 2019 was 17.26499 with maximum and minimum values of 29.81433 and 3.749769 respectively. The standard deviation recorded was 6.414287. The values of skewness and kurtosis was 0.151452 and 2.202150 respectively. The data distribution is moderately skewed and platykurtic. The mean value of INF in Ghana between 1960 and 2019 was 28.62485. The maximum value was 122.8745. The minimum value was -8.422486. The standard deviation value recorded was 26.42402. The value of skewness was 2.038614 and that of kurtosis was 7.413522. This exhibits a data distribution positively skewed and leptokurtic. Besides, the mean value of GE from 1960 to 2019 was 20.44803 with a maximum value of 30.53292 and a minimum value of 12.85021. The standard deviation was 3.936454. The values of skewness and kurtosis was 0.841431 and that of 4.817159. This shows a data distribution that is slightly skewed to the right and leptokurtic compared to the normal distribution. The average value of OPENFDI in Ghana captured between 1960 and 2019 was 3.094657. The maximum and minimum values recorded was 15.06216 and -0.814647 respectively. The standard deviation was 3.058320. The value of skewness was 1.409416 and the value of kurtosis was 5.413619. The data distribution is seen to be positively skewed and platykurtic. The mean value of FD in Ghana from 1960 to 2019 was 706044.8 with maximum and minimum values of 8461962 and 64.28739 respectively. The standard deviation value was 2193798. The value of skewness was 3.053843. The value of kurtosis was 10.70962. This reveals a data distribution that is skewed to the right and leptokurtic with broad tails.

Table 4.1(a): Descriptive Statistics

This table displays the descriptive statistics for economic growth (Y), Labor(L), Capital(K), inflation(INF), Government consumption Expenditure(GE), the openness of the economy to foreign direct investments (OPENFDI), and an aggregate indicator of financial sector development (FD). The statistics were computed using a sample of 60 observations covering the period 1960 to 2019.

	Y	L	K	INF	GE	OPENFDI	FD
Mean	73.52320	54.08024	17.26499	28.62485	20.44803	3.094657	706044.8
Median	61.67560	53.34877	16.46188	18.69271	20.55905	2.228348	101.0911
Maximum	154.5470	58.28154	29.81433	122.8745	30.53292	15.06216	8461962.
Minimum	58.56428	51.32793	3.749769	-8.422486	12.85021	-0.814647	64.28739
Std. Dev.	26.37204	2.198326	6.414287	26.42402	3.936454	3.058320	2193798.
Skewness	2.000607	0.474026	0.151452	2.038614	0.841431	1.409416	3.053843
Kurtosis	5.592564	1.933965	2.202150	7.413522	4.817159	5.413619	10.70962
Jarque-Bera	56.82776	5.088076	1.820790	90.25743	15.33522	34.42844	241.8551

Probability	0.000000	0.078549	0.402365	0.000000	0.000468	0.000000	0.000000
Sum	4411.392	3244.814	1035.900	1717.491	1226.882	185.6794	42362690
Sum Sq. Dev.	41033.59	285.1257	2427.441	41195.51	914.2443	551.8459	2.84E+14
Observations	60	60	60	60	60	60	60

Source: Authors (2020).

From **Table 4.1(b)** below, the average value of FINLIB in Ghana ranging from 1960 to 2019 was 0.5333333. The maximum value was 1.000000 and the minimum value was 0.000000. The value of the standard deviation was 0.503098. The value of skewness was -0.133631 and the value of kurtosis was 1.017857. This shows that the data distribution is slightly skewed to the left, negative, and platykurtic. Also, the average value of STOCKMAKDEV in Ghana from 1960 to 2019 was 22.56176 with a maximum value of 34.10823 and a minimum value of 11.30499. The standard deviation value was 5.514739. The value of skewness and kurtosis was 0.023069 and 2.381354 respectively. This indicates that the data distribution is fairly symmetrical and is platykurtic. The mean value of FSACTIVITY in Ghana recorded between 1960 and 2019 was 8.508930. The maximum and minimum values was 15.88200 and 1.542268 respectively. The standard deviation was 4.574454. The values of skewness and kurtosis was 0.209145 and 1.672794 respectively. This shows that the data distribution is skewed to the right and platykurtic. The average value of FSEFFICIENCY in Ghana between 1960 and 2019 was 26.44111 with maximum and minimum values of 44.07407 and 12.50000 respectively. The value of the standard deviation recorded was 7.528352. The value of skewness was 0.068093 and that of kurtosis was 2.462079. This reveals a data distribution that is fairly symmetrical and platykurtic. The average value of FININNOV in Ghana from 1960 to 2019 was 1.547690. The maximum and minimum values was 11.65357 and 0.000000 respectively. The standard deviation was 3.445621. The value of skewness was 2.080329. The value of kurtosis was 5.861517. This shows that the data distribution is skewed to the right and leptokurtic. Also, the mean value of FININCLUS in Ghana for the period 1960 to 2019 was 705942.6. The maximum and minimum values recorded was 8461836 and 0.000000 respectively. The value of the standard deviation was 2193789. The value of skewness was 3.053846 and that of kurtosis was 10.70964 which indicates a data distribution skewed positively to the right and leptokurtic.

Table 4.1(b): Descriptive Statistics

The table depicts the descriptive statistics computed for financial liberalization (FINLIB), stock market development (STOCKMAKDEV), Financial Sector activity (FSACTIVITY), the efficiency of the financial sector(FSEFFICIENCY), innovations in the financial sector(ININNOV), and financial inclusion (FININCLUS). The statistics were computed using a sample of 60 observations covering the period 1960 to 2019.

	FINLIB	STOCKMAKDEV	FSACTIVITY	FSEFFICIENCY	FININNOV	FININCLUS
Mean	0.533333	22.56176	8.508930	26.44111	1.547690	705942.6
Median	1.000000	22.30640	7.888456	25.81395	0.000000	0.000000
Maximum	1.000000	34.10823	15.88200	44.07407	11.65357	8461836.
Minimum	0.000000	11.30499	1.542268	12.50000	0.000000	0.000000
Std. Dev.	0.503098	5.514739	4.574454	7.528352	3.445621	2193789.
Skewness	-0.133631	0.023069	0.209145	0.068093	2.080329	3.053846
Kurtosis	1.017857	2.381354	1.672794	2.462079	5.861517	10.70964
Jarque-Bera	10.00080	0.962130	4.841107	0.769763	63.74836	241.8559
Probability	0.006735	0.618125	0.088872	0.680531	0.000000	0.000000

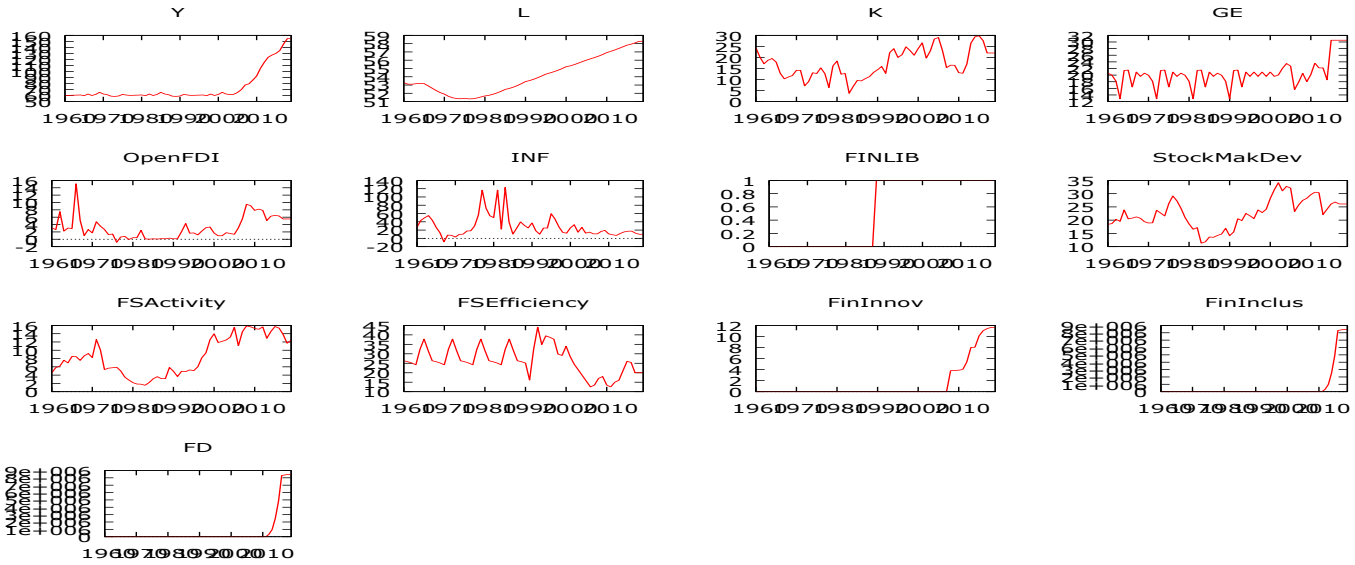
Sum	32.00000	1353.706	510.5358	1586.467	92.86142	42356557
Sum Sq. Dev.	14.93333	1794.328	1234.612	3343.889	700.4660	2.84E+14
Observations	60	60	60	60	60	60

Source: Authors (2020).

4.1.2 Trend lines

Most of the trend lines, namely, economic growth (Y), labor (L), capital (K), Government Consumption Expenditure (GE), the openness of the economy to foreign direct investment (OPENFDI), inflation (INF), the development of the stock market (STOCKMAKDEV), activities in the financial sector (FSACTIVITY), and the efficiency of the financial sector (FSEFFICIENCY) represent random walks with a drift component and linear trend. However, the series for financial liberalization (FINLIB) is a nearly constant series, while that of financial innovation (FININNOV), financial inclusion (FININCLUS), and the aggregate indicator for financial development (FD) represent random walks with likely negative intercepts and linear trends. For these reasons, the unit root tests were performed using the constant intercept and trend assumption.

Figure 4.1: Line Graphs of all Variables



Source: Authors (2020).

The results from the parametric ADF and non-parametric Phillips-Perron (PP) tests reveal that economic growth (Y), the development of the stock market (STOCKMAKDEV), activities in the financial sector (FSACTIVITY), the efficiency of the financial sector (FSEFFICIENCY), financial liberalization (FINLIB), financial innovation (FININNOV), and the aggregate indicator for financial

development (FD) were all non-stationary at level. This implies they are not integrated of zero-order (i.e., they are not I (0)).

It could not be ascertained whether or not labor (L), inflation (INF), financial inclusion (FININCLUS) were stationary at level using the ADF and PP tests conjointly. However, capital (K), Government Consumption Expenditure (GE), and openness of the economy to foreign direct investment (OPENFDI) were conclusively ascertained to be stationary at level using the ADF and PP test results, meaning that the variables were integrated of zero-order (i.e., they are not I (0)). [**Table 4.2(a), Appendix A**].

2. First Differenced Unit Root Tests

The ADF and Phillips-Perron (PP) tests demonstrate that most of the variables, namely, economic growth (Y), the development of the stock market (STOCKMAKDEV), activities in the financial sector (FSACTIVITY), financial liberalization (FINLIB), financial innovation (FININNOV), the aggregate indicator for financial development (FD), inflation (INF), financial inclusion (FININCLUS), capital (K), Government Consumption Expenditure (GE), and openness of the economy to foreign direct investment (OPENFDI) were conclusively stationary at first differences, meaning that the variables were integrated of first-order (i.e., they are I (1)).

Labor (L) and the efficiency of the financial sector (FSEFFICIENCY) were, however, non-stationary at first difference but only became stationary after second differencing, implying that they are integrated of second-order (i.e., they are I (2)).

The ADF and PP results yield two implications. The first is that the variables might possess some vector of long-run cointegration relationships which needs to be verified in the subsequent section using the Johansen Cointegration Test. The second implication is that the traditional Autoregressive Distributed Lag (ARDL) model that has been used to ascertain the long-run and short-term dynamic relationship between financial and economic times series would no longer be valid since the unit root tests yielded variables that were I (0), I (1) and I (2). The ARDL method is applicable irrespective of the order of integration of the underlying variables (*I* (0) and/or *I* (1)) provided the absence of *I* (2) is guaranteed which could invalidate the procedure (Pesaran et al., 2001). [**Table 4.2(b), Appendix A**].

4.1.4 Lag Selection Criteria

As already indicated above, the ADF and PP unit root tests pointed to the existence of cointegrating relationships between the variables and there is the need to formally test it using the Johansen Cointegration Test. However, to perform the test requires first selecting an optimal lag order based on some specific information criterion. A lag order of 1 is selected for the Johansen Cointegration Test and VECM analysis based on the Schwarz information criterion (SIC). [**Table 4.3, Appendix A**].

4.1.5 Johansen's Cointegration Test

The Trace test indicates that there are at least nine (9) cointegrating equations at the 0.05 level between the time-series variables, namely, economic growth (Y), Labor (L), Capital (K), Government consumption/expenditure(GE), inflation rate (INF), the openness of the economy (OPENFDI) to foreign direct investment, financial sector efficiency (FSEFFICIENCY), financial sector activity (FSACTIVITY), financial sector liberalization (FINLIB), financial sector innovation (FININNOV), financial services inclusion (FININCLUS), and stock market development (STOCKMAKDEV). The Max-eigenvalue test, on the other hand, indicates the existence of at least

seven (7) cointegrating equations at the 0.05 level among the endogenous and exogenous variables. In conclusion, it can be said that there are at least 7 to 9 cointegrating vectors between the variables in the series. This points to the presence of cointegration relationships between the variables and provides the necessary underpinning for running the VECM algorithm. [**Table 4.4(a) & 4.4(b), Appendix A**].

But before running the VECM technique, it is important to estimate the parameters of the short-run model using the Fully Modified Ordinary Least Squares (FMOLS) model.

4.1.6 FMOLS Regression Analysis (Equation 1)

1. Short-Run Effects of Economic Growth on Financial Sector Development

The results from the FMOLS regression reveals that financial sector development (FD), in aggregate terms, significantly drives economic growth (Y) in a positive direction (B=0.770756; p=0.0000). In particular, the liberalization of the financial sector (FINLIB) exerts a significant positive short-run effect on economic growth (B=2.170233; p=0.0000). But stock market development (STOCKMAKDEV) significantly undermines economic growth in the short-term (B = -0.075514; p=0.0031). However, the effect of the activity of the financial sector (FSACTIVITY) on economic growth is positive, albeit, statistically non-significant in the short-run ($p \geq 0.05$). The efficiency (FINEFFICIENCY) of the financial sector exerts a statistically significant negative influence on economic growth in the short-run (B= -0.042857; p=0.0020). But this finding should be interpreted with caution: A negative short-run effect of the financial efficiency variable on economic growth points to inefficacy on the part of banking and financial institutions in properly allocating credit to drive economic growth in the short-haul. An interesting finding, however, is that innovation in the financial sector's services (FININNOV) propels economic growth in the short-run (B=0.246749; p=0.0016). However, financial inclusion exerts a negative statistically insignificant short-term impact on economic growth ($p \geq 0.05$).

The control variables exerted differential short-term impacts on economic growth. The short-run effects of labor (L) and capital (K) on economic growth were both negatively significant ($p \leq 0.05$) but government consumption expenditure (GE), the openness of the economy to foreign direct investment (OPENFDI), and inflation (INF) enhance economic growth in the short-haul ($p \leq 0.05$).

Table 4.5: FMOLS Regression Results: Equation 1

The Fully Modified Least Squares (FMOLS) algorithm was used to analyze the short-run effect of financial sector development on economic growth. The data included an adjusted sample of 57 observations spanning the period 1963 to 2019. The cointegrating equation deterministics were based on the constant and trend assumption and the Regressor equations were estimated using differences. Additional regressor deterministics were specified based on a quadratic trend. The Long-run covariance estimate (Prewhitening with lags = 1, and the Quadratic -Spectral kernel, with Newey-West fixed bandwidth = 3.0000) was employed.

Dependent Variable: ΔY

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ΔLnFD	0.770756	0.073062	10.54939	0.0000*
ΔL	-0.617755	0.177417	-3.481938	0.0012*
ΔK	-0.088554	0.020264	-4.370103	0.0001*
ΔGE	0.093102	0.030613	3.041285	0.0041*
ΔOPENFDI	0.125701	0.040581	3.097532	0.0035*
ΔINF	0.019129	0.003409	5.610710	0.0000*
ΔFINLIB	2.170233	0.429269	5.055646	0.0000*
ΔSTOCKMAKDEV	-0.075514	0.023994	-3.147144	0.0031*

ΔFSACTIVITY	0.034974	0.044998	0.777241	0.4415
ΔFSEFFICIENCY	-0.042857	0.013016	-3.292696	0.0020*
ΔFININNOV	0.246749	0.072946	3.382616	0.0016*
ΔFININCLUS	-3.67E-08	9.65E-08	-0.380324	0.7057
C	25.67818	8.709662	2.948241	0.0053
@TREND	-0.074645	0.018797	-3.971123	0.0003

R-squared	0.823987	Mean dependent var	1.719298
Adjusted R-squared	0.759592	S.D. dependent var	3.706916
S.E. of regression	1.817554	Sum squared resid	135.4436
Long-run variance	0.254976		

Source: Authors (2020).

4.1.7 Robustness Check of FMOLS Equation 1 Using Canonical Cointegrating Regression

The canonical cointegrating regression (CCR) still reveals a significant positive short-run effect of financial development on economic growth although its coefficient is slightly lower than that obtained under the FMOLS regression. All the financial sector development indicators maintain their respective signs in the beta coefficients and significance levels under the CCR regression (except FINEFFICIENCY & STOCKMAKDEV) just as the case was under the FMOLS regression. In effect, the liberalization of the financial sector (FINLIB) exerts a significant positive short-run effect on economic growth, while stock market development (STOCKMAKDEV) significantly undermines economic growth in the short-term. Additionally, the effect of the activity of the financial sector (FSACTIVITY) on economic growth is positive, albeit, statistically non-significant in the short-run, while efficiency (FINEFFICIENCY) of the financial sector exerts a statistically insignificant negative influence on economic growth in the short-run. Innovation in the financial sector's services (FININNOV) positively drives economic growth in the short-run, while financial inclusion (FININCLUS) negatively influences economic growth in the short-term although to a statistically insignificant extent.

All the control variables maintain their respective signs under the CCR model comparative to the FMOLS model, except that OPENFDI and L are no longer significant under the CCR model as they were under the FMOLS model. [**Table 4.6, Appendix A**].

4.1.8 Vector Error Correction Model (VECM) Analysis (Equation 1)

1. Long-run and Short-run Causal Effects of Financial Development on Economic Growth

The VECM analysis reveals that financial development (FD), in aggregate terms, exerts a positive but statistically insignificant short-run effect on economic growth ($B=0.215572$; $p=0.6094 \geq 0.05$) but this result might be attributable to loss of degrees of freedom in data observations due to differencing, otherwise, it could have been significant as the FMOLS and CCR models above have already pointed out.

But there are differential long-run causal effects of the financial development variables on economic growth. First, Financial liberalization (FINLIB) exerts a negative insignificant effect on economic growth ($B=-1.75404$; $p=0.2582 \geq 0.05$). Second, the long-run effects of stock market development (STOCKMAKDEV), Financial Sector Activity (FSACTIVITY), and Financial Sector Efficiency (FSEFFICIENCY) are negative and statistically insignificant on economic growth ($p \geq$

0.05). However, innovations in the financial sector (FININNOV) exert positive, statistically significant long-run effects on economic growth ($p \leq 0.05$).

As regards the control variables, labor (L), government consumption expenditure (GE), the openness of the economy to foreign direct investment (OPENFDI), and inflation rates, all exert negative but non-significant long-run influences on economic growth ($p \geq 0.05$). However, the effect of capital (K) is positive, though statistically insignificant, in the long-run, on economic growth ($p \geq 0.05$).

The coefficient of the error correction term (ECt –1) represents the speed of adjustment to the long-run solution that enters the VECM system to affect short-run movements in economic growth (GDP). It should be negative and less than unity in absolute terms since one cannot expect a 100% or instantaneous adjustment. The estimated value of the equilibrium correction coefficient (ECt –1), -0.0577008, has an accurate sign and is statistically significant at a 10% significance level. This suggests that there is an adjustment to the equilibrium level after a shock. Approximately, 5.80% of the disequilibrium from the previous year's shock converges back to the long-run equilibrium in the current year. The R-square statistic reveals a moderate model fit as only about 65.5134% of short-run and long-term variations in economic growth in Ghana could be explained by changes in Financial Sector Development and the control variables. (R-square=0.655134).

Table 4.7: VECM Equation 1

The VECM system equation was computed with a lag order 2 based on the SC: Schwarz information criterion. The Maximum likelihood estimator was applied to T = 56 observations covering the period 1964-2019. The VECM cointegrating rank= 1, and the model was computed with Unrestricted constant specification.

Dependent Variable: ΔY

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	−2.89140	45.3511	−0.06376	0.9495	
ΔYt-1	−0.176105	0.192540	−0.9146	0.3659	
ΔLnFDt-1	0.215572	0.418578	0.5150	0.6094	
Lt-1	−0.000551958	0.922725	−0.0005982	0.9995	
Kt-1	0.0619960	0.0938972	0.6603	0.5129	
GEt-1	−0.216912	0.156940	−1.382	0.1746	
OpenFDIt-1	−0.156823	0.182249	−0.8605	0.3946	
INFt-1	−0.00252749	0.0173648	−0.1456	0.8850	
FINLIBt-1	−1.75404	1.52940	−1.147	0.2582	
StockMakDevt-1	−0.0287328	0.132206	−0.2173	0.8291	
FSActivityt-1	−0.0128389	0.221121	−0.05806	0.9540	
FsSizet-1	0.556372	0.260823	2.133	0.0391	**
FSEfficiencyt-1	−0.0179167	0.0622997	−0.2876	0.7751	
FinInnovt-1	1.46476	0.651776	2.247	0.0302	**
FinInclust-1	−2.09477e-06	1.05746e-06	−1.981	0.0545	*
ECt-1	-0.0577008	0.0314492	1.835	0.0740	*

Mean dependent var	1.675894	S.D. dependent var	3.696924
Sum squared resid	259.2351	S.E. of regression	2.545757
R-squared	0.655134	Adjusted R-squared	0.525810

rho	−0.113884	Durbin-Watson	2.208873

Log-likelihood = -148.01074 Determinant of covariance matrix = 0.67728954
AIC = 6.5004 BIC = 7.7301 HQC = 6.9771

*This table presents the results of the VECM. Equation 1 * Figures in parentheses are probability values. Note: ** and * represent 5% and 10% levels of significance*

Source: Authors (2020).

4.1.9 FMOLS Regression Analysis (Equation 2)

1. Short-Run Effects of Economic Growth on Financial Sector Development

The FMOLS regression analysis reveals that economic growth (Y) undermines financial sector development (FD) insignificantly in the short-term (p≥0.05). In particular, the liberalization of the financial sector (FINLIB) causes a significant short-term disruption of the entire financial system (B=-2.761279; p=0.0029). However, the development of the stock market, significantly enhances the financial sector as a whole, in the short-term (B=1.068583; p=0.0000), whiles increases in financial sector activities (FINACTIVITY) improve the overall financial mechanism in the short-haul (B=1.332894; p=0.0000). Improvements in the efficiency (FINEFFICIENCY) of financial services delivery also enhances the entire financial system significantly in the short-term (B=0.924404; p=0.0000), whiles innovations in financial services (FININNOV) boosts the overall performance of the financial sector in the short-run (B=0.552945; p=0.0034). Short-term improvements in financial inclusion (FININCLUS) also positively trigger general advancement and development of the financial sector (B=1.000000; p=0.0000).

Concerning the control variables, the FMOLS regression shows that Labor (L), Capital (K), and openness of the economy to foreign direct investments (OPENFDI) contribute significantly to improving the financial sector in the short-term (p≤0.0, 0.10). But contributions of government consumption expenditure and inflation to the development of the financial sector in the short-term are positively insignificant (p≥0.05).

Table 4.8: FMOLS Regression Results: Equation 2

The Fully Modified Least Squares (FMOLS) algorithm was used to analyze the short-run effect of economic growth on financial sector development. The data included an adjusted sample of 57 observations spanning the period 1963 to 2019. The cointegrating equation deterministics were based on the constant and trend assumption and the Regressor equations were estimated using differences. Additional regressor deterministics were specified based on a quadratic trend. The Long-run covariance estimate (Prewhitening with lags = 1, and the Quadratic -Spectral kernel, with Newey-West fixed bandwidth = 3.0000) was employed.

Dependent Variable: ΔFD

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ΔY	-0.023057	0.048722	-0.473235	0.6385
ΔFD	-1.000000	3.97E-07	-2515940.	0.0000*
ΔL	1.030418	0.372484	2.766343	0.0084*
ΔK	0.093643	0.048434	1.933409	0.0599**
ΔGE	0.011750	0.069933	0.168016	0.8674
ΔOPENFDI	0.221941	0.093923	2.363012	0.0228*
ΔINF	0.009822	0.008141	1.206480	0.2344

ΔFINLIB	-2.761279	0.873616	-3.160748	0.0029*
ΔSTOCKMAKDEV	1.068583	0.054733	19.52343	0.0000*
ΔFSACTIVITY	1.332894	0.102535	12.99936	0.0000*
ΔFSEFFICIENCY	0.924404	0.030016	30.79716	0.0000*
ΔFININNOV	0.552945	0.177826	3.109475	0.0034*
ΔFININCLUS	1.000000	4.59E-07	2178613.	0.0000*
C	-45.58722	18.84515	-2.419042	0.0200
@TREND	0.248010	0.035029	7.080070	0.0000

R-squared	1.000000	Mean dependent var	148453.9
Adjusted R-squared	1.000000	S.D. dependent var	582460.3
S.E. of regression	1.278585	Sum squared resid	68.66074
Long-run variance	1.469443		

Source: Authors (2020).

4.1.10 Robustness Check of FMOLS Equation 2 Using Canonical Cointegrating Regression

The Canonical Cointegrating Regression (CCR) confirms the robustness of the FMOLS regression that economic growth temporally disrupts the development of the financial sector. All the other control variables and financial sector development variables maintain their respective signs and significance levels under the CCR model just as the cases were under the FMOLS model, further affirming the robustness of the FMOLS findings. [**Table 4.9, Appendix A**].

4.1.11 Vector Error Correction Model (VECM) Analysis (Equation 2)

1. Long-Run and Short-run Causal Effects of Economic Growth on Financial Development

The VECM analysis reveals that economic growth, in aggregate terms, exerts a negative but statistically non-significant effect on financial development in the short-run (B=-0.0149354; p=0.6805). This is consistent with the FMOLS and CCR results already highlighted above. It is interesting to note, however, that the financial sector development variables differentially contribute to the overall growth of the finance sector of Ghana in the long-run. In particular terms, financial liberalization (FINLIB), stock market development (STOCKMAKDEV), the efficiency of the financial sector (FSEFFICIENCY), and the activity of the financial sector (FSACTIVITY) affect the overall development of Ghana's finance sector positively, albeit, to no substantial extent, in the long-haul ($p \geq 0.05$). However, Financial inclusion (FININCLUS), as per the results, have been significantly undermining the development of Ghana's financial sector for a long time ($p \leq 0.05$). An interesting result, however, is that the innovations in the financial sector significantly enhances the overall development of Ghana's finance sector in the long-haul (B=1.25366; $p=0.0001 \leq 0.05$).

Concerning the control variables, labor (L), government consumption expenditure (GE), and openness of the economy to FDI (OPENFDI) and inflation improve the development of the financial sector in the long-run, although not to very significant levels ($p \geq 0.05$). The only control variable that was found to hinder the development of Ghana's financial sector in the long-term is capital (K) ($B=-0.0359590$; $p=0.0472 \leq 0.05$).

The estimated value of the error correction (ECt –1), -0.0601924 has a correct sign and is statistically significant at 1%, 5%, and 10% significance levels. This suggests that there is an adjustment to the equilibrium level after a shock. Approximately, 6.02% of the disequilibrium from the previous year's shock converges back to the long-run equilibrium in the current year.

The R-square statistic reveals a strong fit of the VECM equation to the data distribution as moderate model fit as 85.8157% of short-term and long-haul developments in Ghana's financial sector as a whole, could be accounted for variations in economic growth, specific finance sector advancements, and the control variables (R-square=0.858157).

Table 4.10: VECM Equation 2

The VECM system equation was computed with a lag order 2 based on the SC: Schwarz information criterion. The Maximum likelihood estimator was applied to T = 56 observations covering the period 1964-2019. The VECM cointegrating rank= 1, and the model was computed with Unrestricted constant specification.

Dependent Variable: ΔLnFD

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	−7.57524	8.48122	−0.8932	0.3771	
ΔYt-1	-0.0149354	0.0360074	0.4148	0.6805	
ΔLnFDt-1	0.117837	0.0782793	1.505	0.1401	
Lt-2	0.156890	0.172561	0.9092	0.3687	
Kt-2	−0.0359590	0.0175600	−2.048	0.0472	**
GEt-2	0.0392064	0.0293498	1.336	0.1892	
OpenFDIt-2	0.0195924	0.0340828	0.5748	0.5686	
INFt-2	0.00265591	0.00324743	0.8178	0.4183	
FINLIBt-2	0.449702	0.286018	1.572	0.1238	
StockMakDevt-2	0.0300468	0.0247242	1.215	0.2314	
FSActivityt-2	0.0484243	0.0413523	1.171	0.2485	
FSsizet-2	−0.127323	0.0487773	−2.610	0.0127	**
FSEfficiencyt-2	0.0155764	0.0116508	1.337	0.1888	
FinInnovt-2	1.25366	0.121890	10.29	0.0001	***
FinInclust-2	−1.67371e-06	1.97759e-07	−8.463	0.0001	***
ECt-1	-0.0601924	0.00588139	10.23	0.0001	***

Mean dependent var	0.205327	S.D. dependent var	1.078033
Sum squared resid	9.066412	S.E. of regression	0.476089
R-squared	0.858157	Adjusted R-squared	0.804966
Rho	0.055372	Durbin-Watson	1.853850

Log-likelihood = -148.01074 Determinant of covariance matrix = 0.67728954
AIC = 6.5004 BIC = 7.7301 HOC = 6.9771

*This table presents the results of the VECM. Equation 2 * Figures in parentheses are probability values. Note: **, *** and * represent 1%, 5% and 10% levels of significance.*
Source: Authors (2020).

4.1.12 Further Analysis of VECM Model Equations 1 and 2

1. VECM Residuals

The VECM residuals from the two model equations above follow a random pattern as expected, implying that the innovation or error terms in the two equations are pure stochastic processes. [**Figure 4.2, Appendix A**].

2. Error Correction Terms

The error correction term graph reveals that the speed of adjustment to the long-run solution that enters the VECM system to affect short-run movements in economic growth and financial development is quite slow/low (negative) from 1960 until about 2009. It then adjusts speedily/sharply in 2010 and plummets steeply from 2010 till 2019. [**Figure 4.3, Appendix A**].

3. Impulse Response Functions

The impulse response graphs reveal that economic growth responds positively and gradually to a one standard deviation shock or innovation in itself from period 0 to 9 with values that oscillate around 2.0. (**Panel A**).

Financial development, on other hand, responds negatively to one standard deviation shocks in economic growth, with values of 0 at period 0, and -0.35 at period 9. (**Panel B**).

Economic growth responds differently to shocks in financial sector development. In the early periods, economic growth responds negatively to financial sector innovations with values of about -0.1 at period 0, this increases to about 0.15 in period 2 and becomes almost stable at this value (0.15) up to period 9. (**Panel C**).

Financial sector development also responds in different ways to shocks or innovations in itself. At the early stages, positive shocks in financial innovations trigger a negative, downward trend in the overall development of the finance sector causing the response value to decrease from about 0.35 in period 0 to -0.05 in period 2, and remains approximately constant at this value from period 2 to 9. (**Panel D**).

4.1.13 Simple (Pairwise) Granger-Causality Tests

The efficiency of the financial sector (FSEFFICIENCY) Granger causes economic growth ($F=3.24109$; $p=0.0470<0.05$) but economic growth does not Granger cause financial sector efficiency ($p>0.05$). This result partly confirms the finance-led growth theory of a unidirectional impact from financial sector development to economic growth in Ghana. ($F=3.24109$; $p=0.0470<0.05$).

Financial sector activity (FSACTIVITY) also Granger causes economic growth ($F=4.27325$; $p=0.0190<0.05$) but economic growth does not Granger cause the development of the Financial Sector ($p>0.05$). This further confirms the finance-led growth theory of a unidirectional impact from financial sector development to economic growth in Ghana.

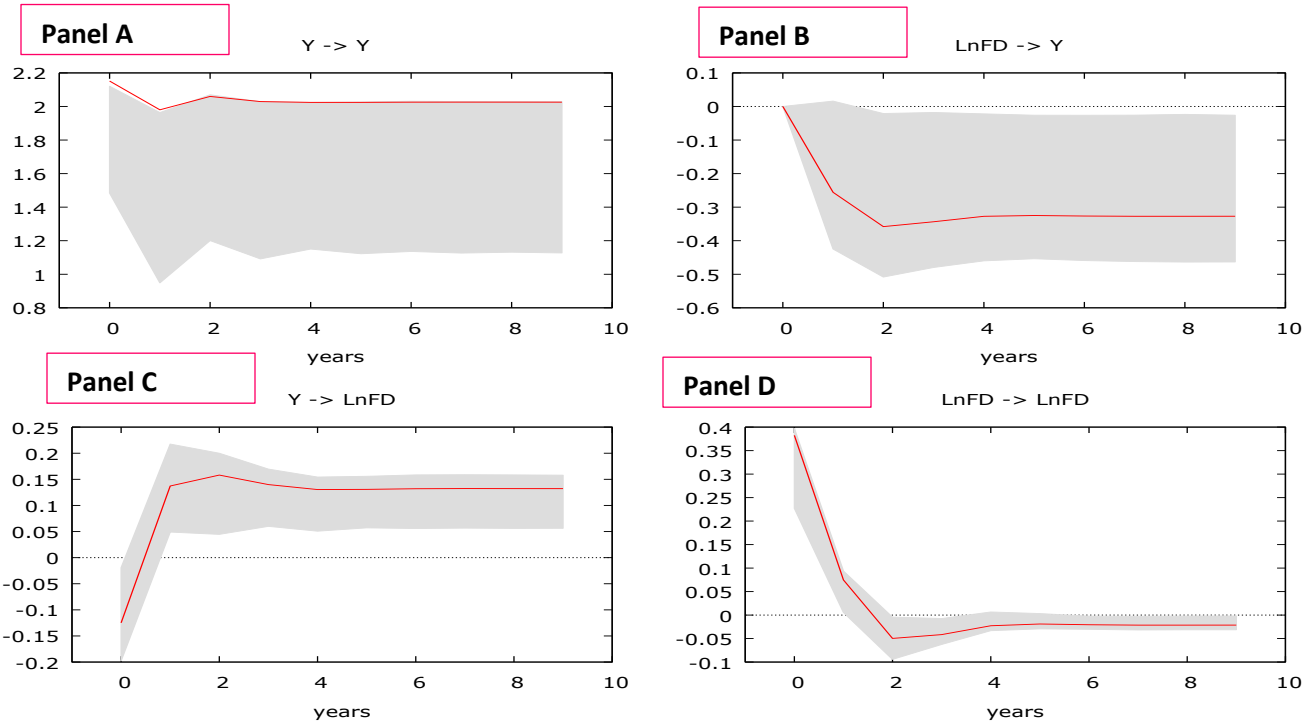
Financial Liberalization (FINLIB), on the other hand, does not Granger cause economic growth, and economic growth does not Granger cause Financial liberalization. ($p>0.05$). This partly rejects the finance-led growth and Growth-led finance theories and confirms, at least faintly, the no-impact hypothesis in Ghana.

An interesting finding is that financial innovation (FININNOV) Granger causes economic growth (F=2.37496; p=0.090<0.10) and economic growth Granger causes financial innovation (F=26.9637; p=8.E-09<0.05). This statistical outcome confirms marginally, the mutual impact hypothesis in Ghana.

On the other side, financial inclusion (FININCLUS) does not Granger cause economic growth (p>0.05) but economic growth Granger causes financial inclusion. (F=22.2868; p=9.E-08<0.05). This result somewhat confirms the Growth-led finance theory in Ghana.

Finally, stock market development (STOCKMAKDEV) Granger causes economic growth (F=2.97531; p=0.0596<0.05) but economic growth does not Granger cause stock market development. This finding also confirms the finance-led growth theory in Ghana. [**Table 4.11, Appendix A**].

Figure 4.4: Impulse Response Functions



Source: Authors (2020).

4.2 Findings and Discussions

The principal purpose of the study was to empirically ascertain whether or not any of the four theories explaining the finance-growth nexus could be confirmed in the Ghanaian context. The findings from the analysis are presented and discussed below.

1. Finance-Growth Theory

The first research question was whether or not *the finance-led growth theory could be confirmed in Ghana because financial sector development variables exert some statistically significant short- and long-run unidirectional causal impacts on economic growth.*

The results from both the Fully Modified Least Squares (FMOLS) and Canonical Cointegrating Regression (CCR) regressions reveal that financial sector development, in aggregate terms, significantly drives economic growth in a positive direction in the short-term. This confirms the finance-growth nexus in Ghana. Specifically, the liberalization of the financial sector and innovations in the financial sector's services (e.g. ATMs) significantly propel Ghana's economic growth in the short-run. However, the effect of the activity of the financial sector on Ghana's economic growth is positive, albeit, statistically non-significant in the short-run.

On the other side, the development of the stock market and the inefficiencies within the financial sector significantly undermine Ghana's economic growth in the short-term. However, financial inclusion exerts a negative statistically insignificant short-term impact on economic growth in Ghana.

The above results imply that the short-run effect of financial development on economic growth is both mixed and inconclusive. On one hand, financial development drives short-run growth through the liberalization of the financial sector, innovation in the financial sector's services, and the general activity of the financial sector. On the other hand, financial development could undermine the economy through the underdevelopment of the stock market, inefficiencies within the financial sector, and lower levels of financial inclusion.

Hence, from a short-run impact perspective, the finance-growth nexus seems to be confirmed on one hand, in the sense that financial development propels short-run economic growth through the liberalization of the financial sector, innovation in the financial sector's services, and the general activity of the financial sector. This finding is consistent with, and partly confirms the finance-growth theory in Ghana.

The finance-growth theory argues that financial development causes economic growth [14]. The theory asserts that the existence of the financial sector, as well-functioning financial intermediations in channeling the limited resources from surplus units to deficit units would provide efficient allocation of resources thereby leading the other economic sectors in their growth process (Schumpeter, 1911; Levine, Loayza & Beck, 2000). **[110, 76].**

As regards causal influence, the results from the simple pairwise Granger-causality tests revealed that the efficiency of the financial sector Granger causes economic growth but economic growth does not Granger cause financial sector efficiency. Moreover, financial sector activity Granger causes economic growth but economic growth does not Granger cause the development of the financial sector. Thirdly, the stock market development Granger causes economic growth but economic growth does not Granger cause stock market development. These findings formidably further confirm the finance-growth theory of a unidirectional impact from financial sector development to economic growth in Ghana. These findings agree with several previous empirical works [15].

The VECM results also demonstrate differential long-run causal effects of the financial development variables on economic growth. First, financial liberalization exerts a negative insignificant long-haul effect on economic growth. This implies that the liberalization of the financial sector, in the long-run, marginally depresses Ghana's economic growth.

[14] (See, Schumpeter, 1911, McKinnon, 1973; Shaw, 1973).

[15] (e.g., Jung, 1986; Ahmed & Ansari, 1998; Darrat, 1999; Xu, 2000; Fase & Abma, 2003; Christopoulos & Tsionas, 2004; Yang & Yi, 2008; Colombage, 2009; Hsueh et al., 2013).

Second, the long-run effects of stock market development, financial sector activity, and financial sector efficiency are negative and statistically insignificant on economic growth. This implies that inefficient activities within the financial sector as a whole slightly undermine Ghana's economic growth in the long-term.

However, innovations in the financial sector exert positive, statistically significant long-run effects on economic growth. This implies that technological advances in Ghana's financial services sector greatly improve economic growth in the long-haul. This finding confirms the finance-growth theory and is consistent with several previous empirical works of literature.[16]

2. Growth-led Finance Theory

The second research question was: *Can the Growth-led finance theory be confirmed in Ghana because economic growth exerts some statistically significant short- and long-run unidirectional causal impacts on financial sector development variables?*

The findings from the FMOLS, CRR, and VECM regressions reveal that economic growth slightly disrupts and undermines financial sector development in the short-term. This partly contradicts the Growth-led finance theory. (Lucas, 1988; Christopoulos & Tsionas, 2004). **[80, 32].**

However, changes within the financial sector as a whole, as measured by variations in the financial sector development variables influence the entire financial system of Ghana. In particular, the development of the stock market, significantly enhances the financial sector as a whole, both in the short-term and long-haul, while improvements in financial sector activities also slightly improve the overall financial mechanism in the short-haul. Enhancements in the efficiency of financial services delivery also enrich the entire financial system significantly, both in the short-term and long-run. It is interesting to state, as per this study's findings, that innovations in financial services slightly heightens the overall performance of the financial sector in the short-run, and significantly boosts the developments of the entire system in the long-haul. Additionally, short-term improvements in financial inclusion also positively trigger general advancement and development of the financial sector but if this trend is not maintained, the financial sector's advancement would be hindered in the long-run. Unfortunately, the liberalization of the financial sector causes a significant short-term depression of the entire financial system but in the long-run, it results in marginal improvements in the entire financial sector.

When it comes to the casual effect of economic growth on the financial sector, the simple (pairwise) Granger-causality tests indicate that financial inclusion does not Granger cause economic growth but economic growth Granger causes financial inclusion. This result partly confirms the Growth-led finance theory in Ghana. The Growth-led finance theory postulates unidirectional causality from economic growth to financial sector development (Lucas, 1988; Christopoulos & Tsionas, 2004) **[80, 32].** Therefore, the findings of this study are also slightly consistent with some previous empirical research (e.g. Liang & Teng, 2006; Odhiambo, 2008; Adeyeye et al., 2015). **[79, 88, 2].**

[16] (e.g., Jung, 1986; Ahmed & Ansari, 1998; Darrat, 1999; Xu, 2000; Fase & Abma, 2003; Christopoulos & Tsionas, 2004; Yang & Yi, 2008; Colombage, 2009; Hsueh et al., 2013).

3. Mutual Feedback Theory

The third research question was whether or not *the mutual feedback theory could be confirmed in Ghana because financial sector development variables exert some statistically significant short- and long-run bi-directional causal impacts on economic growth variables and/or vice-versa?*

The FMOLS, CCR regressions reveal that financial sector development, in aggregate terms, significantly drives economic growth in a positive direction in the short-term. The VECM results, however, demonstrate differential long-run causal effects of the financial development variables on economic growth. Moreover, the findings from both the FMOLS, CCR, and VECM regressions reveal that economic growth slightly disrupts and undermines financial sector development in the short-term. This partly contradicts the Growth-led finance theory which argues that economic development is the key antecedent of financial sector improvement (Lucas, 1988; Christopoulos & Tsionas, 2004). **[80, 32].**

It is very important to mention that the mutual impact hypothesis is confirmed in Ghana only in relation to financial innovation. As per the findings of the study, financial innovation Granger causes economic growth and economic growth Granger causes financial innovation. This statistical outcome implies that improvements in the financial sector advance the economy as a whole and vice-versa. The mutual impact or feedback hypothesis asserts a bi-directional causal linkage between finance and growth and in this regard, the finding of this study regarding the bi-directional causality between financial innovation and economic growth is slightly consonant with previous theses **[17]**

4. No-Causal Relationship Theory

The fourth and final research question was: *Can the no-causal relationship theory be confirmed in Ghana because financial sector development variables exert no statistically significant short- and long-run causal impacts on economic growth variables and vice-versa?*

The results from the FMOLS, CCR, and VECM demonstrate some nexus between most of the financial development variables and economic growth and vice-versa. Hence, the no-causal relationship theory, based on the findings from this long essay, is very much absent in Ghana. Moreover, the pairwise Granger-causality tests further provide additional evidence that suggests that the No-causal relationship hypothesis is not a useful theory in explaining the finance-growth connection in Ghana. This is because the No-causal relationship hypothesis is confirmed in Ghana only concerning financial liberalization and economic growth. The finding means that financial liberalization does not Granger cause economic growth and economic growth does not Granger cause financial liberalization. This makes perfect sense because financial liberalization policies in Ghana are established by the monetary authority. The No-causal relationship hypothesis postulates a zero correlation between economic growth and financial development and in this regard, the study's result of a no-causal link between financial liberalization and economic growth is slightly consistent with some previous empirical literature (e.g., Graff, 1999; Lucas, 1988). **[46, 80].**

In summarizing and concluding the discussion, here are the main findings from this analysis:

1. *The finance-led growth theory is confirmed in Ghana in relation to the following variables:*
   - ❖ Stock market development and economic growth

[17] For example, Demetriades & Hussein, 1996; Luintel & Khan, 1999; Al-Yousif, 2002; Calderon & Liu, 2003; Abu-Bader & Abu-Quan, 2008; Wolde-Rufael, 2009; Bangake & Eggoh, 2011; Kar et al., 2011).

- The efficiency of the financial sector and economic growth; and;
- Financial sector activity and economic growth

2. The *Growth-led finance theory* is confirmed in Ghana only in relation to financial inclusion and economic growth.
3. The *mutual impact or feedback hypothesis* is confirmed in Ghana in relation to is that financial innovation and economic growth.
4. *The No-Causal Relationship theory* is confirmed in Ghana only with respect to financial liberalization and economic growth.

In conclusion, the finance-growth theory is the most substantial theory that can account for the nexus between financial sector development and economic growth in Ghana. This because it can explain the connection between economic growth and a greater majority of the financial sector development variables such as stock market development, the efficiency of the financial sector, and financial sector activity.

The Growth-led finance theory is a minor theory when it comes to explicating the synchrony between the financial sector and economic growth in Ghana as it only accounts for the connection between financial inclusion and economic growth.

The mutual impact or feedback hypothesis is also an inconsequential theory for elucidating the finance-growth nexus in Ghana because it can only account for the relationship between financial innovation and economic growth.

Finally, the no-causal relationship theory is also a marginal hypothesis for explaining the finance-growth nexus in Ghana as it only elucidates the absence of a liaison between financial liberalization and economic growth in Ghana.

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

Four main theories abound in the literature that attempts to account for the link between financial sector development and economic growth. These theories are the *"finance-led growth theory", "growth- led finance theory", "mutual feedback/ impact theory"* and *"no-causal relationship theory"*.

The first theory (finance-led growth theory) contends critical developments and improvements in the financial sector are key drivers of economic growth. The second theory, the Growth-led finance theory argues that economic development is the key antecedent of financial sector improvement. The third theory (the mutual feedback/impact hypothesis) argues for a bi-directional connection between finance and growth, which is a contemporaneous association between finance and growth. In other words, economic growth propels financial development and financial development stimulates economic growth. The fourth and final theory is the No-causal relationship concept, which suggests that economic growth and financial development are unrelated.

The principal purpose of the study was to empirically ascertain whether or not any of the four theories explaining the finance-growth nexus could be confirmed in the Ghanaian context. The study utilized an objectivist ontological paradigm, a positivist epistemological viewpoint, and sound axiological (ethical) principles in collecting the data used for the analysis. A quantitative

research design was applied to mainly secondary data representing the various proxies of financial development and economic growth that were collected from the websites of the Finance Ministry (MoF), Ghana Statistical Services (GSS), African Development Bank (AfDB), Bank of Ghana (BoG), and the World Bank Development Indicators (WDI). The data were annual time-series data spanning the period 1960–2019, capturing both the pre-and post-economic reform and structural adjustment program periods for Ghana.

The data was analyzed using descriptive statistics, Trend Lines, and inferential statistics. Individual Unit Root Tests were performed using the ADF and Phillips-Perron (PP) tests. The Johansen System Cointegration Tests were also carried out to test for the presence of a matrix of cointegrating relationships between the variables.

Empirical models were specified to test the four main theories, namely, the finance-led growth theory, Growth-led finance theory, mutual impact/feedback hypothesis, and no-causal relationship theory.

The model parameters were estimated using *the Fully Modified Ordinary Least Squares (FMOLS) technique.* The FMOLS model was employed to analyse the short-term nexus between financial sector development and economic growth. The robustness of the FMOLS Estimates in terms of the consistency of the statistical significance and effects of the parameter estimates were checked using *Canonical Cointegration Regression (CCR)* model.

The Vector Error Correction Model (VECM) was also further applied to analyze the short-run and long-haul dynamic link between financial development variables and economic growth. Additional VECM diagnostic tests were performed which were mainly graphical analyses of VECM Residuals, Error Correction Term and Impulse Response Functions to ensure the robustness of the VECM results.

The simple pairwise Granger-causality test was also employed to ascertain the direction of causality between economic growth and financial sector development indicators. The analysis was performed using Econometrics Views (EVIEWS 10.0) and GRETL statistical software packages.

Here are the main findings from this analysis:

1. The *Finance-led growth theory* is strongly confirmed in Ghana regarding the following variables:
   - *Stock market development and economic growth*
   - *The efficiency of the financial sector and economic growth*
   - *Financial sector activity and economic growth*
2. The *Growth-led finance theory* is slightly confirmed in Ghana only in relation to financial inclusion and economic growth.
3. The *Mutual Impact or feedback hypothesis* is marginally confirmed in Ghana in relation to financial innovation and economic growth.
4. *The No-Causal Relationship theory* is vaguely confirmed in Ghana only with respect to financial liberalization and economic growth.

5.2 Conclusions

Four main conclusions are drawn based on this long essay's findings. Firstly, the finance-growth theory is the most generous theory that can account for the interconnection between financial sector development and economic growth in Ghana. This is because it can explicate the union

between economic growth and a majority of the financial sector development variables such as stock market development, the efficiency of the financial sector, and financial sector activity. Secondly, the Growth-led finance theory, compared to the finance-led growth theory, is a minor hypothesis when it comes to explicating the synchrony between the financial sector and economic growth in Ghana as it only accounts for the bond between financial inclusion and economic growth.

Thirdly, the mutual impact or feedback hypothesis in comparison with the finance-led growth theory is trifling for illuminating the finance-growth nexus in Ghana because it accounts for the relationship between only financial innovation and economic growth.

Fourthly and lastly, the no-causal relationship theory concerning the finance-led growth theory represents a hypothesis for explaining the finance-growth nexus in Ghana as it only elucidates the absence of a liaison between financial liberalization and economic growth in Ghana.

5.3 Recommendations

Several recommendations are made based on the results of this study. Firstly, the findings from the analysis show that the financial sector development, in aggregate terms, significantly drives economic growth in a positive direction in the short-term. Hence, the Government of Ghana (GoG) and the Bank of Ghana (BoG) are advised to create an enabling environment for the financial sector organizations to thrive.

Secondly, since the liberalization of the financial sector and innovation in the financial sector's services significantly propel Ghana's economic growth in the short-run, the BoG is advised to continue to create a more liberal, competitive financial sector environment as a fundamental precursor to economic growth. Moreover, banks and other financial institutions need to strive to bring more technological innovations into their products and service delivery as this would also propel economic growth in Ghana.

Thirdly, since the effect of the activity of the financial sector on Ghana's economic growth is positive, albeit, statistically non-significant in the short-run, banks and other financial institutions are advised to improve upon their services and inculcate more innovative activities that could boost the economic advancement of the country.

Fourthly, since the study found the development of the stock market and the inefficiencies within the financial sector to significantly undermine Ghana's economic growth in the short-term, the Securities and Exchanges Commission (SEC) should regulate those trading activities on the Ghana Stock Exchange (GSE) that might appear to hinder economic growth in the short-term. Moreover, banks and other financial institutions are advised to minimize the inefficiencies in their allocation of funds to drive economic growth in the short-term.

Fifthly, this study found financial inclusion to be exerting a negative statistically insignificant short-term impact on economic growth in Ghana. This means that the BoG, GoG, banks, and other financial institutions should strive toward widening the portfolios of financial products and services to target even the less privileged in rural and deprived communities since these could, at least, marginally improve economic growth in Ghana.

Sixthly, since financial liberalization exerts a negative insignificant long-haul effect on economic growth, the BoG is cautioned against the "over-liberalization" of the financial sector by which it, until the recent banking scandals, permitted several banks and Microfinance Institutions to operate. Going forward, the BoG, as it has already started doing through the so-called "banking sector clean-up", should keenly guard against the over-liberalization of the financial sector.

Seventhly, the long-run effects of stock market development, financial sector activity, and financial sector efficiency are negative and statistically insignificant on economic growth in the long-run. Therefore, the BoG should strive to always tighten up prudential regulations that are geared toward reducing or eliminating productive and allocative inefficiencies inherent in the financial sector (i.e. the Ghanaian banking sector and the stock market) as this could help boost economic growth in the long-term.

Eighthly, because innovations in the financial sector exert positive, statistically significant long-run effects on economic growth, the BoG should continue to create an enabling environment that allows banking and non-banking financial institutions to create more innovative products and services as these could stimulate long-run economic growth in the country.

Lastly, because economic growth slightly disrupts and undermines financial sector development in the short-term, the GoG is advised to strictly evaluate and re-assess its growth policies and flush out the ones that may be hindering the development of the financial sector, at least, in the short-haul.

5.4 Further Studies

1. Future studies on the finance-growth nexus can focus on testing the four theories using cross-country panel data. The findings from such studies would help test some of the findings of this study using a larger data set, to ascertain the universality or otherwise of the theories.

2. It appears from this study, that the mixed empirical results in the finance-growth nexus literature might be attributable to divergences in the methodologies employed by different authors, coupled with the use of different measures/indicators of financial development and economic growth. It is apparent that the statistical/econometric method employed plus the measure of financial sector development and economic growth used in finance-growth studies strongly influence the kind of results obtained. Hence, future research works could concentrate on employing factor analysis (principal components) and multivariate discriminant analysis to identify and isolate the most critical indicators and best measures of financial performance and synthesize them into a conceptual framework that could be applied for the empirical measurement of the financial sector development. Such a conceptual framework for measuring financial sector development could serve as a "universal measure of financial development". With such a measurement tool available, empirical results from further finance-growth nexus studies around the world, over time, might begin to converge.

3. Since all the four finance-growth nexus theories examined in this paper assume a direct causal connection between financial sector development and economic growth, future studies can explore the mediating effects of other variables in the finance-growth relationship. For example, further studies could employ the structural equation modeling technique to analyze Demirguc-Kunt's (2006) [34] assertion that finance induces development by stimulating technological innovation, savings, and investment. The findings from such a study would be very fascinating.

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APPENDIX A

Table 4.2(a): Unit Root Tests for all Variables at Level

The Augmented Dickey-Fuller Test applied a constant, linear trend assumptions to the exogenous variables. The lag length was automatically selected based on the Schwarz information criterion (SIC). The Phillips-Perron Test at level was performed by assuming a constant linear trend in the exogenous variables. The bandwidth was automatically selected using the Newey-West method with the Bartlett kernel.

Variables	**ADF Test at level**			**Phillips-Perron (PP) Test at Level**			
	Trend and Intercept	p-value	Lags	Trend and intercept	p-value	Bandwidth	Stationarity & Order of Integration
Y	2.331303	1.0000	0	1.893048	1.0000	2	Non-Stationary
L	-9.033740	0.0000*	0	-2.678645	0.2490	5	Inconclusive
K	-3.532116	0.0451*	0	-3.511841	0.0473*	3	Stationary(I(0))
OPENFDI	-3.773910	0.0250*	0	-3.659995	0.0332*	2	Stationary (I(0))
GE	-5.038156	0.0006*	0	-5.189416	0.0004*	4	Stationary(I(0))
INF	-2.896354	0.1713	1	-14.97122	0.0000*	7	Inconclusive
FINLIB	-1.922437	0.6303	0	-1.999591	0.5894	2	Non-Stationary
STOCKMAKDEV	-2.225133	0.4671	0	-2.313107	0.4204	3	Non-Stationary
FSEFFICIENCY	-2.963291	0.1523	7	-3.170767	0.1003	3	Non-Stationary
FININNOV	0.581020	0.9993	0	0.625348	0.9994	2	Non-Stationary
FININCLUS	-6.137413	0.0000*	3	-3.356427	0.0674	2	Inconclusive
FD	-1.955138	0.3055	0	0.611677	0.9994	1	Non-Stationary

P-values significant at 1%, 5% and 10% levels

Source: Authors (2020).

Table 4.2(b): Unit Root Tests for all Variables at 1st Difference

The Augmented Dickey-Fuller Test applied a constant, linear trend assumptions to the exogenous variables. The lag length was automatically selected based on the Schwarz information criterion (SIC). The Phillips-Perron Test at level was performed by assuming a constant linear trend in the exogenous variables. The bandwidth was automatically selected using the Newey-West method with the Bartlett kernel.

Variables	ADF Test at 1st Difference			Phillips-Perron (PP) Test at 1st Difference			
	Trend and Intercept	p-value	Lags	Trend and intercept	p-value	Bandwidth	Stationarity & Order of Integration
Y	-4.980260	0.0008*	0	-4.951596	0.0009*	1	Stationary (I(1))
L**	-3.457504	0.0555	0	-2.150334	0.5074	1	Non-Stationary
K	-7.207061	0.0000*	1	-8.393835	0.0000*	10	Stationary (I(1))
OPENFDI	-10.17231	0.0000*	0	-23.00976	00001*	38	Stationary (I(1))
GE	-10.05305	0.0000*	1	-23.42399	0.0001*	24	Stationary (I(1))
INF	-13.02546	0.0000*	0	-14.97122	0.0000*	7	Stationary (I(1))
FINLIB	-7.550206	0.0000*	0	-7.550181	0.0000*	1	Stationary (I (1))
STOCKMAKDEV	-7.766765	0.0000*	0	-7.767235	0.0000*	1	Stationary (I (1))
FSEFFICIENCY**	-1.972231	0.6024		-7.236425	0.0000*	10	Inconclusive
FININNOV	-7.301321	0.0000*	0	-7.301321	0.0000*	0	Stationary (I (1))
FININCLUS	-6.526353	0.0000*	5	-6.240954	0.0000*	2	Stationary (I (1))
FD	-7.766765	0.0000*	0	-7.767235	0.0000*	1	Stationary (I (1))

***Labor(L) and the Financial Sector's Efficiency (FSEFFICIENCY) became stationary only after 2nd Differencing meaning that the series are I(2).*

Source: Authors (2020).

Table 4.3: VAR Lag Order Selection Criteria

The Endogenous variables were Y, L, K, GE, INF, OPENFDI, FSEFFICIENCY, FSACTIVITY FINLIB, FININNOV, FININCLUS, STOCKMAKDEV. The Exogenous variable was the constant (C). The Lag order selection criteria was performed using a sample of 57 observations covering the period 1960 -2019.

LR	FPE	AIC	SC	HQ

Lag						
0	-2404.183	NA	1.07e+22	84.77836	85.20848	84.94552
1	-1839.286	872.1218	4.55e+15	70.01004	75.60155*	72.18309
2	-1683.948	174.4144	5.96e+15	69.61222	80.36512	73.79117
3	-1405.381	195.4856*	4.91e+14*	64.89057*	80.80487	71.07541*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Authors (2020).

Table 4.4: Johansen Cointegration Test

(a): Unrestricted Cointegration Rank Test (Trace)

The Johansen Cointegration test was performed using an adjusted sample of 57 panning the period 1963 -2019. A Linear deterministic trend was assumed.

Series: Y L K GE INF OPENFDI FSEFFICIENCY FSACTIVITY FINLIB FININNOV FININCLUS STOCKMAKDEV.

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.959088	798.1257	334.9837	0.0000
At most 1 *	0.933757	615.9349	285.1425	0.0000
At most 2 *	0.864438	461.2130	239.2354	0.0000
At most 3 *	0.785412	347.3082	197.3709	0.0000
At most 4 *	0.708603	259.5832	159.5297	0.0000
At most 5 *	0.668618	189.2982	125.6154	0.0000
At most 6 *	0.514354	126.3426	95.75366	0.0001
At most 7 *	0.445687	85.17290	69.81889	0.0018
At most 8 *	0.320706	51.54143	47.85613	0.0216
At most 9	0.255091	29.49942	29.79707	0.0541
At most 10	0.194743	12.71333	15.49471	0.1258
At most 11	0.006427	0.367502	3.841466	0.5444

Trace test indicates 9 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Authors (2020).

(b): Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.959088	182.1908	76.57843	0.0000

At most 1 *	0.933757	154.7220	70.53513	0.0000
At most 2 *	0.864438	113.9047	64.50472	0.0000
At most 3 *	0.785412	87.72503	58.43354	0.0000
At most 4 *	0.708603	70.28499	52.36261	0.0003
At most 5 *	0.668618	62.95558	46.23142	0.0004
At most 6 *	0.514354	41.16974	40.07757	0.0375
At most 7	0.445687	33.63147	33.87687	0.0534
At most 8	0.320706	22.04201	27.58434	0.2182
At most 9	0.255091	16.78609	21.13162	0.1823
At most 10	0.194743	12.34583	14.26460	0.0983
At most 11	0.006427	0.367502	3.841466	0.5444

Max-eigenvalue test indicates 7 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Authors (2020).

Table 4.6: Canonical Cointegrating Regression (CCR) Results

The Canonical Cointegrating Regression (CCR) was applied to an adjusted sample of 57 observations (1963-2019) to ascertain the robustness of the FMOLS regression results. The cointegrating equation deterministics were assumed to possess both a constant and trend component and Regressor equations were estimated using differences. Additional regressor deterministics were applied using a quadratic trend and the Long-run covariance estimate (Quadratic-Spectral kernel, Newey-West fixed bandwidth = 3.0000) was employed.

Dependent Variable: ΔY

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ΔLnFD	0.347272	0.194325	1.787071	0.0813**
ΔL	-0.450812	0.323184	-1.394910	0.1706
ΔK	-0.178542	0.042437	-4.207214	0.0001*
ΔGE	0.187812	0.082922	2.264934	0.0289*
ΔOPENFDI	0.012259	0.093269	0.131443	0.8961
ΔINF	0.018238	0.008463	2.155044	0.0371*
ΔFINLIB	3.083749	0.735804	4.190993	0.0001*
ΔSTOCKMAKDEV	-0.062043	0.053769	-1.153872	0.2552
ΔFSACTIVITY	0.012041	0.088712	-0.135726	0.8927
ΔFSEFFICIENCY	-0.008185	0.022974	-0.356259	0.7235
ΔFININNOV	0.379654	0.136801	2.775225	0.0083*
ΔFININCLUS	-3.56E-07	2.12E-07	-1.681717	0.1002
C	14.27553	15.55592	0.917691	0.3641
@TREND	-0.132894	0.034520	-3.849735	0.0004

R-squared	0.760963	Mean dependent var	1.719298
Adjusted R-squared	0.673511	S.D. dependent var	3.706916
S.E. of regression	2.118104	Sum squared resid	183.9409
Long-run variance	0.553616		

Source: Authors (2020).

Table 4.9: Robustness Check of FMOLS: Equation 2

The Canonical Cointegrating Regression (CCR) was applied to an adjusted sample of 57 observations (1963-2019) to check the robustness of the FMOLS regression results. The cointegrating equation deterministics were assumed to possess both a constant and trend component and Regressor equations were estimated using differences. Additional regressor deterministics were applied using a quadratic trend and the Long-run covariance estimate (Quadratic-Spectral kernel, Newey-West fixed bandwidth = 3.0000) was employed.

Dependent Variable: ΔFD

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ΔY	-0.054977	0.106346	-0.516962	0.6079
ΔFD	-0.999999	8.50E-07	-1176855.	0.0000
ΔL	0.781624	0.437151	1.787996	0.0810**
ΔK	0.131936	0.065527	2.013465	0.0505**
ΔGE	0.111044	0.139244	0.797480	0.4297
ΔOPENFDI	0.304783	0.134985	2.257900	0.0292*
ΔINF	0.011320	0.013079	0.865546	0.3917
ΔFINLIB	-2.719209	0.921383	-2.951226	0.0052*
ΔSTOCKMAKDEV	1.030331	0.079069	13.03080	0.0000*
ΔFSACTIVITY	1.366920	0.141529	9.658219	0.0000*
FSEFFICIENCY	0.906793	0.035016	25.89660	0.0000*
ΔFININNOV	0.552780	0.223262	2.475927	0.0174*
ΔFININCLUS	0.999999	9.58E-07	1044017.	0.0000*
C	-34.21612	21.59790	-1.584233	0.1206
@TREND	0.254953	0.037804	6.744083	0.0000

R-squared	1.000000	Mean dependent var	148453.9
Adjusted R-squared	1.000000	S.D. dependent var	582460.3
S.E. of regression	1.371352	Sum squared resid	78.98546
Long-run variance	1.469443		

Source: Authors (2020).

Figure 4.2: VECM Residuals

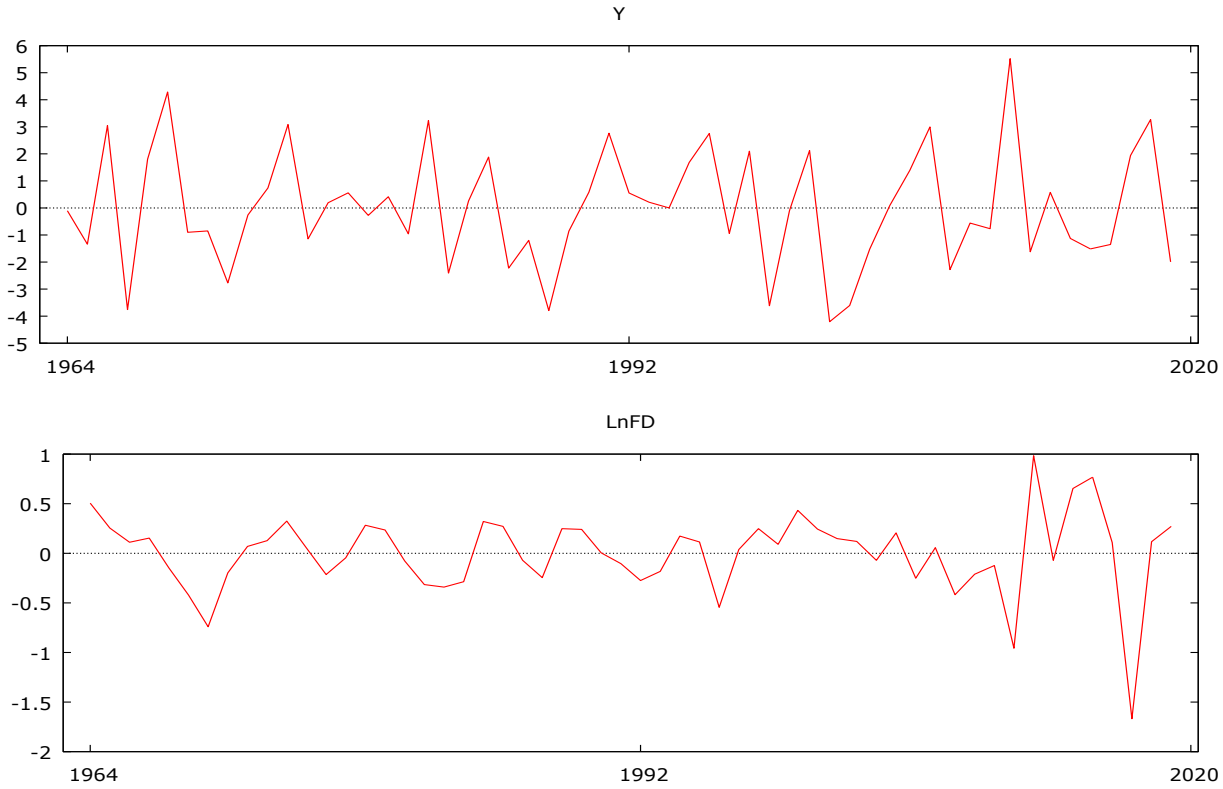
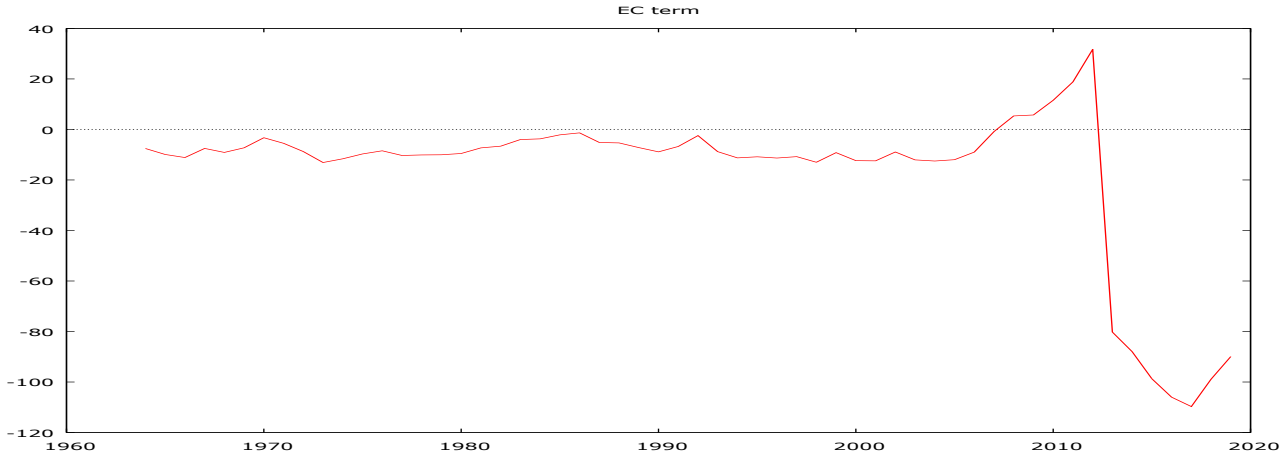


Figure 4.3: Error Correction Term



Source: Authors (2020).

Table 4.11: Pairwise Granger-Causality Tests

The pairwise Granger causality tests were performed on a sample of 58 observations from 1960 2019 using 2 lags automatically selected based on the Schwarz Information Criterion (SIC).

Null Hypothesis:	Obs	F-Statistic	Prob.
FSEFFICIENCY does not Granger Cause Y	58	3.24109	0.0470**
Y does not Granger Cause FSEFFICIENCY		1.00894	0.3715
FSACTIVITY does not Granger Cause Y	58	4.27325	0.0190**
Y does not Granger Cause FSACTIVITY		0.03472	0.9659
FINLIB does not Granger Cause Y	58	1.50871	0.2305
Y does not Granger Cause FINLIB		0.12495	0.8828
FININNOV does not Granger Cause Y	58	2.37496	0.090***
Y does not Granger Cause FININNOV		26.9637	8.E-09
FININCLUS does not Granger Cause Y	58	1.86129	0.1655
Y does not Granger Cause FININCLUS		22.2868	9.E-08
STOCKMAKDEV does not Granger Cause Y	58	2.97531	0.0596***
Y does not Granger Cause STOCKMAKDEV		0.04986	0.9514

*, **, *** Results are significant at the 1%, 5% and 10% significance levels, respectively.

Source: Authors (2020).