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Estimating the Economic Wide Effect of Ethiopian Renaissance Dam on Ethiopian Economy: A Recursive Dynamic Computable General Equilibrium Approach

By

Ashebir Tsegaye[1]

Abstract

This paper examines the economy wide effect of Ethiopian renaissance dam on Ethiopian economy. The model is based on an updated Social Accounting Matrix for 2014/15 that takes into account the structural changes in the economy. Given the additional electricity generation capacity of Ethiopia, the model run a policy simulation in which the additional 6000MW that scheduled to come online near the future form renaissance dam. To analysis this policy option this paper outlined a recursive dynamic computable general equilibrium approach and hence uses the change in real GDP, sectors production, investment, external sector, household income and consumption expenditures, and household's welfare relative to the baseline, as an indicators of the economic wide effects of the renaissance dam. In opting for policy shock, the results of exercise showed that with an increment in power supply from renaissance dam the country can optimize the beneficial impacts on its economy. Specifically the simulation results show a spreading out effect in real GDP, sectors production, real investment, household income and household's consumption expenditure. Results also showed improvement in the welfare for all the household categories. However; the shift in relative income across the household categories favors high income households. Overall, this paper suggests that Ethiopian economy will enjoy the largest improvement with additional power supply resulting from Ethiopian renaissance dam, therefore; concerned bodies should exerted maximum efforts to finalize the projects on time and resolve the age-long problems of the people so that the economy maintains its tremendous progress.

Keywords: *Dynamic Computable general equilibrium, GAMS, electricity supply, Ethiopian Renaissance Dam*

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1. INTRODUCTION

Noticeably, now a day electricity industry becomes a robust industry that enthusiastically contributes to the progress, prosperity and healthy development of a nation. In one hand, electricity has an exceptional 'energy currency' that underpins the economic development mode of the country (Coupal & Holland, 2002); on the other hand, the level and speed of economic development plays a decisive role in determining the demand for electricity (Khandker et al., 2009). Therefore, when the economy has experienced in power failures even an hour, means that a lot of activity is forced to go on a standstill and, hence, directly thwart the fulfillment of the Sustainable Development Goals by fading the society's reaction to economic changes (Vera, 2016).

Like other third world nations, in Ethiopia a severely restricted, inefficient and unreliable supply of electricity has historically recorded as a limiting factor for its economic development (Woldesenbet, 2005). Moreover, with its fast economic growth; electrifying of million households, remote communities and small-scale entrepreneurs remains a challenge in Ethiopia though pleasingly Ethiopia has endowed with abundant water resources and enormous hydropower potential to put her out of poverty trap.

Consequently, after a wake up, to cover an imminent shortfall in electricity, Ethiopian government launched a plan to exploit the electricity generation potentials in the country. A major step in this regard was the notice in 2011 to construct the largest reservoir in Africa near the border to Sudan, the Grand Ethiopian Renaissance Dam with a storage capacity of 74 billion cubic meters and a power generating capacity of above 6000 Mw. In this milieu, the GERD is central to Ethiopia's development vision of becoming a middle-income country by 2025 and to be Africa's energy hub (Block and Strzepek, 2010).

Notwithstanding to these increment in public investments in energy sector, the current utilization of hydropower resources of the country are limited to 2,000 MW which is less than 5 percent of the estimated hydropower potentials of the country (Ferrari et al., 2013). Currently, only 27 percent of all households in Ethiopia have access to electricity and the remaining part of the population still relying on traditional biomass. On average, the electricity wastage in Ethiopia is about 20 percent, which is much higher than the international average, 12-13 percent. As Woldesenbet (2005) have investigated, power outages caused firms without backup generators to lose approximately 15 percent to 30 percent of their potential production. Even when the power shortages were less severe, losses could reach up to 10 percent. Their preliminary results also indicate that the economy may have lost 10 percent to 15 percent of total yearly gross value of production that could have contributed from the sector and 1 percent to 3 percent of total yearly government revenue because of power outages.

In view of this, as the completion of the dam construction is getting closer and closer, more and more studies are being published and controversially discuss the likely consequences of the GERD on its environmental, social, economical, and political blueprints. However, the only other preliminary study that we know of has by Ferrari et al., (2012) and Tewodros et al., (2015) which tried to examine the economic wide effect of the dam. The study presented here employs a Computable General Equilibrium (CGE) modeling framework, but contrary to previous studies this study evaluates the direct and indirect economic effect of GERD on Ethiopian economy: First by employing a dynamic recursive multi-sectoral computable general equilibrium model via modeling the issue of hydropower to a single-country

approach, and Secondly; by substituted the original SAM of Ethiopian with a new one where electricity is produced by two activities: i.e. fossil and hydroelectric sources.

Therefore, by filling the above knowledge gap, this study attempts to answer the following research questions:

- What are the presumable effects of GERD on factors income, household's income and consumption expenditure?
- What are the likely effects of GERD on Ethiopian export and import volumes (i.e. on the external sector)?
- What are the presumable effects of GERD on sectoral productions, real government spending and real investment?
- Will the construction of Ethiopian renaissance dam contribute toward its economic growth?

2. Methodology

2.1. Source of Data

To capture the economic wide effect of Ethiopian renaissance dam to Ethiopian economy, this study employed a dynamic CGE model by utilized 2014/15 SAM of Ethiopia which represents the economy by activities, factors, commodities, and institutions including an aggregate savings-investment account. Therefore, the source of data for this study was 2014/15 SAM of Ethiopia which we have been obtained from IFPRI.

2.2. Social accounting matrix

In a narrower sense, a social accounting matrix (SAM) represents flows of all economic transactions that take place within an economy. It is at the core, a matrix representation of the national accounts for a given country, which provides a static picture of the economy (Pyatt and Thorbecke, 1976). As a data framework, the SAM is a snapshot, which explicitly incorporates various crucial transaction links among variables, such as the mapping of factorial income distribution from the structure of production and the mapping of the household income distribution from the factorial income distribution, among others. In other saying, it is a comprehensive accounting framework within which the full circular flow of income from production to factor incomes, household income to household consumption, and back to production is captured.

In a broader sense, in addition to providing a consistent classification scheme, it can conceive as a modular analytical framework for a set of interconnected a subsystem, which specifies the major relationships among variables within and among these systems (Gajewski and Luppino, 2004). With regard to the structure of the standard SAM, it has a number of accounts such as activities, commodities, institutions, factors of production and saving-investment accounts. In addition to these accounts, SAM may have extra accounts like taxes, total margins (Breisinger et al., 2009).

In this context 2014/15 SAM of Ethiopia captures: the sources of income and expenditure destination of

all accounts, breakdown of sectoral GDP (value addition) by labor and capital factors, income generation and distribution of the institutions in general and household groups in particular, patterns of expenditure by institutions including Household groups, the inter-dependence between activities and institutions with respect to income generation and final demand creation, the inter-dependence among institutions regarding transfer receipts and transfer payments, the role of institutions in capital formation, and the relationship of the domestic economy with the Rest of the World / external sector.

2.3. Model formulation

This paper attempts to examine the economy-wide effects of Ethiopian renaissance dam to Ethiopian economy using a recursive dynamic computable general equilibrium (CGE) model. This is because, CGE models have features that make them suitable for such analysis (Janda et al., 2011), as it has sound micro-economic foundations and a complete description of the economy with both direct and indirect effects of a policy changes. More explicitly, in the CGE model the general equilibrium theories are transformed from an abstract form into a realistic and computable one by using a set of equations to characterize supply, demand and equilibrium conditions in the economic system. Therefore, in these equations there are both economic shocks or exogenous variables and endogenous variables or quantities and prices. Consequently, the impacts of exogenous economic shocks on any sector will spread to the whole system of the economy, which in turns lead to the changes in those endogenous variables. Therefore, the state of equilibrium changes from one point to another. Here, by solving the CGE model we can be obtained a new equilibrium quantities and prices whenever the exogenous variables are changed. This becomes the plus points of CGE model over partial equilibrium.

2.4. Simulation designs

Assessing the economic wide effect of Ethiopian renaissance dam to Ethiopian economy requires economic scenarios that can be simulated with the dynamic CGE model for Ethiopia economy to be defined. Unfortunately, the macro closure of the model imposes restrictions on the type of scenarios that will simulate. Additionally, the simulation exercise by itself requires the definition of a baseline scenario that can be used as a benchmark to measure the impact of a given policy scenario's. Hence, this scenario is run and provides "what if" or counterfactual projections, rather than a forecast.

In a consequence, since the main objective of this paper is to assess the potential economic wide impacts of Ethiopian renaissance dam on Ethiopian economy and currently she has announced a national energy policy, it makes sense to assess the impact of policy prescriptions on Ethiopian's economy. For this sake, we have considered the economic scenario that will be compared with the result of the baseline run.

• Given the additional electricity generation capacity of Ethiopia, we run a policy simulation in which the additional 6000MW that scheduled to come online near the future form renaissance dam.

o Specifically, given that there is no additional power generation capacity expected from Ethiopian renaissance dam between the years 2015 to 2020, the electricity supply growth is set to be zero. However; in 2021 there is additional power generation capacities which expected to come online from Ethiopian renaissance dam. Hence in this year, electricity supply growth is set to 17.5 percent.[1] This simulates the

1 This growth rate electricity supply is computed by the following formula that interpreted as the

new generating capacity of GERD which come online over this period (i.e. as two turbines of GERD each with capacity 375 MW have already been installed and are waiting test electricity generation). From 2022 onward, electricity supply growth rate is set to 94.4 percent in this policy run.

3. Discussion and analysis

3.1. Policy Simulation Results

The main rationale of this paper is to provide an economy-wide examination of the contribution that additional power generation from Ethiopian renaissance dam will make to Ethiopian economy over the coming years. Unless and otherwise the researcher stated, intentionally in this section the policy simulation results are expressed as percentage deviations relative to the baseline. Moreover, although the researcher present results for all years of simulation, the discussion pay particular attention to analyzing results for the years 2020 and 2027, which respectively corresponds to the implementation period of Ethiopian renaissance dam and end of the simulation period. Now let us scrutinize the simulation results more plainly.

3.2. Macroeconomic effects

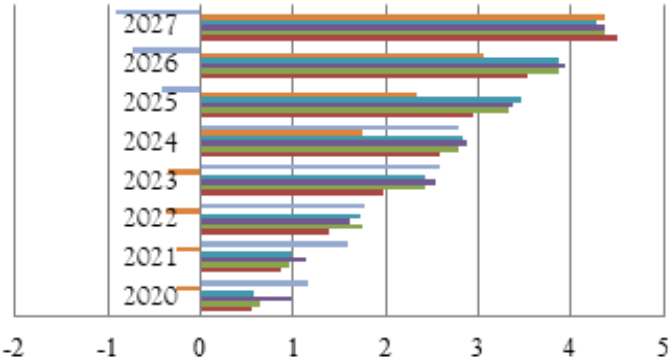
As a basic industry of the national economy, the electricity industry plays an irreplaceable role to support economic development. Thus, the impacts of Ethiopian renaissance dam on GDP should be put in the first place in order to know the power effect better. To do so, the simulation results in this study are presented in a series of real GDP growth, consumption, real investment, export and import deviation from baseline scenarios.

As shown in Figure 1 below, the positive impacts of Ethiopian renaissance dam on GDP are very significant. This change in the GDP is attributed to the change in the GDP distribution due to the reallocation of the factors of production, intermediate inputs among all domestic production sectors, change in the level of consumption and net trade. In opting of the policy shock, GDP gain accelerates with an additional power supplies resulted from Ethiopian renaissance dam, i.e. on average Ethiopian GDP grows by 2.29 from the year 2020 to 2027 compared to the baseline scenario.

Figure 1: The effect of GERD on macroeconomic variables (year on year deviation from its baseline scenario)

smoothed annualized growth rate achieved during the considered time horizon where n is number of periods

$$\sqrt[n]{\frac{\text{ending value}}{\text{beginning value}}} - 1$$



	2020	2021	2022	2023	2024	2025	2026	2027
Import	1.17	1.59	1.78	2.59	2.78	-0.41	-0.73	-0.92
Export	-0.27	-0.25	-0.37	-0.36	1.75	2.34	3.05	4.36
Government consumption	0.58	0.99	1.73	2.42	2.83	3.46	3.87	4.27
Investment	0.98	1.14	1.62	2.54	2.88	3.37	3.93	4.36
Household consumption	0.64	0.96	1.75	2.43	2.79	3.32	3.86	4.37
Real GDP	0.56	0.87	1.38	1.97	2.58	2.95	3.53	4.51

Source: GMAS result and authors' own calculation

On the external sector, in opting of the policy shock, the result of the exercise showed that total export of the country has reduce in the first four simulation periods (i.e. reduced by 0.27 percent in 2020, by 0.25 percent in 2021, by 0.37 percent in 2022 and by 0.36 percent in 2023). This finding is in line with the finding of Bohlmann et al. (2015), but contrary with the result by Levent (2010). This partly might be explained by the appreciation of real exchange rate (i.e. on average by 0.75 percent) which resulted from the increment in electricity export to neighboring countries.

In the viewpoint of domestic producers, appreciation of real exchange rate effect per se reduces in tendency of the price of exports relative to the price in the domestic market, and thus producers shift their optimal profit-maximizing output mix between export and home market production in favor of the latter. As well, an appreciation of real exchange rate makes import cheaper and export expensive in world market this induce firms to import more and export less; and hence, reduce the competitiveness of trade sectors in Ethiopia. Therefore; in opting of the policy shock, an appreciation or overvaluation of real exchange rate become inimical to export performance.

However; in the last four simulation periods the real export grew at a positive rate even if the real exchange rate is continued to appreciate until 2025. This part of the result is in line with the finding by Levent (2010), where doubling of electricity increases export on average by 0.31 percent in turkey. This might be presented as the total factor productivity effect of GERD on sectors which have highly linked with electricity (i.e. industry and manufacturing sectors) coupled with the reduction in production costs exists with the additional power supply from renaissance dam.

Moreover; the possible combined effect of increase in total factor productivity and lower appreciation

of the real exchange rate in later periods result in positive growth of real export in the last simulation periods. Therefore; these upbeat supply side effects of Ethiopian renaissance dam on the productivity of different sectors surmount the possible negative effect of the appreciation of the real exchange rate.

Conversely to export, in this policy experiment import volumes rise in line with an increment in factor income and consumption in the first five shock periods. Imports rise by 1.17 percent in 2020, by 1.59 percent in 2021, by 1.78 percent in 2022, by 2.59 percent in 2023 and by 2.78 in 2023 relative to the baseline scenario. These estimates confirm most of the empirical results found in the literature which examine the economic-wide effect of electric power generation plants (For instance; Bohlmann, et al., 2015; Robinson &Gueneau, 2014). This result can be explained by the increment in factor income and the appreciation of domestic currency as a result of the additional power supply via the construction of renaissance dam.

The intuition is that, in the perspective of domestic residents, an appreciation of real exchange rate reduces the price of imported product relative to domestically produced goods. This induces a substitution effect towards imports for commodities in cases where the exchange rate effect dominates the simultaneous drop in the prices of domestic output due to the electricity price reduction in the new equilibrium. This substitution effect affects both imports of final goods and intermediate inputs. Factor income distribution as well shapes the import demand patterns in important ways and implies the orthodox conclusion that – ceteris paribus – the rise in factor income increases the volume of domestic imports. Consequently, consuming a narrow range of imported product may simply reflect a narrow range of factor income, with no particular welfare loss.

However; in the last three post-shock periods, real imports volume do decline (i.e. reduced by 0.41 percent in 2025, by 0.73 percent in 2026 and by 0.92 percent in 2027). This result highlighted a significant shift in the consumption pattern of domestic consumers from the imported to domestic products, and the increment in the competitiveness of domestic production capabilities to match its counterparts due to the improvement in the ease of doing business with additional power supply from renaissance dam.

On investment level, as it is part GDP components, the construction of Ethiopian renaissance dam induce the capital stocks to rise over the medium and long term in line with the rise in factor income and real GDP growth rate. This result is in line with the finding by Levent (2010), Bohlmann et al. (2015) and Guntilake H. and Roland-Holst D. (2013) who documents a positive effect of additional power supply and real investment. This could be illuminated with the fact that, as the accelerator theory states, when businesses see an improvement in factor income and economic forecasts, they will increase their investment to meet future increment in demand.

In other saying, if factor income increases via the construction of Ethiopian renaissance dam, as the economy is on an up-turn, this induces investment spending in the economy to rise. Our results also confirm this and show that investment expenditure will rise by 0.98 percent in 2020, by 2.54 percent in 2022 and 4.36 percent in 2027, compared with the baseline scenario.

In sequence of events, we have also scrutinizing the question how does the construction of Ethiopian renaissance dam affect consumption pattern? This question is crucial for understanding consumers' behaviour and to evaluate our policy changes impacts on households' resources. Indeed, in virtually

consumption represents more than two thirds of GDP, thus knowledge of how consumers respond to income change with additional power supply from Ethiopian renaissance dam is also crucial for evaluating the macroeconomic impact thoroughly.Consequently, in opting of the policy simulation, it is obvious that the construction of Ethiopian renaissance dam increases factor income through backward and forward linkages (we will discuss this situations in the later sub-section).

Symmetrically, the result of the exercise showed that an additional power supply from Ethiopian renaissance dam increases household's consumption in line with increased factor income, but the short-term increases in income affect consumption less than long-term increases. Household's consumption rise by 0.64 percent in 2020, by 2.43 percent in 2025 and by 4.37 percent in 2027 relative to the baseline scenario. The empirical results obtained in this study are consistent with the finding by Bohlmann et al. (2015) who find a positive relationship between expansions of power supply and household's consumption.

Moreover, through power exports Ethiopian renaissance dam have also contributed significantly to a rise in government revenues via increases in the corporate tax revenue and surplus transfers. Accordingly, the government expenditure rise in line with increases in government revenue. The result also confirms this generalization (i.e. government spending increase by 0.58 percent in 2020, by 2.42 percent in 2025 and by 4.27 percent in 2027). This finding could also be presented as a result of rising in tax revenues in line with increase in economic activity from additional power supplies. In a consequence, the budget deficit slightly becomes narrow and narrow in the long term relative to the baseline scenario.

In a nutshell, from this evaluation the researcher can confidently conclude that Ethiopian renaissance dam should be brought online as expected in the simulation design, since its contribution on GDP components has shown as being unambiguously good for the economy.

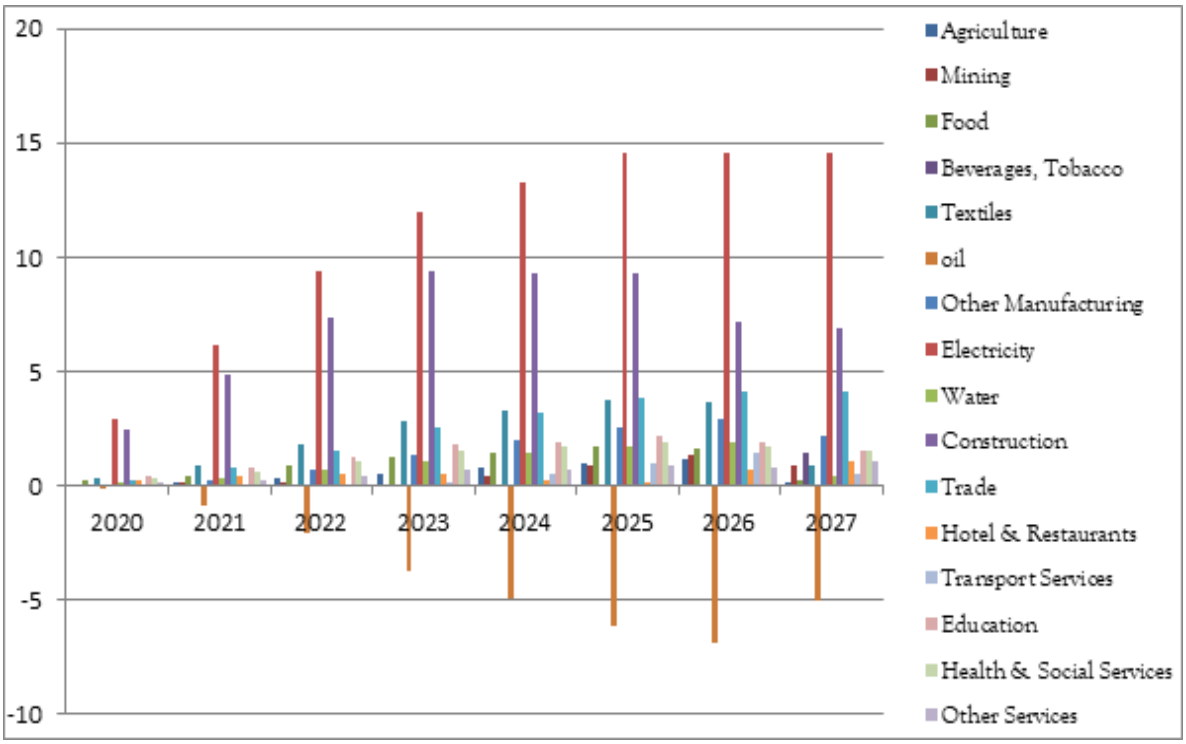
3.3. Impact on real output by sector

Macroeconomic effects that we have seen before, however; represent aggregate impacts. We further need to investigate these effects on different activities of the economy. The impacts of Ethiopian renaissance dam on the output of various sectors have shown in figure 2 below. As can be seen, the impacts of additional power supply from renaissance dam on various sectors are different. The impacts of Ethiopian renaissance dam on real output are fairly positive for almost all the sectors because the construction of Ethiopian renaissance dam benefits all sectors through a reduction in margin costs.

The immediate impact of the construction of Ethiopian renaissance dam is therefore; a significant expansion in output of electricity sector itself. This output expansion in electricity therefore; results in a higher demand for intermediate inputs thereby creating a spillover effect to the rest of the economy (i.e. as other sectors also increase their production to meet higher demand of their products). As a result, employment and returns to factors of production increases as well. Consequently, this higher in return to factors creates a snowball effect, as greater profitability in the electric sectors attract further investments. This is true especially for the sectors which have the strongest forward linkages with electricity. Thus, from our exercise one can ardently conclude that almost all sectors increase production relative to the baseline scenario due to the fact that the reduction in margin costs contributes to the reduction in the cost of production in post shock periods.

All at all, as a basic input for the national economy, additional power supply from Ethiopian renaissance dam makes the output of almost every sector increases. Secondly; the increments in the production of sectors indicating that under the background of a long-term power supply from the renaissance dam, industries transfer to high power-consuming sectors from low power consuming one.

Figure 2: The effect of GERD on real output by sector (Cumulative Percentage Difference Relative to Baseline).

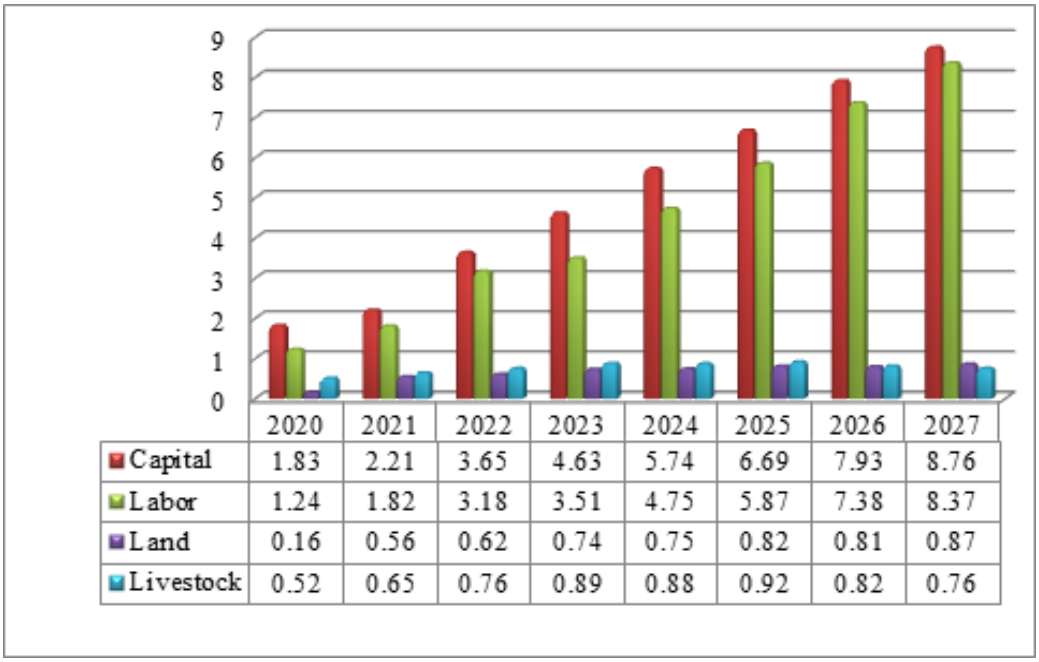


Source: GAMS result and Author's Own Calculations

3.4. Impacts on factor income

Regarding to the effects of GERD on the functional income distribution – that is the distribution of primary income by type of factors – Figure 3 displays the impacts on real factor returns relative to the baseline scenario in the corresponding years. Turning to returns of factors of production, the simulation result of the exercise found that aggregate income of factors of production in all simulation periods are slightly higher than the baseline. On balance, in our simulation periods we have observed that higher-growing sectors are relatively skill- and capital-intensive and thus their additional factor input demand drives up capital returns and skilled wages more than unskilled wages. Consequently, among the factors of production in our model, the return of capital grows at the fastest rate. It grew by 1.83 percent in 2020, by 4.63 percent in 2023 and by 8.76 percent in 2027 compared to the baseline scenario.

Figure 3: The effect of GERD on factor income (percentage change from the reference scenario)



	2020	2021	2022	2023	2024	2025	2026	2027
Capital	1.83	2.21	3.65	4.63	5.74	6.69	7.93	8.76
Labor	1.24	1.82	3.18	3.51	4.75	5.87	7.38	8.37
Land	0.16	0.56	0.62	0.74	0.75	0.82	0.81	0.87
Livestock	0.52	0.65	0.76	0.89	0.88	0.92	0.82	0.76

Source: GAMS result and Author's Own Calculations

As it can be seen from figure 3 above, in opting of our policy shock the aggregate income of labor has recorded positive growth compared with the baseline scenario. It has increased by 1.24 percent in 2020, by 3.51 percent in 2023 and by 8.37 percent in 2027 compared to base line simulation. The reason is emanates from fact that the higher-growing sectors what we have observed in our simulation are relatively skill and capital intensive and thus their additional factor input demand drives up skilled and semi-skilled returns more than the reference scenario. Consequently, the increment in returns of semi skilled and skilled labor offsets the reduction in returns of unskilled labor. Pronouncedly, the increment in income of skilled and semi-skilled labor is may be due to expansion in the output of tradable sector in our simulation. On the contrary, almost in all simulation periods the result of our exercise showed that in opting of our policy shock the returns of land and livestock are slightly rises but at a lower rates. The reason for the reversal of the effect on agricultural land rents and livestock is related to the fact that electricity use in agriculture sector is very low. Thus, in our policy shock agriculture benefits very little from additional electricity supply via the construction of Ethiopian renaissance dam and electricity price reductions.

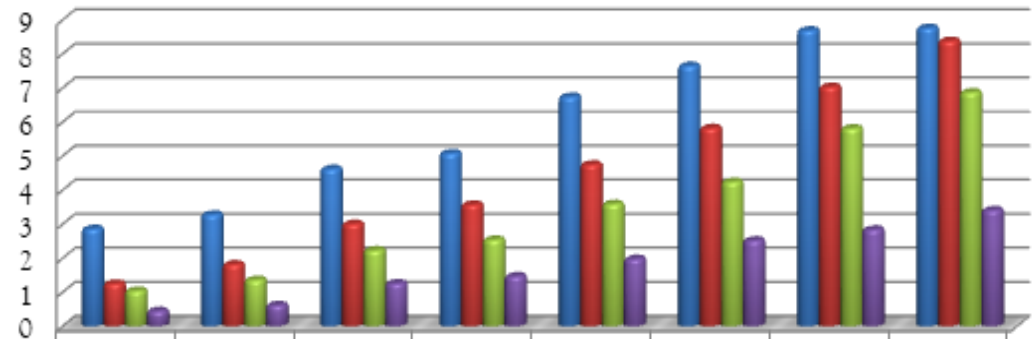
3.5. The effect of GERD on Household's Income

The income effect of the construction of Ethiopian renaissance dam via supplying additional power supply on household is captured through its impact on factor income and income from transfers. This is due to the fact that the primary sources of income for households are emanates from factor payments and transfers from other institutions. In our policy shock, with the rise in the production and productivity of almost in all sectors through additional power supplies, workers will see their nominal returns to rise (see figure 4 below).In consequence the nominal income of both poor and non poor households in both urban and rural areas has improved. However, since the urban and rural high-income groups have higher

shares of capital and skilled labor in their total income mix than the low-income groups, the former groups gain disproportionally.

Differently speaking, in a policy targeting power supply increment from renaissance dam, the increments in the income of poor and non poor households in rural and urban areas are different. For instance, in our policy shocks, the nominal income is slightly lower for rural households particularly for rural poor households than urban ones. For rural households, labor income is lower due to lower agricultural labor returns in rural area while capital income is lower as it is affected by a lower return to agricultural land in rural area. As share however; agricultural labor income is an important source of income for the rural low income households representing 86 percent of total income and 45percent of the total income for the rural rich ones. Conversely, in opting of our policy shock urban households see their income rises compared with the baseline scenario. This can be illuminated with the fact that non-agricultural labor and capital, in which they are highly endowed, have higher returns in urban area compared rural one in all simulation periods as we have seen in section above.

Figure 4: The effect of GERD on household income (%change with respect to baseline scenario)



	2020	2021	2022	2023	2024	2025	2026	2027
Urban Rich	2.86	3.28	4.62	5.08	6.74	7.65	8.69	8.76
Urban Poor	1.25	1.82	3.01	3.57	4.75	5.82	7.03	8.38
Rural Rich	1.04	1.36	2.23	2.54	3.59	4.24	5.81	6.87
Rural Poor	0.45	0.62	1.26	1.47	1.98	2.52	2.84	3.41

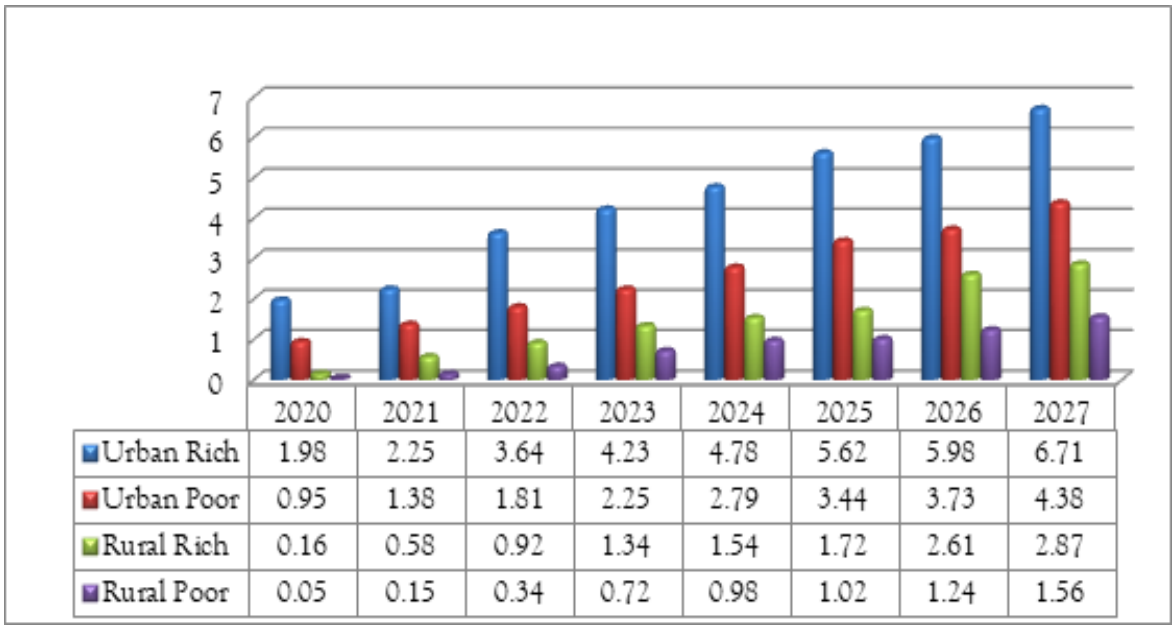
Source: GAMS result and Author's Own Calculations

3.6. Effect on Households Consumption Expenditure

On household's consumption expenditure side, in our model we have assumed that households spend their income on consumption after they pay taxes, save and transfer to other institutions. Hence, additional power supplies from Ethiopian renaissance dam affect the consumption expenditure of households by altering household's consumption. In our policy shock, we have aggregated households in to poor and non poor both in urban and rural areas. In consequence, with additional power supplies from renaissance dam the growth rate of households consumption expenditure of both poor and non poor households in both urban and rural areas has recorded a positive growth rate compared to the

base line simulation. However, as can be seen from figure 5 below the increments in growth rate of consumption expenditures of poor and non poor households in rural and urban areas are different. For instance, the consumption expenditure of urban poor and rich households has increased by 1.98 and 0.95 percent in 2020, by 4.23 and 2.25 percent in 2023 and by 6.71 and 4.38 percent in 2027 compared to the baseline scenario, respectively. The consumption expenditure of rural rich and poor households has also increased by 0.16 and 0.05 percent in 2020, by 1.34 and 0.72 percent in 2023 and by 2.87 and 1.56 percent in 2027 compared with the reference scenario, respectively.

Figure 5 The effect of GERD on household's consumption expenditure (% change with respect to baseline scenario)



	2020	2021	2022	2023	2024	2025	2026	2027
Urban Rich	1.98	2.25	3.64	4.23	4.78	5.62	5.98	6.71
Urban Poor	0.95	1.38	1.81	2.25	2.79	3.44	3.73	4.38
Rural Rich	0.16	0.58	0.92	1.34	1.54	1.72	2.61	2.87
Rural Poor	0.05	0.15	0.34	0.72	0.98	1.02	1.24	1.56

Source: GAMS result and Author's Own Calculations

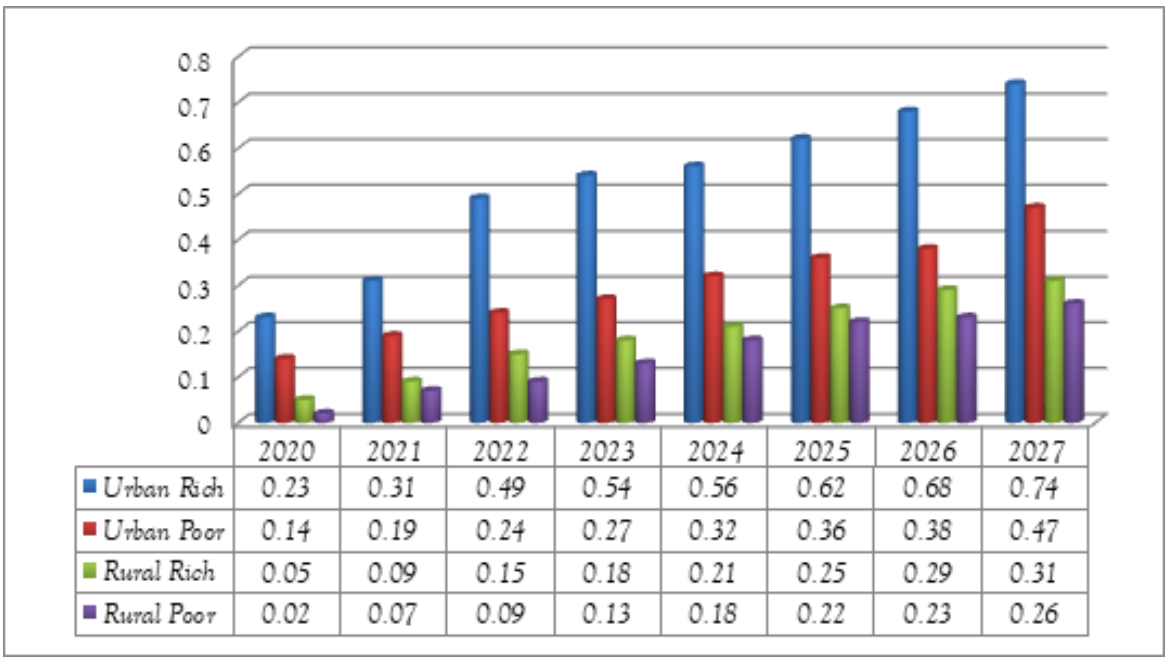
3.7. Welfare effect Of GERD

It is obvious that without changes in the electricity structure, economic and social transformation will lack motivation and the development foundation will be unsustainable. Therefore, its impacts on consumption and hence welfare are paramount. The construction of Ethiopian renaissance dam can affect household welfare through income via changes in factor incomes and through the expenditure via changes in commodity prices (Wiebelt et al., 2013).

To examine the impact of the policy simulation on the household's welfare we can use variables like household consumption expenditure and household real consumption. However, in most literature, to measure the welfare impact, equivalent variation (EV) is used as an important tool. EV compares "the costs of pre- and post-shock levels of consumer utility, both valued at base year prices" (Burfisher, 2011). A positive EV implies a welfare gain due to the new policy/shock: a negative EV indicates welfare loss.

In our experimental simulation the welfare effects of Ethiopian renaissance dam, as measured by the equivalent variation (EV), are substantial. Figure 6 below shows the improvements of welfare for all the households but much smaller compared to GDP gains. As we can see from the same diagram the shift in relative income across the household categories favors high income households. This is due to the fact that these households derive most of their income from increased capital earnings and from increased earnings of skilled labor.

Figure 6: GERD effect on household's welfare (Variation from its baseline scenario)



	2020	2021	2022	2023	2024	2025	2026	2027
Urban Rich	0.23	0.31	0.49	0.54	0.56	0.62	0.68	0.74
Urban Poor	0.14	0.19	0.24	0.27	0.32	0.36	0.38	0.47
Rural Rich	0.05	0.09	0.15	0.18	0.21	0.25	0.29	0.31
Rural Poor	0.02	0.07	0.09	0.13	0.18	0.22	0.23	0.26

Source: GAMS result and Author's Own Calculations

Moreover; a power supply increment causes prices to fall in the long run. This is due to the fact that with the rise in electricity supplies, the output of various sectors increase; hence, the supply of various goods increases more than what demand does. This will cause, ceteris paribus, a fall of final internal prices, which are a composite of prices of imports and domestically produced commodities. This reduction in price will in turn increase the purchasing of the households. Consequently, household's spending habits changed and Ethiopian economy experiences a positive welfare change in opting of our policy changes.

4. Conclusion and Recommendation

4.1. Conclusion

This paper examines the economy wide effect of Ethiopian renaissance dam on Ethiopian economy. The model is based on an updated Social Accounting Matrix for 2014/15 that takes into account the structural changes in the economy. Given the additional electricity generation capacity of Ethiopia, the model run a policy simulation in which the additional 6000MW that scheduled to come online near the future form

renaissance dam. To analysis this policy option this paper outlined a recursive dynamic computable general equilibrium approach. In opting for the policy shock, the results of exercise showed that with an increment in power supply from renaissance dam the country can optimize the beneficial impacts on its economy. Specifically, the simulation results show a spreading out effect in real GDP, sectors output, real investment, factor income, households income and households consumption expenditure. The result of the exercise also showed an improvement in the welfare for all the households' categories, however; the shift in relative income across the household categories favors high income households. Overall, this paper suggests that Ethiopian economy enjoys the largest improvement with additional power supply resulting from Ethiopian renaissance dam, therefore; concerned bodies should exerted maximum efforts to finalize the projects on time and resolve the age-long problems of the people so that the economy maintains its tremendous progress.

4.2. Recommendation

In the backstop of the above mentioned results, this study comes out with the following

recommendations:

- Under the background of a long-term power supply from the Ethiopian renaissance dam, industries transfer to high power-consuming sectors from low power consuming one. Hence; the government should ensure adequate power generation to meet the industrial electricity demand and to avoid the adverse effects of electrical power shortages on industrial production.

- As production and productivity of industrial sector improves more following the construction of Ethiopian renaissance dam shock, Ethiopian government should speed up the adjustment of industrial structure. This is also necessary to increase the proportion of service industry to GDP and employment creation.

- At the same time, national policy makers should give special emphasis on the construction of Ethiopian renaissance dam as additional power supply from GERD makes the output of almost every sector increases and Ethiopian economy experiences a positive welfare change in opting of our policy changes.

- Lastly, in terms of future research, this paper only considered the economic impact of the construction of Ethiopian renaissance dam; further research is required to get a more holistic view on the impact of Ethiopian renaissance dam on the environment and social considerations. Again, this research only creat one simulation scenario i.e amount of electricity gernatated from GERD, hence further research can do a better job by creat additional policy scenarios'. Consequently, alongside policy options that can spur greater employment and economic growth by reducing the cost of adopting environment friendly energy strategies will append attention in the theme.

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The Impact of External Debt, Unemployment, and Inflation on Economic Growth: Evidence from Sub-saharan African Countries

By

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Abstract

Achieving a high rate of economic growth, full employment, and price stability is key to macroeconomic policy objectives and a top priority for all countries worldwide. As a result, if these fundamental macroeconomic policy goals are to be realized, understanding the influence of external debt, unemployment, and inflation on economic growth is crucial. This study aims to examine the impact of external debt, unemployment, and inflation on economic growth in Sub-Saharan African countries. The study used panel data from thirty Sub-Saharan African countries from 2005 to 2019. The researchers employed a dynamic panel regression model, the system generalized method of moments (system GMM) estimation approach, and the Granger causality test. The study found that the three primary factors, external debt, unemployment, and inflation, have a significant negative relationship with economic growth in Sub-Saharan Africa. As external debt, unemployment, and inflation increased, SSA countries economic growth decreased. Our results indicate that foreign debt, as a result of debt servicing, has a detrimental influence on growth by crowding out both private and governmental investments. This supports the debt-overhang hypothesis' applicability in the SSA African region. According to the findings, economic growth had a one-way causal relationship with unemployment and external debt which flowed from unemployment to economic growth and from economic growth to external debt had but it had no causal relationship with inflation.

Keywords: External Debt, unemployment, inflation, economic growth, impulse response, causality, SSA countries, system GMM model

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1. INTRODUCTION

The majority of countries seek to build their economies quickly and sustainably. However, accomplishing such a goal has proven challenging due to a multitude of factors that drive economic growth. Economic growth has always been a key concern for economic policymakers. Researchers have also realized the importance of the topic and have extensively studied economic growth, along with its determinants. Inflation is one of many variables that can be described as a determinant of economic growth (R. J. Barro, 1995).

The external debt burden, along with its servicing, is another issue affecting developing countries economic growth. African countries' external debt is a source of worldwide concern. These economies' widespread indebtedness and their burden of external debt have sparked heated debate among policymakers, economists, academics, and the general public. To fuel economic growth, the majority of Sub-Saharan African countries rely on external debt. This is mostly due to a lack of internal finance sources to support socioeconomic activity and economic growth. When tax collections fall short of government expenditure predictions, governments usually have little choice but to raise taxes or borrow - either internally or abroad (Owusu-Nantwi & Erickson, 2016).

In addition to debt and inflation, in developing countries as well as industrialized economies the rising rate of unemployment has become a source of concern for policymakers and academics. This is due to the significance of unemployment as a crucial labor market outcome and an indicator of the status of an economy in general, as it plainly reflects a country's economic growth (Byrne & Strobl, 2004). Furthermore, the unemployment rate reflects the economy's overall performance and it represents aggregate economic activities. According to a number of country case studies, job creation is critical for rising living standards, increasing productivity, and encouraging social cohesion, all of which contribute to a country's overall growth (WB, 2012).

1.2. Statement of the problem

Theoretical models and empirical studies, has been developed different conclusions about the impact of external debt and inflation on economic growth. About debt and growth: Classicalists argued that external debt hinder economic growth (Krugman, 1988). Keynesians: argued external debt positively affect growth (Elmendorf & Mankiw, 1998). Ricardian equivalence hypothesis (REH): Government debt has no influence on growth (Ricardo, 1951; (R. J. Barro, 1989). And, in relation economic growth and inflation the discoverer of classical theory Adam Smith, considered that there is no apparent link between inflation and the tax effect on profit levels and output. Neo classicalists (Mundell, 1963),(Tobin, 1965) believes as inflation can indefinitely raise output growth rates by encouraging capital accumulation. In

contrast to Mundell and Tobin, Stockman, (1981) developed a model that shows a negative relationship between inflation and economic growth. And, for Keynesians there is initially positive link and then turns to negative as adjustment path develops.

Empirically, also researchers arrived on different conclusion about the impact of debt and inflation on economic growth. Some researchers support the positive link between foreign debt and growth (Sulaiman & Azeez, 2012). While others, supports the negative link (Qayyum & Haider, 2012b) and (Fiagbe, 2015), and some others still conclude, the influence of public debt on economic growth is mostly determined by governments' ability and competency in managing their resources (Ribeiro et al., 2012). Researchers finds a positive relation between inflation and growth (Mallik & Chowdhury, 2001), and a negative relationship (Fischer, 1993), or no relationship at all (Sidrauski, 1967).

From the theoretical models and empirical studies, it concludes that due to a range of variable factors such as the data coverage, methodology, the researcher's choice of control variables, and sampled countries' development level, the impact of external debt and inflation on economic growth is contradictory and inconclusive. This suggests that more research in this area is required.

In addition in the previous studies most researchers used OLS (ordinary least squares) estimation, and others use VAR (vector autoregressive model), VECM (vector error correction model), and ARDL estimation techniques. However, OLS estimation techniques does not take into account endogeneity between the variables and that render parameter estimations unreliable. Similarly, other models such as VAR, VECM, and ARDL models are not efficient to eliminate the problems of endogeneity, omitted variables bias, and measurement error. And are not preferable to obtain a better coefficient of parameters.

Furthermore, in sub-Saharan Africa researchers examined the impact of external debt on growth, the impact of inflation on growth, and the impact of unemployment on growth independently. As a result, they failed to determine the macroeconomic objective to pursue as a priority. Because as they are poor and developing Sub-Saharan African countries cannot simultaneously control inflation, unemployment, and a huge external debt burden.

Finally, unlike the previous studies, the current paper used not only more recent data and a larger number of observations, but also used one of the frontline econometric techniques, the system GMM estimation approach to fill the methodological gap and to untie the external debt, unemployment, inflation-economic growth dynamics in SSA countries and it also employed the granger causality test to find the direction of causality

The General objective of this paper is to investigate the impact of external debt, unemployment, and inflation of sub-Saharan African countries on their economic growth. Specifically, this paper objects

to investigate which one from among external debt, unemployment and inflation is more significant to affect economic growth of sub Saharan African countries and to examine whether there is causality between variables external debt, unemployment inflation and economic growth. What look like trend, structure and magnitude of public debt, unemployment, inflation and economic growth in the study period? Which determinant among public debt, inflation and unemployment is more significant to affect economic growth of sub Saharan African countries? What look like the direction of causality between external debt, unemployment, inflation and economic growth? Does debt overhang hypothesis works for sub-Saharan Africa? Are the question this research aims to address? This research will make a unique addition by establishing a thorough knowledge of the influence of inflation, unemployment, and external debt on economic growth and their causality with it in Sub-Saharan African nations. This research is organized into five sections. The first sections contains an introduction of the investigation, as well as a statement of the problem, the study's purpose, a research question, and the study's importance. The second section summarizes the most important theoretical and empirical studies. The study's methodology is presented in the third section. The fourth section deals with data analysis and the presentation of econometric model results as well as the result of causality test. Finally, in section five, the conclusion and policy implications are presented.

2. LITERATURE REVIEW

Three schools of thought (Classical, Keynesian, Ricardian,) have presented various arguments on the relationship between public debt and economic growth in the theoretical literature. On the subject of public debt, classical economists (primarily Smith, Ricardo, and J.S. Mill) demonstrated that they shared some basic ideas that led to similar conclusions. The three traditional economists' (Smith, 1776), (Ricardo, 1973) and (J.S. Mill, 1976) studies are complementary to one another, and the researchers believe that their combined work contributes significantly to the formulation of a single theoretical framework. According to this viewpoint, borrowing to fund public spending is harmful to the economy and its ability to generate wealth. Borrowing, according to the theory, reduces savings directly, i.e., income available for productive investment. Because government expenditures are, for the most part, nonproductive. Second, the Keynesian school of thought is regarded as a mono-causal explanation of growth, in which debt-financed government spending has a fiscal multiplier effect on national output or income (Elmendorf & Mankiw, 1999). The Ricardian equivalence hypothesis (REH) claims that the impact of the general economic level on demand is the same whether public expenditures are financed through debt or tax increases (Ricardo, 1951). The theory assumes a nonlinear relationship between debt and growth.

The relationship between economic growth and the unemployment rate could be traced from one school

of economic thought to the next. According to the classical economists, the link between economic growth and unemployment is a one-way link that occurs between labor inputs and economic growth (Kaldor (1967) and Dernburg & McDougall) (1985). Cobb-Douglas production function based on technical linkages between output and inputs such as labor and capital is also referred to by classical economists. The model showed that provided all other variables are fixed, the amount of labor force can assist to determine the pace of output increase. According to Hussain & Nadol (1997), Thirlwal (1997), and Grill and Zanalda (1995), the Keynesian theoretical links for economic growth and unemployment indicate that increases in employment, technical change, and capital stock are mostly endogenous. Harrod (1936), Domar (1947), and Solow (1956) investigated the question of long-run unemployment in determining the amount of economic growth and established the theoretical link between economic growth and unemployment. Okun, (1963) proposed a link between economic growth and unemployment, stating that GDP drops by 3% when the jobless rate rises by 1% above the natural rate of unemployment.

According to the traditional classical economist's views the link between inflation and output is implicitly negative due to the decrease in company profit levels and the savings achieved through increasing wage expenses (Gokal & Hanif, 2004). Aggregate Demand (AD) and Aggregate Supply (AS) curves are used in the Keynesian model. In this model, the AS curve is upward sloping in the short run, implying that changes in demand affect both price and output (Dornbusch, 1985). They similarly claim that AD and AS result in a route of adjustment. It indicates a positive association between inflation and economic growth at first, but it eventually turns negative as the adjustment route progresses.

Milton Friedman proposed monetary reform. Inflation, according to monetarists, occurs when the money supply grows faster than the rate of growth of national revenue. According to monetarists unemployment, output, and other real economic variables will be unaffected by inflation. Money neutrality is the term for this concept (Friedman, 1993).

Neoclassical growth economists came up with their own theory for the link between inflation and economic growth. They explained how inflation affects economic growth and claims, that inflation could boost production growth rates indefinitely by promoting capital accumulation (Mundell, 1963). (Tobin, 1965) agreed with Mundell that inflation is a positive indicator of economic expansion. (Stockman, 1981), in contrast to Mundell and Tobin, created a model that reveals a negative link between inflation and economic growth.

William Phillips of Britain discovered in 1958 that there was a negative correlation between inflation and unemployment in the form of a graph or equation in the UK from 1861 to 1958 Phillips (1958). According to Keynesian theory, governments may tolerate a moderate level of inflation, which will reduce unemployment.

Additionally, Lucas (1976) argued against the existence of the Phillips curve, asserting that this may be a compromise relationship between unemployment and inflation until policymakers establish a scenario in which high inflation is associated with low unemployment. On the one hand, employees think that both inflation and pay rises are conceivable. On the other side, the Lucas Criticism foresees high rates of both inflation and unemployment.

Empirically, Researchers came to diverse conclusions about the interaction of external debt and growth. For example: (Deshpande, 1997), attempts to explore the debt overhang hypothesis and after empirically investigating the growth experience of 13 heavily indebted poor African nations and his finding shows that foreign debt has a negative influence on investment. (Anyanwu & Erhijakpor, 2005), argued that massive debt accumulation discourages private investment because of the threat of greater taxes in the future to service the loan. External debt accumulation, according to (Sulaiman & Azeez, 2012), does not imply slow economic growth. Eberkardt and Presbitero (2014) investigated the long-term link between debt and growth in a broad panel of nations. The findings show that a nonlinear link exists in the long run, and that the relationship between public debt and economic development varies per country.

On the basis of their research, (Abrams & Wang, 2007) discovered a negative link between economic growth and unemployment for the 20 OECD nations between 1970 and 1999. The destruction of human capital, social marginalization, demonstrations, increasing crime rates, and sickness are some of the economic and social consequences of unemployment, according to (Kingdon & Knight, 2004). (Mohd Noor et al., 2007) conducted a study on the relationship between unemployment and output in the Malaysian economy; the regression results revealed a negative long-term relationship between unemployment and GDP, as well as a two-way causality link after applying the Granger Causality Test.

Fischer, (1993) published a study titled “role of macroeconomic factor in growth” that looked at the relationship between inflation and economic growth. The paper’s findings suggest that inflation has a negative impact on economic growth by lowering investment and slowing the pace of productivity increase. Barro, (1997), looked into the link between inflation and economic growth as well. He used data from 100 nations spanning 30 years, from 1960 to 1990 and found negative relationship between inflation and growth. on annual data from the IMF International Financial Statistics, (Mallik & Chowdhury, 2001), investigate the link between inflation and GDP growth for four South Asian nations, (Bangladesh, India, Pakistan, and Sri Lanka). For all four nations, the authors find evidence of a long-run positive link between GDP growth rate and inflation. Inflation have a substantial feedback loop with economic growth. On the other hand, According to one study by (Sidrauski, 1967), inflation has no long-term association with growth.

To experimentally study the relationship between public debt and inflation, including mutual impulse

response, (Nastansky et al., 2014) use quarterly data for Germany for the period of 1991 - 2010. According to the estimated findings, the amount of public debt has a very beneficial impact on consumer prices. Therefore, statistically, debt drives inflation and vice versa.

Between 1950 and 2012, (Lopes et al., 2014) examined the effects of public debt on 52 African economies' economic growth and inflation. The results show that public debt has a positive impact on inflation, using time series data from 1950 to 2012. In other words, a high level of public debt causes high inflation.

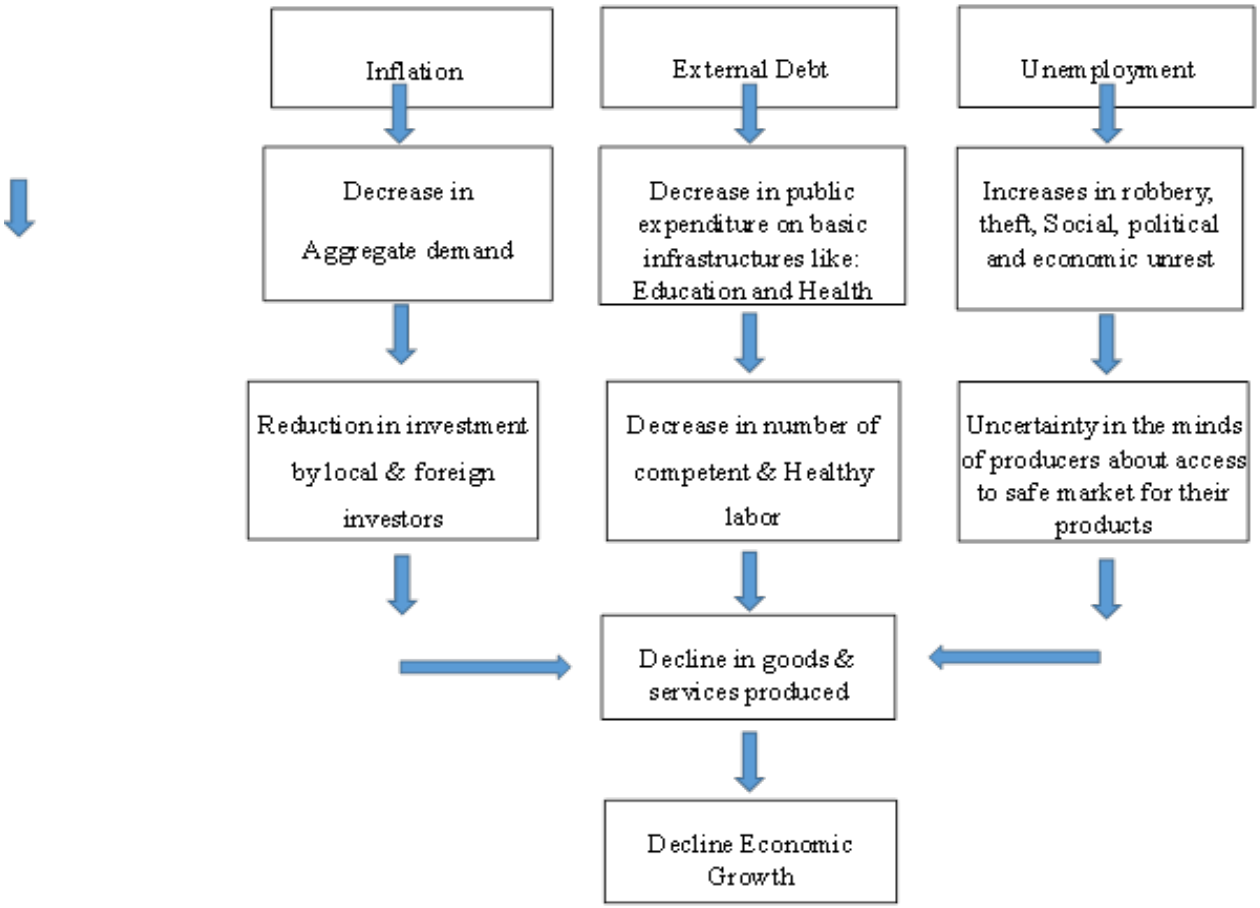
In Nigeria between 1977 and 2009,(Umaru & Zubairu, 2012) conducted an empirical investigation of the relationship between unemployment and inflation. They discovered a negative relationship between unemployment and inflation in Nigeria.

Al-Zeaud, (2014) examined the trade-off between unemployment and inflation in Jordan from 1984 to 2011 using the Unit Root, Cointegration, VECM, and Granger causality tests. He discovered that there is no trade-off between inflation and unemployment.

Generally, Academics and policymakers conducted various studies and research on debt, unemployment, inflation, and economic growth. A number of research have produced conflicting conclusions when it comes to the association between these four variables.

The conceptual framework in this study examines the impact of public debt, unemployment, and inflation on economic growth in nations of Sub-Saharan Africa. The conceptual framework used for the investigation of the influence of foreign debt, unemployment, and inflation on economic growth is shown in Figure 2.1.

Figure 2.1 Conceptual Framework



Source: Author's own formulation based on analytical and empirical review

3. DATA, AND METHODOLOGY

3.1 Data Set

This study used secondary annual panel data for a sample of 30 Sub-Saharan African nations from 2005 to 2019 to examine the impact of external debt, unemployment, and inflation on economic growth. Due to a lack of sufficient data for some variables, the study has been limited to this time period. The data for the dependent variable, economic growth, as well as the main explanatory variables external debt, unemployment, and inflation, and the control variables foreign direct investment, total debt service,

population growth, gross capital formation, gross domestic saving, export, and import, are all obtained from the World bank data source.

3.2 Model specification

In the Solow growth model, unlike the Harrod-Domar model, where capital is the only producing element, both capital and labor can be employed to produce output. Consider how capital (K), labor (L), influence an economy's production function: The production function in Solow's neo-classical model is as follows.

$Y = F(K, L)$ ---------- (1)

According to the production function, output is a function of various inputs. This function has constant returns to scale and a declining marginal product of each element.

$dF/dX > 0$, $d2F/dX2 < 0$----------(2)

Where X stands for each of the factors K, L.

Economic theories, however, are insufficient, according to (Sala-i-Martin, 1997), to identify the exact determinants of growth. They propose the following cross-sectional regression model as a solution to this problem:

$g = \alpha + \beta 1x1 + \beta 2x2 + \ldots + \beta nxn + \varepsilon$

Where g is the vector of economic growth rates, and x1..., xn are vectors of possible explanatory variables that vary from one researcher to another and ε the error term.

Dynamic panel regression model can be specified in the following general form:

$yit = \alpha yit\text{-}1 + \beta xit + \mu i + v it$ ……..……...……..……(*)

Where y denotes output growth, x is the matrix of all explanatory factors, μ symbolizes the unobserved country-specific time-invariant effect, v defines the stochastic error term, and, β is the parameters to be estimated, i denotes a specific country, and t denotes time.

The following general model will be employed to see the impact of public external debt, unemployment and inflation on economic growth:

General Model

$GGDPPCit = \beta i + \beta 1GGDPPCit\text{-}1 + \beta 2TEXDit + \beta 3UNEMPit + \beta 4INFit + \beta 5FDIit + \beta 6TDSERVit + \beta 7$

POPGit+β8GCFit +β9GDSAVit+β10M2it +β11EXPit +β12IMPit+ βit

Where;

GGDPPCit = Gross domestic product per capita growth of country i in year t expressed in %.

TEXDit = Total external debt stock of country i in year t expressed as percentage of GNI.

UNEMPit = Share of unemployed labor out of total labor force in year t expressed in %

INFit = Inflation rate of country i in year t expressed in percentage.

FDIit = Foreign direct investment net inflow of country i in year t expressed as percent of GDP.

TDSERVit = Total debt servicing of country i in year t expressed as percentage of GNI.

POPGit = Population growth of country i in year t expressed in percent.

GCFit = Gross Capital Formation of country i in year t expressed as percentage of GDP.

GDSAVit = Gross Domestic Saving of country i in year t expressed as percentage of GDP.

M2it = Broad Money Supply of country i in year t expressed as percentage of GDP.

EXPit = Export of goods and services of country i in year t expressed as percentage of GDP.

IMPit = Import of goods and services of country i in year t expressed as percentage of GDP.

εit = The error term ,i= 1,2……N and t= 1,2,……..T

3.3 Expected sign

Main variables of interest total external debt, unemployment, inflation and debt servicing, gross domestic saving, and import are expected to have a significant negative impact on economic growth of sub-Saharan African countries and lagged GDP, FDI, population growth, capital formation, money supply, and export are expected to have positive impact.

TEDBT: - it is expected to have negative effect on growth due to low quality of institutions to effectively use the external debt Escobari and Mollick (2013) and it's crowding out effect on private investment (Krugman, 1988)and public investments (Serieux & Sam, 2001).

UNEMP: - It is expected to have a negative and a significant impact on economic growth. Because, it is bad for the economy as it pushes the labor force to inter in to illegal acts like theft and robbery and

other social crimes to fulfill their basic needs (Adarkwa et al., 2017). This creates social and economic unrest and this creates doubt on domestic investors to get secure market and safe transportation of their products and also this social, political and economic unrest decreases foreign direct investment (FDI) finally reduces growth.

INF; It is a substantial increase in the general price level of goods and services in an economy over a period of time. And, an increase in price of goods and services will reduce aggregate demand and this reduction in aggregate demand causes a reduction in investment and finally slow in economic growth (Barro (1995); (Neil, 2000). Therefore, Inflation is expected to have a significant negative impact on economic growth of SSA countries.

Table 3.3.1. Expected Sign of Variables

Variables	**Significance**	**Expected sign**
Total external debt	Significant	Negative
Unemployment	Significant	Negative
Inflation	Significant	Negative

3.4. Model estimation technique

Researchers employ different model estimating approaches like as Ordinary Least Square Estimation (OLS), Fixed Effect and Random Effect (FE & RE), Instrumental Variable Method (IV), and Two-Stage Least Square Estimation (2SLS), in various Formal regression analyses. However, due to the presence of biases, coefficient estimates in different procedures in panel regression analysis become contradictory. The Instrumental Variable (IV) and Two-Stage Least Square Estimation (2SLS) approaches have been identified in the literature as effective tools however, they have a flaw in that they employ "external" instruments. These methods use "external" variables as instruments to compensate for any endogeneity among variables; nevertheless, these instruments rarely match the "validity and relevance" criteria of a good instrument, and are frequently inadequate. But, the Generalized Methods of Moments is the most efficient estimator (Stock and Watson, 2007). The GMM technique employs lags of endogenous variables as instruments, with the endogenous variables being preset and hence unrelated to the error term. The distinction of the GMM technique is based on the moment condition, which assumes weak exogeneity of regressors and no serial correlation.

In general, the GMM technique generates consistent and efficient parameter estimations when the following factors within the data generation process are considered:

a. When lags of the explained regressors are used as instruments to deal with the occurrence of

endogeneity among some variables. The validity of the instruments, on the other hand, is dependent on the source (variable) of endogeneity.

b. There are small time periods and large entities in the data sample (countries).

c. There are country-specific fixed effects that are distributed randomly.

d. There is no cross-country autocorrelation, but there is country-specific autocorrelation and heteroscedasticity in the error term.

e. When the dependent variable is influenced by the lagged dependent variable.

In the literature, two types of GMM estimators have been identified: Difference GMM and System GMM. Arellano and Bond (1991) proposed a difference GMM that uses the initial difference of the equation being estimated to overcome the problem of inconsistency caused by endogeneity among some variables in the model. But, this technique had drawback that it encounters a problem of weak instruments. Therefore, Blundell and Bond (1998) developed the system GMM technique to address the problem of weak instruments associated with the difference GMM technique. Furthermore, the system GMM is deemed the best appropriate panel regression estimate approach over difference GMM because of the following properties inherent in its process:

- The use of lagged values of explanatory variables as instruments overcomes the endogeneity problem.

- It allows for the use of both level and lagged values of the variables in the estimate equation, Because the system GMM uses many data for each entity over time, the problem of information loss associated with cross-sectional regression is eliminated, and

- Even with short time periods (T) and big countries, System GMM can yield reliable and unbiased parameter estimates (N)

3.4.1. Difference or System GMM Specifications:

Given the model, $Yit = a\ Y(it-1)+\beta 1Xit+Eit$

Where, a 0 is coefficient of the lagged dependent variable and $Eit = \mu i + v it$, Bond (2001) Rule-of-thumb for deciding between Difference and System GMM specifications consists of the following steps:

First, we use a pooled OLS and LSDV technique to estimate the dynamic model (i.e. using the within estimation or fixed effect approach). Second, the pooled OLS estimate for a is treated as an upper-bound estimate, whereas the matching fixed effect value for a is treated as a lower-bound estimate. Third, if the resulting Difference GMM estimate is near to or less than the fixed effect estimate for a , the System

GMM estimator should be utilized. Because of the poor instrumentation, the Difference GMM estimate is downward biased. Furthermore, if the model has a random walk (persistent) behavior, it's also a good idea to employ a System GMM.

Because of these advantages the researcher employed system generalized method of moments (GMM) estimation technique. And, the Sargan Test of Over-identification was used to test the hypothesis of valid over-identifying constraints within the GMM system to assure instrument validity. The Arellano-Bond (1991) test for second order autocorrelation in first differenced errors was used.

3.5. Panel causality test

One of the most important yet a difficult issues in empirical investigation is differentiating the causal relationship among economic variable. According to (Lin,2008), this difficulty, arises from none experimental nature of social science data. If cointegration exists between two variables X and Y, then one of three relationships may exist: a) X impacts Y, b) Y impacts X, and c) X and Y impact each other. The first two indicate one way relationship, whereas the third indicates a two-way relationship. Granger, (1969) created a causality test method to determine the pattern of such a relationship. It is claimed that X 'Granger causes' Y if current and lagged values of X improve the prediction of the future value of Y. In this research panel VAR granger causality test was used to investigate the relationship between variables and the direction of causality.

4. RESULTS AND DISCUSSION

4.1. Descriptive statistics

This section contains the analysis and discussion of descriptive statistics and the study's regression results. The mean, standard deviation, maximum, and minimum values of the dependent and independent variables for the sample countries from 2005 to 2019 is presented in Table 4.1 below.

Table 4.1 Statistical summary of the variables from the period 2005 to 2019

Variables	No of Observation	Mean	Standard deviation	Maximum	Minimum
Real GDP per capita growth	450	1.640193	3.790933	14.99794	-36.55692
External debt stock	450	37.12797	26.8217	179.0082	3.895006
Unemployment	450	7.776567	7.20812	29.12	0.32
Inflation	450	6.638868	7.122144	63.29251	-8.97474

Source:-Author's computation.

The average GDP per capita growth rate for the sample nations was 1.64 %, with a minimum value of -36.56 % and a maximum of 15 %. That indicates relatively the fast growing country among the study's sample countries grew at a rate of 15%. External debt was the model's first independent variable. It has a maximum value of 179.00 % and a minimum value of 3.89 %. External debt has a mean of 37.12 % and a standard deviation of 26.82 %. The mean indicates that the studied SSA countries' external debt stock is approximately 40 percent of their gross national income. Unemployment has a mean value of 7.78 %, with maximum and minimum values of 29.12 % and 0.32 %, respectively. Inflation has a maximum value of 63.29 percent and a minimum value of -8.97 percent over the study period, with mean 6.64 percent and standard deviation of 7.12 percent respectively. This means that the average inflation rate in the selected countries was 6.64 percent, with a 7.12 percent variation in its distribution. The relationship of variables is also explained in line graph as follows:

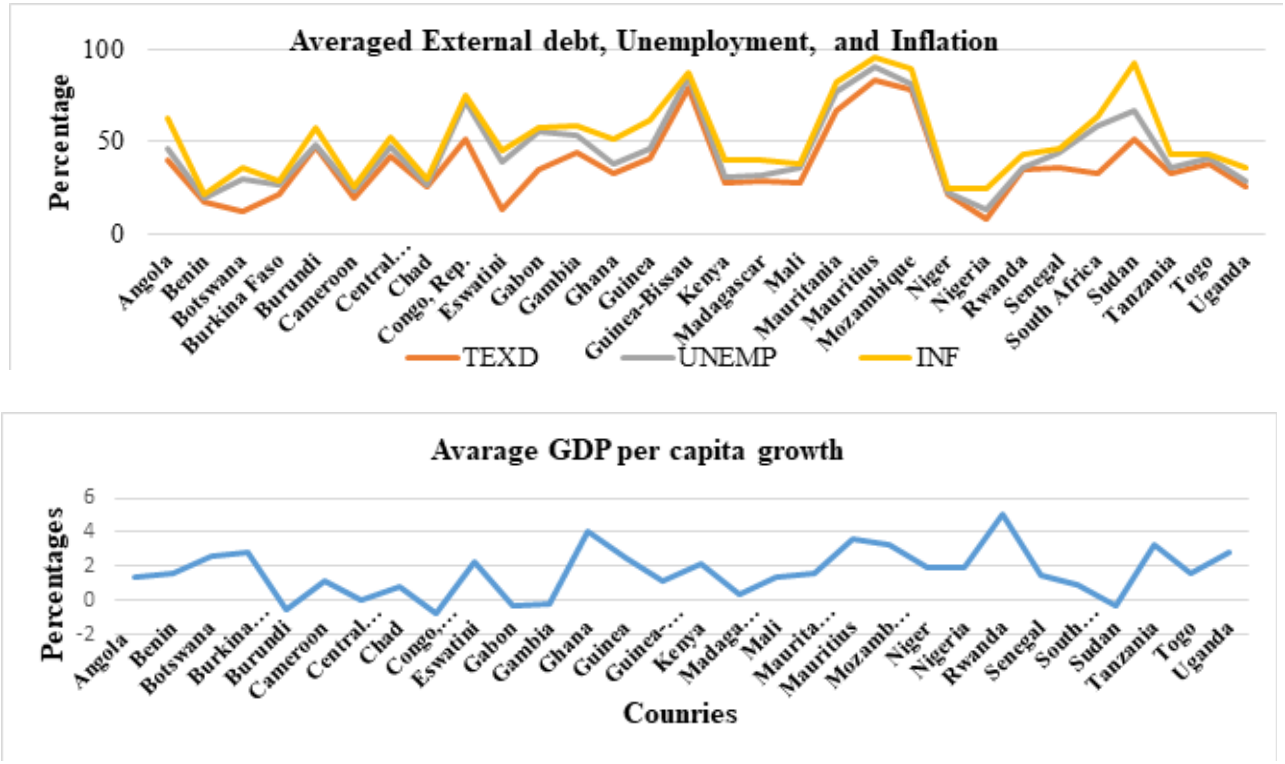


Figure 1: The patterns of average of external debt, unemployment, inflation, and GDP per capita growth of sub Saharan countries from 2005 to 2019.

Source: Author's computation based on the data.

Based on their patterns in the above figure, in SSA the three macro-economic factors foreign debt, unemployment, and inflation are close companions and move hand in hand. This is because, with the exception of a little difference in Botswana, the three variables showed remarkably similar patterns from

the first country, Angola, to the last country, Uganda. The trend of GDP per capita growth fluctuates in the opposite direction of the three variables discussed previously. As the graph shows when the three variables external debt, unemployment, and inflation rises, GDP per capita growth falls and vice versa. In general all the three variables external debt, unemployment and inflation were inversely related with GDP per capita growth and average distribution of all variables GDP per capita growth, foreign debt, unemployment, and inflation across the studied SSA countries was extremely variable from one country to the next over the sample period.

4.2. Econometric Analysis and Estimation and Results

The system generalized method of moments (system GMM) estimation technique was employed to estimate the coefficients of variables due its advantages over the other estimation techniques. It avoids the endogeneity among the variables and it overcame the problem of weak instruments associated with difference GMM.

As stated in the preceding chapter we compared the estimation coefficients of lagged dependent variable GDP per capita growth that derived from fixed effect estimation, difference GMM estimation, and pooled OLS estimation techniques in order to choose between difference and system GMM estimation. The coefficient of the lagged dependent variable, i.e. GDP per capita growth, determined using difference GMM estimation was 0.0067, which is lower than the coefficient calculated using fixed-effect estimation, which was 0.0098.In this situation, the weak instruments will cause the difference GMM estimation to failed Bond (2001).This demonstrates that the system generalized method of moments is the optimum estimation strategy for our model.

The following is the outcome of the empirical model developed in the previous chapter and used in the study to determine the impact of external debt, unemployment, inflation and some other factors on economic growth in the Sub-Saharan African region.

The probability of Hanssen J's statistics is insignificant at 5 % level of significance i.e. ($p > 0.05$). It implies that all instruments used in the model are jointly valid or there is no problem over identification. The Wald test statistics or (prob > chi2) for the overall regressions show that all of the variables are statistically significant when considered together. As an autocorrelation test, the values of Arellano bonds AR (1) and AR (2) are utilized, and the results demonstrate AR (1) is significant and AR (2) is insignificant at 5 % level of significance. As a result, we can conclude that the autocorrelation problem does not exist.

Table 4.2: Estimation Results of system GMM estimators (both one step and two step)

VARIABLES	**(1)** **One-step system GMM**	**(2)** **Two-step system GMM**
Real GDP per capita Growth (t-1)	0.053*	0.073*
	(0.030)	(0.039)
Total External Debt	-0.059*	-0.104**
	(0.032)	(0.041)
Unemployment	-0.326***	-0.289***
	(0.104)	(0.093)
Inflation	-0.076**	-0.084**
	(0.036)	(0.042)
Foreign direct investment	0.225*	0.278**
	(0.123)	(0.130)
Total debt service	-0.123*	-0.099*
	(0.074)	(0.057)
Population growth	-0.996	-0.718
	(0.640)	(0.764)
Gross capital formation	1.072**	1.611**
	(0.471)	(0.653)
Gross domestic saving	-1.070**	-1.572***
	(0.455)	(0.609)
Broad money supply	0.100***	0.142***
	(0.038)	(0.055)
Export	1.136***	1.595***
	(0.439)	(0.591)
Import	-1.131**	-1.628***
	(0.458)	(0.625)
Constant	5.947**	5.203**
	(2.490)	(2.583)
Hansen	0.201	0.394
AR(1)	0.043	0.023
AR(2)	0.661	0.756
Prob > chi2	0.000	0.000
Wald chi2 (12)	162.524	145.272
Observations	390	390
Number of country_ id	30	30
Number of instruments	28	30

Robust standard errors in parentheses;; *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' Estimations.

Notes: *** Significant at 1% level of significance; ** Significant at 5% level of significance; * Significant at a 10% level of significance.

4.3. Discussion of the study result

As can be observed from the regression result in table 4.2 above, one of the explanatory variables for this model was lagged per capita GDP. It has a statistically significant favorable impact on economic growth in the region at the 10% level of significance. We can draw from the estimate that lagged GDP was one of the most important elements in the economic expansion of Sub-Saharan African countries. The positive association between lagged GDP (GDP t-1) and current economic growth indicates that previous year's GDP was used as an initial capital for current period investment, boosting economic growth. This study's findings were similar to the finding of Blomstrom (1996).

The coefficient of external debt is -0.104, with a P-value of (0.010). It can be interpreted as when external debt increased by 1unit, economic growth in Sub-Saharan African countries declined by 0.104 unit, which is statistically significant at the 5 % level of significance. As expected, the association is negative. This negative association shows that external debt in Sub-Saharan Africa has a detrimental influence on economic growth by crowding out private investment. This also support the debt overhang hypothesis (DOH), demonstrating that larger external debt is related with lower rates of real GDP growth in SSA and it rejects the Ricardo equivalence hypothesis (REH), which states that government debt has no impact on growth (Ricardo, 1951). This study's findings were similar to those of (Deshpande, 1997), (Krugman, 1988), (Sachs, 1989), and (Anyanwu & Erhijakpor, 2005). As a result, the researcher failed to invalidate the null hypothesis that external debt in Sub-Saharan Africa has a negative relationship with economic growth.

Unemployment showed negative coefficients as expected, with a coefficient of 0.289 and it is statistically significant at the 1% significance level. It was estimated that a 1 unit rise in unemployment rate will result in a 0.289 unit decline in economic growth when other independent variables are held constant. This is because unemployment has negative economic implications such as the destruction of human capital, social marginalization, demonstrations, and an increase in crime rates. This finding is in line with ((Kingdon & Knight, 2004), (Mohd Noor et al., 2007); (Abrams & Wang, 2007), (Dritsakis & Stamatiou, 2016), and (Makaringe & Khobai, 2018)) studies. As a result, these research fail to reject the null hypothesis that total unemployment and SSA growth have a strong negative connection.

In terms of inflation, this study's regression results indicate that the relationship between inflation and growth is negative and significant at the 5% significance level. It implies that when inflation rises by 1unit, the economic growth of the studied Sub-Saharan African countries falls by 0.084 unit, assuming all other independent variables remain constant. This result matches the a priori prediction given earlier in the inquiry. As a result, the researcher fails to refute the null hypothesis that inflation and growth have a negative relationship. According to the findings of the study, inflation is a drag on the economy. It lowers the purchasing power of money, discouraging investment that could boost the economy's productive capacity. By increasing the cost of borrowing it causes a reduction in investment, and a decline in economic growth. This result has been supported by previous studies like ((Barro (1995); (Neil, 2000); and (Adaramola & Dada, 2020).

Another significant predictor of SSA's economic growth is foreign direct investment. It has a positive coefficient of 0.278 and is statistically significant at the 5% significance. It shows that an increase of 1unit in FDI will boost SSA GDP growth by 0.278 unit. In theory, inward FDI has a positive impact on a host country's economic growth by increasing capital accumulation, access to superior technology, increased efficiency, higher competitiveness, and exports (Hlongwane, 2011). As a result, the null hypothesis that FDI has a positive influence on SSA growth was not rejected. The findings of this study are in line with those of (Michael, 2018),and (Masipa, 2014).

The coefficient of external debt servicing, is -0.106, with a P-value of 0.061. It means that increasing external debt servicing by one unit reduces economic growth in the sample SSA nations by 0.106 unit, which is statistically significant at the 10% significance level. As expected high debt servicing might prevent a country from allocating resources to productive activity - the crowding out hypothesis. Similarly, debt service discourages private investment by raising the prospect of future tax increases to pay for the debt (Krugman, 1988). Furthermore, most SSA nations have large amounts of accumulated debt, as a result of which their governments' short-term revenue is utilized to service the debt, reducing economic growth by crowding out public investment in human capital such as health and education (Serieux & Sam, 2001). This finding is consistent with previous studies of (Fosu, 1999); (Serieux & Sam, 2001), and (John Gachunga, 2019).

The rate of increase in total population as measured by the coefficient of population growth is -0.718, but, it is statistically insignificant.

Gross capital formation has a statistically significant positive impact on regional economic growth. This is exactly what was expected. It can be interpreted as a 1unit increase in gross capital formation resulted in 1.611 unit increases in economic growth. The findings supported the Harrod-Domar model, which showed that national income growth is directly proportional to capital formation. This result is

consistent with (Ugwuegbe, 2013) and (Aslan & Altinöz, 2021) 's research.

The coefficient of gross domestic saving is -1.572, with a P-value of 0.010, it can be deduced that if gross domestic savings increased by 1unit, economic growth would fall by 1.572 unit, which is statistically significant at a 1% level of significance. It implies that when saving increases obviously investment will decline as saving and investment are inversely related and the reduction in investment finally decreases GDP growth. This is because the Keynesian concept of an aggregate demand-driven economy gives birth to the paradox of thrift. An increase in the savings rate reduces spending in the economy, lowering overall production growth (via Keynesian consumption). This result is consistent with the study of (Joshi et al., 2019).

The broad money supply coefficient is positive 0.142, with a P-value of 0.010. Holding all other independent variables constant, when money supply grew by 1unit, SSA's economic growth increased by 0.142 unit, and the effect is stronger at the 5% level of significance. This means that an increase in the money supply will reduce the saving interest rate that banks pay to depositors, lowering gross domestic saving and increasing investment, boosting economic growth. Furthermore, increasing the money supply boosts banks' lending capacity by avoiding liquidity concerns, which lowers bank lending interest rates to borrowers, which increases investment and, ultimately, economic growth. This result is supported by the work of (Gatawa et al., 2017).

The export coefficient is positive 1.595, with a P-value of 0.007. It shows that if all other independent variables remained constant, a 1unit increase in export would result in a 1.595 unit rise in SSA's economic growth, which is statistically significant at a 1% level of significance. As expected, export has a positive impact on SSA's economic growth, meaning that as exports rise, so does economic growth in the same direction. It means that more exports indicate a high level of output from a country's factories and industrial facilities, as well as a larger number of workers employed to maintain these firms running. When a corporation exports a large amount of commodities, it also brings money into the country, stimulating consumer spending and contributing to economic growth. Empirical studies such as (Taghavi et al., 2012); Balassa (1985), Ram (1987), and Khalifa Al-Youssif (1997) found that export positively affects economic growth.

According to table above the coefficient of import is -1.628, with a P-value of 0.009. This shows that when import increased by one unit then economic growth of the sampled SSA countries decreased by 1.628 unit, which was statistically significant at a 1% level of significance. As a result, the null hypothesis that import has a negative impact on SSA growth was not rejected. This implies that when a country's imports exceed its exports, the country's balance of trade is distorted, and the currency devalues. Because the value of a currency is one of the most important indicators of a nation's economic

performance and gross domestic product, devaluation of a country's currency can have a significant influence on citizens' real activities and the country's GDP. This result is consistent with the study of (Taghavi et al., 2012).

Taken together, our empirical findings revealed that external debt, unemployment, inflation, debt servicing, gross domestic saving, and import were found to be statistically significant factors that negatively affect the growth of Sub-Saharan African countries. While initial GDP, foreign direct investment, gross capital formation, money supply, and export were found to have a positive and significant impact on SSA growth, population growth was found to be statistically insignificant, even if it had a negative impact.

4.4. Granger Causality

The optimal lag for the VAR model is chosen after testing the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and, Hannan-Quinn Criterion (QIC). The BIC standard provides an ideal lag of 1. As a result of the test, at lag 1 the VAR model's statistical tests are trustworthy. And, after conducting a unit root test all the variables GDP per capita growth, external debt, unemployment, and inflation are all found stationary at level. As a result, there is no need to conduct cointegration test. This section presented the panel VAR granger causality test result.

Table 4.4.1. Panel VAR Granger Causality test Results

Dependent	Independent	chi2	Degree of freedom	Prob > chi2
GDP per capita				
	Total external debt	0.001	1	0.973
	Unemployment	5.356	1	0.021
	Inflation	0.209	1	0.647
	ALL	5.375	3	0.146
Total external debt				
	GDP per capita growth	9.342	1	0.002
	Unemployment	1.556	1	0.212
	Inflation	10.802	1	0.001
	ALL	27.692	3	0.000
Unemployment				
	GDP per capita growth	1.756	1	0.185
	Total external debt	0.706	1	0.401
	Inflation	3.511	1	0.061
	ALL	5.808	3	0.121
Inflation				
	GDP per pitaca growth	2.485	1	0.115

	Total external debt	5.989	1	0.014
	Unemployment	2.377	1	0.123
	ALL	10.833	3	0.013

Source: Own computation based on the data using STATA 15 software.

Panel VAR-Granger causality Wald test

Ho: Excluded variable does not Granger-cause Equation variable

Ha: Excluded variable Granger-causes Equation variable

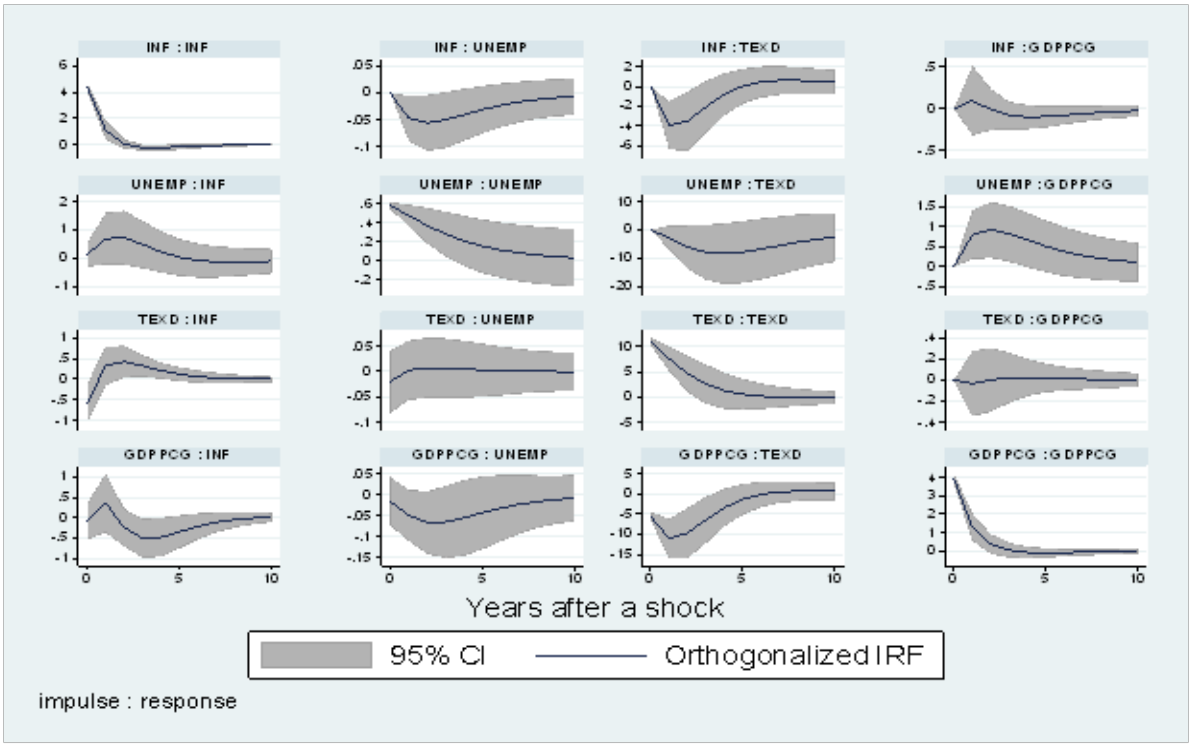
As a rule of thumb, we can reject the null hypothesis and infer that x Granger causes y if the p-value is less than the commonly used significance level (0.05). According to the results of the granger causality test, economic growth has no causal relationship with inflation, but does have a unidirectional causal relationship with external debt and unemployment that goes from unemployment to GDP per capita growth and from GDP per capita growth to external debt at 5% significance level. There was a two-way causation between inflation and external debt at 5% level of significance. And, there is a one way causal association between unemployment and inflation at 10 % significance level that runs from inflation to unemployment.

4.5 Impulse response and the variance decomposition

4.5.1. Impulse response function results

The responsiveness of the dependent variables in a VAR to a unit shock to each of the variables in the system is described by Impulse Response Modeling (Brooks, 2008: 299). The impulse response functions determine the transmission of the shock in the economic variables. The extent to which the shock's effects fade away in impulse responses indicates the system's stability. The system will be regarded stable if the shock gradually fades away (ibid). In this section, the results of the impulse response analysis include a graphical evaluation of the dependent variables' reactions to changes in the explanatory factors, the sign, magnitude, and rate of decay of the reactions was examined. And, it presented as follows:

Figure 4.5.1. Impulse responses of variables



Accordingly, figure 4.5.1. Shows the results of the impulse response functions i.e. a one unit standard deviation shock of one variable result on other variables for next 10 years. The variable on the left represents the impulse variable and the right variable shows the response variable. It can be interpreted as follows: As can be observed from the above orthogonal impulse response function, as compared to the responsiveness of GDP per capita growth, unemployment and inflation to their shocks, external debt is more responsive to its shock. This is because, for a one unit shock of itself it jump up start of 10 and this is higher than the response of other variables. All of the variables requires long period to recover from a shock.it means that in needs ten years or more for a shock to gradually fades away. But, the shocks of all of the variables gradually fades away as the time horizon increases and it indicates that the system is stable.

4.5.2. Forecast Error variance decomposition (FEVD)

The capacity to determine how much of the variability in a dependent variable is lagged by its own variation is achieved by variance decomposition. It also reveals which independent variable is bigger and more powerful in explaining the variability in the dependent variables across time. Because, VAR models are dynamic, a shock to one variable in the model will affect others to differing degrees. Variance decompositions also assess how much of a variable's projected variance is explained by changes in explanatory factors (Brooks, 2008: 300).

The following table shows the variation of the variable explained by their own shock and the shock of the other variables with in the forecast horizon of five years.

Table: 4.5.2. Forecast error variance decomposition (FEVD) result

Response variables and forecast horizon		Impulse variables			
Response Variables	Forecast horizon	GDP per capita	External debt	Unemployment	Inflation
GDP per capita	0	0	0	0	0
	1	1	0	0	0
	2	0.964248	0.000221	0.035147	0.000384
	3	0.930297	0.000224	0.069085	0.000394
	4	0.906950	0.000236	0.092022	0.000792
	5	0.892227	0.000282	0.106057	0.001434
External debt		Impulse variables			
		GDP per capita	External debt	Unemployment	Inflation
	0	0	0	0	0
	1	0.155635	0.844366	0	0
	2	0.23122	0.66222	0.0206	0.08596
	3	0.237406	0.564054	0.0725	0.12604
	4	0.223756	0.504991	0.138706	0.132547
	5	0.207825	0.465242	0.200302	0.126631
Unemployment		Impulse variables			
		GDP per capita	External debt	Unemployment	Inflation
	0	0	0	0	0
	1	0.001182	5.59E-05	0.998763	0
	2	0.008101	0.000719	0.984379	0.006802
	3	0.013995	0.001548	0.969848	0.014609
	4	0.018104	0.002170	0.958969	0.020756
	5	0.020718	0.002567	0.951765	0.024950
Inflation		Impulse variables			
		GDP per capita	External debt	Unemployment	Inflation
	0	0	0	0	0
	1	0.010627	0.003053	0.000454	0.985867
	2	0.009831	0.006984	0.004626	0.978559
	3	0.010794	0.013245	0.009241	0.966719
	4	0.013478	0.017322	0.011073	0.958127
	5	0.015579	0.019232	0.011267	0.953923

As can be observed from the above table 4.5.2 the forecast error variances decomposition result the variables are highly exogenous especially at the initial periods of the forecast horizon but latter on when the forecast period increases the portion of their shock explained by their own shock decreases and the variables becomes relatively more endogenous.

5. CONCUSION AND POLICY IMPLICATION

5.1 Conclusion

This study aims to investigate the impact of external debt, unemployment, and inflation on economic growth in Sub-Saharan African countries, which is an important economic topic that continues to trouble policymakers, with the goal of extending precise policy measures to improve economic growth. It also intends to explore the causal relationship between foreign debt, unemployment, inflation, and economic growth in SSA nations. In this study, strongly balanced secondary panel data from World Bank were used. It covers the period from 2005 to 2019 and contained 30 SSA countries. Economic growth was the study's dependent variable, with external debt, unemployment, and inflation as the main independent variables, and foreign investment, debt servicing, population growth, gross capital formation, gross domestic saving, money supply, export, import, and lagged GDP growth as the control variables. Dynamic panel regression model and system generalized method of moments (GMM) estimation technique were employed to estimate the impact of total external debt stock, unemployment, inflation and other variables on economic growth of sub Saharan African countries and the VAR granger causality test were used to test the relationship between the variables.

The estimation result has shown that our primary variables of interest, external debt, unemployment, and inflation, as well as debt servicing, gross domestic savings, and import, all have negative impacts on SSA economic growth, but domestic and foreign direct investments, money supply, and export all have positive impacts. And population growth were found insignificant. In addition, the debt overhang theory, which asserts that debt hinders investment by instilling dread of future tax increases to service the debt, was applicable to SSA based on the findings of the estimated coefficients. However, the Philips curve theory, which claims that as inflation rises, unemployment falls, did not hold true for SSA as evidenced by both descriptive studies of data distribution patterns and GMM regression results.

The panel VAR granger causality test result has shown that economic growth has unidirectional causation with unemployment and external debt, with unemployment leading to GDP per capita growth and GDP per capita growth leading to external debt. However, economic growth and inflation do not cause each other. On the basis of this link, it is feasible to conclude that while foreign debt and inflation cannot be used to forecast economic growth in SSA, unemployment can. Similarly, economic growth in SSA

countries cannot be used to forecast unemployment or inflation, but it can be used to predict the region's external debt.

5.2 Policy implication

Our empirical findings have identified the significant negative impacts of external debt, unemployment, and inflation on SSA economic growth, as explained in the conclusion section of this chapter. And, the following policy implications are proposed as a result of these findings.

Sub-Saharan African country's governments should decrease the level of external debt stock, level of unemployment, and level of the inflation rate. To do this we recommend those countries governments, to supplement external revenue streams, and state-of-the-art mechanisms for collecting domestic revenue be implemented. We also advocate for a strong macroeconomic climate in SSA so that debt yield negotiations do not empty the treasuries of SSA governments due to high debt servicing expenses. Sub-Saharan African countries should strengthen the quality of their institutions in order to effectively and efficiently use foreign loans and avoid unproductive loan allocation. We also recommend SSA governments to strengthen their price controls mechanisms in order to control inflation. Furthermore, the government must develop flexible labor market policies or legislation, as well as create a conducive environment for new businesses to enter the economy, as well as consolidate existing entrepreneurship activity with new entrepreneurs who absorb a large pool of unemployed people in order to create more jobs.

Finally, according to the study's findings, out of the three primary macroeconomic problems of external debt burden, unemployment, and inflation, unemployment has the greatest impact on SSA countries' economic growth, followed by inflation and external debt. As a result, SSA policymakers should prioritize the decrease of unemployment.

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Financial Innovation, Monetary Policy and Economic Growth in Ethiopia

By

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Abstract

The objective of this study is to explore the relationship among financial innovation, monetary policy, and economic growth of Ethiopia for the period spanning from 1980–2018. In order to analyze the long-run and short-run relationship between real GDP per capita growth rate (dependent variable) and its drivers, the study employed Autoregressive Distributed Lag (ARDL) Approach to Co-integration and Error Correction Models. Furthermore, the Granger-causality test is also employed in order to identify the directional causality among financial innovation, monetary policy and economic growth under the pair wise granger causality frame work. According to the revealed results from the Bounds test there is a stable long run relationship among real GDP per capita growth rate, financial innovation proxy variables (broad to narrow money ratio and domestic credit to the private sector), gross fixed capital formation, interest spread, nominal exchange rate, trade openness, government expenditure, and consumer price index. The empirical results revealed that both gross fixed capital formation and government expenditure are found to have positive association with economic growth and statically significant in the long run. However, consumer price index and broad to narrow money ratio (LM2/M1, proxy for financial innovation) are found to have negative and statistically significant association with economic growth in the long run.

Keywords: Innovation, financial innovation, economic growth, Ethiopia, monetary policy, ARDL

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1. Back Ground of the Study

Financial innovation has been used to refer to a wide range of changes and advances affecting financial markets in a variety of contexts. The term can be used to refer to the introduction of new financial instruments in a very narrow meaning and the changes in the structure and depth of financial markets, as well as changes in financial institutions' roles to the broader one. Because financial innovation is a continuous process, it is difficult in practice to grasp all of its contours; and even more difficult to foresee its repercussions, which adds an element of uncertainty to the economic setting in which central banks work. If financial innovation enhances the financial systems efficiency, it should also have a considerable impact on the functioning of the overall economy.

In both developed and developing countries different studies have been conducted on the nexus between financial sector development and economic growth. However, the current study adds to the previous literature in numerous aspects. First, to the best of my knowledge, this study is the first attempt to examine the relationship among financial innovation, monetary policy and economic growth in Ethiopia. Although quite a few empirical studies in neighboring countries such as Kenya considered the financial innovation from a different perspective, empirical evidence regarding the contribution of financial innovation to economic growth remains narrowed to specific regions. In particular, there seems to be no study related to financial innovation, monetary policy and economic growth from Ethiopia. But a study was conducted on particularly the impact of financial development on economic growth using ARDL approach and financial repression - economic growth nexus using multivariate analysis in Ethiopia. This research gap stimulated to discover how financial innovation plays a perilous part in the growth process and monetary policy aspect of Ethiopia. Second, to accomplish the objective, we apply an autoregressive distributive lag (ARDL) bound testing method in this research.

While financial innovations can help to improve the efficiency of the financial system, making monetary policy easier to implement, they can also complicate the environment in which monetary policy is implemented (Angeloni, et al, 2003; Noyer, 2008). The financial crisis of 2007-2008 demonstrated that financial innovation is not a smooth process. As a result, the problems that central banks face are aimed not only at achieving efficiency, but also at ensuring financial system stability. Ethiopia's present financial crisis serves as a reminder that financial innovation is a bumpy road. To allow digital financial services, the government is currently focusing its reforms through the NBE on digitizing financial services and enhancing financial market infrastructure (DFS). The purpose is to promote financial sector innovation and use DFS to achieve financial inclusion and policy relief. Ethiopia has witnessed a number of financial innovations in the recent period. The launch of Tele - money commenced in 2021 spearheaded by the Ethiopian government is one of the pivotal examples. The other aim of the study is to identify whether

these wave of financial innovations have impacted on the transmission mechanism of monetary policy and economic growth, and if so how using Granger Causality test. Generally, the aim of this study is to investigate the relationship between financial innovation and economic growth in Ethiopia, as well as to investigate the implications of financial innovation on monetary policy.

So far, the existing literature implies that financial innovation fosters economic growth; however, the causation and extent to which financial innovation generates high growth rates in emerging nations has yet to be determined (Levine, 1997). Surprisingly, there has not been much research on the relationship between financial innovation and economic growth in Africa and none for Ethiopia. This study bridges the knowledge gap regarding the relationship between financial innovation and economic growth in Ethiopia. The existing literature implies that financial innovation has a positive or negative association with growth, which stems from the finance-growth nexus. Financial innovation, implicitly, has both a positive and negative impact on Economic growth. This study establishes the causal and directional relationship between financial innovation and economic growth, financial innovation and monetary policy in Ethiopia empirically. These can be achieved using the Autoregressive Distributed Lag (ARDL) bounds tests and Granger causality tests on financial time series data of Ethiopia.

2. Objective of the Study

The general objective of this study is to investigate the linkage among financial innovations, monetary policy and economic growth in Ethiopia thereby addressing the following specific objectives.

i. Ascertain whether long run and short run relationship exist among financial innovation, monetary policy and economic growth in Ethiopia.

ii. Determine the nature of causality among financial innovation, monetary policy and economic growth in Ethiopia.

iii. Examine the implications of financial innovation on the growth performance of Ethiopia.

iv. To recommend possible policy and research implication based on the research findings.

3. REVIEW OF RELATED LITERATURE

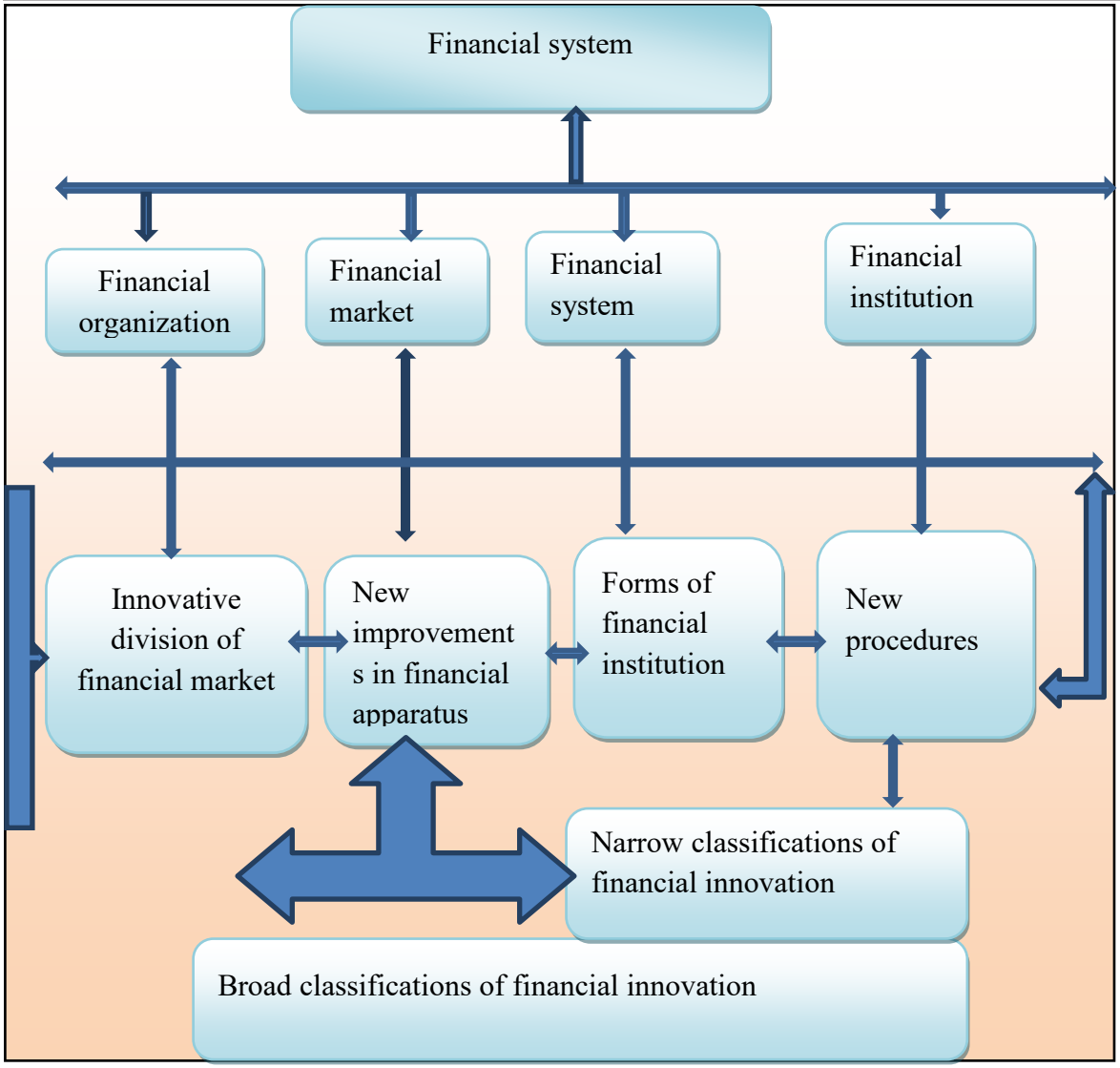
3.1 Theoretical Literature

The term “innovation” has been used to characterize the advances in the technological solutions, new combinations of productive means and generating the above the average rates of return thereby boosting the dynamic development of the overall economy (Targalski, 2006, p. 7). The major sources of innovations can be analyzed either by the demand theory or by the supply theory of the two perspective

innovation from its beginning. According to the demand theory, innovations are emerged as the response to the demand of business entities due to their aspiration for competitive advantage in their business environment (the demand-driven innovations). However, the internal needs of the business entity focus at improvement in its activity or the changes in its environment requiring the proper adjustment in its business strategy affected this demand (Błach, J., 2011).

The evolution of financial innovation is long and has had far reaching impact. This financial innovation can be classified as any financial instruments (besides traditional shares and straight bonds), any financial institutions (besides traditional banks) and any financial markets (besides the traditional markets for the straight bonds and shares), for a certain period of time. The new financial instruments debt contracts and the high liquid markets in the 17th and the 18th century were introduced to gather capital required to finance the oceanic expedition and trading voyage. Then, the investment banks together with the new accounting methods were also introduced in the 19th century to evaluate the profitability of railroad companies and to provide fund for them .Next, the private equity companies were also commenced to analyze and finance high-tech investment project , in the 20th century. The developments of the new forms of investment companies - the pharmaceutical corporations analyzing and funding the bio-tech innovative solutions, at the beginning of the 21st century (Michalopoulos, Leaven and Levine, 2009).

Those mentioned above are the most common and well known approaches on the way to the definition of the financial innovations presented in the financial literature. However, based on the definition of the financial system the new definition of the financial innovations can be developed. Therefore, this broad definition can describe financial innovations as changes in the functioning and the new solutions and advancements in: (a) financial institutions, (b) financial markets), (c) financial instruments and (d) regulations linked with their activity (see figure 1.1). The interconnectedness of these classes of financial innovations is multidimensional and can be designated as the spiral of innovations (compare: Gubler, 2010, p. 1-49). This means that the new financial organizations develop the new financial instruments (products and services) that are operated in the new financial markets and this new resolution need new conventions shortly. Modifications in the market conditions together with the changes in the legal surroundings escort to the formation of new instruments and then establishment of the new markets and organizations focusing in these new improvements (Błach, J., 2011).



Source: Reprinted from "financial innovations and their role in the modern financial system identification and systematization of the problem", by Błach, J. (2011), Financial Internet Quarterly''e-Finanse", 7(3), 13-26".

Figure 1.1: Financial innovations in the broad and narrow meaning

3.2 Review of Empirical Literature

Financial innovation, according to Mwinzi (2014), has a large and favorable impact on economic growth. Financial intermediaries play a significant part in the growth process by moving financial capital from net savers to net borrowers, thereby persuading investment and hence economic development, according to the theoretical point of view of financial intermediation.

King and Levine (1993a), discovered that there is a positive association between financial indicators and growth, and that financial development is significantly correlated with subsequent rates of growth, capital accumulation, and economic efficiency, supporting the supply flowing theories. They accurately point out that policies affecting the efficiency of financial intermediation have a first-order impact on growth. Mwinzi (2014), found that financial innovation has a considerable, beneficial impact on economic growth in Kenya. According to the findings, mobile transactions have a significant impact on economic growth. Financial innovation has been linked to money demand (Kasekende and Opondo, 2003; Mannah-Blankson and Belnye, 2004) and savings (Mannah-Blankson, and Belnye, 2004). Financial innovation has been shown to have a favorable association with money demand or saving in research (Ansong, MarfoYiadom and Asmah, 2011).

A comparable research done by Al-Sowaidi and Darrat (2006), investigated the effects of financial innovations in Bahrain, the UAE and Qatar on the long-run money demand. Despite the rapid speed of financial innovation in the three countries, the study found no undue shifts in the equilibrium money demand relationship. The findings were robust to the measure of the money stock narrow or broad.

Wegayehu Tsegaye (2021), using the ratio of broad to narrow money supply and credit provided to the private sector by banks as percentage of GDP for financial innovation proxy variable examined the impact of financial innovation on money demand in Ethiopia using VECM estimation method. The empirical findings of this study revealed that, when utilizing the VECM coefficient estimate approach, financial innovation has a positive, but not significant, association with both short and long run money demands. However, incorporating financial innovation into money demand functions challenges Ethiopia's well-defined money demand specifications.

This study run a Granger causality test based on our understanding of previous empirical studies to examine the directional causality between variables. The following six hypotheses are put to the test. Furthermore, the causality among financial innovation, monetary policy, economic growth along with the other macroeconomic variables shown as follows:

A. Financial innovation Granger-cause macroeconomic variable and vice versa.

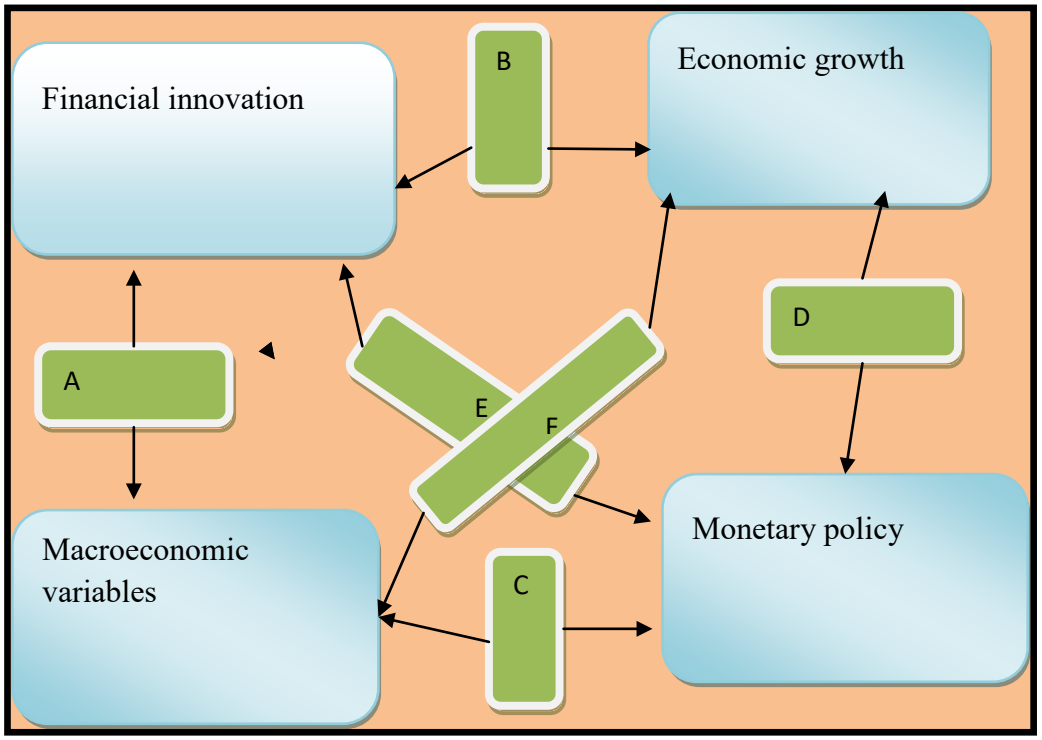
B. Financial innovation Granger-cause economic growth and vice versa.

C. Macroeconomic variable Granger-cause monetary policy and vice versa.

D. Monetary policy Granger-cause economic growth and vice versa.

E. Macroeconomic variable Granger-cause economic growth and vice versa.

F. Financial innovation Granger-cause monetary policy and vice versa



Source: Own formulation

Figure 1.2: Conceptual framework

4. METHODOLOGY OF THE STUDY

4.1 Variables and sources

This study tasted and analyzed the dynamic causality relationship among financial innovation, monetary policy and Economic Growth/GDP assuming other things remained constant (ceteris paribus condition). This study employed explanatory research design in order to show the extent and nature of cause-and-effect relationships. With the help of EViews statistical tool, the study used the Autoregressive Distributed-lag (ARDL) model and Error Correction Model (ECM), which are substantially more efficient in the event of small and finite sample size. Unlike the vector autoregressive (VAR) model, which is only designed for endogenous variables, the ARDL model allows for mixed order of integration and employs both endogenous and exogenous variables. This study employed protracted financial time series data of Ethiopia for the period spanning from 1980-2018 taken from the World Bank (WB), NBE and international monetary fund (IMF).

4.2 Method of Data Analysis and Estimation Techniques

The study employed quantitative method of analysis for the collected data. All estimations were carried out using EViews econometric software. To prove Co-integration and, as a result, estimate the direction of causation between variables, the researcher used the bound testing autoregressive distributed lag (ARDL) technique proposed by Pesaran and Shin (1995, 1999), Pesaran et al. (1996), and Pesaran (1997). The proxies for financial innovation should cover a broad range of elements of the financial system. The ratio of broad money to narrow money, M2/M1, was utilized as a proxy for financial innovation in this study (Ansong, Marfo-Yiadom, &Ekow-Asmah, 2011; Arrau, De Gregorio, Reinhart & Wickham, 1995; Mannah-Blankson&Belnye, 2004). The second is Domestic credit to the private sector (DCP), which refers to the credit services provided to the private sector for investment in loan, securities, and other receivables (Ansong, Marfo-Yiadom, &Ekow-Asmah, 2011; Laeven et al., 2015). The researcher adopted the following as control variables for financial innovation: Gross fixed capital formation (GCF), trade openness (TOP), government expenditure (GEX), interest spread_(IS) the difference between lending and deposit rate), nominal exchange rate_(ER) and Consumer price index_(CPI). Some of these variables were transformed into their logs form for further assessment, and to avoid heteroscedasticity (Gujarati, 2004).

5. The Empirical Model

5.1 The Extended Aghion, Howitt, and Mayer-Foulkes (AHM) Model

This study adopted a financial innovation model that was developed by Laeven et al. (2015), which extended Aghion, Howitt and Mayer-Foulkes'_ (AHM) regression framework and consequently used by (Bara et al., 2016). Laeven et al. (2015) used a model that states that "economies without financial innovation will stagnate, regardless of their initial degree of financial development," to study the impact of financial innovation on endogenous growth. Take the AHM regression framework for example:

$$g\text{-}g0 = b0 + b1F + b2\,(y\text{-}y1) + b3\,F(y\text{-}y1) + b4X + u$$

Where g-g0 is average growth rate of per capita income relative to U.S. growth over the period 1960–1995. F is financial development (measured as credit to the private sector as a share of GDP), y-y1 is log of per capita income relative to U.S. per capita income, X is set of control variables and u is an error term.

To test the concept, Laeven et al. (2015), Bara and Mudxingiri (2016), and Bara et al. (2016) updated the AHM model to include financial innovation and financial development. All of these scholars emphasized financial innovation. They assumed in their models that any period's financial development is the

product of previous financial advances. According to AHM framework, Bara et al. (2016) developed the following model:

g-g0 = b0 + b1F + b2 (y-y1) + b3 F(y-y1) + b4 X + b5f + b6 f(y-y1) + u

The dynamic regression model projected in this investigation is as follows:

$$YXy_{t-1} = Ff_i \quad (1)$$

$$\overbrace{RGDPPCGr_t}^{Y} = \left(\overbrace{GEX_t, CPI_t, IS_t, EXR_t, TOP_t,}^{X} + \overbrace{RGDPPCG_{t-1}}^{y_{t-1}} - \overbrace{GFCF_t}^{F} + \overbrace{M2/M1_t, DCP_t}^{f_i} \right) \quad (2)$$

From the above equations (1) and AHM framework, developed by Bara et al. (2016) we have the following:

Y = real GDP per capita growth rate which is the dependent variable, F = financial innovation, which is the variable for the control of financial development, X = vector of control variables, fi = financial innovation variables and yt-1 denotes the lagged variable of real GDP per capita growth rate. The linear form of equation (2) becomes:

$$RGDPPCGr_t = \alpha_0 + \alpha_1 GEX_t + \alpha_2 CPI_t + \alpha_3 TOP_t + \alpha_4 EXR_t t + \alpha_5 IS_t + \alpha_6 RGDPPCG_{t-1} + \alpha_7 GFCF_t t + \alpha_8 lnM2/M1_t + + \alpha_9 lnDCP_t + \varepsilon_t \quad (3)$$

Where ln is the natural logarithm; RGDPPCGrt is real gross domestic product per capita growth rate; (M2/M1) is ratio of broad to narrow money; GEX is government expenditure; CPI is consumer price index; TOP is trade openness; EXR is the nominal exchange rate; IS is the interest spread (the difference between lending and deposit rate); GFCF is the gross fixed capital formation and DCPS is domestic credit to the private sector. A generic ARDL model for variables X, Y and Z can be written as follows:

$$\Delta Y_{t-1} = \emptyset + \gamma_1 Y_{t-1} + \gamma_2 X_{t-1} + \gamma_3 Z_{t-1} + \sum_{i=1}^{n1} \theta_{1,i} \Delta Y_{t-1} + \sum_{i=1}^{n2} \theta_{2,i} \Delta X_{t-1} + \sum_{i=1}^{n3} \theta_{3,i} \Delta Z_{t-1} + \varepsilon_t \quad (4)$$

Where γ1, γ2, γ3 are long run coefficients whose sum is equivalent to the error correct term in VECM model and θ1i, θ2i, θ3i represents short run coefficients. The generalized ARDL model for testing the relationship between financial innovation, monetary policy and economic growth incorporated in this study shown as follows:

$$\Delta(RGDPPPCGr)_t = \alpha_0 + \alpha_1\Delta(\mathrm{GEX})_{t-1} + \alpha_2\Delta(\mathrm{CPI})_{t-1} + \alpha_3\Delta(TOP)_{t-1} + \alpha_4\Delta(EXR)_{t-1} + \alpha_5\Delta(\mathrm{IS})_{t-1} + \alpha_6\Delta(RGDPPCG)_{t-1} + \alpha_7\Delta(\mathrm{GFCF})_{t-1} + \alpha_8\Delta ln(\mathrm{M2/M1})_{t-1} + \alpha_9\Delta ln(\mathrm{DCP})_{t-1} + \theta_0(RGDPPCG)_{t-1} + \theta_1(GEX)_{t-1} + \theta_2(CPI)_{t-1} + \theta_3(TOP)_{t-1} + \theta_4(EXR)_{t-1} + \theta_5(IS)_{t-1} + +\theta_6(GFCF)_{t-1} + \theta_7 ln(M2/M1)_{t-1} + \theta_8 ln(DCP)_{t-1} + \varepsilon_t \quad (5)$$

Where Δ denotes the difference operator, εt denotes the error term otherwise assumed as white noise, θ1-θ8 denotes the long run coefficients. Under the null hypothesis of no cointegration, basically the bounds test is based on the joint Wald test or F-test, which has is non-standard asymptotic distribution.

5.2 Co-integration and Error Correction

After establishing the long run relationship we have to estimate the following long run ARDL (n1, n2, n3, n4, n5, n6, n7, n8, n9) equilibrium model as follows:

$$(RGDPPPCGr)_t = \alpha_0 + \sum_{i=1}^{n1}\alpha_{1,i}(\mathrm{GEX})_{t-i} + \sum_{i=0}^{n2}\alpha_{2,i}(CPI)_{t-i} + \sum_{i=0}^{n3}\alpha_{3,i}(TOP)_{t-i} + \sum_{i=0}^{n4}\alpha_{4,i}(EXR)_{t-i} + \sum_{i=0}^{n5}\alpha_{5,i}(\mathrm{IS})_{t-i} + \sum_{i=0}^{n6}\alpha_{6,i}(RGDPPCG)_{t-i} + \sum_{i=0}^{n7}\alpha_{7,i}(\mathrm{GFCF})_{t-i} + \sum_{i=0}^{n8}\alpha_{8,i}\ln\left(\frac{\mathrm{M2}}{\mathrm{M1}}\right)_{t-i} + \sum_{i=0}^{n9}\alpha_{9,i}\ln(\mathrm{DCP})_{t-i} + \varepsilon_t \quad (6)$$

The Error Correction Model (ECM) is specified if there is co-integration. Short-run economic growth adjustment is, nonetheless, required for policy goals. Due to this reason a dynamic error correction model (ECM) is also described to account for the speed of adjustment. The specification for the short-run dynamic parameters estimated by the error correction model is specified as follows:

$$\Delta(RGDPPPCGr)_t = \alpha_0 + \sum_{i=1}^{n1} \alpha_{1,i}\Delta(\mathrm{GEX})_{t-i} + \sum_{i=0}^{n2} \alpha_{2,i}\Delta(CPI)_{t-i} +$$
$$\sum_{i=0}^{n3} \alpha_{3,i}\,\Delta(TOP)_{t-i} + \sum_{i=0}^{n4} \alpha_{4,i}\,\Delta(EXR)_{t-i} + \sum_{i=0}^{n5} \alpha_{5,i}\,\Delta(\mathrm{IS})_{t-i} +$$
$$\sum_{i=0}^{n6} \alpha_{6,i}\,\Delta(RGDPPCG)_{t-i} + \sum_{i=0}^{n7} \alpha_{7,i}\,\Delta(\mathrm{GFCF})_{t-i} + \sum_{i=0}^{n8} \alpha_{8,i}\,\Delta\ln\left(\frac{\mathrm{M2}}{\mathrm{M1}}\right)_{t-i} +$$
$$\sum_{i=0}^{n9} \alpha_{9,i}\Delta\ln(\mathrm{DCP})_{t-i} + \gamma \mathrm{ECM}_{t-1} + \varepsilon_t \quad \_\_\_\_\_ (7)$$

Where, α1 to α9 be the model's short-run dynamic coefficients of convergence to equilibrium, ECM(t-1) is the error correction term that confirms the existence of co integration/long-run relationship among the variables when the coefficient on this term is negative and statistically significant.γ=is the speed of adjustment parameter with a negative sign.

$$ECT_t = (RGDPPPCGr)_t - \alpha_0 + \sum_{i=1}^{n1} \alpha_{1,i}\,(\mathrm{GEX})_{t-i} - \sum_{i=0}^{n2} \alpha_{2,i}(CPI)_{t-i} +$$
$$\sum_{i=0}^{n3} \alpha_{3,i}\,(TOP)_{t-i} - \sum_{i=0}^{n4} \alpha_{4,i}(EXR)_{t-i} - \sum_{i=0}^{n5} \alpha_{5,i}(\mathrm{IS})_{t-i} -$$
$$\sum_{i=0}^{n6} \alpha_{6,i}\,(RGDPPCG)_{t-i} - \sum_{i=0}^{n7} \alpha_{7,i}(\mathrm{GFCF})_{t-i} - \sum_{i=0}^{n8} \alpha_{8,i} \ln\left(\frac{\mathrm{M2}}{\mathrm{M1}}\right)_{t-i} -$$
$$\sum_{i=0}^{n9} \alpha_{9,i}\,\ln(\mathrm{DCP})_{t-i} \quad \_\_\_\_\_ (8)$$

This long-run and short-run estimation is of most importance in this technique, as it is on the basis of this that inference can be drawn as to whether financial innovation has a significant impact on monetary policy and economic growth in Ethiopia

5.3 Unit Root Test

The test was carried out for two different cases. It is first tested with constants but no trends, then with constants and trends. The results of the unit root test using the Augmented Dickey and Fuller (1981) and Phillip and Perron (1988) tests for the variables in this investigation are as shown in the Table 1.1 below. The variable RGDPPCGr, is stationary at level I (0) while ln(M2M1), ln(DCPS),GEX, GFCF, TOP, EXR and IS become stationary after first difference and thus I (1) but none of the variables are integrated of order 2.

Table 1.1: Unit root tests (Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests)

	Level				1st difference				I
	Constant		Constant and trend		Constant		Constant ad trend		
	ADF	PP	ADF	PP	ADF	PP	ADF	PP	
RGDPPCGr	-5.779	-5.786	-7.042	-7.106	-	-	-	-	I(0)
	(0.000)*	(0.000)*	(0.000)*	(0.000)*					
CPI	6.298	6.656	2.577	2.859	-2.219	-1.876	-4.115	-4.067	I(1)
	(1.000)	(1.000)	(1.000)	(1.000)	(0.203)	(0.339)	(0.013)	(0.0148)*	
LDCPS	2.085	2.040	-0.083	0.042	-3.410	-3.382	-4.409	-4.088	I(1)
	(0.999)	(0.000)*	(0.993)	(0.995)	(0.016)*	(0.018)	(0.013)	(0.014)*	
EXR	1.874	3.500	-0.353	0.331	-2.906	-2.893	-3.837	-3.704	I(1)
	(0.999)	(1.000)	(0.985)	(0.998)	(0.054)	(0.055)*	(0.025)*	(0.034)*	
GEX	-2.357	9.458	-2.300	5.314	-3.259	-1.226	-3.550	-2.330	I(1)
	(0.160)	(1.000)	(0.422)	(1.000)	(0.025)*	(0.652)	(0.051)*	(0.408)	
GFCF	2.012	17.703	6.410	8.806	5.055	-4.090	4.165	-5.085	I(1)
	(0.998)	(1.000)	(1.000)	(1.000)	(1.000)*	(0.002)*	(1.000)*	(0.001)*	
IS	-1.159	-1.100	-1.950	-1.971	-6.949	-6.939	-6.840	-6.831	I(1)
	(0.681)	(0.705)	(0.608)	(0.597)	(0.000)*	(0.000)*	(0.000)*	(0.000)*	
M2/M1	2.407	2.182	-0.867	-1.121	-4.222	-4.256	-4.778	-4.778	I(1)
	(1.000)	(0.999)	(0.949)	(0.911)	(0.002)*	(0.001)*	(0.002)*	(0.002)*	
TOP	-1.394	-1.264	-0.574	-0.810	-4.772	-4.725	-4.858	-4.773	I(1)
	(0.574)	(0.635)	(0.974)	(0.955)	(0.000)*	(0.000)*	(0.002)*	(0.002)*	

Source: Own computation

5.4 Determining the Optimal Lag Length (k) for the model

Using Akaike Information Criteria (AIC), this study calculated the model's Optimal Lag Length (k). All test statistics indicate that the ideal lag length is two except for the Schwarz Information Criterion (SC), where the maximum (*) is situated. Therefore, the optimal lag length that best fits our model is 2.

Table 1.2: VAR lag order selection criterion

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-537.0507	NA	53.27570	29.51626	29.90810	29.65440
1	-163.0697	545.8101	7.99e-06	13.67945	17.59789*	15.06088
2	-22.59478	136.6783*	7.49e-07*	10.46458*	17.90964	13.08931*

Source: Own computation

5.5 F-Bounds Co-integration Test Results

Following the estimate of regressions, the ARDL bounds testing is used to determine if the variables under investigation are co-integrated or not. The F-Bounds Co-integration test was employed in this investigation. The F-Bounds Co-integration test yielded the following results.

Table 1.3: F bound Co-integration estimation result

	F-statistics	**Critical value lower at 95%**	**Critical value upper at 95%**	**Decision rule**
Model 1	14.82834	2.32	3.5	co integration
Model 2	19.81718	2.32	3.5	co integration

Source: Own computation

Based on table 1.2 above, for both models (model 1 and 2), the variable are co-integrated. This means, if the F-statistic value is greater than upper bound value, we can say that the variables are co-integrated. As shown 1.2 above, the findings of the study for both model 1 and model 2 revealed that the F-statistic_ (model 1) = 14.83, the lower bound I(0) = 2.32 and upper bound I(1)= 3.5 and the F-statistic_(model 2) = 19.82, the lower bound I(0) = 2.32 and upper bound I(1)= 3.5 respectively at 5% significance level. The estimation result confirms that the variables are co-integrated. This implies that there is long-run relationship among variables.

5.6 Long run model estimation

This finding suggests that real GDP per capita growth rate and its determinants have a long-run relationship. The estimated long-run relationship between the variables is estimated after validating the presence of a long-run co-integration relationship between the variables, and the estimated coefficients

are provided in Table 1.3 (a & b) below. The study identified 2 modes; these are the two proxy variables of financial innovation (Broad to narrow money ratio and domestic credit to the private sector).

Table 1.3(a): The Estimated Long Run Coefficients using the ARDL Approach selected based on Akaike information criterion by taking LDCPS as FI variable.

Model 1: LDCPS as FI variable

ARDL Long Run Form and Bounds Test
Dependent Variable: D(RGDPPCGR)
Selected Model: ARDL(2, 0, 1, 2, 0, 0, 0, 0)

Levels Equation
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPI	-0.010145	0.004161	-2.438047	0.0225
EXR	0.002663	0.011877	0.224244	0.8245
GEX	-2.95E-06	1.15E-06	-2.571378	0.0168
IS	-0.005559	0.010914	-0.509352	0.6152
LDCPS	0.020208	0.033911	0.595918	0.5568
GFCF	2.20E-06	4.11E-07	5.350775	0.0000
TOP	0.322532	0.345553	0.933380	0.3599

EC = RGDPPCGR - (-0.0101*CPI + 0.0027*EXR -0.0000*GEX -0.0056*IS +
0.0202*LDCPS + 0.0000*GFCF + 0.3225*TOP)

Source: Own computation

Model 1: Domestic credit to the private sector (DCPS) as a proxy for financial innovation

Model – 1 is developed by considering DCPS as proxy variable for financial innovation. This study found that DCPS had a positive impact on economic growth but the coefficient is statistically insignificant in the long run as depicted from table 1.3(a) above and the result is consistent with the empirical studies of Bara and Mudxingiri (2016). However, Ndlovu (2013), Tyavambiza and Nyangara (2015), and Michalopoulos et al. (2011) found a positive association between them that was significant. In contrast, Idun and Aboagye (2014) found that DCPS as a measure of financial innovation had a long-term negative impact on economic growth using data from Ghana. According to economic development theory, a well-functioning financial sector accelerates the capital accumulation process, resulting in economic development (Kyophilavong et al. 2016). Ethiopia's banking system has played a vital role in

economic development through facilitating financial advancements. In the long run, DCPS one of the financial innovation proxy, show their positive association but insignificant at 5% significance level. The insignificant of DCPS could be due to the fact that, "credit is not well developed and adequately disseminated throughout the economy to influence economic growth", (Bara et al., 2016). In similar fashion, DCPS has positive relation but insignificantly with economic growth in Ethiopia in the short run.

As shown in table 1.3(a) above the ARDL long run form and bounds test result revealed that a percentage change in GFCF affect Economic growth positively and significantly in the long-run. This could be due to the reason that the annual capital goods accumulation boosts the national output or revenue significantly. Capital accumulation is required to provide individuals with productive tools. If the population continues to increase without net capital accumulation, the growing population will be unable to obtain the requisite tools, instruments, machines, and other production tools, resulting in a significant reduction in their capacity to create. The finding of this estimation is consistent with economic growth theories such as, the Keynesian theory of growth and Solow's theory of growth, not only this but also consistent with the study of Biswas and Saha (2014) in India; Iqbal and Zahid (1998) in Pakistan; Ndambiri H.K. et al. (2012) and Patrick Enu et al. (2013) in Africa; Weeks et al. (2004) and in Ethiopia, Tadesse (2011).

Table 1.4(b): The Estimated Long Run Coefficients using the ARDL Approach selected based on Akaike information criterion by taking LM2/M1 as FI variable.

Model 2: LM2/M1 as FI variable

ARDL Long Run Form and Bounds Test
Dependent Variable: D(RGDPPCGR)
Selected Model: ARDL(2, 0, 1, 1, 2, 1, 0, 2)

Levels Equation
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPI	-0.008776	0.003169	-2.769643	0.0118
EXR	0.016789	0.010042	1.671834	0.1101
GEX	2.15E-07	1.22E-06	0.176594	0.8616
IS	0.028815	0.017180	1.677243	0.1091
LM2/M1	-0.742891	0.327122	-2.270992	0.0343
GFCF	1.48E-06	3.04E-07	4.869232	0.0001
TOP	0.248090	0.483501	0.513113	0.6135

EC = RGDPPCGR - (-0.0088*CPI + 0.0168*EXR + 0.0000*GEX + 0.0288*IS
-0.7429*LM2/M1 + 0.0000*GFCF + 0.2481*TOP)

Source: Own computation

Model 2: The ratio of broad to narrow money (M2/M1)

As shown in table 1.4(b) above the ARDL long run model and bounds test result revealed that a percentage change in GFCF affect economic growth positively and significantly in the long-run, but the second proxy for financial innovation, LM2/M1 and CPI affect economic growth negatively and significantly in the long-run. This could be due to the fact that in the long run, an increase in the ratio did not translate into economic growth. In fact, as the ratio rises, so does growth. The result is somehow surprising, because an increase in the ratio should actually be promoting economic growth. This shows that the increase in money supply did not result in immediate economic growth. The long run association between financial innovation and economic growth is negative. Tyavambiza and Nyagara (2015) used the M3 to GDP ratio to show that broad money has a detrimental influence on economic growth, which is consistent with this study's findings. Nonperforming loans, according to Romer (2010, 2012), are a factor that has a detrimental influence on economic growth because financial institutions lose faith in their customers' credit worthiness. Credit to household's leads to consumption, but credit to enterprises is positively connected with economic growth (Beck et al., 2012). Providing more of the former could lead to negative economic growth. Ogunmuyiwa and Ekone (2010), discovered that the money supply M2 and economic growth had a negative relationship.

5.7 Estimation of ARDL model (short run) and Error correction results

The conditions necessary for the ARDL regression model are met according to the pre-estimation test. As a result, the ARDL regression model was used to analyze the causation between financial innovation, monetary policy, and economic growth in this study.

Table 1.5(a): Estimating short run ARDL model using AIC by taking LDCPS as financial innovation variable. Model 1: LDCPS as FI variable

Dependent Variable: RGDPPCGR
Selected Model: ARDL(1, 0, 1, 1, 0, 0, 0, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
RGDPPCGR(-1)	-0.167705	0.181600	-0.923488	0.3639
CPI	-0.012380	0.004416	-2.803232	0.0093
EXR	0.041074	0.020328	2.020519	0.0534
EXR(-1)	-0.036625	0.020523	-1.784629	0.0856
GEX	1.86E-05	4.65E-06	4.005381	0.0004
GEX(-1)	-2.10E-05	4.64E-06	-4.518352	0.0001
IS	-0.009282	0.016659	-0.557174	0.5820
LDCPS	0.006707	0.046046	0.145657	0.8853
GFCF	2.83E-06	4.85E-07	5.845409	0.0000
TOP	0.484742	0.517181	0.937278	0.3569
C	-0.126655	0.337852	-0.374885	0.7107

Prob.*: the significance of each variable at 5% level of significance.

Source: Own computation

According to the results revealed in table 1.5 (a), the percentage change in GEX affect economic growth positively in the short-run. The finding of the short run effect at level is consistent with the Keynesian theory that there is an improvement of economic growth with the increasing government spending (Vane, 2005). In the same manner the percentage change in LDCPS and TOP affect economic growth positively but insignificantly at 5% level, whereas GFCF has significant relationship with growth in the short run at level. CPI and IS are negatively associated with economic growth, however, CPI is significant whereas IS became insignificant at 5% significance level. The log of domestic credit to the

private sector (LDCPS), which is the first proxy to financial innovation has a positive but statistically insignificant impact on economic growth in the short run, this could be due to the fact that an increase in bank credit without consideration of its distribution in the economy may give false analysis that the economy is increasing. However, the estimation result in table above indicates that high access to credit has no relationship to economic growth in the short-run. Furthermore, if the results could have been heavily influenced by the study era; for example, if Ethiopia compensates its public expenditure through seigniorage, this leads to hyperinflation. Added to this, the finding is consistent with the empirical research work (Michalopouloset.al. 2011; Ndlovu, 2013).

Table 1.5(b): Estimating short run ARDL model using AIC by taking LM2/M1 as financial innovation variable. Model 2: LM2/M1 as FI variable

Dependent Variable: RGDPPCGR
Selected Model: ARDL(1, 0, 1, 1, 1, 1, 0, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
RGDPPCGR(-1)	-0.343801	0.194916	-1.763842	0.0905
CPI	-0.012411	0.003958	-3.135936	0.0045
EXR	0.051337	0.021756	2.359683	0.0268
EXR(-1)	-0.041783	0.022326	-1.871464	0.0735
GEX	1.46E-05	4.97E-06	2.929749	0.0073
GEX(-1)	-1.53E-05	5.35E-06	-2.867326	0.0085
IS	0.002322	0.018855	0.123152	0.9030
IS(-1)	0.027696	0.020848	1.328468	0.1965
LM2M1	-0.010642	0.497965	-0.021371	0.9831
LM2M1(-1)	-0.867508	0.474352	-1.828825	0.0799
GFCF	2.84E-06	4.67E-07	6.073959	0.0000
TOP	-0.174071	0.665423	-0.261594	0.7959
TOP(-1)	0.739649	0.617399	1.198008	0.2426
C	0.091203	0.108966	0.836985	0.4109

Prob.*: the significance of each variable at 5% level of significance.

Source: Own computation

The second proxy variable for financial innovation (LM2/M1) is insignificant and has negative coefficient in the short run at level and at the first lag period. This suggests that increased money supply and financial innovation have a negative impact on Ethiopia's economic growth. Added to this, the insignificance of money supply could be due to the fact that, the rise in the money supply did not translate into economic growth in the short run. This outcome is consistent with (Bara et al., 2016 and Ogunmuyiwa and Ekone,

2010).

The variables GEX, EXR and GFCF have positive and significant relationship with growth, whereas CPI has negative and significant relationship with growth as the result revealed from table 1.5(b).

Table 1.6: ARDL Error Correction Regression Result

	Coefficient	*t*-statistic	Standard error	Prob.
Model 1:				
CointEq(-1)*	-1.512515	0.122189	-12.37846	0.0000
Model 2:				
CointEq(-2)*	-1.879661	0.128483	-14.62961	0.0000

Source: Own computation

CointEq= co- integrating equation, which is the ECM

These results reveal that both of the models_ (models 1 and 2) fulfill the criterion proposed by Pahlavani et al. (2005) about the error correction term. It indicates that the ECT (-1) value has a negative sign. According to the report from the table 1.6, the error correction coefficient, estimated for both models, is highly significant, has the correct negative sign and implying a very high speed of adjustment to equilibrium but in an oscillatory manner.

5.8 Pair wise grander causality test

The long-run causality to be ascertained according to ECT should be negative and statistically significant. According to Appendix III, at 5% level of significance there is unidirectional causality running from financial innovation proxy variables to economic growth, i.e.,(LDCPS→RGDPPCGr and LM2/M1→RGDPPCGr),Monetary policy proxy variables to growth,i.e.,(EXR →RGDPPCGr), financial innovation proxy variables to Monetary policy proxy variables, i.e., which is (LDCPS→EXR, LM2M1→EXR), macroeconomic variables such as (GFCF, GEX, CPI, EXR) Granger-causes RGDPPCGr, (LDCPS and GFCF)Granger-causes GEX, (EXR and GEX) Granger-cause CPI. Furthermore, there exists bidirectional causality between GEX and GFCF.

5.9 Hetroscedasticity Test/ARCH

In order to check the presence of heteroscedasticity, this study employed Breusch-Pagan-Godfrey test. Accordingly, the result obtained from the test for both models shows that there is no problem of

Heteroscedasticity because the Prob. Chi-Square (P-value=0.42>0.05 and P- value=0.94>0.05 for models 1 and 2 respectively) is greater than the 5% significance level. Therefore there is no heteroscedasticity problem and accept the null hypothesis of homoscedasticity.

5.10 Serial Correlation Test

The Breusch-Godfrey Serial Correlation LM test was utilized for the examination of the autocorrelation test. Both models do not have an autocorrelation problem. The Prob. Chi-Square (P-value=0.06>0.05 and P-value =0.07>0.05 for model 1 and 2 respectively) which is greater than the 5% level of significance. Therefore accept the null hypothesis of no serial correlation.

5.11 Stability Test

As can be seen from the figure for both models, the CUSUM test plot did not cross the critical boundaries. Likewise, the CUSUMSQ test demonstrates that the graphs do not cross the lower and upper critical limits. As a result, we can conclude that the estimated results are stable and no structural break. Consequently the results of the estimated model are consistent, reliable and efficient (See more Appendixes I).

5.12 Normality test

When the estimated probability value (estimated level of significance) is greater than the 5% significance level, the residual or error term is normally distributed. The probability value of this study is 64%for model 2 and 74%for model 1, which is considerably over the required standards for normality testing, as revealed in the Jarque-Bera test (Appendix II). As a result, the study's error term is normally distributed. Because the p-value for the Jaque-Berra normalcy test is greater than the standard significance level (i.e. Model 2: 0.64>0.05 and Model 1:0.74>0.05), the null hypothesis that the residuals are normally distributed cannot be rejected.

6. Conclusion

This study applied the ARDL model also known as bound test approach and error correction model (ECM). As a result the bound test (F-statistic) value is larger than the upper bound critical value, which indicates there is a long run relationship between real GDP per capita, and its determinants (such as financial innovation proxy variables, gross fixed capital formation, trade openness, interest spread, nominal exchange rate, consumer price index, and government expenditure) during the study period. At last, to check the verifiability and/ adequacy of the estimated model the study employed some diagnostic tests such as serial correlation, normality, and hetroscedasticity test. Moreover, the study employed cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) test to test the stability of the model estimates. As a result the diagnostics tests revealed

that there is no evidence of serial correlation, the residual is normally distributed and no evidence of hetroscedasticity problem. Added to this, the model estimates are stable and has no structural break. This study also runs the Granger causality test under the pair wise Granger causality framework to capture the directional causality between financial innovation, monetary policy and economic growth in Ethiopia.

The empirical findings of this study revealed that gross fixed capital formation ,is found to have positive impact on Ethiopian economic growth during the study period spanning from 1980-2018 and statistically significant both in the short run and in the long run. The positive association of gross fixed capital formation with growth is true for both proxy variables of financial innovation. The results of the ARDL bounds test differ depending on the measure of financial innovation utilized and the time period (short or long run).The financial innovation proxy variables, domestic credit to private sector (LDCPS), has a positive association with economic growth in the short run but the association of LDCPS was insignificant in the short run. In the short run, the ratio of broad to narrow money (LM2/LM1) has a negative effect on growth at level, although was insignificant. Furthermore, the ratio of broad to narrow money (LM2/M1) has negative and statistically significant relationship with growth in the long run. The government expenditure has negative relationship with growth in the long run while using domestic credit to the private sector as proxy for financial innovation, however, has positive relationship in the short run for both proxy variables. Consumer price index has negative relationship with economic growth during the study period in both long run and short run for both proxy measures of financial innovation.

7. Recommendations and Research implication

In a nutshell, the outcomes of this study suggested that future research should focus on the long-run equilibrium relationship between financial innovation, monetary policy, and economic growth in Ethiopia. So, it is recommended that future research should include longer time series data sets than the data used in this study. In investigating the relationship between financial innovation, monetary policy, and economic growth; this study incorporates two proxy variables. Therefore, it is recommended that further research should incorporate additional proxy variables for financial innovation such as mobile banking penetration; market based financial developments, improved financial products, new technological products_(such as ATM, internet banking) etc that would play a role in capturing financial innovation and the nexus with growth. Because gross fixed capital formation has a positive relationship with growth, the Ethiopian government should take steps to increase investment, particularly private investment, which is the “key driver” that drives demand, creates capacity, increases labor productivity, introduces new technology, allows for creative destruction, and generates jobs. This will help the country’s economy thrive. Finally, because inflation has a negative influence on economic growth, the government should implement appropriate monetary policy interventions to lower inflation, which has a negative impact on economic growth.

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Appendix I

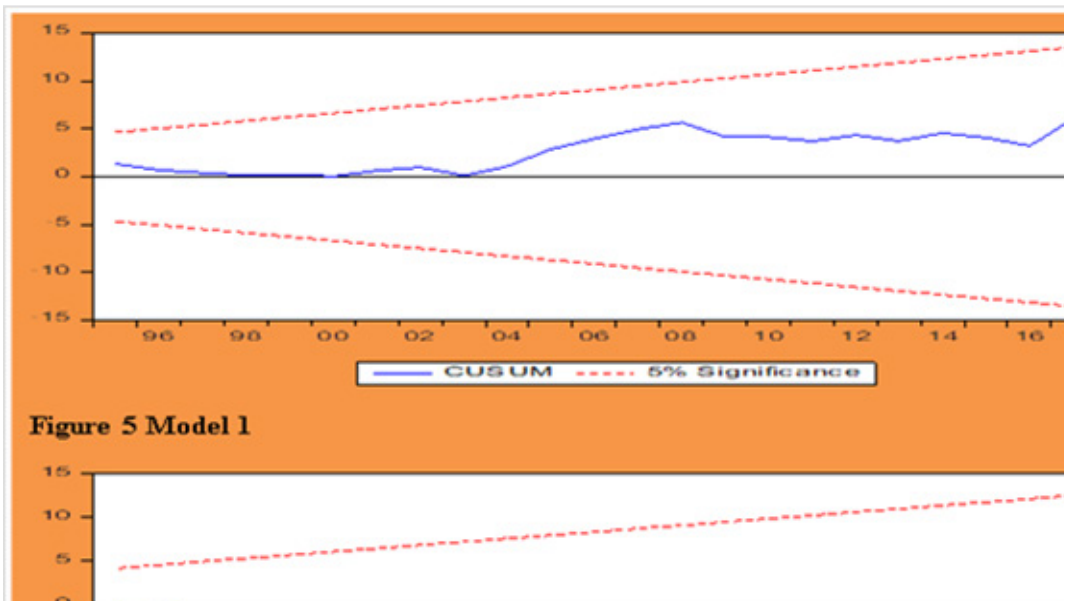


Figure 5 Model 1

Appendix II

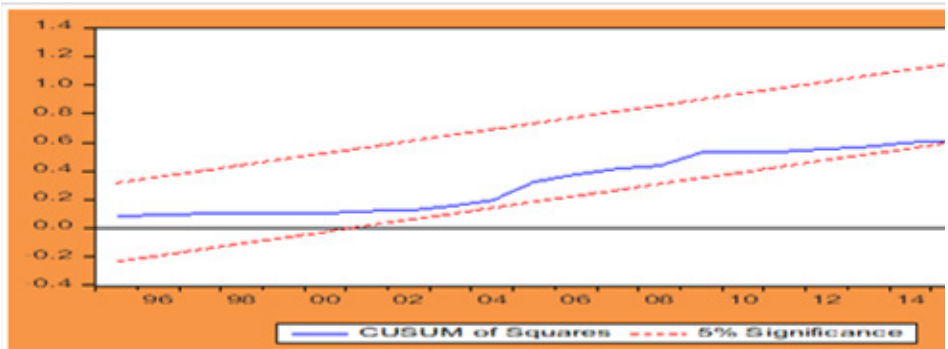
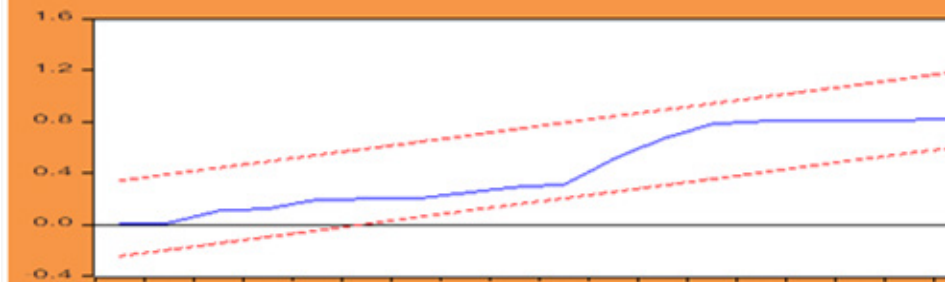
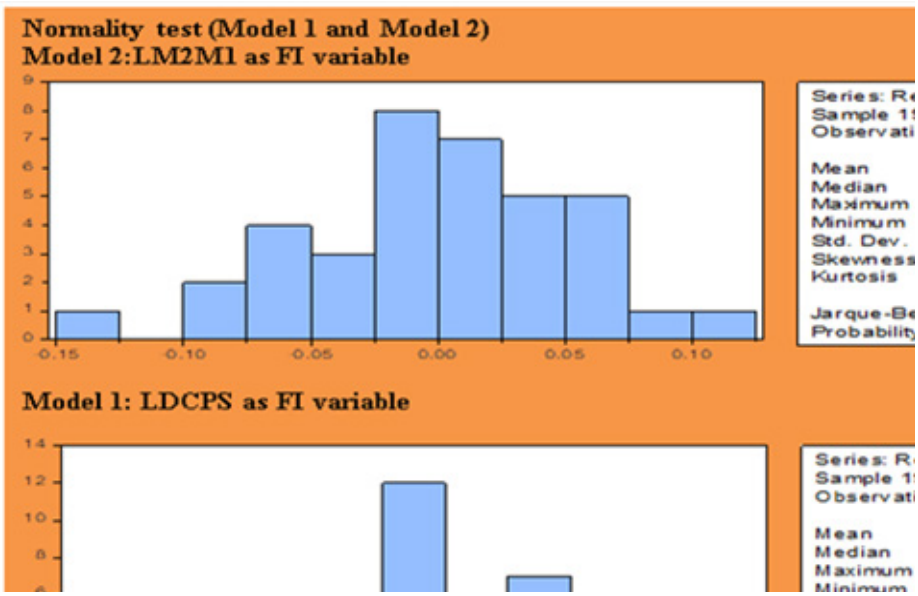


Figure 5 model 1





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Determinants of Rural Household Multidimensional Poverty in Dabat District, North Gondar Zone, Amhara Region, Ethiopia

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Abstract

Poverty has multiple features which demand comprehensive treatment. The multidimensional approach to poverty analysis provides broader and vital information on the causes and poverty status of a country in order to formulate a development and poverty reduction strategy with respect to every dimension and indicator of poverty. Thus, this study aimed to examine the multidimensional poverty status of households and its determinant factors in Dabat District. A multistage sampling technique was used to select 396 households using a structured household questionnaire. The data was analyzed by using Alkire and Foster poverty method and logistic regression. The findings revealed that the household's incidence of deprivation was higher and more prevalent in livestock ownership, land ownership, energy for cooking, and electricity indicators. The multidimensional headcount ratio, intensity, and adjusted headcount ratio of households were also high in the study area. The standard of living and wealth dimension of poverty were the major contributor to households' MPI and deprivation in livestock ownership and landholding appears to be the larger contributor indicators to the overall Multidimensional Poverty Index (MPI). Logistic regression results showed that dependency ratio and distance to the nearest market significantly and positively affect the multidimensional poverty status of households meanwhile access to credit, access to irrigation, and participation in off-farm employment significantly and negatively influenced multidimensional poverty in the study District. The result suggests that improving access and availability of credit, irrigation, and participation in off-farm employment are important policy interventions.

Keywords: Determinant; Incidence; Intensity; Logit; Multidimensional poverty

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1. INTRODUCTION

Poverty is a multidimensional and complex phenomenon and not only to the income or consumption, considered as the monetary dimension of poverty but also to non-monetary dimensions such as education, health, gender equality, and water supply. Due to many countries have different development possibilities; the power of the factors varies from one place to another and also the influential factor of poverty is political, social, geographical (Alma Spaho, 2014). Poverty is the inability of getting choice and opportunities, violation of human dignity and lack of capacity to participate effectively in a society (UNDP 2006).

Although poverty has reduced across the world, about 9.2% (689 million people) of the world population lived below the International Poverty Line ($1.9) in 2017. Moreover, more than 60% of the world's poorest people live in Sub-Saharan Africa, which accounts for 41% of the highest regional poverty rate and followed by the Middle East and North Africa (6.3 %) (World Bank, 2020). According to United Nation report also based on 107 developing countries in 2020, the result shows that 1.3 billion (22 %) of people live in multidimensional poverty. But, most of (84.3 %) of people are found in sub-Saharan Africa and South Asia. On the other hand, 67 % of multidimensional poor are located in middle-income countries (UNDP, 2020).

The majority of people in Ethiopia by any standard are among the poorest in the world (Teshome Kebede and M.K Sharma, 2014). It is found as a low human development indicated that most of its citizens are badly deprived of fundamental needs in the vein of food, education, shelter and health. It's HDI for 2015 was 0.448 and rank of 174 out of 187 countries (UNDP Ethiopia, 2018).The country has been implementing a series of poverty-based development strategies in order to reduce poverty and achieve economic growth especially agricultural growth and investments, given that agriculture accounts for the majority of jobs, regarding 40% of production and exports and contributing 37% of GDP in 2015/16 (NBE, 2016). Despite all these, the most pervasive poverty in Ethiopia geographically concentrated in rural areas (UNDP Ethiopia, 2018).

FDRE Planning and Development Commission also indicates in 2018, the maximum poverty indices were recorded in the Amhara region that is 26.1% and, in the region, poverty head count index is higher in the rural than urban areas with 28.8% and 11.6% respectively (FDRE Planning and Development Commission, 2018). This is mainly attributed to land degradation, recurrent drought, and farmland fragmentation (Anteneh silshi and Daniel Asfaw, 2020). Besides, according to (Ayalneh Bogale et al, 2005 and Anteneh Mulugeta, 2020), lack of crucial household assets such as land, oxen, low non-farm income, poor health, low education and high population growth are also other factors which determine poverty in rural household.

Many studies and assessments are conducted on poverty in Ethiopia. Meanwhile, most of the studies are mainly focused on monetary indicator of welfare to assess poverty. For instance, (Ayalneh Mulugeta et al, 2005; Teshome Kebede and M.K Sharma, 2014; Anteneh silshi and Daniel Asfaw, 2020) and Dawit Alemu ea al, (2011) in their study of determinants of poverty in rural Ethiopia utilized consumption and income based poverty measurement respectively. Besides, the income or consumption expenditure measure indicates the means and not the end. It is not the educational expenditure that determines the level of education, rather the years of education or capability acquired that determines the productive aptitude of people. It is not the amount of money that one spends on medical services, but the number of days of illness, maternal deaths and child mortality rates that need to be reduced to determine the level of healthcare. Therefore, emphasis has to be shifted from the means to the end that is multidimensional view.

Some researchers study about poverty in Ethiopia based on multidimensional measurement approach and related topics (such as, Tilman Bruk & Sindu Workneh, 2013; Gebretsadik Hishe, 2013; Alemayehu Ambel et al, 2015; Mekonnen Bersisa & Almas Heshmati, 2016; Kedir Jemal et al., 2017). However, the majority of studies on multidimensional poverty were based on the secondary data on education, health, living standard and durable asset dimensions of poverty in their analysis. On the other hand, this study was conducted on cross-sectional data.

Among the vast literature and studies about poverty, there is no any study that conducted with either unidimensionally or multidimensional poverty measurement in the case of Dabat District. Therefore, the distinguishing feature of this study was that it utilized a multidimensional poverty measurement based on education, health, standard of living and wealth dimension with different household deprived indicators which are significant indicators of wellbeing for Ethiopian rural households. It could help to close the information and knowledge gaps that are hindering in addressing the poor households through implementation of area specific development interventions and strategies. Thus, this study was designed to investigate the determinants of household poverty in one of the rural areas of Ethiopia, Dabat District by using a multi-dimensional poverty measurement approach.

2. Objectives of the Study

2.1 General Objective of the Study

The general objective of the study was to analyze the determinants of rural household multidimensional poverty in Dabat District, North Gondar Zone.

2.2 Specific Objectives of the Study

- To measure the incidence and intensity of rural multidimensional poverty in Dabat District.
- To measure the contribution of each dimension and indicators to the household multidimensional poverty index
- To examine what factors affecting the household heads on the probability of being multidimensional poor in the rural part of the study area.

3. MATERIAL AND METODS

3.3 Area description

Dabat District is located in the Amhara Region, specifically in the North Gondar Administrative Zone. The District has 5 urban Kebeles and 31 rural Kebeles that cover 122,328 ha. In terms of population size, it has a total population of 188262 and 44011 households. Among which 94884 are females and 93378 are males (DDHO, 2020). The climate condition of the District is 52% Dega (Highland), 14% Woinadega (Temperate) and 34% Kola (Low land) (DDARDO, 2020).

3.2 Sampling technique and sample size determination

Multistage sampling technique was employed for this study. The first stage was stratifying the District in to rural and urban (31 and 5) Kebeles respectively. Second, stratify the rural Kebeles into three agro-ecological areas (12, 14 and 5) Kebeles from Kola, Dega and Woinadega respectively. Third, five Kebeles were selected randomly and distribute those Kebeles based on proportionate to the size of that agro-ecological areas and those Kebeles were selected by using a random sampling technique through a lottery method. that is two from Kola (Guchereb and Ayrefeda), one from Woinadega (Defiya) and two from Dega (Dekua and Benker) which were proportionally indicate and correctly represent the three agro-ecological zones of the study area. Finally, distribute the sampled household in each Kebeles proportionally and selected households by a simple random sampling technique. sample size was determined by using Yamane's (1967) as cited by (Glenn Israel, 2003).

$$n = \frac{\mathrm{N}}{1 + \mathrm{N(e)}^2} = \frac{38430}{1 + 38430\ (0.05 * 0.05)} = \frac{38430}{97.075} = 396$$

3.3 Data source and method of data collection

Both primary and secondary data was carried out the study. To get the primary data, the researcher prepared a structured questionnaire to collect quantitative and qualitative data from the selected kebeles of rural households. The secondary data was obtained from various government institutions including Ministry of Finance and Economic Development (MoFED), Dabat District Health Office (DDHO),

Dabat District Agricultural Rural and Development Office (DDARDO), national planning commission, prior empirical studies and journals.

3.4 Method of data analysis

In order to answer the specified objectives of the study, descriptive statistics, Alkire and foster multidimensional poverty analysis and econometric methods of analysis were employed. Descriptive statistics such as percentages, frequencies, histograms and bar graphs were used to describe the demographic and socioeconomic characteristics of the rural household. Various diagnostic test was used for the poverty indicators used in MPI, explanatory variables and the general model. While other methodologies were included as follows below, step by step.

3.4.1 Multidimensional poverty analysis

Selection of dimension, indictors and poverty cutoff points

In the case of multidimensional poverty analysis, selection of representative dimension and indicators was a difficult task. As much as possible dimensions and indicators that are believed by the researcher to be highly relevant for the studied population were identified and lists of dimensions and indicators were selected based on both normative assumptions and different empirical evidence among them grounded in the United Nations Millennium Development Goals (MDGs) and the newly designed Sustainable Development Goals. Like Alkire, S. & Santos (2010), this study applied equal weighting structure across dimensions and indicators to construct Adjusted Head Count Ratio (MPI). This methodology is suitable, easy to interpret, widely accepted and allows us to have internationally comparable findings. Generally, the dimensions and indicators selected for this particular study are defined as follows.

Table 1: Selected dimension, indicators and deprivation cutoffs

Wellbeing dimension (equal weight)	Deprivation indicator (equal weight)	Household deprivation cutoff
Education (1/4)	Years of schooling (1/8)	1= if no household member has completed five years of schooling; and 0 otherwise
	Child school enrollment (1/8)	1= if any school-aged child in the household is not attending school; and 0 otherwise
Health (1/4)	Health care access (1/12)	1= if a household does not have access to health care services in their village and 0 otherwise
	Health functioning (1/12)	1= if any member unable to pursue household main activities due to serious disease for at least four months; and 0 otherwise
	Child mortality (1/12)	1= if any child had died in the household in the past five years prior to this survey; and 0 otherwise
Living standard (1/4)	drinking water (1/16)	1= if households use unimproved drinking water sources ; and 0 otherwise
	Housing quality (1/16)	1= if the household's housing roof condition is made of thatch; and 0 otherwise
	Energy for cooking (1/16)	1= if the household cooks with dung, wood, or charcoal; and 0 otherwise
	Electricity (1/16)	1= if the household has no electricity; and 0 otherwise
	Land ownership (1/8)	1 = if the household own less than the average of sampled household land; and 0 otherwise
	Livestock ownership in	1 = if the household own TLU less than the

Identification methods and deprivation cutoffs

After selecting representative indicators and dimensions, the assessment of multidimensional poverty includes an identification (k) and aggregation methods (MPI) Alkire & Foster (2011). The identification method explains based on the number of dimensions of deprivation experiences of household, identify poor and non-poor household. Moreover, the identification method uses the dual cutoff method (Alkire et al., 2015). The first one is identifying the deprived and non-deprived households by using single dimensional deprivation cutoffs or any score of one indicator. The second one is also identifying multidimensional poor and nonpoor household by counting the number of deprivations (second poverty cutoffs). That is If c_i (number of deprivation) is less than the poverty cutoff k then a household is not multidimensionally poor while if c_i is equal or more than k, a household is considered as multidimensionally poor. Therefore, the poverty identification function is given by p(yi; z) which identified as:

$$(Y_i\,;Z) = \begin{cases} 1, if\ the\ houshold\ is\ multidimensional\ poor \\ 0, other\ wise \end{cases}$$

$$or\ p(Y_i\,;Z) = \begin{cases} 1, if\ c_i \geq \mathrm{k} \\ 0, if\ c_i < k \end{cases}$$

Where, yi denotes the nxd matrix of multidimensional poverty performance of household

ci – represents the number of indicators of deprivation by household i

The aggregation method obtains a direction of poverty measures (MPI) by mixing together all surveyed data of household in to a total indicator of poverty (Alkire & Foster, 2011). Means that its headcount ratio, intensity and multidimensional poverty index.

$$H=q/n$$

Where, H denotes the head count ratio, q denotes the number of poor households and n represents. the total population. The intensity of multidimensional poverty shows the mean weighted share of indicators for that household is deprived, and it is calculated as,

$$A = \sum_{i=1}^{n} \mathrm{c_i(k)/q}$$

Finally, the Adjusted Headcount Ratio (MPI) is the product of head count ratio and the intensity of multidimensional poverty. i.e.,MPI=HA. The most essential characteristics of MPI is it is easily decomposable in to dimensions as well as indicators in order to know the contributions of indicators and

dimensions to multidimensional poverty index (Alkire, S. & Santos, 2010). Therefore, the MPI is given by,

$$\text{MPI} = W_1CH_1 + W_2CH_2 + W_2CH_2 + W_iCH_i$$

Where, Wi is the weight of indicator i, □CH□_i is the censored headcount ratio calculated through the summation of numbers of household who are poor and deprived in that indicator and divided by the total household. Therefore, the contribution of indicator i to the overall multidimensional poverty index can be defined as: Contribution of indicator i to

$$MPI = \frac{W_iCH_i}{MPI} * 100$$

3.4.2 Econometric model

The dependent variable is the multidimensional poverty status of households. Arbitrary values 0 and 1 can be assigning for the multidimensional non-poor and poor households respectively. Therefore, the researcher employed with logit model and marginal effect after logit by its simplicity for the research (Gujarati, 2004).

Therefore, the probability of being multidimensional poor household is given as follows,

$$\boldsymbol{P_i} = \sum\left(\boldsymbol{Y} = \frac{\mathbf{1}}{\boldsymbol{X_i}}\right) = \frac{\mathbf{1}}{\mathbf{1}+e^{-(\beta_0+\Sigma\beta_iX_i)}} = \frac{e^{(\beta_0+\Sigma\beta_iX_i)}}{\mathbf{1}+e^{(\beta_0+\Sigma\beta_iX_i)}} \text{..... (1)}$$

the probability of multidimensionally non poor household is given as (1-P_i).

$$1 - \mathrm{p_i} = \frac{1}{1+e^{(\beta_0+\Sigma\beta_iX_i)}} \text{..... (2)}$$

Therefore, we can write the odds ratio in favor of being multidimensionally poor

$$\frac{p_i}{1-\mathrm{p_i}} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \text{..... (3)}$$

The above equation can be written in linear form by taking the natural logarithm as:

$$L_i = ln(e^{Z_i}) = \mathrm{Z_i} = \beta_0 + \beta_1X_1 + \beta_2\mathrm{X_2} + \cdots + \beta_i\mathrm{X_i} + \mathrm{e_i} \text{ ... ... (4)}$$

Where; Li is the log of odds ratio(pi/(1-pi)), Zi is a function of independent variable, pi is the probability of being multidimensionally poor, 1-pi is the probability of being multidimensionally non poor, Xi

are independent variables and e_i denotes the stochastic term. Since the above equation rewritten and substitute Z_i with Dmp (dummy of multidimensional poverty) as the dependent variable.

$$\text{Dmp} = \beta_0 + \beta_1(sex) + \beta_2(\text{Edu}) + \beta_3(DM) + \beta_4(\text{FS}) + \beta_5(AI) + \beta_6(POE) + \beta_7(\text{DR}) + \beta_8(\text{age}) + \beta_9(\text{CA}) + \beta_{10}(\text{AAES}) + e_i$$

3.4.3 Description of Independent variables

Sex is a dummy variable with 1 if the household head is male and 0 if female. Female-headed households are less productive in agricultural activity and unable to work together, particularly in the rural area (Apata, T.G. et al., 2010). Therefore, the researcher expected that female- headed household have the probability of being multidimensionally poor. Years of household head education is the educational level of the household head in years. A household head in the higher years of education level have a higher living standard and having knowledge and experience of contacting agricultural extension service. Therefore, the researcher was expected that as increase household education years, it declined the poverty status of households.

Family size is a total number of people in the single household. According to Desalegn Teshale (2019), household size has a positive association with poverty level of a household. Dependency ratio (DR): According to Akerele & Adewuyi (2011), conclude that a household with a large dependency ratio is predominantly poor. Therefore, it was expected that their probability of being multidimensional poor is increased as family size and dependency ratio of a household increased. Age of household head it is a continuous variable. A household head with higher age has stable economy, higher awareness and experience of agricultural activity and higher land size owner than the younger one (Haile, H.K et al, 2005). On the other hand, household found at old age decline its income and saving due to dependency and decrease its productive capacity (Zegeye Paulos, 2017). Therefore, the researcher expected this variable has negative or positive relation with households' multidimensional poverty status.

Credit access (CA): Baiyegunhi LJS and Fraser GCG (2010) indicated that a household with credit access is less affected by poverty as compared to household who doesn't access credit. Therefore, researcher was expected that their probability of being multidimensional poor is lower in a household with access credit. Access to agricultural extension service is an important variable that affect the productivity of farmers by providing improved seeds, improved inputs, advice and knowledge for process of production activity. Therefore, a household who is contacted to agricultural extension agents would have not the probability of being multidimensional poor. Distance to market (DM is a continuous variable measured in minutes and households who have proximity to market center have a better chance to improve their income (Ayalneh Moges & Mada Melkamu, 2020). The searcher expected as positively affect the poverty status.

Access to irrigation is one of the technology options available to enable the farmers to diversify their production, practice multiple cropping and supplement their land when rain shortage happens (Agerie, 2013). Therefore, access to irrigation was expected to be negatively related with poverty. Participation in off-farm employment refers to all activities which do not have direct relation with agricultural activities. A study by Nega Afera (2015) in rural Tigray reveals that participation in off-farm activities is reduced the status of poverty through increasing income. Therefore, this variable is predicted to negative relation with poverty status of households.

4. RESULT AND DISCUSSION

4.1 Descriptive Analysis

Unidimentional deprivation among households

Unidimensional poverty indicated that the percentage of households deprived in each indicator. Almost three fourth of those studied area's household were highly deprived in energy for cooking, access to electricity and livestock ownership. Since, those depend on traditional cooking energy sources such as animal dung, charcoal, fire wood and straw which demands lots of time to gather and produces toxic emissions and use as light such as hand-light, solar and kerosene. This is also another striking finding which prevents household members from performing a wide range of activities such as studying, refrigerating and communicating. The operation of other modern appliances such as radio and television were also limited due to the lack of access to electricity. While about 12.37% of households were deprived in health functioning in that they had experienced health problems in the past four months and didn't participate in household daily activities and 13.13% households were deprived in terms of child mortality in the last five years ago. Such an incidence of deprivation shows that tragic events disturbed households' health status.

Poverty incidences, intensity and multidimensional poverty index

Table 2 illustrated the value of H, A and MPI at poverty cut-off (k) for the value of 4, that is, requiring the poor to be deprived in approximately one-third of the weighted indicators to declare multidimensional poor, and it needs at least deprivation in four indicators. Then the findings revealed that about 62% of sampled rural households were multidimensionally poor with their average intensity and multidimensional poverty index of 53% and 33% respectively. Although this finding shows a severe multidimensional poverty situation in the district, it is largely lower than the MPI reported by Human development report (2020) which shows 83% of Ethiopian rural population was multidimensionally poor with its MPI of 48.9 % in 2016 and in the Amhara region case, as studied by Seff & Jolliff (2016), about 88% of sampled household are chronically multidimensional poor.

Table 2: Poverty incidence, intensity and MPI at k=4

poverty cut of (k=4)	poverty incidence (H)	poverty intensity (A)	multidimensional poverty index (MPI)
Value	0.62	0.53	0.33
percentage	**62**	53	33

Contribution of indicators and dimensions to overall multidimensional poverty index

The adjusted headcount ratio was decomposed to each indicator so as to assess the lowest and the highest contributor to multidimensional poverty of households. Therefore, figure 1 shows that livestock and land ownership were the largest contributors to MPI and accounts for 18% and 15% respectively. In addition, child enrolment, electricity and energy for cooking were the second lager contributors (12% each) followed by health care access (9%), access to drinking water source and years of schooling (6% each). On the other hand, the lowest contributors to multidimensional poverty index were observed in child mortality, health functioning and housing quality and all are accounts for (3% each).

Figure 1: Contributions of each indicator to overall multidimensional poverty index

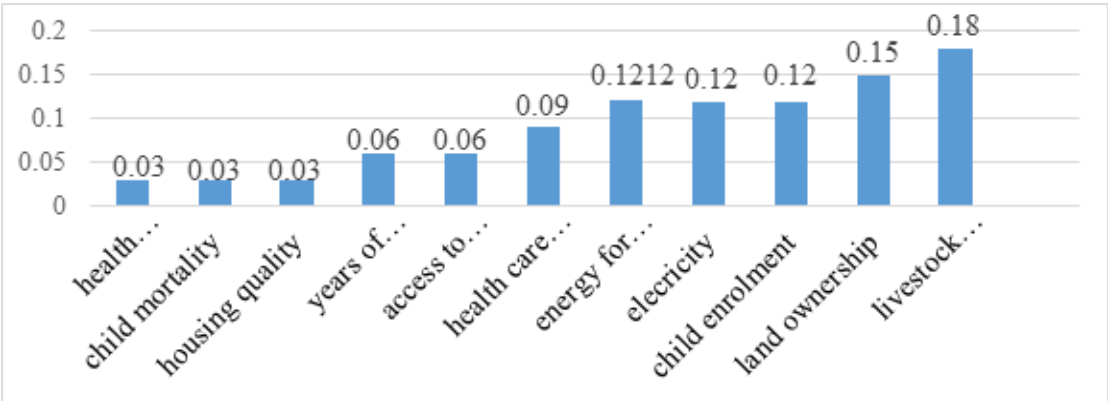
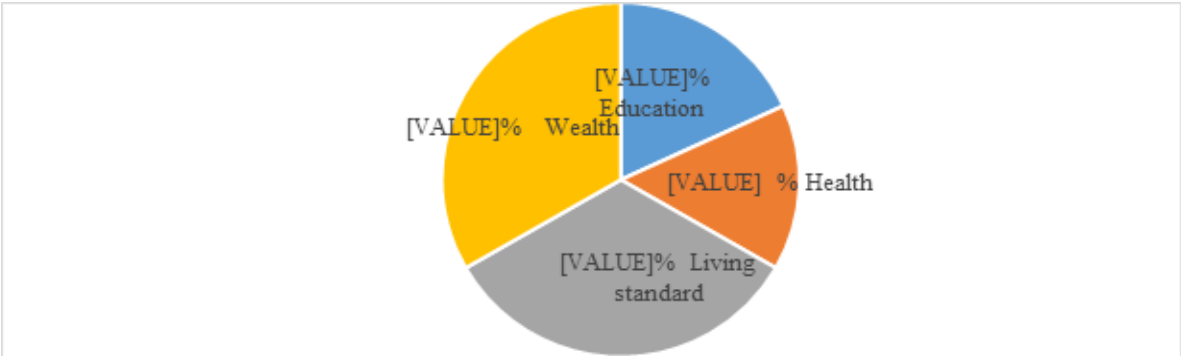


Figure 2: Contributions of each dimension to the overall multidimensional poverty index



The adjusted headcount ratio can be decomposed into wellbeing dimensions in order to evaluate how the overall multidimensional poverty is affected by each dimension. The living standard and health dimension were the largest and lowest contributor to the overall multidimensional poverty index in the account of 33.12% and 15% respectively. Even if the weight of living standard indicators is the lowest share, this dimension shows relatively higher percentage contribution to poverty. The second largest contribution dimension was wealth dimension which accounts for 33% and the third larger contributor was education dimension as it accounted for 18% of the overall multidimensional poverty.

4.2 Econometric analysis

Determinants of household multidimensional poverty

A binary logistic regression model was employed to estimate factors that determine the probability of being multidimensionally poor. The results of logistic estimates for surveyed rural households are existing in Table 3 with their marginal effects and standard errors. However, before presenting logistic regression results and drawing conclusions, various diagnostic tests were applied to prove whether the data come across the basic assumptions of the model or not and included as follows.

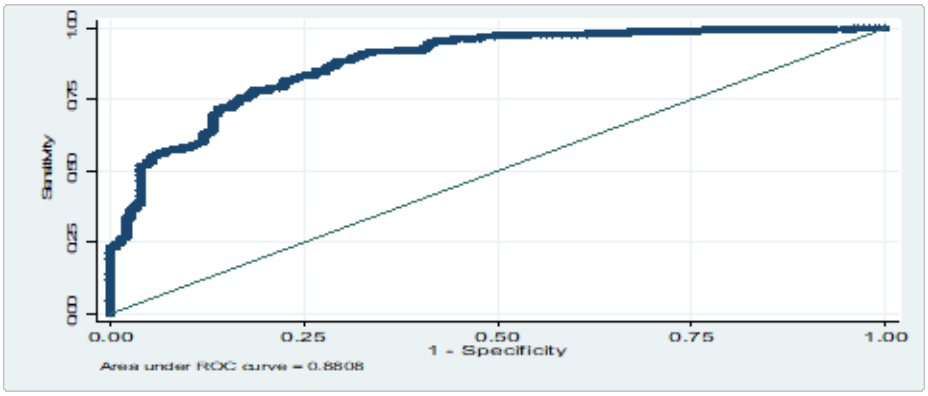
Test for Multicollinearity: According to Bewick et al (2005), less correlation among the independent variables is required before regressing the model. Hence, the researcher was utilized (VIFs) and coefficient of contingency for continuous and discrete explanatory variables respectively. Then, the result of the VIF shows there is very low collinearity between continuous explanatory variables with 1.13 mean and there is no any contingent coefficient between two discrete variables above 0.45. Therefore, there is weak correlation between those continuous and discrete explanatory variables.

Test for Heteroskedasticity: Heteroskedasticity is a condition where the assumption of constant variance of error terms across the data (homoscedasticity) is violated. In order to check either the error term of variance is constant or not, the researcher used Breusch-Pagan/Cook-Weisberg test and the findings shows chi2 (1) = 0.75 and Prob> chi2 = 0.3879 which revealed that the null hypothesis (Ho: Constant

variance) is accepted and the model is free from heteroskedasticity.

Test for Goodness of fit: According to Archer & Lemeshow (2006), The Receiver Operating Characteristic (ROC) curve was used to authorize the assumptions of the model specification (tests for predictive accuracy). Besides, Weiss & Bernstein (2008), if the area under ROC curve is 0.5, it means no discrimination, 0.6-0.7 poor, 0.7-0.8 acceptable, 0.8-0.9 excellent and >0.9 outstanding. With this regard, figure 3 indicates that the model has excellent predictive power as the area under the curve is 0.8808.

Figure 3. The Receiver Operating Characteristic Curve of the logistic regression model



Source: computed from own survey 2021

The link test also used after the logistic regression in order to test specification error. The result of the link test (specification errors test) revealed that the model equations were properly specified as predicted by the hat-statistic (_hat) and (_hatsq) as the p-value is 0.000. This implies that the variable _hat and (_hatsq) should be statistically significant and insignificant predictors respectively in order to check the model is properly specified. Thus, this link test result shows no problem with the specification.

The Hosmer and Lemeshow's goodness-of-fit test also used to check how the existing data fits the model. The Hosmer and Lemeshow's goodness-of-fit test needed high p-value to demonstrate a good fit model. Thus, the result of the goodness-of-fit test shows with p-value of 0.432 which is greater than the chosen level of significance. Therefore, the model was appropriately specified and fitted the data effectively. Overall, it is concluded that all diagnostic tests assessed above confirmed that the logistic regression model is adequate and well fits to the observed data.

The Logistic regression result revealed that dependency ratio and distance to the market have positive and significant effect on multidimensional poverty at less than 1 % significance level. Besides, the marginal effect indicated as a unit increase in dependency ratio and the distance to market increased by one-

minute leads to increase probability of being multidimensional poor by15.2% and 0.4 %. respectively. This finding is associated with (Desalegn Teshale, 2019 and Zegeye Paulos, 2017) respectively.

Table 3: Logistic regression estimates for determinants of household multidimensional poverty

Explanatory variables	**Coefficients**	**Standard error**	**Marginal effect**
Household head sex	-.8732128 **	.4720445	-.1390224
Household head education	-.0406895	.0494392	-.0076029
Family size	.015624	.0792539	.0029193
Dependency ratio	.8123901*	.2793623	.1517956
Household head age	-.0027486	.0031901	-.0005136
Access to credit	-1.203533*	.3056005	-.2404154
Access to agricultural extension service	-.5284384**	.2941669	-.0993149
Access to irrigation	-.729741*	.2807841	-.1413177
Participation in off-farm employment	-1.357519*	.3758607	-.2880299
Constant	1.036384	.702098	
Number of observations = 396 Log likelihood = -163.5	LR chi2(10) = 199.36	Prob > chi2 = 0.0000	Pseudo R2 = 0.3787

Note: * and ** indicates that significant at 1% and 10% level of significance respectively.

As expected, access to credit, Access to irrigation and Participation in off-farm employment were found to be significant and negatively influenced multidimensional poverty status of the household at less than 1 % significance level. The negative relationship shows that the probability of a household being poor decreases as a household receives credit, utilized irrigation and Participation in off-farm employment. The marginal effect revealed that households have access to credit, utilized irrigation and Participation in off-farm employment reduces the probability of being multidimensionally poor approximately by 24%, 14% and 29 % respectively holding other factors constant. These variables are playing a vital role for rural farmers to be involved in long-term income generating activities that ultimately help them move out of poverty. The result is consistent with the findings of (Tsegaye molla et al, 2014 and Dawit

Alemu et al, 2011).

5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The main objective of this study was to examine the determinants of rural household multidimensional poverty in Dabat District. The study depended on Alkire and foster poverty analysis with four dimensions and eleven indicators and logistic regression. The findings revealed that in the unidimensionally case, energy for cooking and electricity have the highest head count ratio While child mortality and health functioning were the lowest headcount ratio. Besides, censored headcount ratio which indicates the proportions of households who are multidimensionally poor and deprived in each indicator. Then, the findings revealed that higher concord headcount ratio was also located in energy for cooking, electricity, livestock ownership and lower level of censored headcount ratios were found in years of schooling, child mortality and health functioning. On the other hand, the multidimensional headcount ratio, intensity and multidimensional poverty index were 62%, 53% and 33% respectively. Regarding the contribution of each indicator and dimension to MPI, it also shows that deprivation in livestock ownership and land ownership were the larger contributor indicators, and living standard and wealth dimension were also the larger contributors to MPI. On the other hand, health functioning, housing quality and child mortality indicators and the health dimension were the lowest contributors to MPI. Logistic regression results also showed that access to credit, access to irrigation and participation in off-farm employment were significant and had negative relation with the probability of being multidimensionally poor while dependency ratio and distance to the nearest market were significant and had positive relation with the probability of being multidimensionally poor.

5.2 Recommendation

The government and non-government development officials should provide and control agricultural extension workers, providing the way of safe drinking water sources and building of a school house especially for kola agro ecological areas. providing rural credit services should be diversified and strengthen to solve vulnerable community groups as well as the land less rural youths in order to start up off-farm business activity. The capacity building trainings on extension systems and developing incentive mechanism to extension agents would be supportive in this regard. Rural livelihood diversification (off-farm and on-farm) could be recommended as enhancing household welfare through absorbing a large number of workers and creating employment opportunity for workers.

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Financial Development, Trade Openness and Economic Growth: Evidence from sub-saharan African countries

By

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Abstract

The main objective of this study was to examine the interaction between financial development, trade openness and economic growth in Sub-Saharan African (SSA) countries. The study applies System GMM (One-step system GMM and Two-step system GMM) dynamic panel data models for a sample of 32 Sub-Saharan Africa countries over the period from 2005 to 2019. Model diagnostic tests are used in the study to guarantee that the estimation results are accurate. According to the revealed results financial development and trade openness are both positive and have significant effect on economic growth in Sub-Saharan African countries. Our results also show that trade openness positively affects economic growth directly and indirectly through its positive effect on financial development. Furthermore, our results also show that government spending and inflation have a negative and significant effect on economic growth while, gross capital formation has positive and significant effect on economic growth in Sub-Saharan African countries. Moreover our findings show that there is bidirectional causality between GDP per capita and Trade openness. On the other hand, there is a unidirectional causation from financial development to GDP per capita and from trade openness to financial development. But the reverse is not true. These empirical findings have significant policy implications for governments pursuing financial development and trade openness initiatives to boost economic growth in Sub-Saharan Africa.

Keywords: Financial development, trade openness, economic growth, SSA countries, System GMM

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1. INTRODUCTION

The level of financial development and the degree of trade openness are two macroeconomic variables that the empirical economic growth literature has found as being substantially linked with growth performance across countries(Beck, 2002).Theoretical perspectives on the finance-growth nexus offer a variety of ways by which financial development enhances economic growth. The growth of the financial sector provides for risk diversification and risk management, as well as easier exchange by lowering transaction costs and better resource allocation through the dissemination of information about investment opportunities (Goldsmith, 1969; Shaw, 1973; Bencivenga and Smith, 1991; King and Levine, 1993; Bencivenga, et al., 1995; De Gregorio and Guidotti, 1995). In terms of trade openness, the theoretical literature on international trade claims that trade promotes economic growth by allowing for more efficient resource allocation, spread of knowledge and technology, and better economies of scale(Grossman and Helpman, 1991,Markusen et al., 1995).Many developing nations have implemented liberalization policies with the goal of opening up and integrating themselves into the global market in order to promote their economic development in light of these anticipated benefits from trade and financial development.

On the empirical side, a large amount of research has looked at the connections between financial development and economic growth, as well as the links between trade openness and economic growth. Despite the fact that the evidence in these literatures is inconsistent, if not contradictory, the general consensus is that financial development and trade openness are necessary for economic progress. Few researches, on the other hand, have looked at the linkages between financial development, trade openness, and economic growth in a multivariate framework. Because financial development and trade openness are significant drivers of economic growth, developing countries must grasp the linkages between these three phenomena in order to establish effective policies. In recent years, a significant amount of empirical study has been devoted to examining the effects of financial development and trade openness on economic growth. Depending on the country, data, factors measured, and econometric approaches utilized, these studies produce mixed and contradictory conclusions.

Previous research used OLS, fixed or random effect estimate methodologies to assess the effects of financial development and trade openness on economic growth, which was a severe flaw. These estimating strategies, on the other hand, are skewed and fail to address the endogeneity problem that comes with dynamic panel data analysis (Roadman, 2009). In addition previous studies mostly depend on the cross-sectional analysis. Because the nature of growth is dynamic, cross-sectional analysis is not applicable. Instead, panel data analyses provide greater information, variability, and efficiency. Furthermore, to the best of the researcher's knowledge, previous studies in the literature on the relationship among financial development, trade openness, and economic growth have only used a single indicator to quantify financial development. his gap is filled bya more comprehensive measure of financial development. In this study financial development measured by financial development index developed by international monetary fund (IMF). Financial development index develop with a combinations of financial institutions (depth, access, and efficiency) and financial markets (depth, access, and efficiency). Therefore, additional research in this area of economics is required. Thus, the following main questions are addressed in this research. Does financial development promote economic growth in SSA countries? Does trade openness promote economic growth in SSA countries? What appears to be the causal relationship between financial development, trade openness, and economic growth?

The main objective of this study is examining the relationship among financial development, trade openness, and economic growth in SSA countries using System-GMM dynamic panel data estimation. This study contributes to current studies by examining whether financial development and trade openness has impact on economic growth, using system GMM models in SSA countries over the period 2005 to 2019. Furthermore the relationship between financial development, trade openness, and economic growth which is investigated with advanced dynamic panel data model is limited in number, in which further study is require in the region. Therefore, this study will help in filling knowledge gap in the area. The findings of this study will be valuable in enhancing policy design, institutional setup, and implementation of important policies on financial development, trade openness, and economic growth, particularly in Sub-Saharan African countries. Furthermore, it has the potential to spark future research in the area.

The rest of this paper is laid out as follows. Theoretical and empirical literature is reviewed in section 2. Section 3 illustrate and discussed data and methodology. In section 4 results and findings are discussed. Lastly, conclusion and policy implications are revealed in section 5.

2. LITERATURE REVIEWS

The debate over the role of financial development in economic growth continues to rage, attracting a slew of theoretical and empirical studies that look at the link between the two (Murinde, 2012). The essential question is (a) whether the financial sector drives economic growth or (b) if economic growth explains financial sector expansion. The first theory, known as 'supply-leading,' asserts that financial development is a necessary precondition for economic growth; as a result, finance precedes economic growth, and causality runs from financial development to economic growth. The number and composition of financial development variables, according to proponents, cause economic growth by directly increasing savings in the form of financial assets, resulting in capital formation and thus economic expansion(King & Levine, 1993).In contrast to the preceding, the second theory, known as 'demand-following,' says that finance follows rather than leads economic growth, and that finance plays a minimal role in growth. Finance, according to this logic, is only a by-product or an effect of economic expansion on the real side (Robinson, 1952).As a result, more financial institutions, financial products, and services are said to arise in response to increased demand for financial services as an economy grows. As a result, as the economy's real sector improves, so does the financial system, expanding the chances for obtaining cash for investment and risk reduction. The lack of financial institutions in emerging countries, according to proponents of the "demand-following" hypothesis, indicates a lack of demand for their services.

A stronger and better financial system can also enhance GDP by increasing aggregate savings and investment rates, allowing physical capital to accumulate more quickly. Financial development also encourages growth by increasing competition and fostering creative activities that increase dynamic efficiency(Estrada et al., 2010). According to Bencivenga and Smith (1991), financial development affects economic growth primarily through boosting capital's marginal productivity by moving funds from less productive to more productive uses and also by increasing the rate of saving. Inefficient financial institutions are frequently connected with economic crises, whereas efficient financial institutions are usually associated with stronger economic growth (Ang, 2008). The financial sector, according to Schumpeter (1912), drives innovation, which in turn propels economic expansion. According to the World Bank (2001), financial development has a vital role in an economy's growth, that it is a basic

prerequisite in poverty alleviation, and that it is significant in income distribution improvement.A well-developed financial system could be a critical tool of promoting healthy and long-term growth. In contrast, an underdeveloped financial sector and limited access to credit are significant impediments to economic progress (Gelbarde and al, 2014).According to Schumpeter (1934), financial development acts as a catalyst for economic growth due to its influence on creative investments.

The importance of trade in supporting economic growth has sparked a growing number of economic studies since the works of Grossman and Helpman(1990),Romer(1990), and Young(1998).The question is whether trade, as stated by the trade-led growth theory, functions as an engine for economic expansion. Trade openness has been proved to increase economic growth in the long run by offering access to commodities and services, increasing resource efficiency, and enhancing total factor productivity through technological diffusion and knowledge dissemination(Barro and Sala-I-Martin(1997) and Rivera-Batiz and Romer(1991)).

Increased trade liberalization has both anti- and pro-growth consequences. Export expansion, according to neoclassical economists, is the primary engine of economic growth(Helpman& Krugman, 1985a). Bhagwati (1988) claimed that economic expansion promotes both the supply and demand sides of the economy, leading to the export hypothesis. The selection effects of the Hopenhayn–Melitz model raise the estimated cost of introducing a new variety, which leads to slow growth. The impact of freer trade on the marginal cost of inventing causes the pro-growth effect(Baldwin & Robert-Nicoud, 2008)

Grossman and Helpman (1991) created an endogenous growth model in which trade between rich and developing countries can increase the less developed country's long-term growth rate under specific conditions. In 1993, Taylor combined the Ricardian trade model of Dornbusch et al. (1977) with the quality ladder endogenous growth model of Grossman and Helpman (1991) (de Souza and Batista, 2011). They show that more trade openness leads to faster economic growth. Furthermore, trade openness encourages resource efficiency, factor accumulation, technological diffusion, and knowledge spillovers. Asia has been a display of economic performance, according to Kuroda (2006), where an external trade policy plays a vital role(Trejos& Barboza, 2015).Other theories for the Singer-Prebisch thesis, on the other hand, argue that trade openness may be detrimental to growth (Tekin, 2012). Spilimbergo (2000) proposes a model in which trade between advanced and developing countries can diminish the developed country's long-term growth rates.

The relationship between financial development and trade openness allows for numerous economic development paths. On the one hand, more trade opening can lead to increased financial development, which can boost economic growth, especially finance-led growth via the allocation channel and accumulation. Finance, on the other hand, can enhance growth by promoting trade openness, which is viewed as a growth factor. Trade openness can aid economic growth in a variety of ways, including as boosting a country's level of specialization or having a favorable impact on innovation and technology development(Ho et al., 2021).(Gries et al., 2009) argue that linking financial development and trade openness together could lead to more complex economic development paths. Increased trade openness, in particular, may increase economic growth where financial depth is found to enhance growth via the allocative and accumulative channels. However, if financial deepening leads to trade openness, it may support economic development in areas where trade openness is determined to be a growth factor.

These theoretical arguments have sparked a burgeoning empirical literature aimed at determining the

impact of financial development and trade openness in fostering economic growth. When we look at the empirical literature, we notice that most extant research on the issue have little in common. Some studies have successfully proven the beneficial association between financial development, trade openness, and economic growth, whereas others have been unable to do so. A number of these studies have found a positive and significant relationship between financial development, trade openness, and economic growth, including studies conducted by Udegbunam (2002) used the ordinary least square estimator to investigate the relationship between trade openness, economic growth, and financial development in Nigeria from 1970 to 1997. According to the study, a combination of financial development and trade openness had a strong positive and significant effect on Nigeria's economic growth.Beck and Levine (2004) examines the impact of stock market and bank expansion on economic growth in 40 countries from 1976 to 1998. The results of the Generalized Method of Moments (GMM) estimators reveal that financial development and trade openness have a beneficial and significant influence on economic growth.Mohamed Sghaier (2014) examines the link between trade openness, financial development, and economic growth on a panel of four North African countries using a GMM panel data model over a five-year period from 1991 to 2015, founds that both trade openness and financial development have a significant and positive impact on economic growth. Kaplan (2008) used a VAR model to analyze the link between trade liberalization, financial development, and economic growth in Turkey from 1963 to 2005 and concluded that trade openness and financial development has a favorable long-run impact on growth. Mohammad Tash (2012) analyzed the joint impact of trade liberalization and financial development on economic growth by using VAR model from the period 1966-2010; founds that both trade openness and financial development have a significant and positive on economic growth. Chandio et al. (2017) using a VAR model to analyze the link between trade openness, financial development, and growth in Pakistan from 1970 to 2014; the results show that financial development and trade openness have a positive and significant impact on economic growth in Pakistan.Altaee and Al-Jafari (2014) using the ARDL model from 1980 to 2012 to explore the relationship between trade openness, financial development, and economic growth in the Kingdom of Bahrain. According to the study, both financial development and trade openness have a positive and significant effect on growth.

Others, in contrast to these studies that indicated a favorable relationship between financial development, trade openness and economic growth, have shown a negligible or negative relationship. For example Yucel (2009) investigated the links between financial development, trade openness, and economic growth in Turkey. The study found that financial development had a negative effect on growth using the VAR model from 1989 to 2007. Samargandi et al. (2015) used pooled mean group estimations to analyze the link between financial development and economic growth in a panel of 52 middle-income countries from 1980 to 2008. Financial development, according to the study, has a negative and insignificant effect on economic growth. Huchet-Bourdon et al (2018) investigated the relationship between trade openness and economic growth used a generalised method of moment estimator (GMM) on a panel of 169 countries between 1988 and 2014. The study found that trade openness had a negative impact on economic growth. Vlastou (2010) investigated the relationship between trade openness and economic growth for a sample of 34 African nations from 1960 to 2003 using panel co-integration analysis and causality tests, and found that trade openness has a negative influence on economic growth.

Because of the mixed findings in the empirical literature, there is a knowledge gap that necessitates further research into the links between financial development, trade openness, and economic growth, where few studies have been done.Specifically, not many studies have been attempted to depict the

relationship among financial development, trade openness and economic growth in the context of SSA countries. Therefore, this paper contributes to the ongoing debate on the growth effects of trade openness and financial development by using relevant estimation methods that accounts for some shortcomings in previous studies.

3. METHODOLOGY

3.1 The Data Set

This study used annual panel data from 2005 to 2019 for selected 32[1] SSA. The nations included for this study were essentially determined by the availability of credible data during the sample period. The main variable of interest (trade openness) and the other control variables are obtained from the World Development Indicators database (World Bank, 2021) and pen world database while, financial development index obtained from international monetary fund (IMF) database. Trade openness is measured by the ratio of total imports plus exports over GDP. Assuming that openness to international trade is beneficial to economic growth, a positive coefficient is expected. Financial development (FD) is measured by financial development index an aggregate of financial institution index (depth, access and efficiency) and financial market index (depth, access and efficiency). A stronger and better financial system can also enhance GDP by increasing aggregate savings and investment rates(Estrada et al., 2010).A positive coefficient is expected. Except for population growth, our baseline model incorporates the explanatory variables seen in most growth regressions in the literature. Gross capital formation (GCF) measured by investment per GDP. Greater investment shares have been found to be favorably associated to economic growth; hence a positive coefficient is expected (Mankiw et al., 1992).Foreign direct investment (FDI) measures the value of real gross foreign direct investment inflows to GDP ratio. A positive coefficient is expected. Government spending (GS) defined as the ratio of central government expenditures to GDP. An overly large government is likely to siphon resources away from the private sector, stifling economic progress. As a result, a negative coefficient is expected. Inflation rate measured as the percentage change in the consumer price index over a year. High inflation has been shown to have a detrimental impact on growth, thus a negative coefficient is expected (Elder, 2004).Population growth measured by fertility rate (FR) defined as total births per women thus a negative coefficient is expected.

3.2 Empirical Methodology

The goal of this empirical analysis is to examine the effect of financial development and trade openness on economic growth in Sub-Saharan Africa Countries. In order to achieve this, we use a specification that is broadly comparable to others (e.g, Asghar and Hussain (2014) ;Gries et al., 2009; Herwartz and Walle, 2014 and Zghidi and Abida 2014). We consider the following model:

$$Y_{it} = \alpha_0 + \alpha_1 Y_{it-1} + \alpha_2 FD_{it} + \alpha_3 TO_{it} + \alpha_4 GCF_{it} + \alpha_5 PO_{it} + \gamma X_{it} + \mu_t + \omega_i + \varepsilon_{it} \quad (1)$$

The subscript t represents one of these 15- year periods, whereas i represents the country, Y is the logarithm of the real GDP per capita, Yit-1 is the log lagged is real gross domestic product (GDP) per

1 List of countries included in our sample: Angola, Benin, Botswana, Burkina Faso, Burundi ,Cameroon, Central Africa, Congo Republic, Eswatini, Guinea, Madagascar, Mauritania, Niger, Senegal, Sudan, Uganda, Gabon, Guinea-Bissau, Mali, Mozambique, Nigeria, Seychelles, Tanzania, Chad , Gambia, Kenya, Mauritius, Namibia, Rwanda, South Africa, Togo and Ghana

capita TOis the log of trade openness, FD is the log of financial development, GCF is the log ofgross capital formation, PO is population growth variable and X is the matrix of other control variables described in the previous section, □t is a time specific effect. ωi is an unobserved country-specific fixed effect and εitis the error term.

Trade openness affects economic growth directly and indirectly through its impact on financial development. Therefore, we model the interaction of trade openness and financial development. Our objective is to examine the interaction of trade openness and financial development; hence we adopted the model of Zhang, Zhu, and Lu (2015), David et al. (2014) and Le et al. (2016), we define financial development in terms of trade openness and other factors. The following is our empirical specification:

$$FD_{it} = \beta_0 + \omega_i + \rho FD_{it-1} + \tau To_{it} + \sigma Z_{it} + \mu_t + \varepsilon_{it} \quad (2)$$

FDit is the log of financial development for country i at time t, FDit-1 is the log lagged of financial development for country i at time t-1, TOit is the log of trade openness for country i at time t, Zit is the control variables for country i at time t. ωi is an unobserved country-specific fixed effect, μt is a time specific and εit is a composite error term. Control variables are economic growth, government expenditure, exchange rate, investment, and inflation.

Therefore, our main model is comprised of the two simultaneous dynamic equations.

$$Y_{it} = \alpha_0 + \alpha_1 Y_{it-1} + \alpha_2 FD_{it} + \alpha_3 TO_{it} + \alpha_4 GCF_{it} + \alpha_5 PO_{it} + \gamma X_{it} + \mu_t + \omega_i + \varepsilon_{it} \quad (3)$$

$$FD_{it} = \beta_0 + \omega_i + \rho FD_{it-1} + \tau To_{it} + \sigma Z_{it} + \mu_t + \varepsilon_{it} \quad (4)$$

This system of equation can write in matrix form as follows:

$$\Gamma y + X'\Phi + \varepsilon = 0 \quad (5)$$

Where y is the vector of endogenous variables, X is the vector of exogenous variables, Φ is the vector of corresponding coefficients and εis the vector of stochastic terms consisting of country-specific component, a time component and white noise. Formally written as:

$$\varepsilon_{it} = \beta_i + \lambda_t + v_{it} \quad (6)$$

The overall effect of trade openness on economic growth ∂Y/∂TO can be derived from the direct and indirect effects of trade openness on economic growth. That is,

$$\frac{\partial Y}{\partial TO} = \frac{\alpha 2}{1-\alpha_3\theta} + \frac{\alpha_3\tau}{1-\alpha_3\theta} \quad (7)$$

This paper applies the GMM panel estimator developed by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). There are two main reasons for choosing this estimator. The first is to control for country specific effects, which cannot be done with country-specific dummies due to the dynamic structure of the regression equation. Second, is to control for a simultaneity problem caused by the possibility that some of the explanatory variables may be endogenous with growth or other dependent variables. The differenced GMM approach corrects endogeneity by first differencing

all regressors and removing fixed effects. However, the first difference transformation has a flaw in that it subtracts the previous observation from the current one, which magnifies gaps in data loss (Ullah and Akhtar, 2018). As a result, it has an effect on the estimated result to some extent. However, using Differenced GMM to estimate dynamic models would result in poor precision and large finite sample bias because the past value is a poor instrument for the first difference (Alonso-Borrego, 1996). As a result, Blundell and Bond (1998) and Arellano and Bond (1998) introduce System GMM (1991).

To dramatically improve efficiency, the System GMM approach corrects endogeneity by introducing more instruments for the lag dependent variable and any other endogenous variable, and it transforms the instruments to make them uncorrelated (exogenous) with fixed effects. System GMM also employs orthogonal deviation rather than subtracting the previous observation from the current one, as Differenced-GMM does; instead, it subtracts the average of all future available variable observations (Roodman, 2009).

The system GMM employs a greater number of moment conditions. Monte Carlo evidence also suggests that when time is limited and the dependent variable is persistent, there is an increase in precision and a reduction in small sample bias (Blundell et al, 2000). The GMM (system) has asymptotic efficiency gain. It is an enhancement to the Differenced GMM, and studies show that System GMM is a superior estimation technique in the dynamic panel model (Blundell and Bond, 1998).

The consistency of the System GMM estimator depends on the validity of the assumption that the error term does not exhibit serial correlation and on the validity of the instruments. Arellano and Bond test for second order autocorrelation (AR (2)) and the Hansen's J statistics, which is the test for instrumental validity and efficiency test of System GMM estimator or a test for over-identifying restriction are among the tests available.

The Hansen J test is used to determine the validity of instruments: it examines the null hypothesis of overall instrument validity (Roodman, 2009). Failures, to reject the null hypotheses give support to the choice of the instruments. The autocorrelation/serial correlation test for the error term is also shown, which is used to test the null hypothesis that the differenced error term is first and second order serially correlated. If the null hypothesis of no second order serial correlation is rejected, it means the initial error term is serially uncorrelated and the moment requirements are appropriately provided (AR (2) >0.05).This would indicate that the model is adequately specified and the instruments are valid.

4. RESULTS AND DISCUSIONS

4.1. Descriptive Statistics

This section presents tables compare the means, standard deviation, maximum and minimum values and the number of observations of selected variables in the 32 sub-Saharan Africa countries studied across regions from 2005 to 2019. Our discussion starts with the basic descriptive statistics of variables calculated in the level of the series/ data of variables not in the transformed form.

Table 1: Summary Statistical results for 32 countries the data series of 2005-2019

VARIABLES	N	Mean	Std. Dev.	min	Max
Real GDP per capita (USD$)	480	2380.08	2958.298	278.312	15913.95
Financial development	480	0.1577677	0.1287118	0.0291346	0.645767
Trade openness –%GDP	480	69.39316	34.54228	1.218845	225.0231

Source: Authors computation.

As show in table 1, the number of observation (N) is similar (480) for all the variables under consideration implying the fact that the panel data used in the study is balanced panel data with non-missing points in the selected sample. According to our data, the average real GDP per capita in Sub-Saharan African countries was 2380.08 USD, with a standard deviation of 2958.298 and minimum and maximum values of 278.312 and 15913.95, respectively, from 2005 to 2019.

The mean of financial development equals 0.1577677% and the standard deviations of these variable0.1287118. The minimum values 0.0291346 and maximum value 0.645767. The mean value of trade openness as a percent of GDP in selected sample Sub-Saharan Africa countries for the period of 2005 to 2019 equals 69.39316% with the standard deviation of 34.54228. The minimum and maximum values are 1.218845 and 225.0231.

4.2. Econometric Results and Discussion

The econometric results are presented in Table 2 and Table 3. Table 2Column (1) reports One-step system GMM analysis on the effects of trade openness and financial development on economic growth. Table 2Column (2) reports Two-step system GMM analysis on the effects of trade openness and financial development on economic growth. Table 3column (1) reports One-step system GMM analysis on the effects of trade openness on financial development. Table 3 column (2) reports Two-step system GMM analysis on the effects of trade openness on financial development.

Table 2: The growth effect of trade openness and financial development

VARIABLES	(1) One-step system GMM	(2) Two-step system GMM
Lag GDP per capita	0.969***	0.977***
	(0.011)	(0.011)
Financial development	0.039**	0.031**
	(0.018)	(0.014)
Trade openness	0.010*	0.007*
	(0.005)	(0.004)
Gross capital formation	0.058***	0.043**
	(0.022)	(0.020)
Foreign direct investment	-0.001**	-0.000
	(0.000)	(0.000)
Government Spending	-0.002*	-0.002*
	(0.001)	(0.001)
Inflation	-0.001*	-0.001*
	(0.000)	(0.000)
Population growth	-0.011*	-0.008
	(0.006)	(0.008)
Year	-0.002***	-0.002***
	(0.001)	(0.001)
Constant	4.836***	4.011***
	(1.480)	(1.506)
Number of observation	448	448
Number of groups	32	32
AR(1)	0.030	0.041
AR(2)	0.509	0.486
Joint P-value	0.000	0.000
Hansen statistics	0.139	0.229
Number of Instruments	24	29

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

A One –step system GMM estimation results in column (2) clearly indicate that the coefficient of financial development and trade openness are both positive and statistically significant at the 5 % and 10% level respectively, which suggests that both trade openness and financial development play a positive role in boosting the economic growth in sub-Saharan African countries. All other things remaining the same, at 5% of level of significance, a one standard deviation increase in financial development leads to 0.039% increase in economic growth and at 10% of level of significance, and a 1% rise in trade openness leads to a 0.01% increase in economic growth. Furthermore the lagged real GDP per capita is positively related with the current real GDP per capita at 1% level of significance. Thus, the current year GDP per capita depends on that of the previous year real GDP per capita. In other words, past real GDP per capita status

is found to be significant in explaining present real GDP per capita. On the other hand, the coefficient of gross capital formation is positive and statistically significant. At 5% level of significance, a 1% rise in gross capital formation leads to 0.058% increase in economic growth assuming all other things remaining constant. Government spending has negative impact on economic growth at 10% level of significance. This means an excessively large government spending is expected to crowd out resources from the private sector and be harmful to economic growth. The coefficient of foreign direct investment has the unexpected sign (negative) and statistically significant at 5% level. The coefficient of inflation has expected sign (negative) and statistically significant at 10% level. Population growth are turn out statistically significant and expected sign (negative) in explaining economic growth in Sub-Saharan African countries.

Moreover Two-step system GMM estimation is depicted in column (2). When heteroscedasticity and serial correlation are present; a Two-Step GMM should be employed to leverage a whiting matrix with residuals from the first step. In a finite sample, however, such standard errors tend to be downward biased, prompting practitioners to employ the Windmeijer adjustment to correct for such small sample bias. As a result, adopting this estimating technique produces reliable findings. The results indicate that in column 2 the coefficients of financial development has positive sign and statistically significant at 5% level of significance implying a one standard deviation increase in financial development boosts economic growth in SSA by 0.031%, all other things remaining the same. Furthermore, the coefficients trade openness is positive and statically significant. All other things remain constant, a 1% rise in trade openness leads to 0.007% increase in economic growth at a 10% level of significance. Moreover gross capital formation and government spending are statistically significant at a 5% and 10% level respectively. On the other hand, the lagged real GDP per capita affects the current real GDP per capita at 1% level of significance and the sign is positive. Furthermore inflation has negative sign and statically significant at 10% level. On the other hand foreign direct investment and population growth have the same sign with One-step system GMM estimation, but statistically insignificant in Two-step system GMM. Similar to with one-step system GMM estimation, the two-step system GMM estimation result shows that financial development, trade openness, lagged real GDP per capita, gross capital formation, government spending and inflation have the same coefficient sign and statistically significant. Foreign direct investment and population growth both have the same sign with the one-step system GMM estimation, but statistically insignificant in Two-step system GMM estimation. Column (2), Two-Step System GMM estimation, yields a more robust result.

In our estimation Hansen-J statistic is 0.139 and 0.229 in one-step system GMM and Two-step system GMM respectively. The p-value of AR (2) is 0.509 and0.486; these outputs are obtained after a series of attempts in making Hansen-J statistic to the recommended level, and the P- AR (2) to the acceptable range. Therefore, the assumptions needed for the system GMM estimator to be valid are not ruled out.

Table 3: The effect of trade openness on financial development

VARIABLES	(1) One-step system GMM	(2) Two-step system GMM
Lag financial development	0.886***	0.905***
	(0.55)	(0.045)
Trade openness	0.045**	0.046**
	(0.022)	(0.022)
GDP per capita	0.077*	0.065**
	(0.039)	(0.028)
Gross capital formation	0.002**	0.0023*
	(0.005)	(0.0012)
Government spending	0.0045**	0.0041*
	(0.0019)	(0.0021)
Inflation	-0.0017	-0.0012
	(0.0015)	(0.0015)
Exchange rate	-0.0034**	-0.0032**
	(0.0014)	(0.0013)
Constant	-0.955**	-0.842***
	(0.421)	(0.321)
Number of observation	448	448
Number of groups	32	32
AR(1)	0.001	0.003
AR(2)	0.638	0.605
Joint P-value	0.000	0.000
Hansen statistics	0.164	0.164
Number of Instruments	31	31

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Further based on our finding in One-step GMM and Two-step GMM estimation of table 3, trade openness positively affects financial development in SSA which is in line with the researcher's prior expectation. All other things remain constant, at 5% level of significance, a 1% rise in trade openness leads to 0.046% increase in financial development in SSA countries. When we observe the coefficient of Lagged financial development in table 3 above, it is positive and statistically significant in both estimation techniques. Thus, the lagged financial development is strongly positively correlated with current financial development. The coefficient of lagged financial development is 0.886% reported in One-Step System GMM and 0.905% reported in Two-Step System GMM. And the coefficient of lagged financial development is similar in sign in both specifications. Real GDP per capita has positively affects financial development in one-step and two-step system GMM estimations techniques in SAA countries at 1% and 5% level of significance respectively.

In the One-Step System GMM specification, the coefficients of gross capital formation and government spending are both positive and significant (Table 3), columns (1)). The corresponding Two-Step System

regression (shown in column 2) is indeed shown the same result. On the other hand the coefficient of inflation is negative and statistically insignificant in both estimation techniques.

All in all, the empirical results given in Table 2 and 3 indicate that financial development and trade openness positively affects economic growth in Sub-Saharan African countries. On the other hand trade openness positively affects economic growth in two ways: in the first place, a direct manner through increase economic output by offering access to commodities and services, increasing resource efficiency, and enhancing total factor productivity through technological diffusion and knowledge dissemination and in the second place indirectly, through its impact on financial development. The direct and indirect effect of trade openness is given by, $\alpha 2/(1-\alpha 3\theta$ and $\alpha 3\ \tau)/(1-\alpha 3\ \theta)$respectively.The overall effect of trade openness on economic growth is equal to$\partial Y/\partial TO = \alpha 2/(1-\alpha 3\ \theta)+(\alpha 3\tau)/(1-\alpha 3\theta)$ as deduced from chapter 3. In One-step system GMM estimate, the direct effect of trade openness on economic growth is 0.01, and the indirect effect is 0.002.The overall effect of trade openness on economic growth is 0.012. In Two-step GMM estimation, the direct effect of trade openness on economic growth is 0.007 and the indirect effect is 0.001.The overall effect of trade openness on economic growth is 0.008.This implies that trade openness positively affects economic growth directly and indirectly through positively impact on financial development in both estimation techniques.

Discussion

Our empirical analysis suggests that financial development and trade openness are associated with economic growth. The role of financial development and trade openness seems to have been important to boosts economic growth in the Sub-Saharan African countries.In this section our empirical findings are compared to existing theoretical and empirical literature, and we attempt to make sense of the findings.

Let us look to general theory and empirical evidence to understand our findings. Financial development, in theory, has a favorable impact on economic growth in Sub-Saharan Africa countries through numerous pathways. First, it aids in the conversion of savings into more useable forms, as well as the efficient allocation of capital and increased total factor productivity (TFP). Second, it encourages risk diversification and management. Third, it lowers information inequities as well as transaction and monitoring expenses. Fourth, it can minimize economic volatility by providing people and businesses with a variety of instruments and information to help them cope with adverse shocks through consumption and investment smoothing(Mlachila et al., 2016).

In a comprehensive analysis of the literature, Levine (2005) discovers a strong positive relationship between financial development and economic growth. By raising aggregate savings and investment rates, financial development can help boost economic growth(Estrada et al., 2010).The financial sector propels economic expansion by driving innovation (Schumpeter, 1912).

Financial development, in general, boosts economic growth in Sub-Saharan African countries, according to our empirical findings. In other words, increased financial development leads to increased economic growth. Our finding is comparable to the works of(Asghar& Hussain, 2014);(Zghidi& Abida, 2014);(Chandrashekar et al., 2018);(HONG et al., 2018);(Mohamed Sghaier, 2014) and(Kar, Osman, et al., 2008). We also found a similar result with empirics of(Mlachila et al., 2016);(De Gregorio & Guidotti, 1995);(Khan & Senhadji, 2000);(Ram, 1999);(Hassan et al., 2011) and (Assefa & Mollick, 2017) are among others. All of the above researches agree that financial development positive effect on economic growth.

Furthermore, our empirical finding depicted that trade openness positively affects economic growth in SSA countries. Trade openness has a favorable impact on economic growth through increasing technology transfer and knowledge-related externalities, as well as increasing competitiveness. These outcomes have a favorable impact on local enterprises and sectors productivity patterns, resulting in increased value added and income. A country's potential to profit from technological advancements, diversification of industrial production, and export base, on the other hand. Essentially, it assumes that differences in industrial development and technological capabilities between countries may be linked to possible different effects of trade openness on economic growth, depending on the size of the economy, technological proficiency, and degree of industrial diversification. Finally, while global trade openness may boost global economic growth, it has a negative impact on individual countries(Silajdzic& Mehic, 2018). Similar to the findings of (Akinlo & Okunlola, 2021); (Sukar et al., 2001); (Ltd, 2018); (Deng, 2010) and (Okungbowa et al., 2018) , our empirical result asserted that trade openness has positive impact on economic growth in SSA countries.

Let us now consider some more explanatory variables that influence economic growth. Gross capital formation has a favorable impact on economic growth in Sub-Saharan African countries, according to our empirical findings. Domestic investment is used to measure gross capital formation in this study. Domestic investment has a necessary component to foster economic growth (ODI, 2016). According to Keynes, new and additional investment boosts the economy's aggregate demand (Tobin, 1965). When current enterprises make new investments or new domestic investors enter the market; there is an increase in domestic investment (Faulkner, Loewald&Makrelov, 2013). In conclusion, this process may result in a high degree of capital formation, which will lead to greater productivity and, in turn, long-term economic growth. Greater investment shares have been found to be positively associated to economic growth(Mankiw et al., 1992).Our findings are consistent with the findings of(Dritsakis et al., 2006); (Alemu & Lee, 2015) and (Ibrahim & Alagidede, 2018).

Moreover, our findings confirmed that government spending has negative impact on economic growth in Sub-Saharan Africa countries. Excessive government expenditure affects productivity by diverting resources away from the productive private sector and into the unproductive public sector. This is expected to crowd out resources from the private sector and be harmful to economic growth(Mitchell,2005).Similar to the findings of Hermes and Lensink (2003) and (Kamara, 2010), our empirical result asserted that in One-step system GMM estimation foreign direct investment has negative impact on economic growth in SSA countries. Dependency theorists argue that reliance on foreign investment will have a negative impact on growth and income distribution in the modernization perspective. According to Bornschier and Chase-Dunn (1985), foreign direct investment, generates an industrial structure dominated by monopoly, resulting in underutilization of productive forces. The assumption being that an economy controlled by foreigners would not develop organically, but would rather grow in a disarticulated manner (Amin, 1974).This is due to a poor multiplier effect, in which demand in one sector of an economy generates demand in another, resulting in stagnant growth in developing countries. This point is relevant since the natural resource sectors (Pigato, 2000) receive the majority of FDI to Africa and have high entry barriers. Foreign direct investment, on the other hand, negatively affect to economic progress. Foreign direct investment has the potential to harm the host economy by decreasing the balance of payments due to repatriated profits, lack of positive linkage with local businesses, negative environmental impact, and crowding out domestic investment (Kumar, 1990).

Furthermore, our findings confirmed that inflation has a negative impact on economic growth in Sub-Saharan Africa countries. According to Barro (1995), high inflation diminishes investment, and lower investment has a negative impact on economic growth. All taken together, our empirical findings revealed that financial development and trade openness both have a favorable impact on economic growth in Sub-Saharan African countries. Gross capital formation captured by domestic investment, on the other hand, was found to have a positive impact on economic growth. Furthermore, our empirical findings revealed that government spending and inflation had a detrimental impact on economic growth in Sub-Saharan African nations, which is statistically significant.

4.3 .Causality and Panel Unit root test

4.3.1. Panel Unit root test

Before proceeding to determine the causalities among the main target variables, we should test their level of stationarity. Levin-Lin-Chu panel unit root test is used and the results show that the variables do not have unit root at level. That is they are I (0) variables as shown in Table 4.4(a).

Table 4: ADF Test based on Levin-Lin-Chu panel unit root test

Variables	Stationarity level	Levin-Lin-Chu panel unit root test	
		Statistic	P-value
Real GDP per capita	I(0)	-1.8428	0.0327
Financial development	I(0)	-6.0616	0.0000
Trade openness	I(0)	-2.7455	0.0030

Since the target variables are found to be stationary at level, it implies that there are no long run relationships. Therefore we don't need to perform a cointegration test among the variables. However we can test the causality between the variables and the direction of causation.

Dumitrescu-Hurlin (2012) made an extended panel data version of the granger causality test which was introduced by Granger (1969). The regression to test panel causality is given by

$$y_{it} = \alpha_i + \sum_{k=1}^{k} \delta_{ik}\, y_{it-k} + \sum_{k=1}^{k} \theta_{ik}\, x_{it-k} + \varepsilon_{it}$$

Where, y(it-k) is a matrix of past values of the dependent variables yit and x(it-k) are the lags of the explanatory variable xit. The approach for determining the existence of causality, as in Granger (1969), is to test for substantial effects of previous values of x on the present value of y. The null hypothesis of no causality for all the individuals in the panel is given by

H0: $\theta_{i1} = ... = \theta_{ik} = 0, \forall\ i = 1... N$

By using the panel VAR model lag selection criteria of the Bayesian Information Criterion (BIC), the Hannan-Quinn Criterion (HQC), and the Akaike Information Criterion (AIC) proposed by Andrews and Lu (2001), we selected the optimal lag and found it to be lag 1. Then after running the VAR model and

testing for granger causality, we have come up with the following granger causality results.\

Table 5: granger causality result

Dependent	Independent	chi2	df	Prob> chi2
Real GDP per capita				
	Trade openness	20.822	1	0.000
	Financial development	16.731	1	0.000
	All	35.971	2	0.000
Trade openness				
	Real GDP per capita	4.546	1	0.033
	Financial development	0.743	1	0.389
	All	5.044	2	0.08
Financial development				
	Real GDP per capita	0.382	1	0.537
	Trade openness	6.177	1	0.013
	All	6.91	2	0.032

As it is indicated in Table 5, there is bidirectional causality between GDP per capita and Trade openness. On the other hand, there is a unidirectional causation from financial development to GDP per capita and from trade openness to financial development. But the reverse is not true.

5. CONCLUSION

Over the last three decades, economists have paid close attention to the relationship between financial development, trade openness, and economic growth. Despite much research on the subject, empirical data is inconclusive. This is especially true for research that looks at African countries experiences. This study has investigated the relationship between financial development, trade openness and economic growth (real GDP per capita) in 32 Sub-Saharan African countries using a system GMM (One-step system GMM and Two-step system GMM) panel data model over the period of 2005-2019. We utilized macroeconomic data from World Bank's World Development Indicators (2021), pen world database and an international monetary fund (IMF). Our empirical findings of this study revealed that both trade openness and financial development have a significant and positive effect on economic growth in Sub-Saharan Africa Countries. Furthermore, the results derived from the estimations give us empirical evidence that trade openness positively affects economic growth directly and indirectly through its positive impact on financial development. Other economic factors such as lagged real GDP per capita and gross capital formation has significant and positive coefficients meaning that these variables promote economic growth to Sub-Saharan African countries.

The findings of the study indicate that government spending and inflation have a significant and negative impact on economic growth in Sub-Saharan African countries. Furthermore, our results show that there is bidirectional causality between GDP per capita and Trade openness. On the other hand, there is a unidirectional causation from financial development to GDP per capita and from trade openness to financial development. But the reverse is not true.

The general findings of this study's policy implications show that financial development appears to be a policy variable for increasing economic growth in Sub-Saharan countries. The government must deepen the financial sector and take necessary steps to strengthen the long-term relationship between financial development and economic growth in order to preserve sustainable economic growth. More financial integration and elevating the status of financial institutions are among these approaches. Aside from these steps, the macroeconomic climate must be stabilized in order to promote financial sector development. According to the conclusions of this study, trade openness benefits economic growth in Sub-Saharan African countries. As a result, more efforts should be taken to allow countries to have more trade openness in order to achieve high and long-term economic growth.

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Effect of Instability on Sesame Production in Northwest Amhara, Ethiopia

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Abstract

Since 2015, there has been political instability in the entire country. This political tension is more violent and unwavering in northwest Amhara region of Ethiopia, which supplies nearly half of sesame production country wide. Though there are some empirical literatures on sesame production and productivity, there is a dearth of empirical studies that shows the empirical relationship among political instability and sesame investment in the study area. The aim of this paper is to empirically investigate the interplay between political instability and sesame investment in Northwest Amhara. This analysis mainly relies on primary data. The data is analyzed using descriptive statistics and econometric models. The results from the descriptive analysis revealed that local conflict, hostage and border conflicts are the main sources of political instability. The robust OLS result also shows political instability is a significant factor that hampers sesame production by 32.75% on average for producers that encounters political instability in the study area. Based on the findings, we recommend local and regional governments to provide long-lasting resolutions to local conflicts through discussions with the local communities. The border conflict with neighboring Sudan also demands close attention by the federal government for mutual and sustainable development.

Keywords: Instability, Sesame Production, Productivity, Northwest Amhara

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1. Introduction

In the history of human beings, nothing is as common as conflict. The contemporary world is the result of conflict (Acemoglu and Robinson, 2012). Political conflict escalation and its impact on economic development of many developing countries has been a topical issue in recent economic development literature (Abeyratne, 2004). Conflict linked to inequality, the opportunity costs of engaging in conflict rises for the poorest, if the gap between richest and poorest shrinks (Hartzell et.al, 2010). It has long lasting effects of eroding economic development even after it has ended (Flores and Noorduin, 2006). This has established evidence in the Arab spring, which brought huge economic consequences (Sidamor et.al, 2016) and affects bank's performance in Gulf region (Jaara, 2021).

Many Sub-Saharan African countries have prolonged conflict and political instability induced economy, which demolished agriculture production in the region (Herbst, 2013). Institute for Economics and Peace (2018) estimated about $616 billion Sub-Saharan Africa's economic loss in 2017 due to conflicts, which is 6% higher than what it was ten years ago. From this estimate, Ethiopia shares 9% of the GDP lost, equivalent to $19 billion. Political instability dampens agricultural investment and even government spending for different infrastructure, which have a prolonged effect on economic development. Instability has two fold effects. On one side, conflict and its management expense boosts the expected cost of investment, these negative expectations will weaken private investment. Secondly, variance of instability decreases the amount of investment, stated as criminal activity acts like a tax on the economy (Detotto and Otranto, 2010; Carboni and Detotto, 2016).

Ethiopia is among the top-five sesame producing countries in the world and the third world exporter of sesame seed following India and Sudan (Alemu and Meijerink, 2010). For the country, sesame is the second most important agricultural commodity next to coffee in foreign exchange earnings (Girmay, 2018). Ethiopia's sesame is the highest quality and thus highly demanded by the international market (Sorsa, 2009; Fiseha and Muez, 2019). It is mainly grown for the export market; only 5% of the production is consumed locally (CSA, 2014). Nearly half (48.84%) of Ethiopia's sesame is grown in Northwest Amhara (Gela et.al, 2019).

Political instability disrupts the economic system and bring structural changes about economic, social and political (Beser and Kilic, 2017). It undermine agricultural production FAO et al., (2018 & 2020), if violence intensifies with presence of non-state armed actors; farmers concentrate on subsistence activities (Arias et.al, 2019). Conflict can affect agriculture and rural economy in various ways (Adelaja and George, 2019). It disrupt the supply and distribution of inputs and outputs and cause massive displacement of labor (Kimenyi et al., 2014), with higher uncertainty farmers are likely to drop agricultural production due to conflict (Masset et al., 2019).

Northwest Amhara is the major contributor of the country's total sesame production, which creates employment both for skilled and unskilled labor, generates foreign exchange, and income source for households at the country level. In the study area, there was continued dispute with Tigray region, prolonged on and off conflict with Sudan, and the most devastating conflict (ethnic) emanates from within the Amhara region, particularly in the West and Central Gondar Zone, which brought about robbery, hostage, killing and displacement. As a result, free movement of local community, civil servants and input delivery (laborers, seeds, fertilizer, and pesticide) were restricted. By then economic activities, mainly agricultural investment, were highly restricted. This uncertainty adversely affects

sesame investment, which is a common seasonally planted crop in the area.

Several scholars (Bitar et.al, 2020; Sidamor et.al, 2016; Kamga et.al, 2022; Williams and Pradhan, 2008) studied the effects of political instability on key economic variables such as investment, production, unemployment and migration. Few others (Kimenyi et.al, 2014; Ikuemonisan et.al, 2020; Warsame et.al, 2022) studied the effects of political instability on specific crops. However, implication of the political instability on sesame production is not scientifically investigated in the study area. Thus, evidence based research output, which shows the causal effects of political instability on sesame production is needed to design appropriate policy towards conflict management.

Therefore, this research aimed at examining the interplay between political instability and sesame production in Norwest Amhara complimented by specific objectives of assessing the trends of sesame production, and exploring the political unrest indicators that most affects sesame production.

2. Materials and Methods

2.1 Description of the study area

This study is conducted in Northwest Amhara (former North Gondar Zone), where political instability has intensified since 2015 (Davison, 2016). The Amhara people have been protesting against the Ethiopian People's Revolutionary Democratic Front (EPRDF) for structural change (Ademe, 2022). The area shares a boundary with Sudan in the west, one of the disputed areas, Wolkayit in the north, South Gondar Zone in the south, and Benishangul-Gumuz region in south. It is centered by the historical town of Gondar, which is located 728 km away from Addis Ababa, the capital city of the country, and 173.5 km from Bahir Dar, the capital city of the regional state. The area produces the largest share of Ethiopia's sesame. It accounts for 48.84% of national sesame production (Gela et.al, 2019).

2.2 Data Source, Sampling Method, and Sample Size Determination

The study relied mainly on primary data collected from February 15, 2021 to April 7, 2021 and partly on secondary data obtained from District, Zonal and Regional Agriculture offices and Zonal security offices. Structured questionnaire was employed to collect data about demographic characteristics, labor mobility, farm input, input cost, crop diseases, sesame production, political instability and its indicators. Trained experts with diverse professional backgrounds were engaged to collect the primary data.

This research applied a multistage sampling technique. In the first stage, two sesame producing zones (Central and West Gondar) were purposely selected. In the second stage, 5 Woredas, three (Quara, Metema and West Armachiho) from West Gondar; two (Tach Armachiho and Tegedie) from Central Gondar were selected. In the third stage, a sample unit was selected proportional to the number of sesame producers in each sampled Woredas.

Single population proportion formula (n0 = (z2 pq)/e2) with 50% proportion (0.5) was employed to determine the study sample size. The value of Z (1.96) is taken from a statistical table. It represents the area under the normal curve. Therefore, the sample size was estimated to be approximately 384 sesame producers with an error margin of 1%. With a response rate of 78%, 300 sesame producers were actively engaged in the study. The escalation of border dispute with Sudan during data collection has significantly impacted the response rate in West Armachiho. As a result, 300 respondents were engaged from only four Woredas. Of these sampled study units, only 259 respondents were included in the ordinary least

squares (OLS) regression analysis due to lack of complete information on the covariates.

2.3 Method of Analysis

This data was analyzed using descriptive statistics and econometric models. Using descriptive statistics, the general trends of sesame production is discussed using graphs. On top of this, OLS regression is employed in econometrics analysis. Following Gujarati, (2014) OLS model, which fulfills the classical linear regression assumption is specified as follow:

$$Y = \beta 0 + \beta i\ Xi + \epsilon i \qquad (1)$$

Where Y is volume of sesame production Xi is a vector explanatory variable (family size, labor, other inputs, crop disease, experience in sesame farm, land size, political instability (a dummy variable: 1 if there is instability, 0 otherwise)). Political instability is included in the model based on the following two justifications. One, studying whether political instability affects sesame production is the main research question of the current study. Two, economic performance depends on the functioning of institutions, mainly political institutions, the important factor that explains economic growth differences across nations.

3. Result and Discussion

3.1. Descriptive Analysis

This study retrospectively analyzed the trend of sesame production. The respondents were asked to provide information on the trend of their sesame production since 2015 when conflicts began to occur recurrently. As shown in figure 3.1 below, the production of sesame has declined over time. The respondents argue ethnic conflict as the major factor that deterred further production during that period. The dramatic fall in production of sesame might be associated with the political turmoil, which the area has experienced. The correlation analysis in appendix A, table A1 also discloses a negative association between sesame production and political instability for our dataset. This result is consistent with the Ethiopian commodity exchange (ECX) assessment report, which shows a 24% drop in volume of sesame export since 2015.

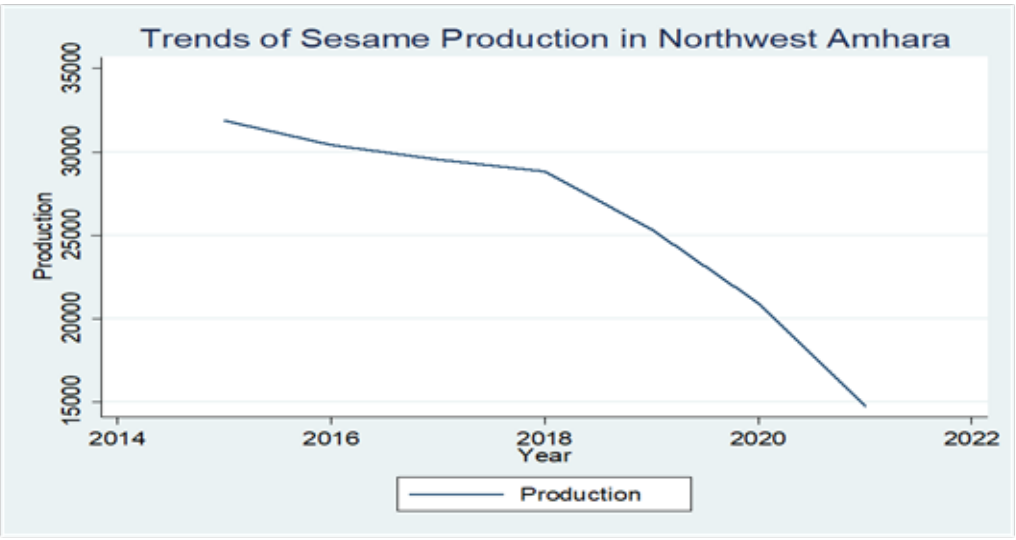

Figure 3.1: Trends in Sesame Production in Northwest Amhara

Source: own computation

The result discussed above coincides with the finding by Fiseha and Zenawi (2019) which shows a trended drop in volume of Ethiopia's sesame export since 2015. Besides production, productivity has also shown a declined trend in our study. This coincides with the FAO's (2015) report where an increase in productivity from 0.4 tons/ha in 2000 to 1.0 tones/ha in 2008 was wedged by instability in the years that follow. Figure 2 below depicted the same story with existing empirics.

Figure 3.2: Sesame Productivity in Northwest Amhara

Source: own computation

3.2. Econometric Analysis

Besides the descriptive analysis, the study also applied an econometric analysis. The OLS regression result shows that political instability negatively affects the volume of sesame production in the study area at 5% level of significance. Specifically, the finding revealed that sesame production under political unrest scenario declined by 32.75% on average compared to the scenario with no political unrest. It implies that a producer who experiences political instability produces less than a producer who does not experience political instability. In fear of hostage, losing life the sesame farm may not managed properly in the presence of political instability. Similarly, crop diseases also negatively affect sesame production at 10% level of significance. The finding illustrates a farmer who is faced with crop disease has 25.3% lower sesame production compared to a producer, who produces in the absence of crop diseases.

Contrarily, years of experience and labor used are positively and significantly affect sesame production. As shown in table below, as producers' farm experience increases by one year the production of sesame increases by 2.93%. Since sesame, production is labor intensive and needs strong follow up particularly in harvesting season, the positive effect of farm experience and labor employed are justifiable. Furthermore, family size do not contribute for sesame production. This may be because most sesame producers in the area employ market labor.

Table 3.1: Determinants of Sesame Production: Regression Results

Output	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
Political instability	-32.7484	13.2290	-2.48	0.014	-58.8029	-6.6939
Labor	0.1368	0.0240	5.69	0.000	0.0894	0.1842
Input	0.0009	0.0004	2.32	0.021	0.0001	0.0018
Experience	2.9289	1.5743	1.86	0.064	-.17166	6.0295
Crop Disease	-25.3689	13.6425	-1.86	0.064	-52.2378	1.4999
Family size	1.5205	1.7981	0.85	0.399	-2.0208	5.0618
Land size	0.2251	0.1473	1.53	0.128	-0.0649	0.5152
_cons	42.58649	36.02526	1.18	0.238	-28.3652	113.5382

Source: survey result (2021)

The study also tried to investigate the sources of instability that affects sesame production in the study area. Majority (92%) of respondents said that labor immobility, mostly in fear of armed conflict, which prominently distorts sesame production. The immobility frequently occurred because of local clashes (ethnic) and hostage in the study area. Unlike local clashes, however, respondents in all sampled areas believed that hostage has twofold effects on the production of sesame. Labor mobility restriction is a direct effect of hostage that lets labor to stay at home. In addition, payment for criminals exploits the community and limits sesame production capacity.

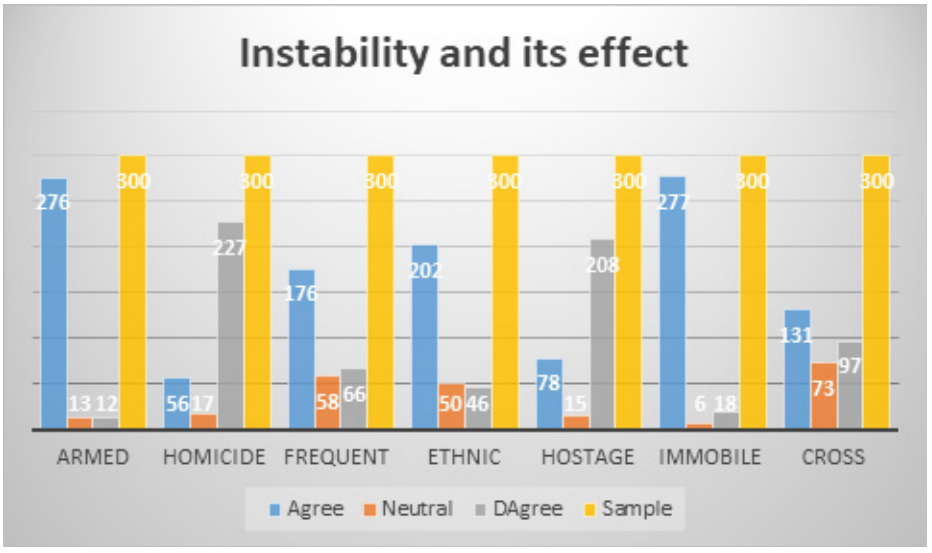

Figure 3.3: Perception on effect of Instabilities

Source: own computation

The finding is consistent with previous studies (Kimenyi et.al, 2014; Ikuemonisan et.al, 2020; Warsame et.al, 2022). For instance, two studies (Warsame et.al, 2022; Warsame et.al, 2022) in Somalia shows political instability hampers maize production by 1.07% and hamper sorghum production significantly. Similarly, Kimenyi et.al, 2014 shows instability dampens agricultural investment in Mali and Nigeria

and has a prolonged effect on their economic progress. Moreover, a study by Ikuemonisan et.al, 2020 in Nigeria shows political instability reduced Cassava production.

3.3. Post Estimation Tests

The regression analysis in section 3.2 is supplemented by econometric tests that are demanded to guarantee the OLS assumption under the cross-sectional analysis. The current study was subjected to Ramsey test for model specification; Breusch–Pagan/Cook–Weisberg test for heteroskedasticity; variance inflation factor (VIF) test for multicollinearity and Shapiro-Wilk test for normality. The specification test result indicates no variable is omitted in the model specification. The robust OLS regression is applied to adjust for the standard errors that are from heteroskedasticity.. Furthermore, the model is also free from multicollinearity, non-normality, and non-linearity problems (appendix B). Therefore, the OLS regression result discussed above fulfilled all the classical linear regression assumptions.

4. Conclusion and Recommendation

Political instability has negative (or at least equally bad) effects on labor mobility thereby on sesame production. Among political instability indicators, local conflict takes the lion share in affecting sesame production. Based on this, local governments shall exert efforts to secure and rehabilitate the area. Policymakers also should note that in the fighting of this existential challenge, community centered participatory local conflict resolution methods are worthwhile instead of top-down political solutions. Therefore, local conflicts should be resolved sustainably. The border conflict with Sudan also demands close attention by the federal government for mutual and sustainable development.

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Appendices

Appendix A

Table A: Descriptive Statistics

Table A1: Correlation Analysis

	output	Pins	labor	Incost	Experi~e	CropDis	fsize	lsize
output	1.0000							
Pins	-0.2013	1.0000						
labor	0.3902	0.0498	1.0000					
Incost	0.5301	-0.1688	0.1942	1.0000				
Experience	0.1970	-0.1298	0.0903	0.0717	1.0000			
CropDis	-0.1423	0.0320	0.0628	-0.1365	0.0635	1.0000		
fsize	0.1116	-0.1994	-0.0220	0.0797	0.2390	-0.0378	1.0000	
lsize	0.3093	-0.0849	0.1086	0.1354	0.0749	-0.1186	0.0284	1.0000

Appendix B

Table B1: Model Specification Test

model including family size and land size

Source	SS	df	MS	Number of obs	=	258
Model	2586434.66	7	369490.666	F(7, 250)	=	29.05
Residual	3180263.64	250	12721.0546	Prob > F	=	0.0000
				R-squared	=	0.4485
Total	5766698.3	257	22438.5148	Adj R-squared	=	0.4331
				Root MSE	=	112.79

output	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
Pins	-32.7484	14.90217	-2.20	0.029	-62.09821	-3.398594
Lmobility	.1368062	.0228648	5.98	0.000	.091774	.1818384
Incost	.0009998	.0001215	8.23	0.000	.0007605	.0012391
Experience	2.928942	1.288404	2.27	0.024	.3914324	5.466452
CropDis	-25.36894	14.42933	-1.76	0.080	-53.78748	3.049598
fsize	1.520492	2.610868	0.58	0.561	-3.621608	6.662592
lsize	.2251118	.0557258	4.04	0.000	.1153599	.3348637
_cons	42.58649	35.17707	1.21	0.227	-26.6947	111.8677

```
Ramsey RESET test for omitted variables
Omitted: Powers of fitted values of output
H0: Model has no omitted variables
F(3, 247) =   2.56
 Prob > F = 0.0554
```

Table B2: Homoscedasticity Test

Breusch–Pagan/Cook–Weisberg test for heteroskedasticity

```
Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Assumption: i.i.d. error terms
Variables: All independent variables
H0: Constant variance
F(7, 250) =  20.61
Prob > F = 0.0000
White's test
H0: Homoscedasticity
Ha: Unrestricted heteroskedasticity
   chi2(33) = 164.57
Prob > chi2 = 0.0000
Cameron & Trivedi's decomposition of IM-test
-------------------------------------------------
              Source |       chi2     df         p
---------------------+---------------------------
  Heteroskedasticity |     164.57     33    0.0000
            Skewness |      20.36      7    0.0048
            Kurtosis |       4.37      1    0.0366
---------------------+---------------------------
               Total |     189.31     41    0.0000
-------------------------------------------------
ROBUST OLS
------------------------------------------------------------------------------
reg output Pins labor Incost Experience CropDis  fsize lsize, robust

------------------------------------------------------------------------------
             |               Robust
      output | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        Pins |   -32.7484   13.22901    -2.48   0.014    -58.80292   -6.693882
    Lmobility|   .1368062   .0240529     5.69   0.000      .089434    .1841784
      Incost |   .0009998   .0004308     2.32   0.021     .0001513    .0018483
  Experience |   2.928942    1.57431     1.86   0.064    -.1716587    6.029543
     CropDis |  -25.36894    13.6425    -1.86   0.064    -52.23783    1.499942
       fsize |   1.520492   1.798066     0.85   0.399    -2.020795     5.06178
       lsize |   .2251118   .1472633     1.53   0.128    -.0649229    .5151466
       _cons |   42.58649   36.02526     1.18   0.238     -28.3652    113.5382
------------------------------------------------------------------------------
```

Table B3: Multicollinearity Test

Variable	VIF	1/VIF
Pins	1.09	0.919947
Lmobility	1.07	0.930736
CropDis	1.05	0.954202
lsize	1.05	0.954336
Incost	1.11	0.900367
Experience	1.09	0.917004
fsize	1.10	0.909533
Mean VIF	1.08	

Table B4: Normality Test

```
swilk — performs the Shapiro-Wilk W test for normality. we reject non-normal
                  Shapiro-Wilk W test for normal data
    Variable |        Obs       W           V         z       Prob>z
-------------+-------------------------------------------------------
           r |        256    0.98396      2.970     2.536    0.00561
```

Table B5: Linearity Test

```
Nonlinearity test:
       F(  9,   239) =    5.30
            Prob > F =    0.0000
```

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