

The Impact of Foreign Remittances on the Growth of the Ghanaian Economy: An Assessment of the Mediating Role of the Technology

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ABSTRACT

The aim of the study was to investigate how remittance inflows affect economic growth while taking technology's mediating function into account. Ghana was the subject of the 46-year study, which ran from 1975 until 2020. The Ordinary Least Square regression model was employed in the investigation. The findings showed that remittance inflow had a small but negative impact on economic growth in the absence of the interaction effect. The analysis finds a strong positive correlation between the introduction of an interactive term (technology) and economic growth. Technology showed a strong positive correlation with economic growth, but remittances showed a negligible positive correlation. According to the study, life expectancy, exchange rates, and foreign direct investment (FDI) are the main factors influencing economic growth. The study's findings indicate that in order to maximize the benefits of foreign remittances on economic growth, policymakers should establish a suitable technological framework for their management and utilization. This will improve financial inclusion, lower transaction costs, and encourage the effective use of funds.

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Keywords: Ghanaian Economy, Foreign Remittances, Economic growth, Information and Technology, Foreign Direct Investment, Exchange Rate, Life Expectancy, Money Transfer Companies.

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1.0 Introduction

Remittances are monetary and material aid sent to family members by migrant workers who work outside their native country. Workers (remitters) who are living and working abroad from their homes, send remittance monies all over the world to their friends and families. Although the usage of remittances varies by country, most remittance recipients utilise them to cover living expenses, education, and investments [1]. Due to the huge and growing aggregate flow of remittances, these private donations not only enhance the living conditions of recipient families but also have a significant impact on national economies [2]. Remittances have long been seen as a key and reliable source of external revenue in developing countries. In underdeveloped nations, remittances are primarily used to bridge the balance of payment (BOP) imbalance and maintain better economic conditions. Remittances can theoretically boost economic growth by facilitating the development of financial markets, providing financing for entrepreneurial activities, providing shock insurance, financing household expenditure, financing household capital formation, bridging the savings gap, and bridging the external financing gap. A segment of literature found that remittance inflows led to economic growth, which has been empirically confirmed [3], [4], [5], and [6].

In many developing countries, Information and Communications Technology (ICT) has been a key driver of growth, thanks to its ability to facilitate trade, capital flows, communications, and mobile money transfer services. In underdeveloped and emerging economies, remittances are another interesting source of growth. In this study, we looked into the connection between growth, remittances, and technology. Over the past 20 years, information and communication technology (ICT) and remittance inflows have steadily increased in Ghana, an emerging African economy. Technology affects every part of our everyday life in some way. This aroused our interest, so we set out to look

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into the implications of the relationship between economic growth, technical advancements, and remittance inflows.

1.1 Statement of the Problem

Advocates of remittances as a source of external capital for development claim that when remittances are invested in a country, they contribute to the growth of an economy, while when they are consumed, they have positive multiplier effects [7]. As a result, remittances have a favourable impact on economic growth [8, 9 and 10]. They? claimed that remittances helped to smooth the balance of payments at the macro level and that remittances are generally distributed in cash and used for consumption and education at the micro-level. Overall, it can be said that remittance inflows have aided economic growth and contributed to beneficiaries' higher welfare gains [11]. On the contrary, other studies claimed that remittances can stifle economic growth. This may happen if remittances are largely used for consumption rather than productive investment, which would lead to economic development [12]. When remittance inflows cause the local currency to appreciate, it might impair the country's economy by discouraging exports and thereby limiting entrepreneurial rivalry in the recipient's country [13]. This is revealed in previous studies that remittances have a significant negative impact on growth [14], [15]. The purpose of this study is to empirically explore whether remittances lead to economic growth in Ghana, based on the two strands of literature.

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Finally, with the increasing number of mobile phones in Ghana, a record of 44.90 million mobile connections as of January 2022, [16] coupled with the surge in mobile banking in Ghana to similar networks and across networks. This has replaced the old way of posting money, sending them through people and banks. This resulted in a much easier means of transferring money from other countries into Ghana. However, as to whether the influx in the use of mobile phones to remit money from abroad to Ghana has improved the Ghanaian economy has not been proven empirically. This study, therefore, seeks to investigate the impact of remittance inflows on the growth of the Ghanaian economy considering the mediating role of mobile technology.

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1.2 Objectives of the Study

This study generally focuses on the effect of foreign remittance on economic growth considering the mediating role of technology. The study aims to accomplish the following particular goals in order to fulfil this overall objective:

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1. To determine the trend of Ghana's foreign remittance, economic growth, and technology.
2. To investigate the effect of foreign remittance on economic growth in Ghana.
3. To investigate the mediating role of technology on the effect of foreign remittance on economic growth in Ghana.

The objectives of this study ~~is~~are achieved by examining, the trend of Ghana's foreign remittance and its impact on the economic growth, where technology plays a mediating role in getting the remittances to their destination for the intended purposes.

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1.3 Scope and significance of Study

The study focuses on the empirical understanding of the relationship between foreign remittance and growth considering the mediating role of technology. This ~~research study~~more specifically studies focuses on Ghana, a developing country sited at the Western end of Africa. The importance of the study can be divided into two categories: policies and research. The study examines the impact of

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foreign remittances on economic growth, taking into account the function of technology as a mediating factor. Understanding the relationship between economic growth factors like technology and remittances is crucial for various reasons. First, the government ~~couldan~~ utilise ~~this data~~ the data panel adopted in the study to determine the best policies for accelerating Ghana's economic development. Secondly, international financial and development agencies ~~like such as~~ the World Bank, the International Monetary Fund, the Agricultural Development Bank, and the United Nations Development Programme ~~couldan~~ use these findings generated from the study to decide on the best policies to adopt to improve the growth of the Ghanaian economy. This ~~research study~~ would make a significant contribution to the field and ~~would~~ serve as a foundation for additional empirical research. It ~~would also serve asis~~ a valuable resource for Ghanaian researchers, academics, managers, and students of economics and finance. This investigation would finally ~~bringsbring~~ to the notice of the Ghanaian government feasible areas for improvement.

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2.0 Literature Review and Theoretical Underpinnig

In order to provide a context for analysing the remittance inflow and economic growth, remittance inflow and technology, and economic growth and technology this section describes the remittance inflow in various countries. The underlying question is whether the influence of technology on remittances affect the economic growth of recipient countries. The empirical review provides studies relating to remittance inflow and economic growth, remittance inflow and technology, and economic growth and technology. In this section, the study evaluated the initialtheoretical review exploring the endogenous growth model and followed with the empirical review on remittance inflow, technology and economic growth.

2.1 Endogenous Growth Model

The endogenous growth model, which presupposes a continuous return, serves as the fundamental theory behind this investigation. According to the endogenous growth model, total factor productivity, physical capital, and human capital are endogenous inputs that drive the growth of national output. [17]. Scholars have backed this hypothesis by arguing that the endogenous growth model's emphasis factors—human capital development, total factor productivity, technological diffusion, and physical investments—are the means by which the remittance-growth impact is identified. [18], [19]. The idea that the development of human capital and the diffusion of technology promote economic growth and development through their impact on total factor productivity (TFP) is well-supported by the endogenous growth model. [20] Contends that the degree of human capital proficiency determines the increase in TFP. There is a dearth of research on how factors related to technical innovation and remittances affect economic growth. Microanalyses that attempt to gauge the impact of remittances on households make up a large portion of the existing literature on remittances and technological development variables [105]. This restriction is addressed by endogenous growth theory, which demonstrates that TFP and technology diffusion factors complement the effect of remittances on growth. Endogenous growth theory, according to [18], pinpoints the channel by which remittances will support development and expansion. This theory's major justification is that remittances are purportedly able to accelerate economic growth through the improvement of human capital or increased productivity. [18], however, contends that while remittances have little effect on economic growth, they may have a considerable impact on the latter due to their influence on technology.

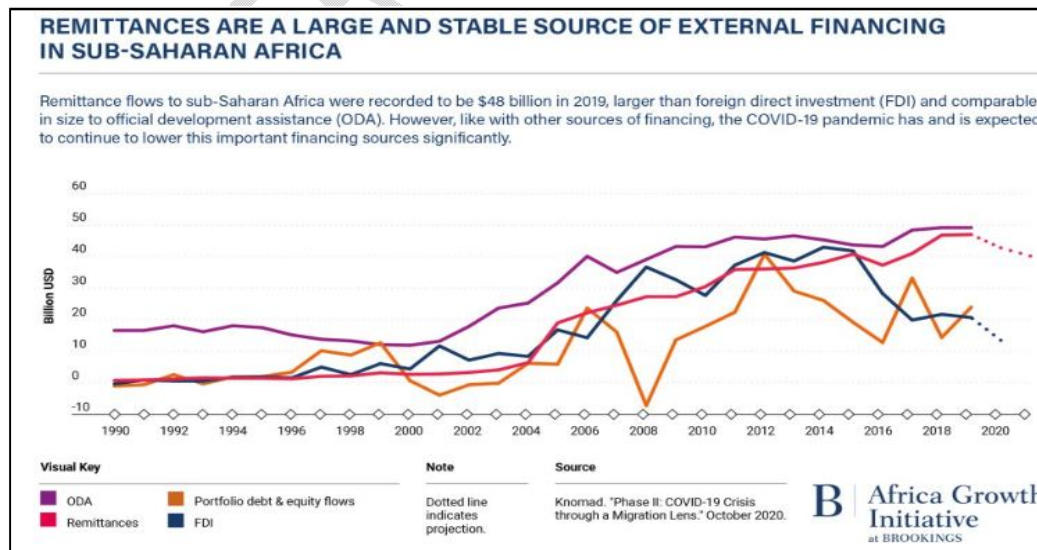
2.3 Empirical Review of the Literature

The empirical review evaluates the current literature on remittances inflow and economic growth, coupled with the remittances, remittance's inflow and technology, channels of remitting money, economic growth and technology. This evaluation covers their research period, methodology, study sample size, and research findings.

2.3.1 Remittance Inflow and Economic Growth

Remittances are a natural by-product of migration and are paid to the nations of emigrants as compensation for losing a portion of their labour force, [21]. It has been determined to be a quicker, more affordable, and simpler method of moving money internationally, [22]. In 2013, \$416.6 billion, \$429.9 billion in 2014, \$432 billion in 2015, with \$52 billion of that amount going to Africa[23]. According to Rajan and Zachariah's analysis from 2019, Africa experienced average economic growth of 5% in 2010 and roughly 5.5% between that year and 2015 throughout the same time period. These figures were far higher than those in the Middle East and Asia, where average growth for the same time was 5% and less than 5% respectively. Remittances are emphatically shown to positively correlate with financial development through the deposit flow and remittances received overseas to home banks according to[24] Yaseen (2012). Broad money's ability to measure financial progress has revealed a number of trends in the chosen countries along with their GDP growth rates. Remittance to low and middle-income countries hit \$550 billion in 2019, exceeding Foreign Direct Investment (FDI) and Official Development Aid (ODA). According to[25], these are merely documented flows; the actual volume, which includes those via unofficial routes, is much higher. The ability to measure financial progress has revealed a number of trends in the chosen countries along with their GDP growth rates. Figure 2.1 shows that Sub-Saharan Africa received \$48 billion in remittances in 2019, but the actual amount is probably far higher. About half of all remittances to Sub-Saharan Africa were sent to Nigeria alone (Figure 1). Smaller, poorer and more vulnerable nations typically depend more on remittances for their economies: taking into consideration the size of the economy, South Sudan (35% of GDP), Lesotho (21% of GDP)

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Fig.1: Remittances sent to sub-Saharan Africa as a whole

Source: World Bank Data.

Figure 2 shows that the remittances to Nigeria are the highest in our sample. It reached \$23.8 billion in 2019. It is followed by Ghana, Kenya, and Senegal with \$ 3.5 billion, \$ 2.8 billion and \$2.5 billion. The remittances flowing into South Africa are the lowest among study ample with \$0.9billion.

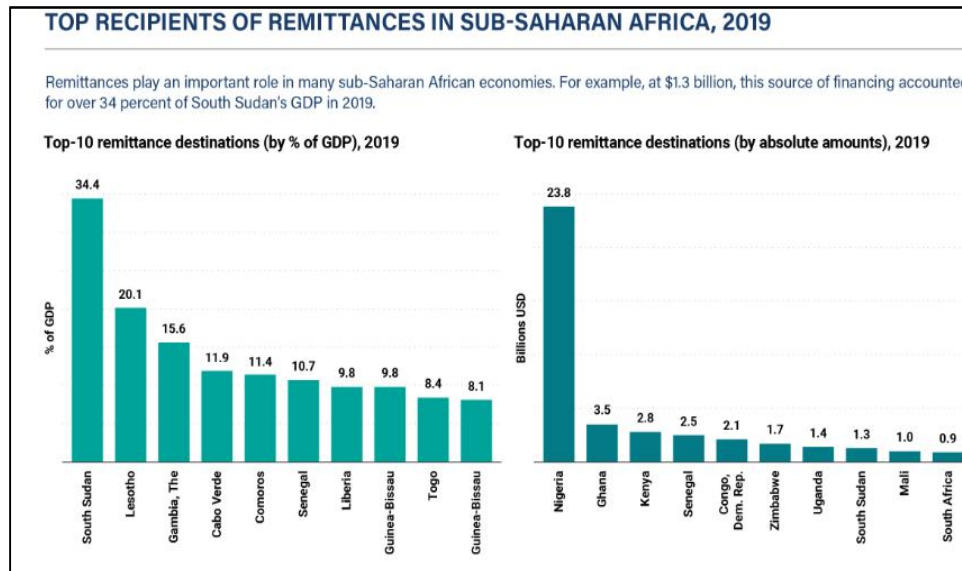


Fig.2: Remittances to countries sample in billions
Source: World Bank Data

However, figure 3 shows the level of remittances arriving in Ghana. The top countries from which Ghana receives remittances are the United States of America, Nigeria, the United Kingdom, Italy, Germany, Côte d'Ivoire, Canada, Togo, Burkina Faso, and the Netherlands, as shown in figure 2.3. Contrary to popular opinion, remittances do not solely originate in Europe and the United States; evidence indicates that a sizeable number of remittances originate in African nations including Nigeria, Burkina Faso, and Côte d'Ivoire.

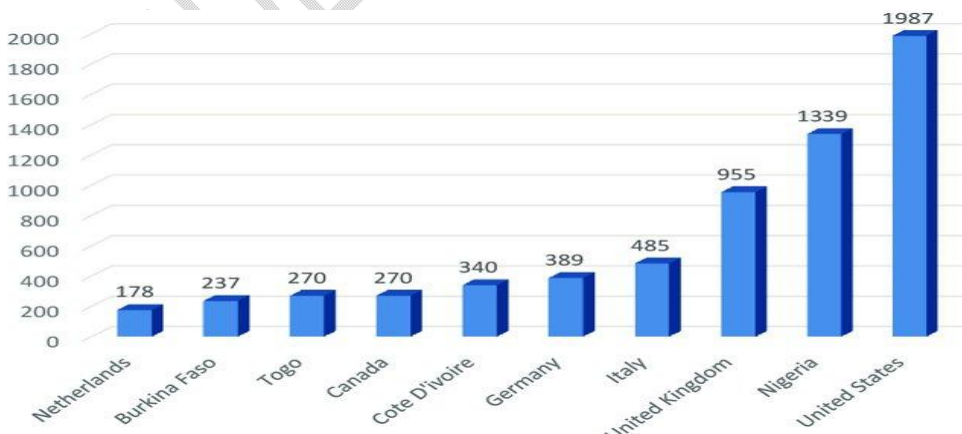


Fig 3: Major countries of origin of remittances to Ghana
Source: Bank of Ghana

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In comparison to earlier research, [26] employed the generalized method of moment to evaluate the applicability of increasing remittances on value-added economic sectors in sub-Saharan Africa from 1980 to 2014. The ability of remittances to measure financial progress has been reviewed by a number of trends in the chosen countries along with their GDP growth rates. First, there study found that, increasing remittances has a net positive impact on the net manufacturing sector added value. Given that the unfavourable net occurrence of remittances to the service sector is connected with positive marginal or conditional impacts, the study expanded by estimating the threshold at which remittances include net positive impact on added value to the service sector. An increase in remittances must reach a critical mass of 4 at 8.5% of GDP according to the extended research, in order to provide a positive net on the value-added service sector search.

[27],investigated the effects of remittances on the financial development of nations in South-Eastern and Eastern Europe from 1994 to 2007. The study looked at whether these funds help boost the volume of deposits and credit that are processed through local banks. The results show that remittances significantly contribute to the financial development of South-Eastern and Eastern European nations. It has been noted that the impact of bank orders on private investors is more significant than the impact on bank deposits.

In their study,[28]tried to determine how inbound remittances impacted Ghana's economic development. Using annual data from 1970 to 2016, the orthographic distributed lag ARDL estimate approach was utilized to look for a connection between remittances and economic growth. The findings showed that remittances have a short-term favourable impact on economic growth and a long-term negative impact on GDP.

However, [29]divide the 30-year period into six non-overlapping five-year periods to investigate the impact of remittances and economic growth permanence on the economic growth of low-income, lower middle-income, and upper middle-income economies. They use pooled cross-country time series for the period of 1981 to 2010. In new ways, this time period made contributions to the literature on remittances, economic growth indicators, and related topics. According to the research, remittances are not linked to the expansion of low-income economies' economies. Remittances are, nevertheless, found to be favourably and significantly linked to the expansion of lower middle-income and higher middle-income economies, according to the study's findings.

In developing Asia,[30]investigated the macroeconomic effects of FDI and remittance inflows. The majority of remittances go to emerging countries in Asia, and the area has consistently done well in attracting foreign direct investment (FDI) inflows. Foreign direct investment (FDI) and remittance inflows have an impact on output and foreign exchange rates since they are an external source of capital formation. This study uses data from 1981 to 2015 to give empirical evidence on the effects of FDI and remittances on real effective exchange rates and GDP in Asian developing nations. The endogeneity problem was solved using the dynamic panel GMM approach. According to their findings, remittances and FDI inflows both have positive and significant effects on currency rates and GDP in developing Asia. Due to generally steady inflows, remittances have more influence and considerable effects.

In eleven MENA nations, [31]investigated the impact of governance and remittances on economic growth. They selected these nations because of their rather stable political environments. Due to the

fact that the series included in this analysis have varying degrees of integration, we estimate panel Autoregressive Distributed Lag (ARDL) models using annual data from the World Bank for the years 2002 through 2017. These models incorporate control variables including gross capital formation, per capita consumption, and openness, among others. The six governance indicators from the World Bank are used to calculate a governance composite. To investigate their effect on economic growth, these indicators are utilized singly in various Autoregressive Distributed Lag (ARDL) models and their interactions with remittances. The results showed that the remittance had a negative effect on economic growth in the quasi-totality of the models. Although the governance composite indicates a favourable effect on economic growth, taking the governance dimension into account produces contradictory results.

2.3.2 Channels of Remitting Money

Most remittances are sent to Ghana via both official and unofficial methods. While official channels are offered by licensed financial institutions, informal channels involve remitting services and procedures that are not part of the wire transfer and financial services businesses. The issue of record keeping is brought on by the usage of informal channels.

According to studies by [32] and [33], a significant portion of remittances to Ghana are still primarily transferred through unofficial channels, such as when friends and relatives travel home, carry cash with them when they visit, or cloak money in letters that are sent to Ghana. In a study by [32] it was found that 41% of money sent abroad was received through formal financial institutions, and a study by [33] finds that formal financial institutions and money transfer companies received 53% of remittances sent during a year of the study. Given that 73% of Sub-Saharan Africa's overall remittances are not documented, these figures are not surprising [34].

The study by [32] found that higher transfer fees and financial institutions' refusal to pay remittance in foreign currencies are two additional factors contributing to immigrants' preference for informal channels over formal ones. [35], looked into what factors influence migrants' decision regarding the method of payment when sending money to family members who live overseas.

The survey was carried out by using 1680 migrants in the Netherlands. The investigation revealed five remittance services and five money transfer operator services in cash transfers through unofficial intermediaries. Bank services were also recognized. The study also revealed other significant factors such as individual trait and mission specific factors, prices, usability, and availability of remittance choices have a role in deciding the choice of payment channels. Based on the findings, according to [35], new (mobile) remittance solutions, cost-cutting measures, and financial education may all be beneficial.

Table 1. Money Transfer Companies in Ghana

<ul style="list-style-type: none"> ● Western union ● MoneyGram ● Ria Money Transfer ● Vigo Money Transfer ● Express Money Transfer ● Small World Money Transfer ● Lawrence Associate ● Unity Link ● Samba ● Trans fast ● Oasis ● Suri Change 	<ul style="list-style-type: none"> ● Coinstar Money Transfer ● Ghana Money Transfer ● UT transfer ● Universal Money Transfer ● Unity Monetary Services ● FamilyLink Money Transfer ● Money Exchange ● GES money ● MTN mobile money ● Tigo cash ● Airtel money ● Vodafone cash ● T Money
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Source: Authors Compilation (2023)

2.3.3 Remittance Inflow and Technology

By reducing the cost of production, streamlining supply chain procedures, facilitating access to information (thereby assisting consumers with decision-making), and offering high-quality goods at reasonable prices, technology has increased productivity and growth, see [36] and [37]. [38], over the past three decades, a sizable body of literature examining the dynamism in technological advancement, which has proven to be essential in the growth and development process, has arisen. Numerous studies have looked at the impacts of technology at different levels, including firm-industry, national, cross-country, and regional levels, with a special emphasis on industrialized nations [39]. For instance, [40] examined enterprises in Canada's service industries at the firm-industry level and discovered that personal computers had a favourable impact on productivity development. ICT and productivity are strongly correlated, according to [41] investigation into 57 significant US industries. According to [42], [43], information and communications technology (ICT) services have the potential to boost the economy by increasing labour productivity, enable technology-dependent industries (such as manufacturing and services) to operate profitably, and give consumers more information about a wide range of goods and services. The availability of effective technology offers a global virtual platform for communication and trade inside and across numerous industries for countries that are sea-locked, remote physically, and cut off from major business centres [44]. Thus, as ICT services expand due to a growth in connections, which is mostly fuelled by cables and other technological equipment, effective and affordable communication links are built, which facilitates other types of economic activity than tourism [38]. Additionally, there is a clear causal relationship that links broadband infrastructure to growth, especially when there is a sufficient amount of that infrastructure [45].

In their study, [46] looked at the relationship between ICT, remittances, and output per worker in Vietnam from 1980 to 2012. They use Granger causality tests and autoregressive distributed lag bounds to analyze the short- and long-term impacts as well as the direction of causation within the augmented Solow framework. The findings indicate that ICT has a significant short-run (0.002%) and long-run (0.006%) impact on output per worker. The elasticity coefficient of remittances is favourable over the long term but is not significant at the 1%–10% level of significance, and the short-term results are varied. The causality conclusion shows a unidirectional causality from capital per worker and ICT to remittances, respect, and a bidirectional causality between remittances and output per worker, stressing their mutually reinforcing effect.

[47], examined how linkages between information and communication technology (ICT) and remittances affect the doing of business. Their study focused is on a panel of 49 Sub-Saharan African (SSA) countries for the period 2000–2012. The empirical evidence is based on the generalized method of moments. While the authors establish some appealing results in terms of net negative effects on constraints to the doing of business, some positive net effects are also apparent. The authors also establish ICT penetration thresholds at which the unconditional effect of remittances can be changed from positive to negative.

[48], in their research looks at how remittance and information and communication technology ICT are related in businesses operations. Focus was placed on a panel data of 49 Sub-Saharan African nations from 2000 to 2012. Making use of a generalised method of moment the study established that ICT penetration thresholds positively influenced remittance inflow.

2.3.4 Economic Growth and Technology

The relationship between Technology and economic growth has been debated extensively in endogenous growth, growth accounting, new economy and policy literature.

The question as to whether ICT spur economic growth has been much debated in literature. It is both theoretically and empirically agreed that ICT should spur growth[49]. According to [50], ICT affects growth through improvement in the quality of life; improvement in the competitiveness of doing business; diversification of the economy and retention of business. [51],claim that ICT significantly lowers the cost of transactions in the financial services industry. The rapid development of ICT has boosted e-commerce, increased human capital development, encouraged information dissemination, and network externalities in addition to creating new jobs[52]. By encouraging economic freedom, social and political stability, network externalities, and productive efficiency, ICT indirectly fosters growth.

[53], [54], [55], [56], [57] and [58], are a few previous research on ICT and economic growth that have a national focus. In their estimation of the impact of broadband on Brazil's productivity from 2007 to 2011.[59],discovered that broadband raises Brazil's productivity. Similarly, [54]discovered that mobile telephony promotes India's economic growth while concentrating on 14 Indian states between 2001 and 2012. India's economic growth is accelerated by ICT investment, according to[60], study of the direct and indirect effects of ICT on India's economic growth from 1986 to 2011. [61],investigates the effect of ICT on Singapore's economic growth from 1990 to 2008 with a focus on Australia.[62], concludes that ICT accelerates Singapore's economic growth. When[63] looks at the impact of mobile and fixed-line on China's economic growth from 1991 to 2011, she finds that both technologies boost the country's GDP. ICT boosts China's economic growth, according to [58] who looked at the short- and long-term effects of ICT on China's economic growth from 1980 to 2013. The Swedish government has also recognized that ICT has a favourable impact on economic growth [56].

[64], [65], [66], [67]. [68], [69], and [70]among others, are some of the studies on ICT and growth that have also concentrated on a panel or cross-country studies. ICT help G-20 countries' economies thrive, according to [71], who looked at the effects of ICT and innovation on carbon emissions and economic growth for 13 G-20 countries from 2000 to 2014. ICT infrastructure has a positive impact on the economic growth of EU countries, according to research by[64], who looked at this issue from 2000 to 2017. [65], compares nations with higher access to education and those with less access to determine whether education modifies the influence of ICT on economic growth. By concentrating on 45 SSA nations between 1993 and 2015, researchers discovered that, given improved education, the internet contributes to economic growth.[72], focusing on 40 SSA nations between 2006 and 2015, discovered

that SSA countries' economies are boosted by mobile. ICT helps Small Pacific Island States' economies expand in both the short- and long-terms, according to [58]Kumar et al. (2015), who looked at the effect of ICT on economic growth for these countries from 1979 to 2012.[68], focusing on OPEC, discovered that ICT fuelled the region's economic growth from 2002 to 2015. [73], examined the economic growth of 9 ASEAN nations between 1991 and 2009 and discovered that ICT is a major driver of this growth. Focusing on the BRICS and[69], discovered that from 2000 to 2014, ICT helped the BRIC countries' economies thrive. Using a global dataset,[56]discovered that from 2002 to 2014, broadband accelerated economic growth in 135 nations. In a similar vein, [74], discovered that from 1991 to 2000, 207 countries' economies grew as a result of internet use. On the other hand,[75]discovered that from 1991 to 2015, the internet slowed economic growth in 207 countries. Contrarily, [76], discovered that from 2005 to 2009, mobile broadband was more advantageous for 43 nations (divided into high-income and low-income countries) in low-income countries. For 74 nations (divided into SSA and OECD countries) between 2006 and 2016.[77], discovered that SSA countries profit more from mobile telecommunications, whereas OECD countries typically benefit more from internet usage. Finally,[66] finds that the gains from ICT investment are the same for 59 countries (categorized into developed, emerging, and developing countries) from 1995 to 2010.

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3.0 Data and Methodology

In this section the study design, study area, the sample procedures, the procedure for data collection and the analytical technique used to analyze the data will be discussed. The chapter also explains remittance inflow, technology and economic growth. The interactive effect of technology on the relationship between remittance inflow and economic growth was analyzed using econometric model.

3.1 Research Design

The research design is an important aspect of the study of remittances. It is important to devise a method for accurately collecting data and analyzing it. A research design may be explanatory, exploratory, or descriptive, according to [78]. To determine the best technique to collect data, researchers must first select a research strategy. According to [78], the research design is the overall strategy for a study that entails the research philosophy and method employed to effectively address a defined problem. This philosophy describes the viewpoints and presumptions of how data about a phenomenon ought to be obtained and investigated. [79], define a research approach as a plan that identifies three main research methodologies and acts as a road map for achieving the research objectives. They are the mixed approach, the qualitative approach, and the quantitative approach. The quantitative technique will be used in this study since it allows for the objective assessment of hypotheses[79].

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3.2 Data Source and Sampling Criteria

A time series data of Ghana, a Sub-Saharan African country for a level of forty-six-year period from 1975 to 2020 due to data availability was employed. Using econometric methods for time series regression models, the complete set of data is analyzed/analysed. Time series analysis is a specific way of analyzing/analysing a sequence of data points collected over an interval of time. In this regard, data points recorded are at consistent intervals over a set period of time rather than just recording the data points intermittently or randomly. However, this type of analysis is not merely the act of collecting data over time. Our study employed sets time series data and this is different from other data because the analysis can show how variables change over time. In other words, time is a crucial variable because it shows how the data adjusts over the course of the data points as well as the final results.It

offers a different information source as well as a predetermined hierarchy of data relationships. Because consistency and dependability in time series analysis usually demand a high number of data points, we decided to investigate the 46-year period data for the study. A large data set guarantees a sample size that is representative, and the analysis can filter out noisy data. Additionally, it guarantees that any patterns or trends found are not anomalies and can take seasonal variation into consideration. Time series data can also be utilized for forecasting, which is the process of projecting future data based on past data. The World Development Index (WDI) from the World Bank Development database is the data's primary source. Because most studies on remittance inflow have gotten their data from WDI, this analysis depends on the information provided by WDI [80], [81], [82], [83]. The temporal features and forecasting skills of the time series data analysis employed in this work are the main focus. The ordinary least square, which was used to model linear relationships and was not intended for time-dependent data, is also taken into consideration, as is the sequential nature of the data. This is not the case for panel data analysis, general least square, or structural equation models that were employed in previous research, where the goal was to address the analytical capacities of complex data structures and offer more nuanced insights using both cross-sectional and time series dimensions.

3.3 Econometric Model

The use of time panel data technique to reveal the relationship between remittance inflow and economic growth and the relationship between the interactive effect of technology and remittance inflow and economic growth in Ghana. Time series data is used because this will tell whether the aim of remittance inflow; thus, to ensure economic growth is met in Ghana. According to [84], the panel estimate technique must be used due to the nature of the data and the numerous benefits it offers.

The panel estimation technique is recommended due to the characteristics of the data and the benefits that come with using panel estimation, according to [85]. Panel estimate also has the benefit of controlling the impacts of factors that are insurance-specific, allowing for both long-run and short-run effects, and overcoming the limitations of the times series and cross-sectional techniques [84]. This therefore enables a better understanding and measurement of phenomena that are not captured in either cross-sectional or time series models and therefore allows for the modelling and testing of complex behavioural models [85]. According to [86], the error term structure in a panel data modelling makes the ordinary least square estimation an inefficient and biased estimator of panel model. Time-series increases the likelihood of correlation between the error terms of different periods. Again, the assumption of homoscedasticity does not always hold for panel data models. Two methods are used to analyze panel data. These models have fixed effects and random effects.

A time series regression model is used to test the relationship between macroeconomic factors and mutual fund prices. A time series regression model is more appropriate for estimating the relationship because the sample data consists of a set of random variables indexed by time [84]. All open-end mutual funds in Ghana face the same degree of systematic risks emanating from macroeconomic factors like interest rates, inflation rate, exchange rate etc., hence using a time-series model will suffice. The generalized static time series model can be expressed as

$$y_t = \beta_0 + \beta_1 X_{it} + \varepsilon_{it} \quad (3.1)$$

3.3.1 Relationship between Remittance Inflow and Economic Growth

As a result of the data's panel structure, the study uses the empirical model below.

$$Growth_t = \beta_0 + \beta_1 Remit_t + \beta_2 FDI_t + \beta_3 Life\ Exp_t + \beta_4 Inflation_t + \beta_5 Ex\ Rate_t + v_t \quad (3.2)$$

$$Growth_t = \beta_0 + \beta_1 (Remit * Mob\ sub)_t + \beta_2 FDI_t + \beta_3 Life\ Exp_t + \beta_4 Inflation_t + \beta_5 Ex\ Rate_t + v_t \quad (3.3)$$

Where;

$Growth_t$ is the Economic growth of Ghana at period t

$Remit_t$ is the proxy for Remittance inflow of Ghana at various time periods t .

$Mob\ sub_t$ is the proxy for technology (mobile subscription ratio) of Ghana at time t

FDI_t is the foreign direct inflow of Ghana at time t

$Life\ Exp_t$ is the life expectancy of Ghana at time t

$Inflation_t$ is the proxy of inflation for Ghana at time t

$Ex\ Rate_t$ is the exchange rate of Ghana at time t

v_t is the error term

3.4 Variable Definition

In this section, the variables utilized in the panel model are discussed.

3.4.1 Growth and Remittance Inflow

One of the finest metrics for assessing an economy's performance is its GDP per capita. As a stand-in for economic growth in this study, GDP per capita growth (annual percentage) expressed in constant 2005 US dollars is employed. Thus, our dependent variable is the annual percentage growth in GDP per capita. Personal remittances received as a proportion of GDP are employed in this study as a stand-in for remittances [87], [88]. The World Bank data set is the source of the remittance data.

3.4.3 Foreign Direct Investment (FDI)

A stand-in for foreign direct investment (FDI) is net inflows, expressed as a percentage of GDP. The World Bank dataset is where FDI data is obtained. Instead of using total flows, FDI net inflow is utilized since it is a more accurate indicator of how FDI influences a nation's economic growth. The source of this determinant is the World Bank database.

3.4.4 Population Growth

Different methods can be used to measure population growth. Numerous authors in the growth and convergence literature incorporate depreciation, population expansion, and technology growth into their models [89]. This combo is predicated on the Solow model. Remittance literature, however, uses population growth alone, not the combination of these three variables. Population growth (annual percentage) is used as a stand-in for population increase in this study [90]. This variable comes from the World Bank database.

3.4.5 Inflation

Although there are several benchmarks available, this analysis uses consumer prices (annual %) as a proxy for inflation [5]. The World Bank database is where the inflation data is obtained.

Comment [OA22]: Kindly do away with tautologies and specify directly the model you adopted.

3.5 Method of Data Analysis and Presentation of Results

The times series data of remittances inflows to Ghana, [ICT technology](#), an economic growth of Ghana was analysed using times series analysis. STATA software was used in running the data. Results for the analysis were displayed in [chapter session four](#).

4.0 Results and Discussion

The methods for obtaining, evaluating, and deriving the results, as well as their interpretations, are described in this part. It shows the correlation matrix, the selected variables' correlation statistics, and finally the regression analysis of the study's objectives.

4.1 Descriptive Statistics

Table 2 provides the [variables](#)—descriptive statistics [of the dataset](#) from the regression. The mean, maximum and lowest values as well as the standard deviation of the pooled data from 1975 to 2020 for each variable serve as the primary descriptive metrics.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GDP	46	1.259	4.434	-14.509	11.315
REMIT	46	1.439	2.375	0	10.085
MOB. TECH	46	31.636	49.676	0	137.517
FDI	46	2.738	2.866	-.66	9.467
LIFE EXP	46	57.538	3.844	50.811	64.347
INFLATION	46	30.941	28.375	4.865	122.875
EXC. RATE	46	1.03	1.546	0.000114	5.596

Source: Construct of the Authors (2023).

Our variables' statistical characteristics are displayed above. The tables provide information on the different variables included in the model, the total number of observations (Obs) for each, the mean, standard deviation (Std.Dev), minimum (Min) and maximum (Max) values for each variable used in this study as shown in the columns. The highest number of observations for all variables in table 2 is 46, suggesting that data for Ghana was gathered during a 46-year period. While economic growth is proxied by the Gross Domestic Product (GDP) Per Capita growth as used in most studies, remittance is measured as personal remittance received to GDP and technology is proxied as mobile subscription ratio.

To begin with our dependent variables, GDP, the proxy for economic growth in Ghana recorded a minimum of -14.509 and a maximum of 11.315 with a mean of 1.259. Given this observation, it is quite evident that Ghana has experience period of improved growth in the economy and periods of recession as well.

The average Remittance inflow was 1.439 which implies that the overall remittance inflow to GDP was 1.439. The standard deviation of remittance inflow recorded for the period was 5.552. Over the period, remittance inflow attained a maximum of 10.085 and a minimum of 0. The data implies that, whereas some has had periods where large amount of remittance was received, there were periods where very small remittance was received. As a proxy for mobile subscription, the number of mobile cellular subscriptions (MCS) per 100 individuals had an average of 31.636 and ranged from zero to 137.517. This is expected because mobile use was ones non-existent in Ghana but has increased all over the country at a very high rate.

Foreign Direct Inflows, proxied by FDI inflows to GDP, averaged 2.738, with a standard deviation of 2.866 and maximum and minimum scores of 9.467 and -0.66 respectively. According to the net FDI values, Ghana may have received both positive and negative net FDI inflows during the time period under consideration. Life expectancy measures the life expectancy of people in Ghana. The average value of 57.538 indicates that on average, Ghanaian is expected to live 58 years. The life expectancy variable has a standard deviation of 3.844, has a minimum of 50.844 and attains a maximum of 64.347 during the study period. Consumer price index was used as a stand-in for inflation. The inflation variable for the study period averaged 30.941, meaning that Ghana's inflation output increased by an average of 30.941 points each year, with a range of up to 112.875 points and down to 4.865 points. This shows that for Ghana over the study period, inflation increased to about 112.875 points in one particular year.

Over the course of the study, Ghana's average exchange rate was 1.03 with a standard deviation of 1.546. Additionally, the exchange rate fluctuated between 0.000114 and 5.596.

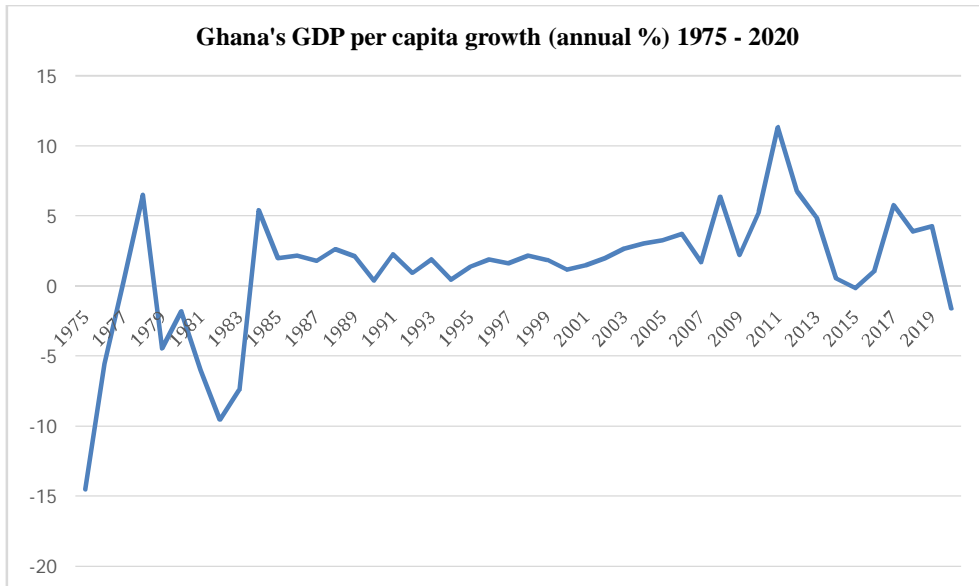
4.2 Trend Analysis

This section discusses the trend of Economic growth, remittance inflow into Ghana and technology in Ghana.

4.2.1 Trend of Economic Growth

The trend analysis of economic growth proxied as GDP per capita growth across the study period (this from 1975 – 2020) is presented in Figure 4 below. The figure 4 reveals that, economic growth reached its highest peak in 2012. The growth of the economy is attributed to the increase in the export of oil, cocoa and gold[91]. Figure 4 shows that the least growth was recorded in 1975 where there was political instability which resulted to inefficient public policies and bureaucratic mismanagement. Throughout the study period we observe a rise and fall of economic growth indicating that Ghana's economy has experienced periods of booming as well as recession.

Figure 4: **Trend of Economic Growth**

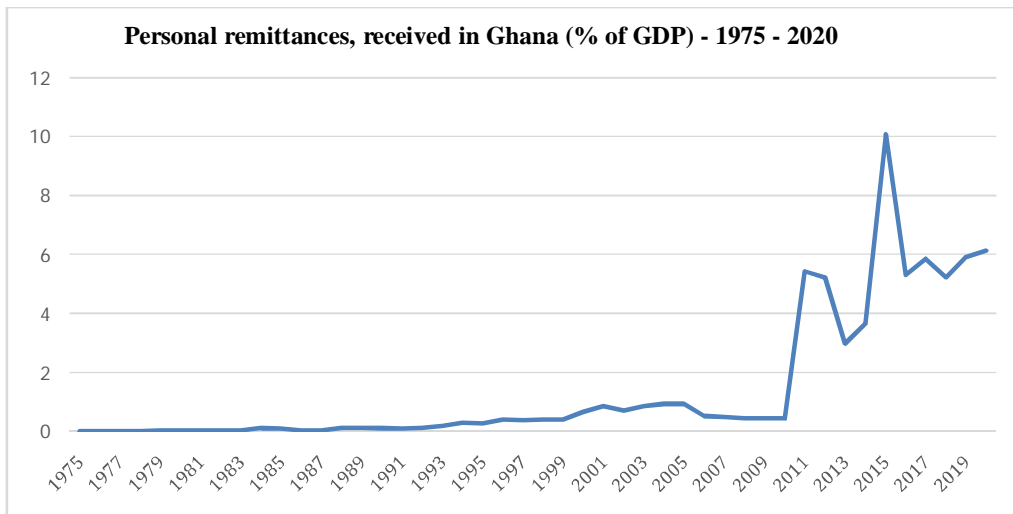


Source: Construct of the Authors (2023)

4.2.2 Trend of remittance inflow

Figure 5 below shows that remittance inflow into Ghana began to increase from 2010. This is because several money transfer companies began to operate making it easier to remit money into the country. The highest point was achieved in 2015 and there seem to a drop in remittance in 2017-2018 which may be attributed to the collapse of some financial institution which may be serving as a remittance agent.

Figure 5: Trend of remittance inflow to Ghana

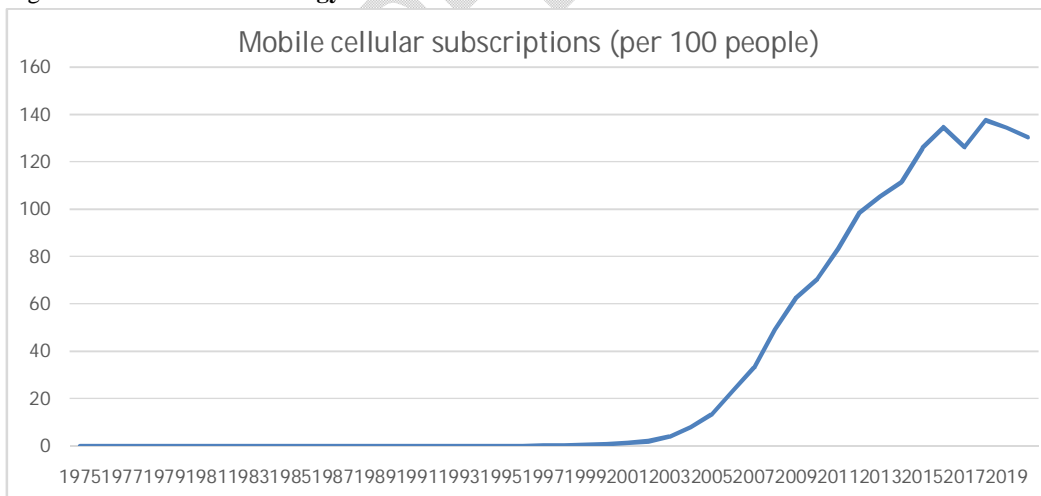


Source: Construct of the Authors (2023)

4.2.4 Trend of Technology

Figure 6 reveals the trend in technology in Ghana proxied as mobile cellular subscription rate. The figure shows that mobile cellular subscription has risen from 1999 and had a very sharp increase from the year 2001 to 2017. It is at this stage that mobile technology became a household device in Ghana. Also for the year 2019 and 2020, the graph is seen to be falling. This fall may be attributed to the effects of COVID-19 on the telecommunication sector.

Figure 6: Trends of Technology



Source: Construct of the Authors (2023)

4.3 Testing assumption of no multicollinearity

Multicollinearity is said to be present when two of the independent variables employed in regression analysis are highly linearly correlated. When multicollinearity exists, it becomes difficult to isolate the relationship between each independent variable and the dependent variable. Table 3 below shows the Pearson's correlation coefficient matrix for the study's variables. The test statistic known as Pearson's

correlation coefficient examines the statistical link or association between two continuous variables and provides data on the strength and direction of the association or correlation. A significant correlation is stated to exist if the coefficient values between the variables are between 0.50 and 1. However, the study establishes a threshold of 0.7, in accordance with [92], for Pearson's correlation to demonstrate the existence of strong collinearity between the independent variables.

Table 3: Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) GDP	1.000						
(2) REMIT	-0.068	1.000					
(3) MOB SUB	0.197	0.610	1.000				
(4) FDI	-0.058	0.583	0.510	1.000			
(5) LIFE EXP	-0.166	0.625	0.630	0.535	1.000		
(6) INFLATION	-0.042	-0.484	-0.438	-0.544	-0.710	1.000	
(7) EXC RATE	0.129	0.632	0.445	0.213	0.459	0.148	1.000

The greatest correlation coefficient from the correlation matrix in Table 3 is 0.630, which is less than 0.70 and indicates that there is no significant collinearity. We employ the Variance Inflation Factor (VIF) to test for multicollinearity in order to ascertain whether the issue of multicollinearity is present. According to [93], multicollinearity exists when the VIF of the independent variables is greater than 10. Given that the VIF of the independent variables is less than 10, the multicollinearity issue is not present, as evidenced by Table 4's VIF.

Table 4 Variance Inflation Factor

	VIF	1/VIF
LIFE EXP	3.681	.272
FDI	3.25	.308
REMIT	3.094	.323
INFLATION	2.025	.494
MOB SUB	1.867	.536
EXC RATE	3.558	.281
Mean VIF	2.783	.

Because all of the variables' VIFs, as indicated in table 4 above, were below 10, the results from the table above indicate that all of the variables can be included in our estimation. Additionally, this is in line with the suggestions made by [94].

4.4 Heteroscedasticity

The results of the Breusch-Pagan test, which was used to determine if our regression models had heteroscedasticity, are displayed in the table below. This test's null hypothesis indicates that the panel exhibits homoscedasticity, or constant variance. From the table below, we fail to reject the null

hypothesis at the 5% level of significance confirming that there is constant variance and therefore heteroscedasticity does not exist.

Breusch-Pagan / Cook-Weisberg test for heteroscedasticity

Ho: Constant variance

Table 5: Test for Heteroscedasticity

F(5 , 40)	1.88
Prob > F	0.1194

4.5 Test for Normality

The Shapiro-Wilks test for normal distribution can be used to ascertain whether the variables are regularly distributed. The population's normal distribution is the test's null hypothesis. As a result, if the p value is smaller than the selected 0.05, the null hypothesis is disproved and it is shown that the tested data are not normally distributed.

Table 6: Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
GDP	46	0.962	1.681	1.102	0.135
REMIT	46	0.957	1.885	1.345	0.089
MOB SUB	46	0.926	3.260	2.508	0.060
FDI	46	0.921	3.485	2.649	0.040
LIFE EXP	46	0.957	1.882	1.342	0.090
INFLATION	46	0.971	1.266	0.501	0.308

The table 6 shows that all variables for our regression model are normally distributed. This makes it appropriate for our regression model.

4.6 Test for Autocorrelation

The absence of any serial correlation of any order is the null hypothesis for the Breusch-Godfrey LM test for autocorrelation. When we use the Breusch-Godfrey LM test for autocorrelation on the data, we discover a p-value higher than 0.05. As a result, we reject the null hypothesis and come to the conclusion that there is no first-order serial correlation of any real significance in the series.

Table 7: Breusch-Godfrey LM test for autocorrelation

chi2	df	Prob>Chi2
1.044	1	0.307

H0: no serial correlation

4.7 Econometric Result and Analysis

This section estimates the ordinary least square regression stated in chapter three. Table 8 show the relationship between economic growth proxied as GDP per capita growth and remittance inflow to Ghana. Table 9 shows the effect of remittance inflow on economic growth considering the mediating role of technology.

Comment [OA23]: 1.Remove bold format from the title of the table
2.Provide sources for all the tables
3.Some of the tables are test of the data but you did not generate any hypotheses prior to this session.

Comment [OA24]: Table 7 was not mentioned in the analysis. Why?

4.7.1 Effect of Remittance Inflow on Economic Growth.

Table 8: Regression Results

GDP	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
REMIT	-.1	.137	-0.73	.472	-.376	.177	
EXC. RATE	.183	.046	4.00	.001	.09	.275	***
FDI	.051	.016	3.31	.002	.02	.083	***
LIFE EXP	-10.465	3.918	-2.67	.011	-18.384	-2.547	**
INFLATION	-.39	.251	-1.55	.128	-.898	.118	
Constant	44.188	16.17	2.73	.009	11.507	76.868	***
Mean dependent var	0.880		SD dependent var	0.940			
R-squared	0.248		Number of obs	46.000			
F-test	4.283		Prob > F	0.003			
Akaike crit. (AIC)	122.752		Bayesian crit. (BIC)	133.724			

*** $p < .01$, ** $p < .05$, * $p < .1$

Table 8 presents the results of the regression of remittance inflow and other explanatory variables on economic growth. The R-squared of model 1 is 24.80%. The p-values of 0.003 in the model show the model is well fitted.

As expected, there is a negative relationship between remittance inflow and economic growth. This implies that as remittance inflow increases, economic growth also declines. This finding is consistent with the results of [28], who studied the impact of remittance on economic growth in West Africa and found a negative relationship. This negative relation is as a result of remittance money being channelled into non-economic ventures. Their study recommends that governments of West African countries should put in measures to channel remittance into economic ventures. This finding however contradicts the study by [95], [96] and [97] who studied Asian countries. Their results revealed that remittance inflow positively affects economic growth. This is because, the more remittance a country receives, and people receive enough money to invest into economic ventures. Therefore, improving economic growth.

Taken as a whole, foreign direct inflow had a significant positive relationship on economic growth. This positive relationship is confirmed by [98], who studied 24 developing countries, [99], who studied 104 countries in the world and [100], who studied 69 developing countries. This implies that an increase in FDI increases economic growth. Life expectancy had a significant negative impact on economic growth. Consistent with our results, [101], recorded a negative significant relationship between life expectancy and economic growth of 141 developing countries. Again, [102], studied 146 countries and found a negative relationship between life expectancy and economic growth. However, contrary to our findings, [102] established a positive and significant relationship between life expectancy and growth. For the last control variable, exchange rate revealed a significant positive relationship. This result is confirmed by [103] Razmi et al (2012) who studied developing countries and found a significant positive relationship between exchange rate and economic growth.

Comment [OA25]: Can you just explain the implications of all the contradictions and or consistencies to Ghana economic growth?

4.7.2 Effect of Remittance Inflow on Economic Growth the Interactive Effect of Technology

Looking at the relationship between remittance inflow and economics considering the interactive role of technology, the study makes use of an ordinary least square regression.

Table 9: Regression Result

GDP	Coef.	St.Err.	t-value	p-value	[95% Conf Interval]	Sig
REMIT	-.123	.15	-0.82	.417	-.426 .18	
MOB SUB	.194	.075	2.59	.013	.043 .345	**
REMIT*MOB SUB	.014	.048	0.28	.078	-.084 .111	**
FDI	.13	.163	0.79	.432	-.201 .46	
Exc Rate	10.476	2.233	4.69	0.00	5.967 14.984	***
LIFE EXP	-11.144	4.446	-2.51	.016	-20.138 -2.151	**
INFLATION	-.393	.238	-1.65	.107	-.875 .089	
Constant	46.882	18.219	2.57	.014	10.031 83.733	**
Mean dependent var	0.880		SD dependent var	0.940		
R-squared	0.250		Number of obs	46.000		
F-test	2.163		Prob > F	0.008		
Akaike crit. (AIC)	124.659		Bayesian crit. (BIC)	137.459		

*** $p < .01$, ** $p < .05$, * $p < .1$

Table 8 presents the results of the regression of the interactions between remittance inflow and technology and other explanatory variables on economic growth. The value of R-squared for the model is 25.0% while the p-values of 0.008 show the validity of the overall fitness of the model, and that jointly, all the coefficients are significantly different from 0.

When remittance inflow interacts with technology, the interaction reveals a significant positive relationship with economic growth. This implies that with the rise in adaptation of technology in remitting money from abroad into Ghana, economic growth however tends to rise. [104], indicated that remittances have a globally positive impact on economic growth. Technology therefore boosts remittance inflow into translating to economic growth. However, without the technology factor, it is revealed that remittance does not translate to a boost in technology. For the control variables exchange rate revealed a significant positive relationship with economic growth when technology is interacted with remittance. Again, life expectancy revealed a significant negative relationship with economic growth.

5.0 Conclusions and Policy Recommendations

The section includes a description of the findings, inferences about how well the research met its goals, and suggestions based on the findings. The summary provides a quick glance at the work while reliving the key moments. The conclusion captures inference based on the empirical study, and recommendations are suggested based on the results reached. Recommendations are pertinent to both future research and the governments of certain nations.

5.1 Summary of the study

The study evaluates how remittance influx affects economic expansion. Three goals were established for the investigation. The first involved figuring out the trends in technology, remittance inflow to Ghana, and economic growth in Ghana. Data from Ghana covering the 46-year period from 1975 to 2020 is used for this. The Gross Domestic Product (GDP) is used as a proxy for economic growth. In most studies, per capita growth is employed as a proxy for technology, and remittance is calculated as

Comment [OA26]: This #ph seems to capture the discussion of the findings, however, the previous findings and their implications were not captured in the discussion. Kindly generate robust discussion from the findings.

the ratio of personal remittances received to GDP. Economic growth reached its lowest point in 1975 and its maximum point in 2011, according to our first aim. The financial sector crisis was blamed for the dramatic decline in remittance inflow that occurred between 2017 and 2018, despite the fact that it had started to rise sharply in 2001. Up until 2019 or 2020, mobile technology was on the rise; the COVID-19 pandemic was also a contributing factor in this decline.

The findings of the regression showed that remittance inflow had a negative but negligible impact on economic growth in the absence of the interaction effect. This implies that substantial financial transfers to Ghana do not result in increased economic activity. According to model one, FDI, life expectancy, and exchange rate are the main factors influencing economic growth. While rate life expectancy shown a substantial negative link, FDI inflows and exchange revealed a strong favourable relationship. An ordinary least square regression model was employed in model two of the investigation, which introduces technology as an interacting variable.

According to the study, there is a strong correlation between economic growth and the interaction term. While there was a slight negative correlation observed between remittance inflow and economic growth, there was a strong positive correlation observed between mobile technology and economic growth. According to model two, the exchange rate and life expectancy have a considerable impact on economic growth. Our study's findings indicate that remittance inflows have a negligible detrimental impact on economic growth. Nonetheless, there is a strong positive correlation between remittance inflow and the introduction of technology as an interaction variable. Exchange rates, life expectancy, and foreign direct investment were shown to be the main drivers of economic growth.

5.2 Managerial Implication and Policy Recommendations

Remittances are unable to account for the economic expansion of low-income economies, as has been made clear. Consequently, decision-makers ought to focus on alternative systems. Since investment and human capital can hasten the economic development of low-income economies, authorities should first concentrate on these areas. More significantly, the most crucial component for economic growth is human capital. This is because investments in human capital have the ability to convert remittances into profitable ventures. Additionally, FDI investment can spur economic growth through the development of innovative human capital. These countries also benefit from trade openness since it gives them the opportunity to gain a competitive edge. Nonetheless, since excessive spending lowers a nation's revenue, the government should cut back on final consumption spending. Once more, Ghana's government is able to invest in mobile technology since it boosts remittance to enhance growth in the economy.

5.3 Limitations of the Study

The time series used in this study are primarily limited in dealing with stationarity, complexity, autocorrelation, and seasonality; therefore, proper modelling and, to the extent possible, sufficient data are required to generalize accurate results. This could have an impact on the robustness and reliability of the results. Additionally, OLS regression necessitates work to assure correct inferences due to its limitations with assumptions about linearity, independence, endogeneity, and lack of multicollinearity. Because of the technique employed, the study can have erroneous results and inaccurate conclusions.

5.4 Suggestions for Future Studies

Future study should assess the effects of current remittance laws and regulations on technology-mediated remittances and economic growth in order to fill in knowledge gaps and offer a thorough grasp of how remittances mediate the impact on economic growth. In addition, it can examine cross-

national or longitudinal research and take into account behavioural insights, obstacles to technology adoption, financial inclusion, and economic development.

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