POPULATION GROWTH AND ITS EFFECT ON LABOUR PRODUCTIVITY IN GHANA

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ABSTRACT

This study analyzes population growth and its effect on labour productivity in Ghana. In addition to the main objective**,** the study looks at the various factors affecting overall labour productivity, labour productivity in the manufacturing and agricultural sectors. The factors included in this study are government size, gross fixed investment, human capital, inflation, and trade openness. The study is founded on the data in Ghana from 1980-2019 by using the autoregressive distributed lag (ARDL) model to define the long-run association between the variables. According to the empirical evidence, increased population growth would reduce overall labour productivity in Ghana's economy in the long-run. No significant long-run impact was observed between population growth rate and labour productivity in the manufacturing sector. Finally, the research revealed that an increase in population growth would have more than a proportionate fall on agricultural labour productivity in the long-run.

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CHAPTER 1

1.1 Introduction

One fundamental factor influencing businesses' profit margin in most developing countries and some advanced countries is labour productivity. The variation in productivity rates in certain or all economic sectors affects the existence and maintenance of inequality. Any attempt to reduce economic inequalities will mean an investigation into the factors that help determine labour productivity. Polyzos and Arabatzis (2006:4) saw productivity as an "expression of the degree of exploitation of the most important coefficient in the productive process". One of the most important determining factors of an economy's total output is productivity. Workforce productivity is sought after in every economy to guarantee development. Quality education is one important factor of labour productivity, which impacts development in every economy. However, the degree of skills and knowledge positively affects development compared to just educational accomplishment (Hanushek and Woessman, 2020).

"Labour productivity is defined as the output level produced per unit of labour inputs employed in production" (Kahyarara, 2020:1). Polyzos and Arabatzis (2006) confirmed that the term is used interchangeably to depict labour productivity and other production factors. Labour, technology, and capital are commonly calculated using the ratio of outputs divided by the unit of input employed in the productivity activity. A productive and efficient labour force is said to be the one that has developed the necessary training and skills, and this leads to economic growth (Heshmati and Rashidghalam, 2018). As the population of most developing countries increases, due to high birth rates, it is expected that the amount of labour employed for economic activities will also increase (Maestas, et al. 2016).

Some theories find a rise in population growth to adversely impact economic growth with the explanation that, with immense population growth, each worker will have other factors of production to work with (Hamza, 2015). Other theories suggest that population growth will lead to greater labour productivity either by producing or inducing innovations (Hamza, 2015). While some studies testing these theories have found population growth to impact labour productivity positively, others found the effect of population growth on labour productivity to be small or non-existent. Population growth in most sub-Saharan African countries is alarming as most of them are not equipped to handle the dramatically increased needs for food, water, sanitation, education, and employment. Slower growth in population will guarantee that more individuals will gain access to social amenities and medical care (Population Impact Project, 1994).

The population dynamics of most developing countries keep changing due to the rising birth rate as against the low death rate which hinders development. Economic activities within most African countries have increased and due to that, the demand for labour has also increased. As indicated by Kahyarara (2020), most developing countries rely on the agricultural sector and activities in this sector are concentrated in the rural areas. In Ghana, most of the people who migrate to the urban centres are in the informal sector and economic activities within the informal and agricultural sectors are predominantly reliant on unskilled labour. 60% of employment is contributed by the informal sector with about 90% from the micro-and medium-scale sectors, despite the recent increase in economic growth in South Africa, Ghana, Uganda, and Tanzania (Danquah, Schotte and Sen, 2019). An increase in the amount of labour is, however, expected to either affect labour productivity negatively or positively (Hamza, 2015).

Amade and Bakari (2019) also indicates that although the theoretical association between output (GDP) and population growth is negative, empirically the relationship is inconclusive. However, recent studies show that due to technological advancement and population growth countries such as India and China have experienced development. This benefit has allowed for more workforce participation and, ultimately, increasing productivity (Kahyarara, 2020). India, and China are countries that have contradicted this position as population seems to affect growth positively.

There are numerous studies on the impact of population growth on economic growth in most sub-Saharan African countries (e.g., Akintunde, Olomola and Oladeji, 2013; Cist, Mora and Engelman, 2017; Hamza, 2015) but the exact relationship between population growth on economic growth in these countries remain to be inconclusive. The difference in these studies lies in how economic growth is measured and the methodology and estimation technique used.

In calculating economic growth, much research has used GDP or GDP per capita (Amade and Bakari, 2019; Rahman, et al. 2017; Azuh, et al. 2016). While the connection between economic growth and population has been largely examined, studies examining the link between population growth and labour productivity have been fewer. According to Kahyarara (2020), the few studies that sought to investigate the impact of population growth on labour productivity have brought about some controversies in their labour productivity measurement. The first controversy is how best to measure output, and the second is defining labour input. The two options are the value-added and the gross output. The gross output is "the number of goods and services produced while ignoring the total intermediate inputs used" (Attar, et al.

2012). This research looks at Ghana's population growth on labour productivity by measuring labour productivity as gross output per employed person (GDPPEP). Similar to this is the empirical study of Guest and Swift (2008).

1.2 Statement of Problem

Studies show that countries such as India, China, and Brazil have proved that countries have profited from increased labour force growth from an increased population. The influence of population growth rate on macro and microeconomic factors has been well established in the literature. The investigation focuses on economic growth, labour force participation, manufacturing productivity, and agricultural productivity. Since the publication of Rev. Malthus' work on population in 1798, the impacts of population growth on economic parameters have been subjected to empirical debate. Some people argue that population has a positive correlation with labour productivity, some argue that the relationship is negative, and others believe that the relationship between the two is insignificant. Dawson (1998:149) pointed out that most textbooks on development economics have sections dedicated to the connection between population and growth. They highlight the importance of the population to the development of an economy. According to Thornton (2001) and Amade and Bakari (2015), population growth can affect diverse ways of economic performance. Population growth is one of the ways through which productivity is affected.

Productivity is one of the ways through which the output of the economy can be increased. This is because increased productivity enhances overall growth hence helping to reduce poverty and unemployment, improving living standards and well-being. Labour is central in development process and the process of learning new skills and gaining information that is relevant to a specific technology. All productivity measures share the relationship between output and inputs required in production (Boadu, 1994). The question asked is how much output is produced by each unit of labour, which gives rise to the definition of labour productivity. Such a definition of labour productivity has brought much argument concerning how best to measure productivity and define labour input.

According to Attar, et al. (2012), there is no universally accepted definition and measurement for labour productivity. The definition and measurement of productivity can center on the individual, the firm, and the whole economy. Kahyarara (2020) states that to measure labour productivity, gross domestic product (GDP) and value-added measures have been the widely used measures of productivity. The GDP measure of productivity focuses on the number of goods and services produced without considering the intermediate inputs used. According to Attar, et al. (2012), the reliance on gross output as a measure of labour productivity is mainly due to the availability of data. Studies that use gross output do not struggle to get data to be used as a proxy for labour productivity. Much of the concentration has been on value-added and gross output (e.g., Kahyarara 2020; Hamza 2015).

While most literature has focused widely on economic growth and population growth in most Asia and Latin American Countries (LAC) (e.g., Thornton, 2001; Hsieh, 2002; Timmer and Akkus, 2008; Adullah, et al. 2015; Üngor, 2017) quite a number have also concentrated on Africa and sub-Saharan Africa (e.g., Amade and Bakari, 2015; Hamza, 2015; Rahman, et al. 2017). However, the connection between population and labour productivity has not been examined in Ghana.

Concerning population growth and labour productivity, much emphasis has then again been placed on Latin American countries (LAC) and Asia countries (e.g., Jha, 2006; Imai, Gaiha and Bresciani, 2018; Dua and Garg, 2017) and on some African countries (e.g., Polyzos and Arabatzis, 2006; Diao, et al. 2018; Kahyarara, 2020). Studies' examining the connection between population growth and labour productivity have not been few in Ghana. There is, therefore, the need to investigate the impact that population growth rate has on labour productivity in Ghana. With the Statistical Service of Ghana estimating the country's total population to be about 30 million, it is important to examine if the growth in population is equivalent to a higher level of labour productivity within the agricultural and manufacturing sectors of Ghana since the agriculture sector employs about 60% of the population and the manufacturing sector 23% (GSS, 2015). In addition to the above, this study further examines the disagreement among several other studies on population growth and its effect on labour productivity in Ghana.

1.3 Objectives of the Study

The main goal of the research is to examine how population growth affect labour productivity. Specifically, this research seeks to:

1. Identify the factors influencing labour productivity in Ghana.
2. Examine the trend analysis on labour productivity and some determinants of labour productivity.
3. Examine the factors that affect the agricultural sector's labour productivity in the long run.
4. Examine the factors that determine the manufacturing sector's labour productivity in the long run.

1.4 Research Questions

1. What are the determinants of labour productivity?

2. What is the trend between labour productivity and some of the determinants of labour productivity?

3. What are the factors that affect labour productivity in the agricultural and manufacturing sectors in the long run?

1.5 Significance of the Study

The study of population growth and its effect on labour productivity in Ghana has much significance. Several factors determine labour productivity, and quite a number of studies have examined various determinants of labour productivity, especially in Latin America (LAC), Asia, North America and Middle East. These studies have either been examined at the individual, the firm, and the economy level. Surprisingly, there has been no study conducted within the Ghanaian context. This thesis will add to the literature by examining the extent to which population growth affects labour productivity in the Ghanaian economy and help identify the factors responsible for determining labour productivity in Ghana. Also, we will investigate factors responsible for labour productivity in the agricultural and manufacturing sectors and how that impacts the economy. With this evidence the policymakers will be able to make sector-specific, agricultural, and manufacturing policies that will go a long way to affect overall productivity and economic growth. Again, this study is significant because it will contribute in several says to this area of study.

1.6 Organization of the Study

This thesis is divided into five chapters, with the first chapter capturing the introduction, background, problem statement, objectives, research questions, the significance and the organization of the study. The relevant theoretical and empirical literature is reviewed in chapter two. The methods, data, and procedures are discussed in chapter 3. Presentation and discussion of results are done with reference to the literature in chapter four. The summary, conclusions and policy recommendations are presented in chapter five.

CHAPTER 2

2.1 Theoretical Literature

This section looks at theories put forward to explain population growth and labour productivity.

2.1.1 Theories of Population

Pessimistic Theory

The pessimistic theory can be traced back to an essay written by English scholar Reverend Thomas Malthus in 1798, titled "An Essay on the Principle of Population". In the face of an ever-increasing population, Malthus wondered whether society could change in the future. He came to the popular conclusion that the demands of a rapidly increasing population would soon overwhelm food production. To put it another way, "the scenario of arithmetic increases in food production combined with simultaneous exponential or geometric increases in population expected a future in which humans will be unable to feed themselves". According to Malthus, population growth could reduce per capita output because the output growth rate cannot match up with the population growth rate (Landreth and Colander, 1989). Thus, although population growth is supposed to increase output per capita there will be more people added to the workforce and this will lead to the limitation or unavailability of capital and decreasing marginal returns to labour (Landreth and Colander, 1989). To maintain the natural balance between production and consumption, he asserted that preventive and positive controls on population growth are needed (Malthus, 1826).

An extension to Malthus' theory was a work by Ehrlich (1968) in his book titled "The Population Bomb" where he predicted that millions of people will die of starvation in the 1970s due to overpopulation. He asserted population control as the only way to save humanity from self-destruction. Many pessimists believe that reducing population is the most significant step toward increasing economic growth, and improving living conditions (Easterlin, 1997). A significant amount of research has projected that population growth would have a net negative impact. The pessimistic theory implies that a rise in population growth would have a detrimental impact on labour productivity.

Pessimistic advocates explain that, in relation to the effects of overall population growth on wealth, there is possible negative relationship between capital and population growth in an economy (Palumbo, et al. 2010). Increased population necessitates the renting of more factories and the construction of more facilities to meet the needs of people in the economy, which could result in lower standard of living.

Optimistic Theory

Optimistic theory can be found in the work of Danish economist Ester Boserup, who used similar claims to transform the Malthusian view. Rather than being influenced by agriculture, as Malthus (1798) believed, Boserup (1996) claimed that growth in population is a positive determinant of agricultural productivity. The study argued against the assumption of Malthus and claimed that higher population growth might lead to an efficient division of labour and increase agricultural productivity. “Necessity is the mother of invention”, she stated, because population growth puts strain on resources, it will encourage people to be resourceful and innovative, particularly in difficult times (Boserup, 1996).

According to Kuznets (1960:2), “an increase in population will lead to an increase in the labour force of an economy”. He claimed that “if the labour force grows at the same level as population, it would be able to produce the same amount of output or more output per labour”.

Another criticism of Malthus’ theory, which predicted misfortune as population grows, is Julian Simon’s book, “The Ultimate Resource”. Simon (1976) claimed that technological progress was dependent on population size, and that a rising population continues to advance in knowledge overtime, increasing productivity. He came to the conclusion that as population grows, people will continue to create new resources, recycle old ones, and find new creative solutions. As a result, the idea that population growth would lead to human stagnation was wrong.

The Neutralist Theory

The neutralist theory’s underlying principle is that population growth is independent of output (Bloom, et al. 2003). Since the mid-1980s, the neutralist theory has become the dominant viewpoint (Bloom and Freeman, 1988). Despite the variations within the neutralist school, the National Academy of Sciences (NAS) maintained that “slower population growth would be beneficial to the economic development of most developing countries” (National Research Council, 1986). According to Kelley (2001), natural resources negatively affect population growth since, as population grows, natural resources are depleted as people require more farmlands, space for habitation, and a variety of other activities. The optimistic theory of population growth did not look into this. Multi-country research found no proof of pessimists' perceived resource diversification from more efficient sector to less productive sectors such as education, medical care and safety measures. According to Kelley (2001), the results of these findings, along with the claims by Simon and Bartlett (1985), were significant reasons for the progress of neutralist ideas. The authors claim that, "the scarcity of resources increases the cost of a product, thereby creating the incentive to find alternative materials".

2.1.2 Human Capital Theory

Human capital is characterized as "productive wealth embodied in labour, skills and knowledge" (OECD, 2001), and it refers to acquired knowledge, or characteristics related to an individual (Garibaldi, 2006). The idea that education which is referred to as human capital has an economic effect started from a consistent research program in the 1950s. Allan Fisher (1946) emphasized the importance of considering education on economic policy. Human capital, according to Becker (1997), is described as "activities that influence future monetary and income by increasing resources in people" with schooling and on-the-training as the most common types.

Human capital theory, as established by Schultz (1971), Sakamota and Powers (1995) and Psacharopoulos and Woodhall (1997), is based on the premise that education is extremely useful and even indispensable for improving an individual's production ability. In a nutshell, human capital researchers argue that a well-educated population is more profitable since thispopulation is perceived to boost production in an economy. Human capital theory emphasizes how education boosts people's efficiency and competitiveness by enhancing efficient human capability, which is a result of investment and natural abilities. The acquisition of formal schooling and training demonstrates an efficient investment in human resources, which the theory's authors consider to be more equally valuable than physical capital, since physical capital only has to do with the investments in assets, such as buildings, machinery and vehicles used in production processes. These also need experienced and well-educated labour to operate, which is the outcome of human capital.

The theory proposes that as investment in human capital rises then the individual is expected to engage in the labour market (Becker, 1997). This is due to the fact that skills and expertise increase an individual's productivity and therefore their earning power in the labour market. As a result, people with higher education would be more active and make more money on the job than people with lower education.

2.2 Empirical Literature Review

2.2.1 Empirical Evidence on Population and Economic Growth

This section reviews literature on the relationship between population growth and economic growth. It is critical to examine the relationship between population and economic growth since population is believed to be an incentive for production and could have a positive impact on output and productivity.

Dao (2012) used data from World Bank's World Development Indicators on 43 countries to examine the economic effect of demographic change in developed countries and discovered that population growth is positively linked to GDP per capita. Several other studies have found the negative impact of population growth on GDP growth rate. Hamza (2015) used GDP growth rate to determine how economic growth and population growth are linked and indicated a significant negative relationship between economic growth and population growth. Hamza used panel data on a cross-section of 30 developing countries for 14-years, with these countries selected from Africa, Asia, and Latin America. Population parameters such as birth rates, death rates and net migration were negatively related to economic growth, with only the death rate being statistically significant. Similar results were observed by Cist, Mora and Engelman (2017) and Akintunde, Olomola and Oladeji (2013) who also observed that most sub-Saharan African countries have a negative relationship between economic growth and population growth.

Brückner and Schwandt (2015) performed a panel data analysis covering 139 countries from 1960-2007, looking at the income-population relationship. The two variables had a positive relationship, according to the researchers. The relationship indicates that when population in a country rises, GDP per capita growth rises as well. Nwosu, et al. (2014) and Tartiyus, et al. (2015), found a long run significant positive effect between economic growth and population growth.

Abdullah, et al. (2015) found the opposite results in Bangladesh. Their findings, based on data from 1980 to 2005 and a multiple linear regression model, show that economic growth and population growth are negatively related, meaning that an increase in Bangladesh's population would have a negative effect on the country's economic growth.

The figure below shows the link between population and GDP growth rate in Ghana.

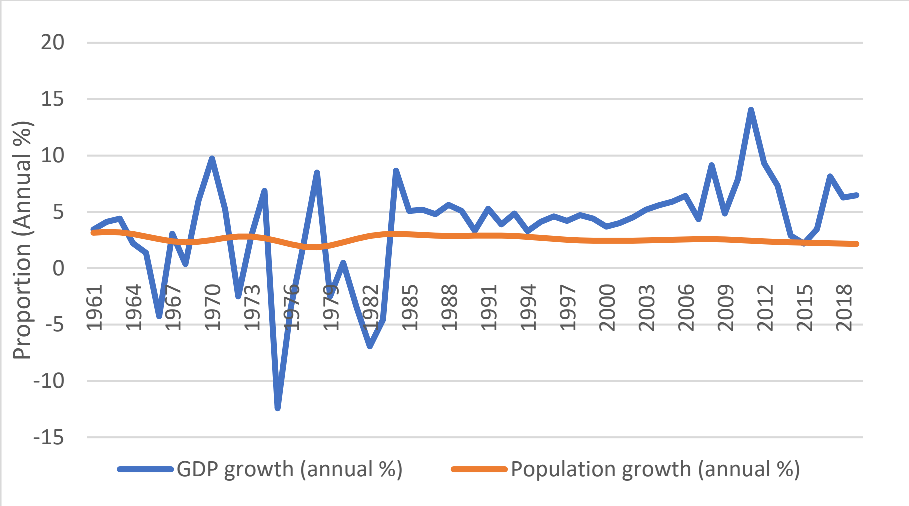

Figure 2.1: Population and GDP growth rate from 1961-2019

Source: World Bank, WDI (2020)

Figure 2.1 shows the population and GDP growth rate for Ghana. The key drivers of Ghana's population growth are fertility rate, death rate and net migration. In Ghana, migration from other countries to Ghana is extremely rare, with only few cases of migration from countries within Africa. Ghana's population growth rate has been stable from 1984 after a drastic decline in growth rate in 1975, the lowest the country has ever witnessed. The drastic decline in GDP growth rate in 1975 was due to political unrest and upheavals. The post-independence conditions of the country were better, with the highest growth rate in 1962 (3.21%), declining to 2.29% in 1968. This rose further to 2.81% in 1972, declining drastically to 1.85% in 1978. Thereafter, the population growth rate has been stable. According to Jong-a-Pin (2009), a high level of political uncertainty delays economic growth. Darko (2015) confirms that the time between the 1970s and the early 1980s was highly volatile due to political turmoil, which had a great impact on the GDP growth rate. Darko (2015: 4) reports Anyemedu (1993) as indicating that "the economy of Ghana was nearly at the verge of collapse in 1983 when the inflation rate was high to 123%". Darko (2015:4) indicates that, although Anyemedu indicates that "this was as a result of the devastating drought which reduced the production of main agricultural commodities and other export crops like cocoa", clearly, from the population growth rate observed above, the period of slow economic growth corresponded to rising population growth rates. When the population growth rate was declining from 1975, with the lowest growth rate in 1977, the economy was growing at a rate of 8.48 %. At the lowest growth rate of -12.48%, population growth rate was fairly stable. This shows that population had no significant impact on economic growth. The highest growth rate experienced by the country was 14.07% in 2011 when the country commenced oil production. From thence, economic growth has been declining sharply, with a lower economic growth rate of 2.27% in 2015 rising thereafter.

2.2.2 Literature on Labour Productivity

Using data from the Groningen Growth and Development Centre, Diao, et al. (2018) looked at the level of agricultural and industrial sectors productivity of a few African countries. For countries that have effectively industrialized, the authors discovered a positive association between the manufacturing and agricultural labour productivities. Similarly, Schultz (1953) stated that advancement in agricultural productivity is necessary for improving sustained economic growth for countries with a closed economy. This became the benchmark for several other studies predominantly featured (Johnson and Kilby, 1975; Johnson and Mellor,1961). Unlike Schultz (1953), Lewis (1954) believes that low agriculture labour productivity will continue until non-agricultural labour force expands to absorb population growth in the rural sector, and that industrialization will easily help increase productivity in the agriculture sector by reducing the amount of labour in the sector. Several other studies have analyzed the relationship between agricultural productivity and economic growth concentrating on an open economy rather than the closed economy model (e.g., Matsuyama, 1992; Wright, 1979).

Settsu and Takashima (2020) examined labour productivity growth and its long run impact in Japan from 1600 to 1909 using regional panel data for sector share. The results suggest that the Tokugawa period's industrial system was fairly stable. They show that an increase in population provides adequate labour for different sectors of the economy, resulting in increased performance.

Broadberry and Irwin (2005) also looked at whether labour efficiency in the US and UK differed during the 19th century. According to the authors, the UK had higher efficiency of labour in the industrial sector while the US had higher efficiency of labour in the service sectors. The agricultural labour efficiency on the other hand, was comparable in both countries. The conclusion from the findings was that the UK had higher aggregate labour efficiency in the industrial sector, and the US had a higher share of the work force in the low value-added agricultural sector in the mid-nineteenth century.

Moussir and Chatri (2019) examined the differences in labour productivity between the traditional and modern sectors of the Moroccan economy by investigating the structural changes of the economy using an input-output model. The authors found that structural change, which is the reallocation of resources from the agricultural sector to the non-agricultural sector of the country, has significantly impacted the overall level of labour productivity growth which is explained largely by intra-sector growth. They indicate that although overall labour productivity growth for the country has improved, there are some aspects of the economy that makes use of unskilled labour in the traditional sectors. Timmer and Akkus (2008) showed that structural transformation, especially among developing countries through investment in human capital, improved technologies, and lowered transaction costs, facilitated the integration of economic activities and the efficient allocation of resources, and hence improved labour productivity. Also, the United Nations Industrial Development Organization (UNIDO, 2012) says that structural transformation of an economy is a key source of productivity growth and increased per capita income.

Jha (2006) also examined agricultural labour productivity in India with changes in the real wages of agricultural workers while investigating the movement out of agricultural employment. The findings show that the proportion of women working in agriculture is decreasing, resulting in a drop in labour productivity. Concerning the movement out of agricultural employment, both small, marginal farmers, and agricultural workers have been moving between and within work and regions. This, therefore, could not result in a balance in the regional development of agriculture. Although the study examined female labour productivity in the agricultural sector, it did not investigate the factors influencing labour productivity.

Imai, Gahia and Bresciani (2018) investigated the gap between labour productivity within the agricultural and non-agricultural sectors of thirty-seven Asian countries using panel data. The findings suggest that for some selected Asian countries, the gap within the agricultural and non-agricultural sectors has widened. The authors, however, did not investigate the determinants of labour productivity among the thirty-seven Asian countries, including India.

Using the World Bank’s Enterprise Survey database for 2013, Heshmati and Rashidghalam (2018) investigated the effect of labour productivity on the service and manufacturing sectors of Kenya’s economy. The authors found that as the ratio of female-to-male workers in the labour force increases, labour productivity declines. While the study identified the factors that influence labour productivity, they did not examine the difference in labour productivity for the manufacturing sector.

2.2.3 Determinants of Labour Productivity

This section assesses the empirical evidence on the determinants of labour productivity.

One of the key determining factor of the profitability, competitiveness and the growth of enterprises, firms, and/or businesses is labour productivity. Some international organizations mention the importance of labour productivity. The United Nations noted the importance of labour productivity through one of its Sustainable Development Goals (SDGs) target. Labour productivity is the most essential component of production (OECD, 2001). It is also mentioned by the International Labour Organization (ILO) that labour productivity measures efficiency to produce goods and services and reflects the standards of living (ILO, 2016). Therefore, it is necessary to analyze the determinants of labour productivity.

A study by Dua and Garg (2017) identified the determinants of labour productivity in developed and developing countries. The authors used panel cointegration and group-mean fully modified ordinary least squares estimation to analyze the data. The result showed that trade openness, technology, capital, government spending and human capital significantly affect labour productivity in developed and developing countries, but the impact is different.

Population growth impacts the environment, economy, and society in different ways; for developed, and developing countries, according to Rawat (2014). Kahyarara

(2020), using time series data from 1967 to 2012 and a Cobb-Douglas production function, examined the effects of population growth on economy-wide productivity. The author analyzed how changes in population increased labour force participation which led to an increase in productivity. Findings from the study revealed a positive effect of population on labour productivity after controlling for other inputs like raw materials and capital. Because of the positive effects of population growth on the economy through increased productivity, the author advocates for the need to intensify labour productivity in the establishment of new economic enterprises and or businesses. Rawat (2014) found that population impacts productivity positively and hence on the economic growth rate, however, this varies at country level since countries vary in their endowments. The relationship is negative for China, India, Japan, Nigeria, and Brazil, but positive for United States, Pakistan, Bangladesh, Russia and Mexico.

Goedhuys, et al. (2014) looked into the factors that influence productivity in Tazanian manufacturing firms. Using cross-sectional data at the firm level, the authors examined how advancement in technology and the environment in which firms operate affect their efficiency. They found that among the technological variables, research and development (R&D), innovation, technology, and training of employees have no impact on productivity, but rather higher educational level of management and foreign ownership have an impact.

Fallahi, et al. (2010) used a cross-sectional regression model with a sample of 12,299 manufacturing firms to investigate the determinants of labour productivity. The authors found that labour productivity and education, R&D activity, wage, capital per employee, and export orientation of the labour force are positively related. They noted further that, although R&D expenditure of the firm, the level of information technology (IT) of the firm, and the size of the firm are widely recognized factors that affect the productivity of labour, it is education, and training of human resources that "has a special place over the above-mentioned factors" (Fallahi, et al. 2010: 3). They believe that a well-educated labour force is capable of operating physical capital as well as creating or using new technology in the production process. And, as such, any activity of the firm that is not geared towards expanding the skill and knowledge base of labour would imply a reduction in the profitability of the firm due to the increased cost of production. Similarly, Aggrey, et al. (2014) stated that human capital development contributes significantly to output and labour productivity just like any other factors of production such as technology and innovation. They were quick to add that the latter is dependent on the development of human capital through education and training. Also, Mahmood and Afza (2008) indicated that secondary education enrollment had a positive effect on total factor productivity.

Corvers (1997), in discussing the determinants of labour productivity, identified education and training as one of the unique determinants of labour productivity. He identified four effects that human capital has on labour productivity. These four effects include worker effect, allocation effect, diffusion effect, and research effect. To him, these four effects work to determine the quality of labour for an enterprise or business. He indicated that it is through the allocation effect and worker effect that human resources contribute to the level of productivity and the growth of productivity through diffusion and research effects.

Another determinant of labour productivity widely investigated in literature is the capital of the firm. Wijaya (2019) found that capital formation, a proxy to capital, has a positive impact in the short run and long-run on the productivity of labour. According to the study, higher capital formation led to higher labour productivity, i.e., higher capital formation itself can be generated from an improvement in a total of the net inventory changes and fixed asset accumulation such as construction of railways, roads, public and private buildings, machinery, and land improvements. Similarly, Papadogonas and Voulgaris (2005), in examining the effect of capital equipment on industrial firms of Greece, found that increasing the capital equipment of firms causes labour productivity to improve.

Using dynamic ordinary least squares to analyze panel data from 1980-2014, Samargandi (2018) examined the determinants of labour productivity in North Africa and Middle East countries. The author found that human capital and capital stock positively impacts labour productivity. Furthermore, it was found by the author that financial growth, trade openness and industrial value addition have a substantial effect in boosting labour productivity, and innovation is an important factor in increasing labour productivity.

According to Jiang (2010), trade openness has a positive impact on labour productivity in China. The author used a dynamic panel data approach and compiled data from 29 provinces in China over the period 1984 to 2008. Also, Saha (2012) studied the effect of trade openness on total factor productivity in India. Applying ordinary least squares and Granger causality tests, the results showed that there was a one-way relationship and a significantly positive effect between trade openness and total factor productivity. On the contrary, Ishmail, et al. (2011) found trade openness have a negative and substantial impact on labour productivity. The authors employed panel data and a multiple regression model to estimate labour productivity in the

Malaysian manufacturing industries from 1985 to 2008. The result indicated that globalization indicators such as trade openness and foreign direct investment had a significant negative effect on labour productivity. Although Irwin and Tervio (2002), Rodriguez and Rodrik (2001), and Rodrik (2000) argued that trade openness is an insignificant determinant of labour productivity, particularly when a proxy to capital is used or when quality of institutions and climate controls are included in the empirical study.

Many economists believe that high inflation rates create distortions that result in unproductive resource allocation and hence reduce productivity (Sbordone and Kuttner, 1994). In consequence, as they examined the post war relationship between inflation and productivity in the US, they found a negative relationship between inflation and labour productivity resulting from a monetary contraction where inflation remains high as output contracts. They explained that each one percent increase in the annual inflation rate was accompanied by a reduction in labour productivity growth of about one-quarter percent per year. Following this are theoretical reasons that inflation has been the major cause of productivity slowdown, such that Konya, et al. (2019) for 22 OECD countries established that productivity increase also induces inflation to fall. On the contrary, Freeman and Yerger’s (2000) analysis with 12 countries of the OECD did not support the assertion that there exists an inverse relationship between inflation and labour productivity growth. In their bivariate and multivariate tests of inflation and productivity, they revealed no proof of a consistent relationship between inflation and productivity growth.

Smoluk and Andrews (2005) in examining the factors that affect labour productivity among 48 states in the US from 1993 to 2000, used a Constant Elasticity of Substitution (CES) production function framework by building upon the empirical study of Carlino and Voith (1992). The authors concentrated on the impact of population density and education on labour productivity while introducing a state tax burden variable in the empirical model. Their findings show that labour productivity is positively related to the percentage of population with a bachelor's degree.

Wijaya (2019), using time series data from 1978 to 2017 and an ARDL model, identified government expenditure as a determinant of labour productivity in Indonesia. In the study, he observed that in both the short run and long run, government expenditure had a positive effect on labour productivity. The findings indicate that a rise in government spending will lead to an enhancement in labour productivity, but the findings are contradictory to Dua and Garg (2017), who provided evidence of a negative impact of government expenditure on labour productivity in both upper-middle-income economies and developed economies. In the case of lower-middle economies, their analysis gave the same results. Awotunde (2018) proved that government expenditure that goes into labour issues such as health affects labour productivity positively. Hence, spending more on sectors that are related to labour issues such as health, education and training programs, social etc., seems to be the channel through which labour productivity can be encouraged.

Dhiman and Sharma (2017) also looked into the Indian textile industry’s productivity patterns and determinants. The study used labour and capital productivity levels in the Indian textile industry to examine how efficient labour and capital were, as well as their effect on the economy. The study found that both labour and capital productivity levels in industries have been decreasing, using a time series regression model with a cointegration test. According to the authors, productivity varies by industry and is dependent to a large extent on the productive existence of labour and capital in the Indian labour market.

2.2.4 Literature on Labour Productivity in Ghana

Teal (1999) discovered that there had been no increase in technical efficiency among Ghanaian companies, but that production growth had been balanced by sufficient increases in labour and capital inputs. He also discovered no evidence that smaller businesses expand at a faster rate than larger businesses. Also, Sodërbom and Teal (2004) accessed the impact of the level of technology and allocative efficiency in the manufacturing sector. They found that large firms face a far higher relative cost of labour than small firms; hence labour productivity is higher for large manufacturing firms in Ghana. Using a Crépon-Duguet-Mairesse (CDM) structural model to examine the effect of innovation on 501 manufacturing firms in Ghana, Xiaolan, et al. (2018) found a positive effect of innovations on manufacturing firms in Ghana. They indicate that informal firms are less productive compared to formal firms, and that innovations affect the productivity level of formal firms more than informal firms. Similarly, Agyapong, et al. (2017) found a positive association between different forms of innovation and success in small and medium enterprises in Ghana in a cross-sectional analysis of 500 micro and small-scale businesses.

Codjoe (2006) investigated the effects of population dynamics in Ghana's Volta basin, and found that there had been a rapid rise in population in these areas between 1960 and 2010. The size of the agricultural labour force, as well as productivity, increased as the Volta basin's population grew rapidly. The rise in population also increased the availability and engagement of labour in agriculture, forest reserves and water resources along the Volta basin, and this trend is expected to continue as the majority of people in the area are drawn to this sector.

Aragón and Rud (2011) examined the extent to which pollution from manufacturing industries affects agricultural productivity. Using an agricultural production function, the authors showed that agricultural lands for farming purposes located in areas close to industries had their total factor productivity reduced by almost 40 percent between 1997-2005. This means that industrial pollution has a negative effect on agricultural labour productivity. In addition, Hanna and Olivia (2011) and Graff and Neidell (2012) found that air pollution negatively affects labour supply and agricultural productivity.

The findings from the empirical literature on how population growth predicts labour productivity is inconclusive. In Ghana, the majority of the studies that have examined population growth have limited the study to economic growth, which is measured by either Gross Domestic Product (GDP), and or GDP per capita. However, there are no studies that address the relationship between population growth and labour productivity in the case of Ghana. To date, only one study has looked into this problem with the Tanzanian population. Since the labour force structures in Tanzania and Ghana are so close, it is reasonable to believe that the relationship between population and labour productivity found in Tanzania can also be found in Ghana. Therefore, having a deeper understanding of the condition of population and labour productivity in Ghana is necessary to fill the gap and contribute to further policy decisions.

The next chapter goes through the data sources, variables, and research methods that will be used for the estimations.

CHAPTER 3

3.1 Introduction

This chapter discusses the methodology and data employed for the study. More specifically, it describes the empirical model underpinning the effects of population growth and some determinants of Ghana's labour productivity. The study further examines labour productivity in the agriculture and manufacturing sectors. It discusses some of the determinants of labour productivity in these two sectors as these two sectors are labour-intensive. It also discusses the econometric techniques used in addressing the research questions, specifies the models to be estimated, and describes the variables employed for the study, the sources of data, and the means of estimating the various parameters.

3.2 Model Specification

In this study, the empirical model used is similar to Wijaya (2019) and Dua and Garg (2017). The study specifies labour productivity as a function of population growth, government size, trade openness, inflation, human capital, and gross fixed investment**.** The study defines labour productivity to be gross domestic product per the number of people employed, consistent with the work of Wijaya (2019). The equations below show that labour productivity is influenced by inflation, government size, trade openness, human capital, gross fixed investment, and population growth.

The study further estimates two separate models using labour productivity in the agricultural and manufacturing sectors to determine some of the determinants of labour productivity in the sectors where all variables are as defined in equation 3.1. The separate models in 3.2 and 3.3 will help capture the different effects of all the variables defined on Ghana's labour productivity in two sectors of the economy.

Model 1

$$lnGDPPEP_t = \beta_0 + \beta_1 lnGFI_t + \beta_2 lnGOV_t + \beta_3 lnHK_t + \beta_4 lnINF_t + \beta_5 lnOPEN_t + \beta_6 lnPGR_t + \varepsilon_{1t} \quad (3.1)$$

Model 2

$$lnGDPPEP_t^{MANU} = \gamma_0 + \gamma_1\, lnGFI_t + \gamma_2\, lnGOV_t + \gamma_3 lnHK_t + \gamma_4 lnINF_t + \gamma_5 lnOPEN_t + \gamma_6 lnPGR_t + \varepsilon_{2t} \quad (3.2)$$

Model 3

$$lnGDPPEP_t^{AGRIC} = \alpha_0 + \alpha_1 lnGFI_t + \alpha_2 lnGOV_t + \alpha_3 lnHK_t + \alpha_4 lnINF_t + \alpha_4 lnOPEN_t + \alpha_6\, lnPGR_t + \varepsilon_{3t} \quad (3.3)$$

where $lnGDPPEP_t$, $lnGDPPEP^{AGRIC}{}_t$ and $lnGDPPEP^{MANU}{}_t$ is overall labour productivity, labour productivity in the agricultural sector and manufacturing sector respectively at time t. $lnGOV$ is the size of government, lnINF is the inflation rate, lnHK is human capital, ln$OPEN$ is trade openness, lnPGR is the population growth rate and ln*GFI* is the gross fixed investment t. β_k α_k, γ_k where k = 0, 1, 2, 3, 4, 5, and 6 are the coefficients, and ε_{it} is the residual terms. The three models above are estimated separately. All the three models have the same independent variables but different dependent variables, this is because it will allow us to identify which variable (independent variables) significantly affect each of the dependent variables.

3.3 Definition of Variables

This section explains the dependent and independent variables employed for the study. The choice of these variables is based on an empirical and theoretical body of work on the impact of population growth on labour productivity. To have a broader understanding, we incorporate some of the explanatory variables employed by Dua and Garg (2017). In their analysis, they proved that there are some variables which had a significant impact on labour productivity such as gross fixed investment (proxy for capital), human capital, government expenditure, institutional quality, and trade openness. Regarding the data availability, we use human capital, population growth, gross fixed investment, size of government, inflation, and trade openness. The description of these variables and their sources of data are provided in Table 3.1

Table 3. 1 Description of Variables, their acronyms, and sources of data (1980- 2019).

VARIABLES	ACRONYM	DESCRIPTION	EXPECTED SIGNS	SOURCE(S) OF DATA
Labour productivity	GDPPEP	The ratio of real GDP (measured in constant 2010 prices) to the total number of employed persons (between 15-64 years)		World Bank Development Indicators (WDI, 2019), Ghana Statistical Service (GSS,2019)
Labour productivity in the agricultural sector	$GDPPEP^{AGRIC}$	The GDP contribution of the agricultural sector per unit of an employed person (between 15-64 years) in the sector		WDI (2019), GSS (2019)
Labour productivity in the manufacturing sector	$GDPPEP^{MANU}$	The GDP contribution of the manufacturing sector per unit of an employed person (between 15-64 years) in the sector		WDI (2019), GSS (2019)
Population growth rate	PGR	Annual percentage change in a country's population	-	WDI (2019)
Inflation	INF	Annual percentage change in consumer price index (CPI)	-	WDI (2019)
Trade openness	OPEN	Trade openness is the sum of exports and imports of goods and services measured as a percentage of GDP	+	WDI (2019)
Human capital	HK	Human capital is measured as gross enrolment in secondary and tertiary education	+	WDI (2019)
Government size	GOV	The general government final consumption	-	WDI (2019)

		expenditure is expressed as a ratio of GDP		
Gross fixed investment	GIF	The annual percentage change in capital stock (it includes land improvements, plants and machinery)	+	WDI (2019)

3.3.1 Dependent Variables

The dependent variables in this study are labour productivity, and labour productivity in the agriculture and manufacturing sectors.

Following Guest and Swift (2008), labour productivity is a continuous variable that is measured as gross domestic product (GDP) per employed person (between 15-64 years).

Manufacturing and agricultural labour productivity is measured by computing the total output of the agricultural and manufacturing sectors divided by the number of people employed (between 15-64 years) within the sector.

3.3.2 Explanatory Variables

3.3.2.1 Population Growth Rate (PGR)

Several studies have found a connection between labour productivity and population growth. 'Population optimists' believe that increased population makes labour more innovative and makes countries take advantage of economies of scale, both of which increase labour productivity. It is also believed that population growth reduces the number of resources available to labour and hence makes labour unproductive. However, it is unclear whether there is a negative or positive relationship with labour productivity. The average percentage change in population is used to calculate the population growth rate.

3.3.2.2 Size of Government (GOV)

The size of government is considered as a fiscal indicator that is important in determining productivity within an economy. The effect of this indicator on productivity can either be beneficial or harmful depending on the level of efficiency of government expenditure. For instance, when the government sector competes with the private sector for existing limited resources, productivity might be reduced if the government does not spend efficiently (Dua and Garg, 2017). However, if government expenditure is efficient, this might translate into an increase in private sector investment and result in higher productivity levels, other factors being held constant. A study by Awotunde (2018) proved that government expenditure that goes to health affects labour productivity positively. Hence, spending more on sectors which are related to labour issues such as health, education and training program, social, etc. seems to be a channel through which labour productivity can be encouraged. Landau (1983), on the other hand, found that the share of government expenditure on consumption affects labour productivity hence economic growth negatively.

Therefore, the impact of the government size is calculated in terms of government consumption expenditure as a percentage of GDP (Loko and Diouf, 2009).

3.3.2.3 Inflation (INF)

Inflation is defined as “the persistent increase in the general price level of goods and services over a period”. Various authors such as Banerji and Dua (2004), and Tang (2014) have assessed the effect of inflation on labour productivity. Anytime there is increased inflation, it is assumed that resources are diverted to unproductive activities that are the cost of fighting inflation rather than towards activities that improve productivity (Jarrett and Selody, 1982). A persistent increase in the price level results in uncertainties that discourage the urge to invest by the private sector. In situations where investments are carried out, inputs are not combined to achieve their maximum outputs, which impacts the productivity of labour and other inputs in the long run.

3.3.2.4 Human Capital (HK)

Human capital is measured by the gross enrollment in secondary and tertiary education in the country (Dua and Garg, 2017). This includes vocational and technical education. Several studies on productivity have established the positive relationship between human capital and productivity.

3.3.2.5 Trade Openness (OPEN)

The summation of exports and imports as a percentage of GDP is the measure of trade openness. It is argued that an economy that opens up to the rest of the world tends to benefit from the resources of other parts of the world. For instance, a country that opens up and imports machinery and other capital goods can build the economy's technological base, which in turn increases productivity. Additionally, an economy that exports its goods and services to other parts of the world enjoys the benefit of producing more goods and services when demand increases. Also, localized businesses become competitive, which in turn improves their productivity.

Comparative advantage theory argues that international trade makes an economy produce more output in areas where it has a comparative advantage. Studies on the effect of trade openness on labour productivity show that trade openness has a significant positive effect on labour productivity (e.g., Valadkhani, 2005; Dimelis and Papaioannou, 2010; and Fraga, 2016), while some others obtained the opposite result. Follmi, et al. (2018) discovered that real and nominal trade openness is not significantly related to labour productivity in Switzerland at the aggregate level, and

Ishmail, Rosa and Sulaiman (2011) using manufacturing industries found a negative relationship between trade openness and labour productivity in Malaysia.

3.3.2.6 Gross Fixed Investment (GFI)

Capital is a key variable in production, and it refers to assets or goods that have already been produced and are used in the production of other goods and services. Gross fixed investment as a percentage of GDP is used as proxy for capital in this study, and it represents percentage change in capital stock over a period. This is believed to affect labour productivity as labour tends to be more productive with an increase in the share of capital used in the production process.

3.4 Data Sources

The data for this study is sourced from the World Bank World Development Indicators (WDI) database and the Ghana Statistical Service (GSS) database. All the variables are sourced from World Bank World Development Indicators except employment which is sourced from the GSS. The employment data is sourced from GSS due to the availability of data for the time period which is not available in the WDI database. The dependent variables are labour productivity, and labour productivity in the manufacturing and agricultural sectors. The explanatory variables are population growth, government size, human capital, inflation, trade openness and gross fixed investment. Annual data spanning from 1980-2019 are employed in the study. The selection of the time period is largely based on data availability.

3.5 Estimation Technique

The variables are subjected to preliminary tests to ensure that the parameters calculated using time series data from the described econometric model are consistent and accurate. The tests consist of stationarity and cointegration tests. The former will help us avoid estimating a spurious regression, while the latter will help establish cointegration among the variables in the models (i.e., whether there is a long run impact among the variables).

3.5.1 Unit Root Tests

Stationarity tests are important when studying time series data because macroeconomic data usually tend to either increase or decrease over time and might also be trended, thus making it possible for time-series data to be non-stationary. The stationarity test helps us test for model specification to avoid misleading conclusions from a spurious regression analysis. The study employed the two most robust and commonly used stationarity tests for time series data (i.e., the Phillips-Perron (PP) and the Augmented Dickey-Fuller (ADF) tests) since they ensure that the test for stationarity is more reliable than other tests of stationarity. The ADF and PP tests are identical, but they vary in how they deal with autocorrelation in the error term. The PP test is used to solve the problem of heteroscedasticity but the ADF test does not solve this problem. The PP test, unlike the ADF test, assumes that the error terms are weakly dependent and heterogeneously distributed, yielding more accurate estimates than the ADF which assumes the error terms are independent. In addition, with the PP test, we do not need to define the lag length for the test regression.

Unit root test are used to avoid spurious estimation, which is a common problem when working with time series data (Gujarati, 2007). It is also needed for analyzing long-run connections between two or more time-series data (Engle and Granger, 1987). For example, the autoregressive distributed lag (ARDL) bounds test needs that the variables be incorporated of order one, order zero or a combination of both, and this is confirmed by the unit root test. The stationarity properties of each of the variables in question are tested with and without a time trend and constant. The Akaike Information Criterion and the Newey- West bandwidth selects the automatic lag length for the ADF and PP tests.

The ADF is specified as follows:

$$\Delta Y_t = \alpha_0 + \beta_1 Y_{t-1} + \beta_2 t + \sum_{i=1}^{n} \mu_i \Delta Y_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots..(3.4)$$

Where Y_t denotes the series at time t, n is the optimal lag length, α_0,β_1, β_2 and μ_i are parameters to be estimated, **Δ** is the first difference operator, and **ε** is the error term.

The null hypothesis under the ADF and PP test is that the series has unit root and the alternative hypothesis is that the series does not have unit root. We fail to reject the null hypothesis if the t-statistics is less than the critical values in absolute terms but if the t-statistic is greater than the critical values in absolute terms, then the null hypothesis is rejected (i.e., the series is stationary). The assumption is that the series is integrated of order zero if stationarity is attained at the levels. If stationarity occurs at first difference, the series is integrated of order one. This study carried out unit root test to establish that none of the series is of order two as this will render the results invalid. Mackinnon (1991) gives the critical values for the t-statistics.

3.5.2 ARDL Bounds Test for Co-integration

The methodology employed in this study was developed Pesaran, et al. (2001), the autoregressive distributed lag (ARDL) model. The ARDL approach to testing for cointegration between variables works regardless of the order of integration; it can be integrated of order one I (1), I (0) or a combination of both. The ARDL bounds test approach to cointegration is chosen over other approaches like Engle and Granger (1987) and Johansen (1991) because of its multiple advantages.

The ARDL bounds test is a useful method for determining cointegration relationship in a small sample. The ARDL bounds test can also be used to establish an unrestricted error correction model through a simple linear change. The error correction model combines the short run dynamics and the long run equilibrium without sacrificing long run information.

The results from the bounds test will determine if we are to specify either short-run (ARDL model) or both short-run and long-run (error correction model) model. Hence, if the results show that the variables are cointegrated then we specify both the short-run and long-run models. We only use the short-run (ARDL) model if the variables are not cointegrated.

The ARDL bounds test for this study is formulated below considering each of the variables as a dependent variable. We do this to verify if cointegration exists when each variable (both dependent and independent) is set as a dependent variable.

$$\Delta lnY_{i_t} = \beta_0 + \beta_{GD} lnY_{i_{t-1}} + \beta_{GF} lnGFI_{t-1} + \beta_{GV} lnGOV_{t-1} + \beta_{HK} lnHK_{t-1} + \beta_{IN} lnINF_{t-1} + \beta_{OP} lnOPEN_{t-1} + \beta_{PG} lnPGR_{t-1} + \sum_{k=1}^{m} \theta_k \Delta lnY_{i_{t-k}} + \sum_{k=0}^{n} \pi_k \Delta lnGFI_{t-k} + \sum_{k=0}^{O} \vartheta_k \Delta lnGOV_{t-k} + \sum_{k=0}^{P} \tau_k \Delta lnHK_{t-k} + \sum_{k=0}^{q} \emptyset_k \Delta lnINF_{t-k} + \sum_{k=0}^{r} \delta_k \Delta lnOPEN_{t-k} + \sum_{k=0}^{s} \gamma_k \Delta lnPGR_{t-k} + \varepsilon_{i1t} \quad (3.5.1)$$

$$\Delta lnGFI_t = \beta_1 + \beta_{GF} lnGFI_{t-1} + \beta_{GD} lnY_{it-1} + \beta_{GV} lnGOV_{t-1} + \beta_{HK} lnHK_{t-1} + \beta_{IN} lnINF_{t-1} + \beta_{OP} lnOPEN_{t-1} + \beta_{PG} lnPGR_{t-1} + \sum_{k=1}^{m} \omega_k \Delta lnGFI_{t-k} + \sum_{k=0}^{n} \pi_k \Delta lnY_{it-k} + \sum_{k=0}^{o} \vartheta_k \Delta lnGOV_{t-k} + \sum_{k=0}^{p} \tau_k \Delta lnHK_{t-k} + \sum_{k=0}^{q} \lambda_k \Delta lnINF_{t-k} + \sum_{k=0}^{r} \delta_k \Delta lnOPEN_{t-k} + \sum_{k=0}^{s} \gamma_k \Delta lnPGR_{t-k} + \varepsilon_{i2t} \quad (3.5.2)$$

$$\Delta lnGOV_t = \beta_2 + \beta_{GV} lnGOV_{t-1} + \beta_{GD} lnY_{it-1} + \beta_{GF} lnGFI_{t-1} + \beta_{HK} lnHK_{t-1} + \beta_{IN} InINF_{t-1} + \beta_{OP} InOPEN_{t-1} + \beta_{PG} InPGR_{t-1} + \sum_{k=1}^{m} \omega_k \Delta lnGOV_{t-k} + \sum_{k=0}^{n} \pi_k \Delta Y_{it-k} + \sum_{k=0}^{o} \vartheta_k \Delta lnGFI_{t-k} + \sum_{k=0}^{p} \tau_k \Delta lnHK_{t-k} + \sum_{k=0}^{q} \lambda_k \Delta lnINF_{t-k} + \sum_{k=0}^{r} \delta_k \Delta lnOPEN_{t-k} + \sum_{k=0}^{s} \gamma_k \Delta lnPGR_{t-k} + \varepsilon_{i3t} \qquad (3.5.3)$$

$$\Delta lnHK_t = \beta_3 + \beta_{HK} lnHK_{t-1} + \beta_{GD} lnY_{it-1} + \beta_{GF} lnGFI_{t-1} + \beta_{GV} lnGOV_{t-1} + \beta_{IN} lnINF_{t-1} + \beta_{OP} INOPEN_{t-1} + \beta_{PG} lnPGR_{t-1} + \sum_{k=1}^{m} \omega_k \Delta lnHK_{t-k} + \sum_{k=0}^{n} \pi_k \Delta lnY_{it-k} + \sum_{k=0}^{o} \vartheta_k \Delta lnGFI_{t-k} + \sum_{k=0}^{p} \tau_k \Delta lnGOV_{t-k} + \sum_{k=0}^{q} \lambda_k \Delta lnINF_{t-k} + \sum_{k=0}^{r} \delta_k \Delta lnOPEN_{t-k} + \sum_{k=0}^{s} \gamma_k \Delta lnPGR_{t-k} + \varepsilon_{i4t} \qquad (3.5.4)$$

$$\Delta lnINF_t = \beta_4 + \beta_{IN} lnINF_{t-1} + \beta_{GD} lnY_{it-1} + \beta_{GF} lnGFI_{t-1} + \beta_{HK} lnHK_{t-1} + \beta_{IN} InGOV_{t-1} + \beta_{OP} InOPEN_{t-1} + \beta_{PG} InPGR_{t-1} + \sum_{k=1}^{m} \omega_k \Delta lnINF_{t-k} + \sum_{k=0}^{n} \pi_k \Delta lnY_{it-k} + \sum_{k=0}^{o} \vartheta_k \Delta lnGFI_{t-k} + \sum_{k=0}^{p} \tau_k \Delta lnHK_{t-k} + \sum_{k=0}^{q} \lambda_k \Delta lnGOV_{t-k} + \sum_{k=0}^{r} \delta_k \Delta lnOPEN_{t-k} + \sum_{k=0}^{s} \gamma_k \Delta lnPGR_{t-k} + \varepsilon_{i5t} \qquad (3.5.5)$$

$$\Delta lnOPEN_t = \beta_5 + \beta_{OP} lnOPEN_{t-1} + \beta_{GD} lnY_{it-1} + \beta_{GF} lnGFI_{t-1} + \beta_{HK} lnHK_{t-1} + \beta_{IN} InINF_{t-1} + \beta_{OP} InGOV_{t-1} + \beta_{PG} InPGR_{t-1} + \sum_{k=1}^{m} \omega_k \Delta lnOPEN_{t-k} + \sum_{k=0}^{n} \pi_k \Delta lnY_{it-k} + \sum_{k=0}^{o} \vartheta_k \Delta lnGFI_{t-k} + \sum_{k=0}^{p} \tau_k \Delta lnHK_{t-k} + \sum_{k=0}^{q} \lambda_k \Delta lnINF_{t-k} + \sum_{k=0}^{r} \delta_k \Delta lnGOV_{t-k} + \sum_{k=0}^{s} \gamma_k \Delta lnPGR_{t-k} + \varepsilon_{i6t} \qquad (3.5.6)$$

$$\Delta lnPGR_t = \beta_6 + \beta_{PG} lnPGR_{t-1} + \beta_{GD} lnY_{it-1} + \beta_{GF} lnGFI_{t-1} + \beta_{HK} lnHK_{t-1} + \beta_{IN} InINF_{t-1} + \beta_{OP} InOPEN_{t-1} + \beta_{GV} InGOV_{t-1} + \sum_{k=1}^{m} \omega_k \Delta lnPGR_{t-k} + \sum_{k=0}^{n} \pi_k \Delta lnY_{it-k} + \sum_{k=0}^{o} \vartheta_k \Delta lnGFI_{t-k} + \sum_{k=0}^{p} \tau_k \Delta lnHK_{t-k} + \sum_{k=0}^{q} \lambda_k \Delta lnINF_{t-k} + \sum_{k=0}^{r} \delta_k \Delta lnOPEN_{t-k} + \sum_{k=0}^{s} \gamma_k \Delta lnGOV_{t-k} + \varepsilon_{i7t} \qquad (3.5.7)$$

Where ln is the natural log function $Y_i, i = 1, 2, 3$ are the dependent variables in the three models respectively (i.e., Y_1 is GDPPEP, Y_2 is GDPPEPMANU, and Y_3 is GDPPEPAGRIC), $\beta_i, \theta_i, \omega_i, \pi_i, \vartheta_i, \tau_i, \emptyset_i, \delta_i,$ and γ_i are the coefficients to be estimated, Δ is the difference operator, m,n,o,p,q r s are the lag length, t = 1, 2,….T, k = 0 (coefficient of the independent variables) and k = 1(lag coefficient of the dependent variables) and ε_t is the error term.

In order to determine whether there exist cointegration relationship among $Y_{i,}$ PGR, GFI, GOV, HK, INF, and OPEN in the long run we tested the null hypothesis that

H_0: $\beta_{Yi}=\beta_{GF}=\beta_{GV}=\beta_{HK}=\beta_{IN}=\beta_{OP}= \beta_{PG}=0$ against the alternative hypothesis that H_1: $\beta_{Yi}\neq\beta_{GF}\neq\beta_{GV}\neq\beta_{HK}\neq\beta_{INF}\neq\beta_{OP}\neq\beta_{PG}\neq0$. Also, in order to estimate the ARDL bounds test, it is important to obtain the appropriate lag length to avoid biased results. The Akaike Information Criterion (AIC)selects the appropriate and optimum lag length.

We therefore compute the F-statistics to compare with the lower and upper critical bounds values to determine whether cointegration exists in each of the bounds test equations above. Studies show that the upper and lower critical values obtained by Pesaran, et al. (2001) are suitable for large sample size between 500 to 40,000 and it may provide biased estimates if a small sample size is used regarding the cointegration of the series. Therefore, we use Narayan (2005) critical values, an advancement to the Pesaran, et al. (2001) critical bounds test. Narayan's critical values are suitable for small sample size ranging from 30 to 80 and with our case where the sample size is 40 the Narayan critical values may be appropriate. The critical values under the I (1) is the upper bound critical values and the I (0) is the lower bound critical values.

The null hypothesis of no cointegration is rejected if the computed F-statistics is greater than the upper bound critical value. We fail to reject the null hypothesis if the computed F-statistics is lower than the lower critical bound. The outcome is inconclusive if the F-statistics is within the lower and upper bounds. A two-step approach to estimate the model is undertaken given that cointegration exists.

3.5.2.1 Long-Run and Short-Run Model

Having found that cointegration exist with the three main dependent variables, equation 3.1, 3.2 and 3.3 will be estimated using the following ARDL (m,n.o,p,q,r,s) model, where m, n, o, p, q, r, s are the lag orders of each variable and this will be automatically selected by the Akaike Information Criterion.

$$lnGDPPEP_t = \beta_0 + \sum_{i=1}^{m} \theta_i lnGDPPEP_{t-i} + \sum_{i=0}^{n} \pi_i lnGFI_{t-i} + \sum_{i=0}^{o} \vartheta_i lnGOV_{t-i} + \sum_{i=0}^{p} \tau_i lnHK_{t-i} + \sum_{i=0}^{q} \emptyset_i lnINF_{t-i} + \sum_{i=0}^{r} \delta_i lnOPEN_{t-i} + \sum_{i=0}^{s} \gamma_i lnPGR_{t-i} + \mu_{1t} \quad (3.6)$$

$$lnGDPPEP_t^{MANU} = \beta_1 + \sum_{i=1}^{m} \theta_i lnGDPPEP^{MANU}{}_{t-i} + \sum_{i=0}^{n} \pi_i lnGFI_{t-i} + \sum_{i=0}^{o} \vartheta_i lnGOV_{t-i} + \sum_{i=0}^{p} \tau_i lnHK_{t-i} + \sum_{i=0}^{q} \emptyset_i lnINF_{t-i} + \sum_{i=0}^{r} \delta_i lnOPEN_{t-i} + \sum_{i=0}^{s} \gamma_i lnPGR_{t-i} + \mu_{2t} \quad (3.7)$$

$$lnGDPPEP_t^{AGRIC} = \beta_2 + \sum_{i=1}^{m} \theta_i lnGDPPEP^{AGRIC}{}_{t-i} + \sum_{i=0}^{n} \pi_i lnGFI_{t-i} + \sum_{i=0}^{o} \vartheta_i lnGOV_{t-i} + \sum_{i=0}^{p} \tau_i lnHK_{t-i} + \sum_{i=0}^{q} \emptyset_i lnINF_{t-i} + \sum_{i=0}^{r} \delta_i lnOPEN_{t-i} + \sum_{i=0}^{s} \gamma_i lnPGR_{t-i} + \mu_{3t} \quad (3.8)$$

Before the model is estimated, the Akaike Information Criterion (AIC) will select the orders of the optimum lags. Pesaran and Shin (1999) indicated in their study that for annual data it is best to choose maximum lags of 2, therefore the lag length that minimises the AIC will be used. Also, if cointegration exists, the short run dynamics will be derived by establishing an error correction model. This is specified below:

$$\Delta lnGDPPEP_t = \beta_0 + \sum_{i=1}^{m} \theta_i \Delta lnGDPPEP_{t-i} + \sum_{i=0}^{n} \pi_i \Delta lnGFI_{t-i} + \sum_{i=0}^{o} \vartheta_i \Delta lnGOV_{t-i} + \sum_{i=0}^{p} \tau_i \Delta lnHK_{t-i} + \sum_{i=0}^{q} \emptyset_i \Delta lnINF_{t-i} + \sum_{i=0}^{r} \delta_i \Delta lnOPEN_{t-i} + \sum_{i=0}^{s} \gamma_i \Delta lnPGR_{t-i} + \zeta_1 ECM_t^{L} + \nu_{1t} \quad (3.9)$$

$$\Delta lnGDPPEP^{MANU}{}_t = \beta_1 + \sum_{i=1}^{m} \theta_i \Delta lnGDPPEP^{MANU}{}_{t-i} + \sum_{i=0}^{n} \pi_i \Delta lnGFI_{t-i} + \sum_{i=0}^{o} \vartheta_i \Delta lnGOV_{t-i} + \sum_{i=0}^{p} \tau_i \Delta lnHK_{t-i} + \sum_{i=0}^{q} \emptyset_i \Delta lnINF_{t-i} + \sum_{i=0}^{r} \delta_i \Delta lnOPEN_{t-i} + \sum_{i=0}^{s} \gamma_i \Delta lnPGR_{t-i} + \zeta_2 ECM_t^{MANU} + \nu_{2t} \quad (3.10)$$

$$\Delta lnGDPPEP^{AGRIC}{}_t = \beta_2 + \sum_{i=1}^{m} \theta_i \Delta lnGDPPEP^{AGRIC}{}_{t-i} + \sum_{i=0}^{n} \pi_i \Delta lnGFI_{t-i} + \sum_{i=0}^{o} \vartheta_i \Delta lnGOV_{t-i} + \sum_{i=0}^{p} \tau_i \Delta lnHK_{t-i} + \sum_{i=0}^{q} \emptyset_i \Delta lnINF_{t-i} + \sum_{i=0}^{r} \delta_i \Delta lnOPEN_{t-i} + \sum_{i=0}^{s} \gamma_i \Delta lnPGR_{t-i} + \zeta_3 ECM_t^{AGRIC} + \nu_{3t} \quad (3.11)$$

Where the error correction term (ECM) for each model is defined as:

$$ECM_t^L = lnGDPPEP_t - \hat{\alpha}_0 - \sum_{i=0}^{m} \hat{\theta}_i lnGDPPEP_{t-i} - \sum_{i=0}^{n} \hat{\pi}_i lnGFI_{t-i} - \sum_{i=0}^{o} \hat{\vartheta}_i lnGOV_{t-i} - \sum_{i=0}^{p} \hat{\tau}_i lnHK_{t-i} - \sum_{i=0}^{q} \hat{\emptyset}_i lnINF_{t-i} - \sum_{i=0}^{r} \hat{\delta}_i lnOPEN_{t-i} - \sum_{i=0}^{s} \hat{\gamma}_i lnPGR_{t-i}$$

$$ECM_t^{MANU} = lnGDPPEP^{MANU}{}_t - \hat{\alpha}_1 - \sum_{i=0}^{m} \hat{\theta}_i lnGDPPEP^{MANU}{}_{t-i} - \sum_{i=0}^{n} \hat{\pi}_i lnGFI_{t-i} - \sum_{i=0}^{o} \hat{\vartheta}_i lnGOV_{t-i} - \sum_{i=0}^{p} \hat{\tau}_i lnHK_{t-i} - \sum_{i=0}^{q} \hat{\emptyset}_i lnINF_{t-i} - \sum_{i=0}^{r} \hat{\delta}_i lnOPEN_{t-i} - \sum_{i=0}^{s} \hat{\gamma}_i lnPGR_{t-i}$$

$$ECM_t^{AGRIC} = lnGDPPEP^{AGRIC}{}_t - \hat{\alpha}_2 - \sum_{i=0}^{m} \hat{\theta}_i lnGDPPEP^{AGRIC}{}_{t-i} - \sum_{i=0}^{n} \hat{\pi}_i lnGFI_{t-i} - \sum_{i=0}^{o} \hat{\vartheta}_i lnGOV_{t-i} - \sum_{i=0}^{p} \hat{\tau}_i lnHK_{t-i} - \sum_{i=0}^{q} \hat{\emptyset}_i lnINF_{t-i} - \sum_{i=0}^{r} \hat{\delta}_i lnOPEN_{t-i} - \sum_{i=0}^{s} \hat{\gamma}_i lnPGR_{t-i}$$

The difference operator is Δ, β, θ , π_i,$\vartheta_i \tau_i$, $\emptyset_i$, δ_i, and γ_i, are the coefficients of the model and ζ measures the speed of adjustment. The error correction term informs us on how quickly the variables can adjust in the long run when there is deviation or shock in the short run. The error correction term should be negative and significant. A positive error correction term, on the other hand, indicates that the variables are in an explosive state and that there is no convergence to the equilibrium.

3.6 Diagnostic Test

A series of diagnostic test are run to ensure that the ARDL model is free from any econometric issues. These tests consist of normality test, serial correlation, heteroscedasticity, functional form, and a stability test using a plot of cumulative sum and cumulative sum of squares.

Normality Test

The Jarque-Bera (JB) test is used to test if the error terms follow the normal distribution. Normality test is not required but we assume normality for the error terms for the convenience to do statistical test. The JB test the skewness and kurtosis measures to see if it matches a normal distribution and the computed test statistics follows the chi-squared distribution. The test statistics is given as

$$JB = \frac{N}{6}\left[\hat{s}^2 + \frac{1}{4}\left(\hat{k} - 3\right)^2\right]$$

where N = sample size, $\hat{s}$= skewness coefficient and $\hat{k}$ is the kurtosis coefficient. If the variables are normally distributed, then $\hat{k}$=3 and $\hat{s}$ = 0. We test the null hypothesis that the errors follow the normally distributed against the alternative hypothesis that they are not normally distributed. We, therefore, make a decision based on the p-values. If the p-value exceeds the 5% significant level then error terms follow the normal distribution, but if it is less than the 0.05 then the parameters are not normally distributed.

Serial Correlation

The problem of serial correlation occurs when the residual terms in the regression model relates or are dependent overtime. There are two tests for autocorrelation: Breusch Godfrey LM test and Durbin Watson D test. The null hypothesis in the Durbin Watson D test is that the error terms are serially uncorrelated against the alternative hypothesis that they follow a first order autoregressive process. The Durbin Watson statistics is computed and compared with the upper and lower Durbin Watson critical values and a decision is made on whether to reject or accept the null hypothesis.

The Breusch Godfrey test is more appropriate for this study since it has advantages over the Durbin Watson test. First and foremost, it is less sensitive to the hypothesis that the errors are normally distributed. The Breusch Godfrey test allows researchers to test for serial correlation using a number of lags rather than lag one which is what the D-W test allows, i.e., it tests the relationship between the residuals with time t and t-k, where k is the number of lags. The null hypothesis states that there is no serial correlation between the error terms against the alternative hypothesis that serial correlation is present. An LM test which is converted to an F-test is computed to make a decision and if the p-value is greater than 5% the null hypothesis is rejected, meaning that there is no serial correlation between the residuals in the model. Alternatively, if the p-value is less than 5% then the problem of serial correlation exists.

Heteroscedasticity

The Breusch Pagan test for heteroscedasticity is used for the study. This is used to test for heteroscedasticity in a linear regression model, with the null hypothesis that the variance of the errors are equal as against the alternative hypothesis that they are not equal. The test follows the chi-squared distribution such that if the test statistics has a p-value lower than the threshold of 5%, the null hypothesis is rejected i.e., heteroscedasticity exists. We fail to reject the null hypothesis if the test statistics have a p-value greater than 5% significance level, implying that no heteroscedasticity exists.

The conditional heteroscedasticity in the residual terms is examined using the Autoregressive Conditional Heteroscedasticity (ARCH) test in this study. The ARCH test is a regression of the squared residuals on a constant and lagged residuals. The computed F-statistics from this test follows a chi-squared distribution and the null hypothesis is that there is no conditional heteroscedasticity against the alternative hypothesis that the ARCH model describes the series. We fail to reject the null hypothesis that if the p-value is greater than the 5% significance levels but if the p-value is less than the 5% significance levels then the null hypothesis is rejected.

Functional Form

One of the basic problems in econometrics is model misspecification. The Ramsey RESET test is used to detect misspecifications like incorrect functional form (i.e., when some or all of the series are log transformed, or whether the powers of the fitted values of the dependent variable have any power in describing the dependent variable this can occur), measurement errors (which occur when the residual terms and the independent and values of the lagged dependent variables are correlated), and omitted variables. It simply tests if the functional form of the short-run model is appropriately specified. The regression equation is specified as follows:

$$\hat{y} = E\{y\text{I}x\} = \hat{\beta}x$$

Ramsey's test tests whether $\hat{\beta}x, (\hat{\beta}x)^2, \dots, (\hat{\beta}x)^k$ has any power in explaining y. This is done by estimating the following regression

$$y = \alpha x + \tau_1 \hat{y}^2 + \cdots + \tau_{k-1}\hat{y}^k + \varepsilon$$

The null hypothesis is $H_0\colon \tau_1 = \tau_2 = \cdots = \tau_{k-1} = 0$ againt the alternative $H_1\colon \tau_1 \neq \tau_2 \neq \cdots . \neq \tau_{k-1}$. A significant F-test statistic where the p-value is less than the 5% significance levels (i.e., rejection of H_0) means that the model suffers from specification error. Otherwise, the model is correctly specified.

Stability Test

According to Pesaran, et al. (2001) it is important to check for the stability of the parameters. Following Pesaran, et al. (2001), we use the cumulative sum (CUSUM) and the cumulative sum squared (CUSUMSQ) to test for the stability of the long run and short run parameters. The null hypothesis is all the parameters in the model are stable and the alternative hypothesis is that the parameters are not stable. The CUSUM and CUSMSQ tests substantially test for structural breaks and are amended repeatedly and plotted against their break point. The CUSUMSQ test determines whether the residual terms' variance is unstable, while the CUSUM test determines whether the intercept term is unstable. If the plot exceeds the bounds of 5% significance level, then the parameters are not stable but if it falls within the bounds of 5% significance level, then the parameters are said to be stable.

3.7 Descriptive Statistics

Table 3.2 Summary Statistics

Variables	*Obs.*	*Mean*	*S.D.*	*Min*	*Max*
GDPPEP	40	2715.006	868.469	1685.132	4638.104
GDPPEPAGRIC	40	1875.167	367.107	1402.475	2742.82
HK	40	43.801	12.558	33.2	71.320
OPEN	40	62.905	28.050	6.32	116.048
PGR	40	2.587	0.256	2.163	3.045
GOV	40	10.242	2.090	5.861	15.308
INF	40	26.481	25.021	7.126	122.875
GFI	40	4.07e+09	5.08e+09	1.11e+08	1.61e+10

Source: Author's calculations using data from WDI and GSS 2019

Using data from 1980-2019, there are 40 observations for labour productivity represented by real gross domestic product per employed person (GDPPEP), manufacturing labour productivity represented by the contribution of the sector to GDP per unit of employed persons in the sector (GDPPEPMANU), labour productivity in agriculture represented by GDP contribution of the agricultural sector per unit of employed persons in the sector (GDPPEPAGRIC), human capital (HK), trade openness (OPEN), population growth (PGR), government size (GOV), inflation

(INF), and gross fixed investment (GFI). The result from Table 3.2 shows that the average labour productivity measured as real GDP per employed person is around USD 2,715 for the period under study. It reached its minimum (USD1685.13) in 1983 when Ghana recorded its worst post-independence recession and peaked around 2019. Labour productivity grew steadily at 1.5 percent in the period. Population growth (PGR) was very stable throughout the period averaging around 2.59% annually. The lowest population growth rate was recorded in 2019 (2.16%). It can partly be attributed to increased sex education and the use of contraceptives. Another key explanatory variable for the study is inflation (INF). It averaged around 26.48%, indicating that the general price levels were increasing at a rate above the Bank of Ghana's medium-term inflation target of 8% +/-2 percentage points in 2002.

Human capital (HK), as measured by the gross enrollment in secondary school, and averaged 43.80% over the period. This means that two out of every five children aged between 15 and 19 years were enrolled in secondary school from 1980 to 2019. Gross enrollment was lowest in 1991 when it was 33.2% but has since grown steadily and reached a record high in 2018 (71.32%). The recent high enrollment from 2017 is partly attributed to the free secondary school policy that absorbs all fees of every Ghanaian child attending public high school. The sum of Ghana's export and import volumes as a percentage of GDP (OPEN) averaged 62.91% annually. The average government size (GOV) was 10.24% of GDP. The government size has a direct impact on the government's fiscal position and leads to excessive borrowing since government revenue is way below its planned expenditure, but between 1986-1989 were the only years when the government of Ghana achieved a budget surplus. It can be observed that in the years 1992, 2004, 2008 and 2012, government size increased considerably because of the elections in those years. In 2011, expenditure of government as a proportion of GDP rose to 13.79% from the previous year's 7.07%. This was partly due to the implementation of the Single Spine Pay Structure (SSPS). The SSPS was introduced to compensate workers in the public sector with comparable qualifications as those in the private sector who received higher salary (Ampofo and Tchatoka, 2019). Between 2010 when the policy was rolled-out to 2012, public sector expenditure on salaries increased from USD 343 million to USD 1.2 billion by the end of 2012.The average annual addition to capital stock over the period stood at USD 4.07 billion over the period. The minimum gross fixed investment (GFI) was recorded in the year 1981 and was USD 110.59 million. The maximum gross fixed investment between 1980-2019 was USD 16.07 billion, which was recorded in 2013.

CHAPTER 4

4.1 Introduction

The results and findings of the study are presented in this chapter. It first presents the trend analysis of labour productivity and other key variables. It also includes stationarity and cointegration tests as well as the study's long and short-run outcomes. The chapter ends with a discussion on the model diagnostic tests.

4.2 Trend Analysis for Labour Productivity and Other Key Variables

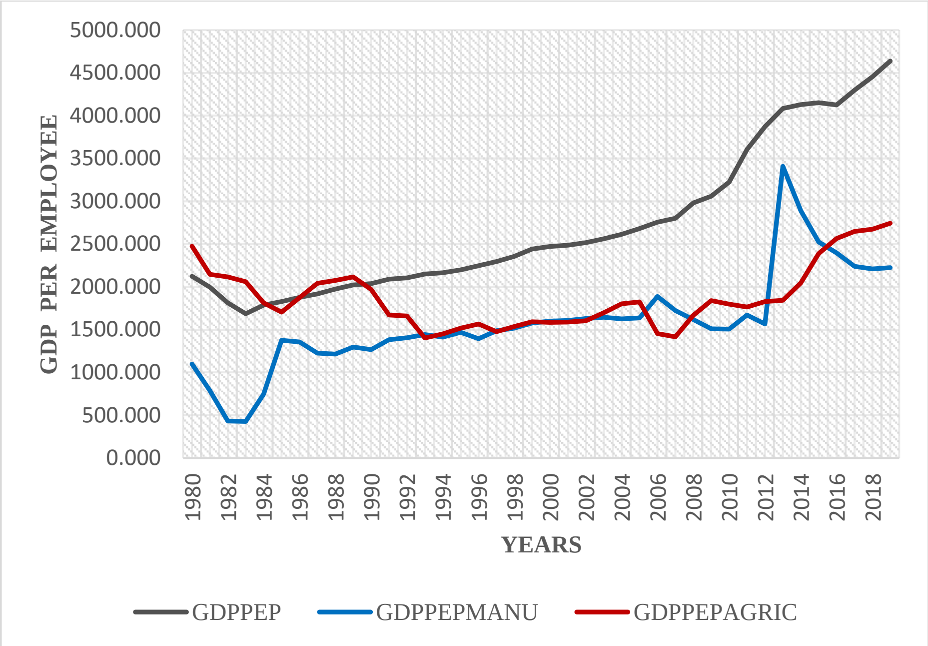

Figure 4.1 Trends in overall labour productivity, manufacturing labour productivity and agricultural labour productivity in Ghana, 1980-2019

Source: Author's calculations using data from WDI.

Figure 4.1 depicts a graphical representation of three measures of labour productivity; GDP per employed person, GDP per person employed in the manufacturing sector, and GDP per employed person in the agricultural sector.

It can be seen from the graph that between the periods of 1980 to 1983, there are considerable falls in all three labour productivity measures, due to the declining overall economic performance of the country during that time. The dip in economic activity around this period can be attributed to prolonged drought, economic mismanagement, and the mass repatriation of Ghanaians from neighbouring Nigeria (Aryeetey and Baah-Boateng, 2015). The economy started to recover with the introduction of the structural adjustment programme (SAP) and the economic recovery programme (ERP) by the government of Ghana in collaboration with the World Bank in 1983/84; this accounts for the steady rise in the variables despite significant drops in 1993 and 2008. According to Aryeetey and Baah-Boateng (2015), some of the policies that were adopted to restore the economy included labour market reforms, investment expansion and foreign trade reforms.

The performance of the manufacturing sector measured by the GDP per person employed in the manufacturing sector is far below that of the agricultural sector from 1980 to 1992. However, from 2012 the manufacturing sector performed better than the agricultural sector, with its GDP per person employed rising faster than the GDP per person employed in the agriculture sector. This confirms the findings that the agricultural sector is no longer the leading contributor to GDP in Ghana. It's worth noting that the huge rise in manufacturing labour productivity observed in 2013 from USD 1565.17 the previous year to a staggering USD3,408.47 is due to an increase in oil sector's production in Ghana, and the subsequent decline after the period goes beyond the often addressed issues of macroeconomic stability, but rather due to the fall in energy price (Acquah-Sam, 2014).

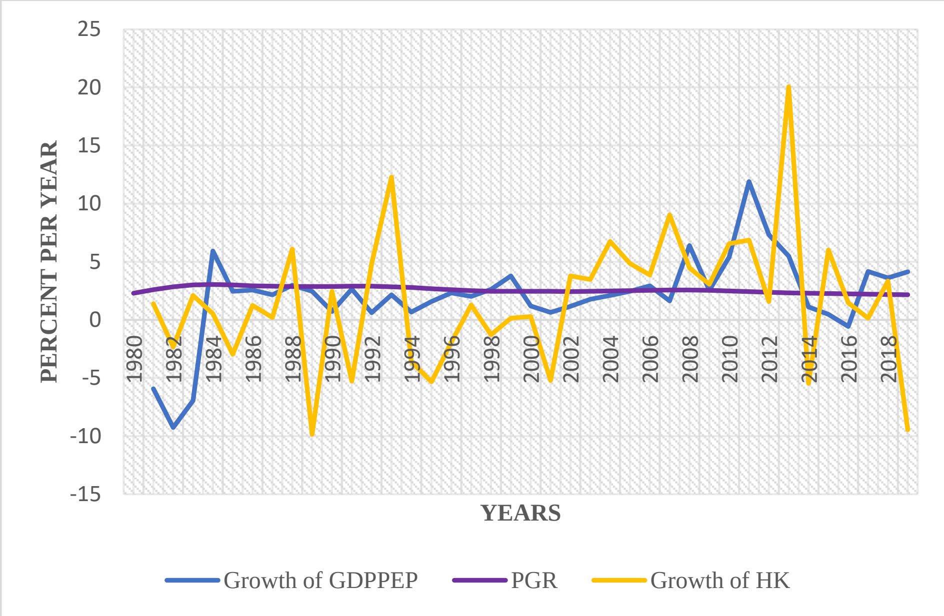

Figure 4.2 Trend in the growth of labour productivity, human capital, and population
Source: Author's calculations using data from WDI.

Figure 4.2 shows that population grew at a very steady rate of about 2.56% on average from 1980 – 2019 with very minimal variation. The steady growth may be attributed to birth rate growing at a slower pace. However, there is a significant oscillation in the GDP per employed persons from Figure 4.2 which shows that labour productivity (GDPPEP) experienced negative growth between 1981-1983 but began to reverse the pattern from 1984 when the economic recovery program (ERP) was implemented. It then grew steadily between 1984 to 2010, reaching a high of 11.90% in 2011. The growth of gross enrollment in secondary school was 1.38% in 1981. The lowest rate was recorded in 1990 (-10%) and this was because the government could not fulfill its promise of free education at the secondary level. An upward trend was observed from 1996 through the first decade of the twenty-first century reaching its peak in 2013 (20%).

4.3 Unit Root Test

To decide whether a time-series is stationary or not, a unit root test is necessary to be carried out for all the variables in the model. If the results show that there is no unit root, we can conclude that the series is stationary; otherwise, it is not stationary. We employ the Augmented Dickey-Fuller (ADF) and the Phillips-Perron test to check if each series is stationary or not. For both tests, the null hypothesis is that unit root exists, while the alternative hypothesis is that the series is stationary. Each variable is tested in levels and first difference at the constant, and at the constant with a time trend.

In conducting these two tests we use the automatic lag length selection based on the Newey-West bandwidth and the Akaike Information Criterion (AIC) for the Philips-Perron and ADF tests respectively.

The unit root decision is made using p-values, and the results are compared with the critical values. The results of the unit root test for each of the variables are shown in Table 4.1.

Table 4.1 Stationarity test results

	LEVELS			
	ADF		**Phillip Perron**	
	Constant	Constant and trend	Constant	Constant and trend
LNGDPPEP	0.461	-2.780	1.576	-3.325*
LNGDPPEPMANU	-1.651	-3.147*	-1.291	-3.143
LNGDPPEPAGRIC	-1.226	-1.447	-1.074	-1.298
LNGFI	-2.226	-1.072	-2.218	-1.072
LNGOV	-3.057**	-3.041	-3.203**	-3.195*

LNHK	0.225	-1.504	0.177	-1.479
LNINF	-1.022	-6.038***	-3.308**	-5.485***
LNOPEN	-1.698	-1.366	-1.688	-1.424
LNPGR	-0.147	-4.151**	-1.268	-5.102***

FIRST DIFFERENCE

	ADF		**Phillips-Perron**	
	Constant	Constant and trend	Constant	Constant and trend
LNGDPPEP	-3.544**	-3.722**	-3.383**	-3.465*
LNGDPPEPMANU	-5.138***	-5.063***	-8.801***	-10.163***
LNGDPPEPAGRIC	-4.754***	-4.290***	-4.665***	-8.788***
LNGFI	-3.081**	-3.448*	-3.054**	-3.433*
LNGOV	-5.104***	-3.180*	-7.739***	-8.286***
LNHK	-6.315***	-6.660***	-6.396***	-6.670***
LNINF	-5.636***	-5.548***	-18.359***	-17.669***
LNOPEN	-6.201***	-8.034***	-5.195***	-5.615***
LNPGR	-4.491***	-4.400***	-5.641***	-4.922***

Note: ***, ** and * represent statistical significance at 1%, 5% and 10% levels, respectively. The test statistics were compared with the Dickey-Fuller critical values. For the regression with constant, the critical values are -2.608, -2.939, and -3.610 for 0.1, 0.05, and 0.01 significance levels respectively. For the regression with a constant and trend terms, the critical values are -3.196, -3.530, and -4.212 respectively.

Source: Author's calculations.

Since both the PP and ADF test values are greater than the critical values at 5% significance levels, the findings from the PP and ADF test for the variables in Table 4.1 suggest that some of the variables are stationary at the levels. Also, after first differencing, some of the variables are stationary because the test statistics are greater than the critical values at 5% significance level. This, therefore, shows that some of the variables are integrated of order one, while others are integrated of order zero.

To have consistent and reliable results devoid of any spurious outcomes, it is essential to work with stationary results. Thus, some of the series are of order zero I (0), while others are of order one I (1).

The null hypothesis of the existence of unit root is rejected for inflation (INF), government size (GOV) at constant, and population growth (PGR) at constant and trend. Since all the series are not stationary at the levels, the study further test the null hypothesis at the first difference. From the results of the first difference table, the null hypothesis of unit root is rejected for population growth (PGR), size of government (GOV), trade openness (OPEN), gross fixed investment (GFI), and human capital (HK), indicating the absence of unit root in all the variables at the 5% significance level, hence stationarity at first difference. As a result, the series are integrated of order zero and one i.e., I (0) and I (1).

When other approaches are applied to the data, statistically, the data have the ability to produce spurious relationships, the ARDL method of estimation, therefore, becomes the appropriate estimation method to be adopted for the study.

4.4 ARDL Bounds Test for Cointegration

The ARDL bounds test for cointegration introduced by Pesaran, et al. (2001) is used to determine whether the variables are cointegrated after identifying that the variables are integrated of order zero and one. The ARDL bounds test has an assumption that none of the variables should be integrated of order two, if not we cannot interpret the values of the F-statistics provided by Pesaran, et al. (2001). The null hypothesis is that the variables have no level relationship, while the alternative is that they have a long run relationship. If the test statistics exceeds the upper bound for each level of significance (0.05 and 0.01), the null hypothesis is rejected but the null hypothesis cannot be rejected if the test statistic is less than the lower bound at all levels of significance. The test is inconclusive if the test statistic is between the lower and upper bound.

The existence of a long run relationship between the variables is determined using the ARDL bounds test. In the study, we used a maximum lag of 2 automatically selected by the Akaike Information Criterion (AIC). Table 4.2 shows the calculated F-statistics, with each of the independent variables considered as a dependent variable, as shown below.

Table 4.2 Bounds test Results

Model 1	F-statistics	Decision
$F_{lngdppep}$(lngfi,lngov, lnhk, lninf,lnopen,lnpgr)	6.280***	Cointegration exists
F_{lngfi}(lngdppep,lngov,lnhk,lninf,lnopen,lnpgr)	2.314	No Cointegration
F_{lngov}(lngdppep,lngfi,lnhk,lninf,lnopen,lnpgr)	2.333	No Cointegration
F_{lnhk}(lngdppep,lngfi,lngov,lninf,lnopen,lnpgr)	4.528**	Cointegration exists
F_{lninf}(lngdppep,lngfi,lngov,lnhk,lnopen,lnpgr)	4.352**	Cointegration exists
F_{lnopen}(lngdppep,lngfi,lngov,lnhk,lninf,lnpgr)	1.748	No Cointegration
F_{lnpgr}(lngdppep,lngfi,lngov,lnhk,lninf,lnopen)	1.641	No Cointegration

Model 2	F-statistics	Decision
$F_{lngdppepmanu}$(lngfi,lngov,lnhk,lninf,lnopen,lnpgr)	5.939***	Cointegration exists
F_{lngfi}(lngdppepmanu,lngov,lnhk,lninf,lnopen,lnpgr)	2.228	No Cointegration
F_{lngov}(lngdppepmanu,lngfi,lnhk,lninf,lnopen,lnpgr)	3.150	No Cointegration
F_{lnhk}(lngdppepmanu,lngfi,lngov,lninf,lnopen,lnpgr)	3.197	No Cointegration
F_{lninf}(lngdppepmanu,lngfi,lngov,lnhk,lnopen,lnpgr)	4.352**	Cointegration exists
F_{lnopen}(lngdppepmanu,lngfi,lngov,lnhk,lninf,lnpgr)	1.582	No Cointegration
F_{lnpgr}(lngdppepmanu,lngfi,lngov,lnhk,lninf,lnopen)	2.760	No Cointegration

Model 3	F-statistics	Decision
$F_{lngdppepagric}$(lngfi,lngov,lnhk,lninf,lnopen,lnpgr)	4.134*	Cointegration exists
F_{lngfi}(lngdppepagric,lngov,lnhk,lninf,lnopen,lnpgr)	3.181	No Cointegration
F_{lngov}(lngdppepagric,lngfi,lnhk,lninf,lnopen,lnpgr)	2.091	No Cointegration
F_{lnhk}(lngdppepagric,lngfi,lngov,lninf,lnopen,lnpgr)	1.792	No Cointegration
F_{lninf}(lngdppepagric,lngfi,lngov,lnhk,lnopen,lnpgr)	3.390	No Cointegration
F_{lnopen}(lngdppepagric,lngfi,lngov,lnhk,lninf,lnpgr)	1.591	No Cointegration
F_{lnpgr}(lngdppepagric,lngfi,lngov,lnhk,lninf,lnopen)	2.169	No Cointegration

Note: The critical bounds test values presented on this table are obtained from the Narayan (2004) critical values. The critical values for all the regressions with constant have a lower bound of 3.80, 2.797, 2.387 and upper bound of 5.60, 4.211, 3.671. ***, ** and * represent statistical significance at 1%, 5% and 10% levels, respectively.

Source: Author's calculations**.**

The F-test statistics reported in Table 4.2 were arrived at when all the variables in the separate models 1, 2 and 3 were used as dependent variables in their respective models. The test statistics are then compared with the lower and upper bounds obtained by Narayan (2005). From Table 4.2, the F-statistics for the main dependent variables LNGDPPEP, LNGDPPEPMANU, and LNGDPPEPAGRIC exceeded the upper bounds critical values obtained by Narayan (2005). For $F_{lnGDPPEP}$(lnGFI, lnGOV, lnHK, lnINF, lnOPEN, lnPGR) = 6.280; $F_{lnGDPPEPMANU}$(lnGFI, lnGOV, lnHK, lnINF, lnOPEN, lnPGR) = 5.939; and, $F_{lnGDPPEPAGRIC}$(lnGFI, lnGOV, lnHK, lnINF, lnOPEN, lnPGR) = 4.134. The F-statistics exceeded the upper bounds at the 1% significance level for $F_{lnGDPPEP}$, $F_{lnGDPPEPMANU}$, and F-statistics for $F_{lnGDPPEPAGRIC}$ at 10% significant level in the third case.

4.5 Results of the Long-run and Short-run relationship

We proceed by estimating the long run and short run models for the analysis with the optimal lags selected by the Akaike Information Criterion after establishing that the variables are cointegrated. The optimal lag length (the numbers in bracket) for each variable in model 1 is ARDL (1, 2, 2, 2, 2, 2, 1), model 2 is ARDL (1, 1, 2, 0, 1, 2, 2), and ARDL (1, 2, 2, 0, 0, 2, 2) for model 3.

Table 4.3 below shows the findings for both the long-run and short-run results

Table 4.3 Long-run and short-run estimates, LNGDPPEP, LNGDPPEPMANU, and LNGDPPEPAGRIC

Long-run	**Model 1**	**Model 2**	**Model 3**
Variables	**LNGDPPEP**	**LNGDPPEPMANU**	**LNGDPPEPAGRIC**
LNGFI	0.022 (0.588)	0.507*** (2.828)	0.009 (0.076)
LNGOV	-0.206*** (-2.898)	-0.048 (-0.138)	-0.440 * (-1.864)
LNHK	0.629** (3.550)	-1.420* (-1.762)	0.558 (1.241)
LNINF	-0.109*** (-2.754)	-0.191 (-1.494)	0.208** (2.759)
LNOPEN	0.123* (1.708)	-0.455 (-1.582)	-0.329* (-1.994)

LNPGR	-0.629**	-0.671	-1.273*
	(-2.250)	(-0.613)	(-1.852)
Short-run			
Constant	2.621***	3.346***	3.939***
	(7.637)	(7.256)	(6.096)
D(LNGFI)	0.008	0.079	-0.002
	(1.252)	(1.664)	(-0.084)
D(LNGFI(-1))	0.051***		-0.176***
	(-4.595)		(-4.096)
D(LNGOV)	0.003	0.114	0.132**
	(0.196)	(0.961)	(2.177)
D(LNGOV (-1))	0.033**	-0.227*	0.237***
	(2.255)	(-1.940)	(3.421)
D(LNHK)	0.033		
	(0.682)		
D (LNHK (-1))	-0.125**		
	(-2.217)		
D(LNINF)	-0.024***	-0.024	
	(-5.381)	(-0.689)	
D(LNINF (-1))	0.021***		
	(4.415)		
D(LNOPEN)	0.026*	-0.390***	-0.260***
	(1.776)	(-3.152)	'(-3.686)
D(LNOPEN(-1))	-0.054***	0.481***	0.096
	(-3.182)	(4.227)	(1.595)
D(LNPGR)	-0.711***	1.355	5.941***
	(-5.417)	(0.453)	(3.510)
D(LNPGR(-1))		-4.741**	-5.581***
		(-2.060)	-4.452
ECM_{-1}	-0.438***	-0.679***	-0.476***
	(-7.606)	(-7.274)	(-6.069)
R-squared	0.905	0.863	0.675
Adjusted R-squared	0.859	0.806	0.585
F-statistic	19.800	14.940	7.516
Prob(F-statistic)	0.000	0.000	0.000
Durbin-Watson stat	1.993	2.284	1.702

Note: T-statistics are reported in (). ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Source: Author’s calculations.

4.5.1 Analysis of the Long and Short-run Estimates

4.5.1.1 Labour Productivity (Overall)

Table 4.3 shows that a 1% rise in population growth is linked to a 0.63% fall in overall labour productivity, which is statistically significant at 5%. This shows that as the population increases, it reduces the overall productivity of labour in the economy of Ghana. This is consistent with the findings of Hamza (2015). Also, government size is found to have a negative relationship with labour productivity. All other things being equal, a 1% rise in government size is associated with a 0.21% decline in labour productivity in the long run. The result is consistent with the findings of Dua and Garg (2017), where they found a negative relationship between government spending and labour productivity. But this finding contradicts with the findings of Awotunde (2018) who showed that government spending that goes into labour issues increases labour productivity significantly.

Again, from the estimation, a percentage increase in human capital will increase on average the overall labour productivity by 0.63% in the long run, ceteris paribus. At 5% significant level, this relationship is considered statistically significant. This again, confirms our earlier supposition that labour productivity will increase with an increase in enrollment of labour in secondary and tertiary schools. This result is in line with previous studies by Dua and Garg (2017) and Samargandi (2018).

Also, if all other factors remain stable, a percentage rise in inflation will result in a 0.11% decrease in labour productivity, on average. This was expected and consistent with our initial hypothesis that inflation reduces labour productivity. It also corresponds to Yildirim (2015) and Hondroyiannis and Papapetrou (1997) results. They argued that inflation erodes nominal wages and makes the opportunity cost of working less costly. It also distorts the market in the sense that investors are unable to accurately predict price changes. At 1% significance level, this relationship is statistically significant.

The coefficient of trade openness is positive as expected from our supposition. It is statistically significant at the 10% level. Specifically, the result shows that, if trade openness increases, labour productivity will increase by 0.12%. This means that increased trade openness is a factor influencing labour productivity in Ghana in the long run. In fact, Ghana has trade relations, especially in the export of cocoa, timber, mineral fuels and precious metals. Since the mid-1980s, when import substitution policies were relaxed, imports have increased. As a result, Ghana's trade liberation policies have produced positive results. Hence, the positive relationship between trade openness and labour productivity supports this finding and also consistent with previous research in Ghana (Abosi, 2008; Djokoto, 2012). With gross fixed investment, no statistically significant relationship exists with labour productivity in the long-run.

The error correction term (ECM_{-1}) refers to how easily the dependent variable reacts to changes in the independent variables before settling into its long run equilibrium level. The negative and significant ecm term shows how the adjustment process is effective and able to restore to equilibrium. An error correction term of -0.44 in the first model shows that any disequilibrium will be corrected within a year at a speed of approximately 44%.

The first lag of GFI is found to have a substantial positive effect on labour productivity. If gross fixed investment in the previous year increases by 1%, there will be a 0.05% rise in the overall labour productivity in the current year and this is significant at the 0.01 significance level. Government spending is found to be insignificant but the first lag is significant at 5%, and it has a positive effect on labour productivity. This means that a 1% increase in the previous year government spending is related to a 0.03% increase in overall labour productivity. This contradicts the long-run coefficient.

Also, a 1% rise in human capital in the previous year will lead to a 0.13%, decrease in labour productivity, holding other variables constant. Human capital in the current year indicates a positive relationship on labour productivity by 0.03% but this is statistically insignificant. This is in line with the long-run estimate and a study by Dua and Garg who used the same indicator, enrollment in secondary school as we used but the only difference is that it is statistically not significant.

The study also found that a percentage increase in inflation rate is associated with a 0.024% fall on labour productivity in the economy. This conforms to the long-run estimate and shows that rising prices has the tendency of reducing labour productivity since it reduces the purchasing power of labour. However, the first lag of inflation rate shows a positive impact on labour productivity by 0.021%, all other things being equal, and it is statistically significant.

Finally, population growth and the first lag of trade openness were all found to have a significantly negative impact on labour productivity in the short run. With trade openness, the effect is minimal on labour productivity with an elasticity value of approximately -0.05.

4.5.1.2 Manufacturing Labour Productivity

At a 1% significance level, a percentage rise in gross fixed investment is associated with a 0.51% increase in manufacturing labour productivity in the long run, all other things held constant. This means that increasing capital investment will improve labour productivity in the manufacturing sector in the long run, resulting in overall economic growth. Also, a 1% increase in gross enrollment is associated with a 1.42% fall in manufacturing labour productivity. Theoretically, an investment in human capital in an economy improves labour productivity, the empirical evidence is somewhat mixed especially with developing countries. The relationship is only significant at the 10% significance level. The coefficients of population growth, government size, inflation, and trade openness are all negative and statistically insignificant.

The error correction term has a coefficient of -0.679 and this means that in the current year, roughly 68% of the previous year's disequilibrium will return to long run equilibrium. Trade openness and its first lag have a significant impact on manufacturing labour productivity in the short run. In the short run, an increase in total imports and exports to GDP, as well as an increase in its first lag is associated with a 0.39% fall and 0.48% increase in manufacturing labour productivity, respectively. Population growth is statistically insignificant in the short run, but its first lag is negatively linked to manufacturing labour productivity. With a 1% rise in population is associated with a 4.74% decline in the sector's productivity at 5% significance level.

4.5.1.3 Agricultural Labour Productivity

Government spending has a detrimental effect on agricultural labour productivity in the long run. In the long run, a percentage rise in government spending is associated with a 0.44% drop in agricultural labour productivity. This is only significant at a 10% level of significance. Surprisingly, inflation had a positive effect on the sector's labour productivity. The level of responsiveness of agricultural labour productivity to a change in inflation, in the long run, was 0.21%. This was statistically significant at 5%. Increases in trade openness and population growth are linked to decreases in agricultural labour productivity by 0.33% and 1.27%, respectively.

ECM_{-1} is -0.476 which means that a shock in the previous year will revert to the equilibrium level at a speed of 47.6%. In the short run, the first lag of gross fixed investment, government size, the first lag of government size, trade openness, population growth, and its first lag have a substantial effect on agricultural labour productivity. From the estimates, the first lag gross fixed investment, trade openness and the first lag of population growth are negatively related to agricultural labour productivity. However, government size, population growth, the first lag of government size and trade openness are positively related to agricultural labour productivity.

4.6 Diagnostic Tests

Table 4.4 Results of diagnostic test

	Model 1	**Model 2**	**Model 3**
Test	Test statistics	Test statistics	Test statistics
χ^2 Normality	1.255	2.929	0.214
	(0.534)	(0.231)	(0.899)
χ^2 Serial Correlation	0.176	0.221	1.25
	(0.840)	(0.803)	(0.308)

χ^2 Breusch Pagan	24.124	17.347	15.603
	(0.151)	(0.299)	(0.409)
χ^2 ARCH	0.092	0.345	1.087
	(0.763)	(0.557)	(0.297)
χ^2 Functional form	0.976	0.507	0.574
	(0.336)	(0.484)	(0.457)
CUSUM	STABLE	STABLE	STABLE
CUSUMSQ	STABLE	STABLE	STABLE

Note: P-values are in parenthesis
Source: Author's calculations.

The Jarque-Bera test for normality is used to test if the residuals in the models are normally distributed. The statistics for models 1, 2, and 3 are 1.255, 2.929, and 0.214, respectively. Their respective p-values are 0.534, 0.231, and 0.899 which means that the null hypothesis that the error terms are normally distributed cannot be rejected at 1% statistical significance level.

Similarly, the Breusch-Godfrey test is used to test for serial autocorrelation. The test followed an F-distribution. From the test, the test statistics are 0.176, 0.221, and 1.250 for the three models respectively. The p-values for model (1), model (2), and model (3) are 0.840, 0.803, and 0.308 respectively which means that the series has no serial autocorrelation at the traditional significance level.

Again, to ensure that we do not arrive at misleading conclusions, we need to be sure that error terms have constant variance. The Breusch-Pagan test for heteroscedasticity is used to ascertain whether the error term has an equal variance. The null hypothesis of the test is constant variance; against the alternative that the error terms are not homoscedastic. From the test result in Table 4.5 above using the chi-squared distribution, it's evident in all three models that the null hypothesis of homoscedasticity cannot be rejected. The ARCH test on the other hand shows that the three models are free from ARCH effect.

Also, Ramsey's RESET test is often used to ensure the functional form is defined correctly. The null hypothesis of no omitted variable bias cannot be rejected at 5% significance level. Finally, we test whether the parameters are stable over time. We used the cumulative sum (CUSUM) and the cumulative sum squared (CUSUMSQ) to test if the parameters are stable, as suggested by Pesaran, et al. (2001). The CUSUM and CUSUMSQ is presented in the Appendix and it shows that at 95% confidence interval the parameters are stable over time in all the three models. The main problem with the CUSUM and CUSUMSQ tests is that they have low power of rejecting the null hypothesis, such that they only report the periods where there is stability of the parameters in the model.

CHAPTER 5

5.1 Introduction

The study was carried out basically to assess the effect of population growth on labour productivity as well as to ascertain the various determinants of total labour productivity, labour productivity in the manufacturing and the agricultural sectors. The chapter is made up of summary of the findings of the study, conclusion, and recommendations for policy implementation.

5.2 Summary of Research Findings

The aim of this research was to look at the effect of population growth on labour productivity, examine the trends in labour productivity, and assess what factors are driving labour productivity across two sectors of the economy. The research used the autoregressive distributed lag (ARDL) estimation method to analyze time-series data from 1980–2019. The study commenced by looking at the trends in the endogenous variables (i.e., labour productivity, and labour productivity within the manufacturing, and agriculture sectors). The trend analysis did indicate that all three variables had a positive trend over the period under consideration. To check the accuracy of the estimation and to cure the model of any spurious outcomes, the PP and ADF stationarity tests were carried out. These tests revealed that some of the variables were stationary at levels or some were stationary at first difference. This formed the basis for us to specify an ARDL model since it is most suitable for estimating parameters that are a mixture of I (0) and I (1). The next step was to see if the variables were cointegrated. Following Pesaran, et al. (2001), the bounds test result for cointegration established a long-run association for the three dependent variables employed in the models: GDPPEP, GDPPEPMANU and GDPPEPAGRIC. We then estimated the long-run impacts and the error correction models related to the long-run estimates. The various diagnostic tests did indicate that the models did not suffer from serial autocorrelation, heteroscedasticity, or functional misspecification. The results of the CUSUM and CUSUMSQ also indicate that the models were stable.

The study concludes that for the period between 1980 and 2019, Ghana's overall labour productivity, as well as agriculture and manufacturing sectors labour productivities have been increasing, which is an indication that the country's economic policies over the years are gradually yielding positive results, at least on the labour front. This is consistent with earlier works on the impact of economic growth in Ghana (Aryeetey and Baah-Boateng, 2015). However, more work needs to be done to sustain and even increase these gains.

The study also concludes that the main drivers of overall labour productivity in Ghana are human capital, trade openness, and gross fixed investment. As expected, the study revealed that population growth, government size, and inflation would eventually serve as a disincentive for workers, thereby reducing labour productivity. However, we found that the first lag of gross fixed investment and size of government has a positive effect on labour productivity in the short run, while population growth and its first lag has a negative impact.

The study found that the factors influencing labour productivity in the agriculture sector vary from those influencing manufacturing sector's labour productivity. Gross fixed investment is found to be strongly linked to the manufacturing labour productivity in the long run. The exact opposite is true for gross enrollment in secondary schools and manufacturing labour productivity, although it was significant at 10%. In the short run, its only trade openness, its first lag and population growth that significantly impacted manufacturing labour productivity.

Finally, the analysis found a significant and negative association in the long run between government size and agricultural labour productivity (GDPPEPAGRIC). Inflation in the long run was positively related to agricultural labour productivity. The first lag of gross fixed investment, government size, first lag of government size, trade openness, the first lag population growth, and population growth all have a significant impact on agricultural labour productivity in the short run.

5.3 Conclusion

The study primarily set out to look at the effect of population growth on labour productivity and also to look at the various factors affecting labour productivity in the manufacturing and agricultural sectors. The empirical evidence indicated that, in the long run, increased population growth would hurt the Ghanaian economy's overall labour productivity. In the manufacturing sector, there was no evidence of a long run relationship between population growth and labour productivity. Finally, the analysis showed that a proportionate increase in population growth in the long run, would affect agricultural labour productivity by more than proportionate decline.

5.4 Limitations of the Study

The main limitation of this study is the lack of data which restricted the choice of proxy for human capital to be gross enrollment in secondary and tertiary schools. Also, due to the unavailability of data for the agricultural and manufacturing sectors in Ghana, we used the same data for gross fixed investment, human capital, and trade openness for both sectors.

Also, in this study, labour productivity was measured by GDP per employed persons, but this is not the only measure for labour productivity. Therefore, it is recommended that future researchers identity other measures of labour productivity and reliable data in this area of study.

5.5 Policy Recommendations

A sound and stable macroeconomic outlook benefits the economy, labour productivity, and citizens' well-being. The following suggestions are made based on the study's findings.

The government, through its agencies such as the Ghana Health Service (GHS), the National Commission for Civic Education (NCCE), and the traditional authorities, should increase it education on birth controls in Ghana as increased population growth would have a negative effect on labour productivity in the long run, lowering the standard of living of every Ghanaian.

The second recommendation the study makes is for the monetary authority in Ghana (Bank of Ghana) to continue to pursue its inflation-targeting monetary policy. The monetary policy must be kept reasonably tight to control liquidity in circulation. This will stabilize prices and purge the country of the negative effect of accelerated inflation.

Finally, any policy geared towards increasing enrollment in the secondary and tertiary levels of education must be highly encouraged. Policies such as the government's free SHS recently introduced in 2017 must be given sustainable funding so that the labour force will be more competent. This, as the study suggests, will boost GDP per employed person in the country.

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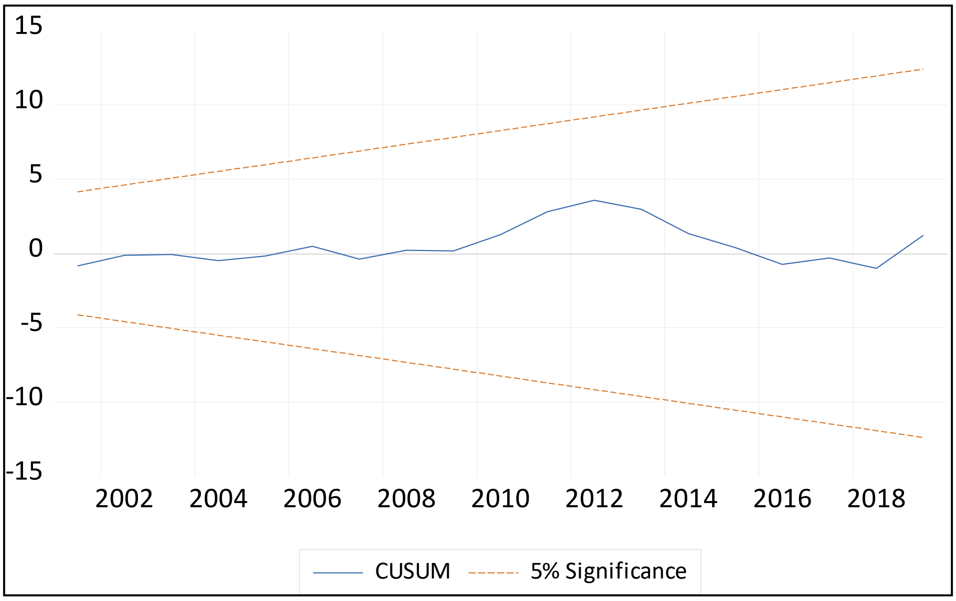
APPENDIX: Stability Test for Model 1-3

Figure A.1: CUSUM and CUSUMSQ for Model 1



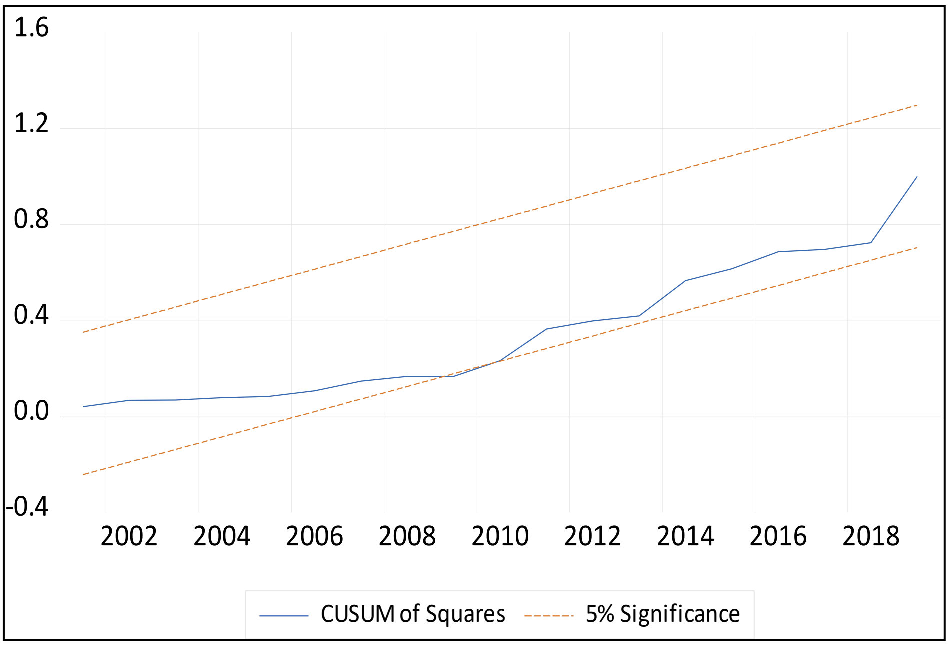
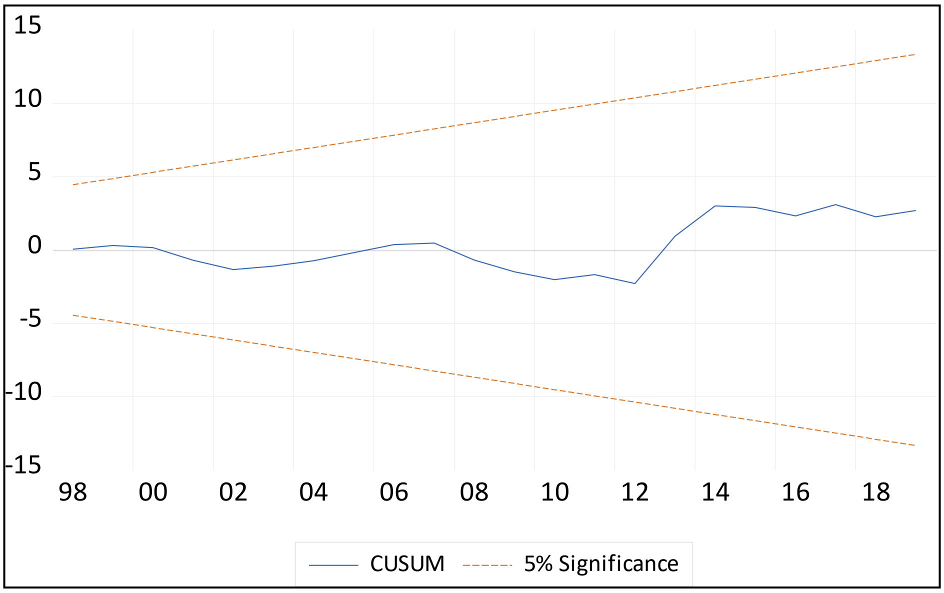


Figure A.2: CUSUM and CUSUMSQ Test for Model 2



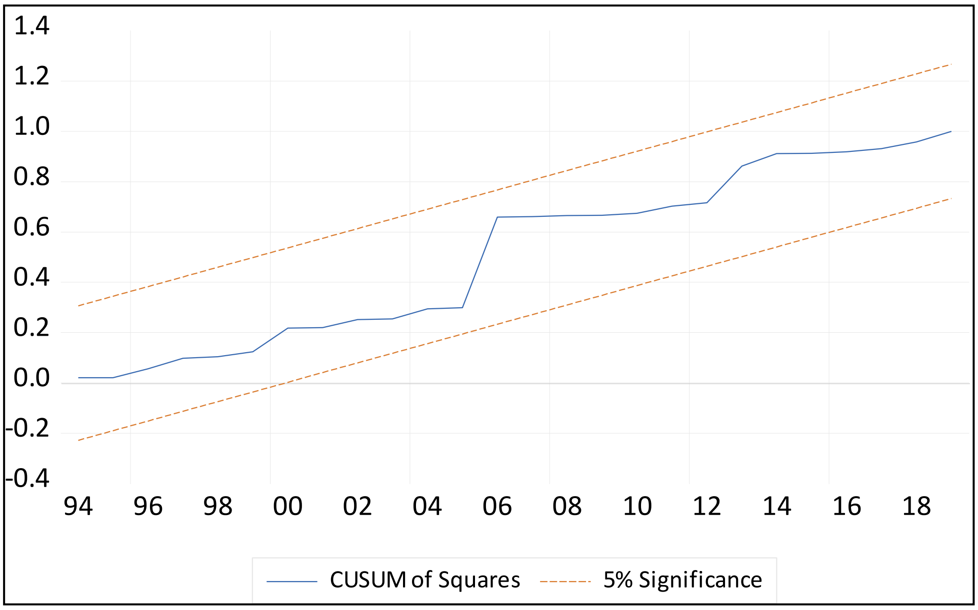


Figure A.3: CUSUM and CUSUMSQ test for Model 3