UNIVERSITY OF CAPE COAST

INEQUALITY AND RETURNS TO EDUCATION IN GHANA

BY

ELLEN ANIMAH BOADI

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been submitted for another degree in this university or elsewhere.

Candidate's Signature: ………………………… Date………………

Name: Ellen Animah Boadi

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature …………………………. Date………………

Name: Professor Samuel Kobina Annim

Co-Supervisor's Signature: …………………………...... Date………………

Name: Dr. Bernard Yaw Sekyi Acquah

ABSTRACT

The study investigated: 1) the effect of infrastructural inequality on academic performance in Ghana; 2) the effect of education inequality on labour returns in Ghana; 3) the effect of gender inequality on labour returns in Ghana and; 4) the moderating role of culture in the relationship between gender inequality and labour returns. Firstly, based on Education Statistics (2018), ANOVA was used to estimate whether district-level academic performance differs at various distributions of infrastructure. The study further assessed the relationship between infrastructure inequality measured by "Infrastructure Quintiles" and academic performance using the Dynamic General Methods of Moments technique. It found that difference in district-level academic performance in Ghana is conditioned on infrastructure inequality. Secondly, based on a generated education Gini, a Heckman estimation technique and quantile regression, the study assessed the effect of education inequality on labour returns using the last two rounds of the Ghana Living Standard Surveys (GLSS 6 and 7). It was observed that education inequality and earnings were negatively related. It suggests that education inequality reduces wages by 6.25%. Lastly, using GLSS 6 and 7, the study examined whether discriminations, sticky floors and glass ceiling exist in the labour market of Ghana, from the perspective of gender differences, while considering the moderating role of culture. The results showed a mean wage of 8.1 and 7.6 for males and females respectively, representing about 6 percent wage differential. The results support the existence of wage discrimination against women across all wage distributions and the assertion that individualism moderates wage discrimination. There is evidence of the presence of sticky floors and glass ceiling in the labour market of Ghana. It is recommended that the government of Ghana pursue policies aimed at bridging the education infrastructure gap and accelerating equity in male-female education towards improved academic performance, fair wage returns and sustainable development

KEY WORDS

Academic performance

Blinder-Oaxaca decomposition

Collectivism

Earnings

Education Gini

Education inequality

Gender inequality

Infrastructure inequality

Individualism

Labour returns

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DEDICATION

To my ever-supportive husband Professor Samuel Kwaku Agyei

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LIST OF ACRONYMS

AfDB	African Development Bank
BECE	Basic Education Certificate Examination
EMIS	Educational Management Information System
GES	Ghana Education Service
GLSS	Ghana Living Standards Survey
GSS	Ghana Statistical Service
ILO	International Labour Organisation
ISCED	International Standard Classification of Education
JHS	Junior high school
MoE	Ministry of Education
MoF	Ministry of Finance
OECD	Organisation for Economic Co-operation and Development
PCA	Principal component analysis
PNDC	Provisional National Defence Council
SDGs	Sustainable Development Goals
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WASSCE	West African Senior School Certificate Examination
WEF	World Economic Forum

CHAPTER ONE

GENERAL INTRODUCTION

Background to the study

Education drives development through human capital accumulation, and increase in innovation propensity that are generally considered as catalysts for economic growth and poverty reduction. Differences in the wealth of nations are partly explained by the heterogeneity in literacy levels of the citizenry. In view of this, arguably, a knowledgeable economy will sustain its development. The global economy's ability to ensure inclusive and equitable quality education and promote life-long learning for all (SDG 4) is correlated with inclusive and sustainable economic growth, indiscriminate productive employment (SDG 8) and ending all forms of poverty for everyone everywhere (SDG 1). This explains the consistent attention of global policy makers on addressing disparities in investment in education worldwide. By serving as a formidable conduit for global development, no amount of attention given to education development could be considered as overemphasis.

Returns to education justify the investment in education. The floodgate for research on returns to education was opened by Becker (1962) and others after conceptually considering education as a capital investment. Returns to education are generally considered marginal gains from additional investments made in education. This is considered to be the additional benefit to education relative to additional investment (private or public) in education. In monetary terms, it could be measured as wage per hour or month associated with the investment made in education. Returns to education have been largely found to be heterogenous based on level of education, gender, sector of engagement, data sets and assumptions used, estimation techniques deployed (Gashi & Adnett, 2022; Wang et al., 2019; Dickson & Harmon, 2011), education policies pursued at appoint in time as well as the level of development of an economy. Gaining understanding of human capital accumulation, efficiency of labour resource allocation and providing a direction on where investment in education should be channelled requires an understanding of the various forms of returns to education (Wang et al., 2019; Zang et al., 2005)

Dickson and Harmon (2011) observe that considering returns to education in only monetary terms is restrictive and argue for a broader consideration to include non-monetary returns (social returns). Premised on the fact that education improves the health of the acquirer, spouse and family, general satisfaction in life, consumer choice efficiency, marital efficiency, crime reduction, social cohesion, social value, voter turnout, happiness, free speech and civic knowledge (Oreopoulos, 2007; Dee, 2004; Lochner, 2004; Milligan et al., 2004; Haveman & Wolfe, 1984), the argument on non-monetary returns to education has gained prominence. Monetary and non-monetary returns to education also depend on how well concepts and principles taught are grasped and deployed for quality decisions. This is evidenced by the ability to pass assessments used as benchmarks for ascertaining the level of comprehension of these concepts and principles. Thus, it could be argued that passing exams is a first-order return to education that serves as a gateway for achieving monetary and other non-monetary returns. Jensen (2010) contends that irrespective of how actual returns to education is considered, actual schooling decisions by students and parents are influenced by the perceived returns to education rather than the actual returns since data on returns to education are large and require complex econometric analysis far beyond the ability of these stakeholders. Gaining understanding of all forms of returns to education is necessary for the proffering of cogent policies on investment in education.

Market and system imperfections that are likely to confound education returns need to be addressed. The term inequality is usually seen as an indication of "discrimination and the disparity in opportunities or outcomes between people or groups of peoples" (United Nations (UN), 2016). The forms of inequalities comprise infrastructure, education and gender inequality (Banzragch et al., 2019; Brosio et al., 2018; Cuberes & Teigneir, 2016; Murillo & Roman, 2011; Qian, & Smyth 2008; Thomas et al., 2001). The existence of inequality in the education and labour market sometimes obscures the strides made in education.

In spite of the general acknowledgement of the socio-economic benefits of education, evidence on unequal access to education abound (Thomas et al., 2001). Since education drives development through human capital accumulation and increase in innovation propensity, disparities in education suggest a widening in these key economic development catalysts. This attenuates the expected education induced progress to any economy since socio-economic mobility of the poor is prevented. At the same time, industries and the nation as a whole are denied the opportunity to pursue growth for all eventually perpetuating poverty's virtuous cycle.

Mesa (2007) contends that education inequality is conditioned on poverty, average years of schooling gross domestic product, income GINI index, poverty incidence, and poverty gap. Significant welfare losses occasioned by education inequality needs attention just like all other forms of inequality because of its ability to thwart progress made on poverty through minimizing returns on education.

The education production function argues that education inputs determine its outputs (Barrett et al., 2019; Harris & Sass, 2011). Consequentially, differences in education inputs could explain differences in education outputs. The infrastructure that spurs up the educational system includes classrooms, water, desks, chairs, toilets, libraries, workshops, laboratories, equipment, electricity, audio-visual and visual aids. These inputs will likely motivate students to learn (Akomolafe & Adesua, 2016) and improve educational outcomes. Education infrastructure is key to explaining the first-order education returns (academic performance). Unequal distribution of education infrastructure may condition academic performance due to: 1) destruction to continuous learning; and 2) demotivation. Academic institutions that are not privileged to have quality infrastructure are more susceptible to the negative effects of the weather and poor student concentration which could prevent continuous academic work and lead to the non-completion of the assigned syllabus. Knowledge of the unevenness of distribution of academic infrastructure could demotivate teachers and students. The feeling of unfairness and marginalization may discourage teachers and students leading to sub-optimal academic performance.

The positive effect of educational infrastructure on academic performance is advanced in some studies (Mewomo et al., 2022; Simons et al., 2010; Asiabaka, 2008; Lyons, 2001). A good infrastructure facility is deem to create a conducive learning environment and improve teaching and learning. On the other hand, failure to create and maintain optimum learning environments can undermine other efforts to boost education outcomes (Nepal, 2016; Vendiver, 2011). Jacobs (2010) and Hochschild (2003) argue that equitable distribution of educational infrastructure could spur education productivity output of academic performance. However, most communities and schools lag behind in terms of the distribution of educational infrastructure. The examination of the effect of infrastructure inequality on academic performance is as vital as assessing the relationship between infrastructural quality and academic performance (Salary et al., 2018; Picus et al, 2005; Earthman & Lemasters, 1997). This explains the attention that should be accorded to the quantity, quality and distribution of educational infrastructure, when academic performance is of relevance.

The link between education inequality and returns to education (labour returns) can be attributed to the reduction in human capital formation, increased volatility in productivity, demotivation, and negative signals to the labour market. Differences in education imply unequal human capital and innovation abilities which widen productivity gaps that have the potential to reduce average returns to labour. Similarly, volatility in productivity is likely to be bigger in labour markets with educational disparities since marginal productivity is not guaranteed. This uncertainty can fuel a downward pressure on labour returns as employers may be motivated to look for alternative sources of labour such as automation. Also, since labour markets recognise and reward efforts, differences in education can potentially spark labour market apathy especially from the section of the market that is likely to earn lesser wages because of their lower levels of education. Lastly, education inequality can send a negative signal to the labour market occasioning a perceived mistrust of the quality of efforts supplied to the market. In effect, the human capital and the signalling theories are conduits for explaining the potential negative relationship between education inequality and labour returns.

The direct relationship between education and earnings suggests that education inequality could impact earnings (Finn & Leibbrandt, 2018; UNESCO, 2016; Lam et al., 2015; Lam & Levison 1992). Labour returns vary at various levels of education (Colcloucgh et al., 2010; Psacharopoulos & Patrinos, 2004; Bennell, 1996). The plethora of studies on education returns generally conclude that additional year of schooling impacts earnings positively and that there are variations in the returns associated with the level of education—primary, secondary or tertiary education (Patrinos, 2019; 2016; Psacharopoulos & Patrinos, 2018; Montenegro & Patrinos 2014; Psacharopoulos & Patrinos 2004). The less educated would have lower employment opportunities in the labour market which would, in effect, reduce their returns. Impliedly, the magnitude of returns to education is conditioned on the equality of learning opportunities for all. Equal learning opportunities would improve the successful participation of individuals in the labour market and hence their earnings.

Gender-wage gap is one of the key labour market imperfections that have blurred the returns to education. Gender-wage gap could be described as a labour market phenomenon where differences in wages between males and females could be explained primarily by their gender. It is a common feature of the labour market (Hegewisch et al., 2010). Through labour market rigidities (Olsen & Walby, 2004), interruptions in work experience accumulation due to family responsibilities, interruptions in the human capital acquisition, direct discrimination, preferences of some labour markets as well as demotivation, the labour market sometimes favours men in terms of rewards eventually widening gender wage gap. In effect, the presence of gender inequalities may inhibit labour returns. Although gender-wage gap analysis has generally received considerable attention (Brosio et al., 2018; Cuberes & Teigneir, 2016), its persistence and heterogeneity have guaranteed continuing research interest.

Labour markets may not be independent of the cultural settings because of the contagion effect of culture. Labour market structures and regulations may exhibit the cultural traits of their environment. Culture, which generally reflects the way of life a group of people live, is diverse and reflects the associated group's beliefs, norms, values, standards and aspirations. Given that decisions of individuals are hardly distinct from their cultural orientations, the existence and magnitude of discriminations in the labour market are likely to be influenced by the inclinations of players in the labour market. Collectivism and individualism cultural dimensions are popular in behavioural studies. These cultural orientations differ mainly on the basis of whether returns to labour is a private good or social good. While collectivist argue that returns to labour is a common good, individualist contend that labour return is a private good (Weber, 1930) suggesting that those who expense a lot of effort must receive commensurate returns. Thus, collectivists are less likely to address discriminations in the labour market because of their belief that the entire society is the ultimate beneficiary of labour market conditions. On the other hand, individualists are likely to address labour market imperfections because of the distortions it can create in the market on the efficient allocation of labour market returns (Hammar, 2019; Kyriacou, 2015; Triandis, 1993). In this way, culture may attenuate or amplify the gender wage gap of a particular labour market depending on whether not the environment is collectivist or individualistic.

Ghana, like other countries, has witnessed moderate improvements in education and inequality, in line with the requirements of the SDGs on education and inequality (Sachs et al., 2019). Despite the strives made, several challenges still remain that hinder the country from meeting the standard of “ensuring that no one is left behind”. The disparity in the distribution of infrastructure across the schools and districts in the country is still a challenge despite the success story concerning improved access to education (Jacobs, 2010). Again, there are concerns about the persistent uneven distribution of labour returns across country and between males and females (Ponthieux, & Meurs, 2015; Hegewisch, Liepmann et al., 2010). This study assesses the relationship between inequalities (infrastructure, education, and gender) and labour returns (academic performance and wages).

Stylised Facts

Education infrastructure and academic performance

Academic performance in the Basic Education Certificate Examination (BECE) of Ghana over the study period (2010 to 2016) improved for all subjects (Mathematics, English, Social Studies and Science) that were considered for the study. Table 1 presents the trend analysis for the performance of basic school students in each subject. Generally, Table 1 suggests that Ghana experienced a rise in basic school academic performance between 2010 to 2012 and 2013 to 2016. On average, the performance in the subjects saw between 5% and 7% increase. There was an improvement in the students to a classroom, writing place and seating place ratios but a reduction in the toilet and water ratios.

Also, it is observed that academic-related infrastructure in the form of classroom, seating place and writing place generally improved, over the study period. Meanwhile, other non-academic related infrastructure like toilet and water have deteriorated over the same. For example, students to seating place ratio improved from 2.004 to 1.324. This means that lesser students are sharing that infrastructure and more students are getting a place to sit for academic work. Comparatively, there is the provision of more seating and writing places as well as classrooms.

Unfortunately, it could be observed that provision of non-academic infrastructure like toilet and water worsened. For instance, the proportion of basic schools with access to toilet out of the total number of schools reduced from approximately 60 percent (0.595) to 39% (.386). The fall in this infrastructure could be attributed to deterioration resulting from the general lack of maintenance of the educational facilities and a general neglect of non-academic infrastructure. It could also be that even though the number of schools may have increased over the period, these schools may not have good toilet facilities, therefore reducing the proportion of schools with toilets

Generally, academic performance for all the subjects considered in this study improved over the study period. Mathematics, English, Social Studies and Integrated Science witnessed 7%, 7%, 6% and 7% improvement in the number of students passing these exams relative to those who sat for the exams. Several reasons could account for this improved performance but what is not known is whether infrastructure inequality played any role in this improved performance.

Table 1: Mean of Infrastructure and academic performance between 2010 to 2012 and 2013 to 2016

		2010 to 2012	2013 to 2016
Infrastructure	Toilet	.5948409	.3863106
	Water	.6142569	.2818249
	Seating place	2.006441	1.324453
	Writing place	1.364813	1.303337
	Classroom	41.94667	38.7302
Academic performance	Performance in Mathematics	62.13155	69.01076
	Performance in English	59.31393	66.09045
	Performance in social studies	62.07122	67.98275
	Performance in Integrated science	61.78027	68.70403

Source: Ghana Statistical Service (GSS) Education Statistics Data (2018)

Education and labour returns

Evidence of the association between educational qualification and wage returns can be inferred from Figure 1. The figure suggests that increases in the level of education may lead to addition to wage returns as there are upward differences in wage returns as education level progresses. In other words, while the labour force with postgraduate qualification earns more than those with undergraduate qualification, labour force with secondary qualification earns less than those with undergraduate qualification and in that order. Also, the evidence in Figure 1 suggests that the labour market in Ghana recognizes and rewards experiences gained from informal education. Labour market participants with no basic education earned an average of GHS4,256.73 over the study period. Even though labour market participants with basic school education qualification earned more than those with none, the difference was 26 percent which was far below the difference in wage returns of labour market participants with undergraduate and postgraduate qualifications (245.32%). It could be deduced that education offers opportunity for labour market participants to improve on their wage returns.

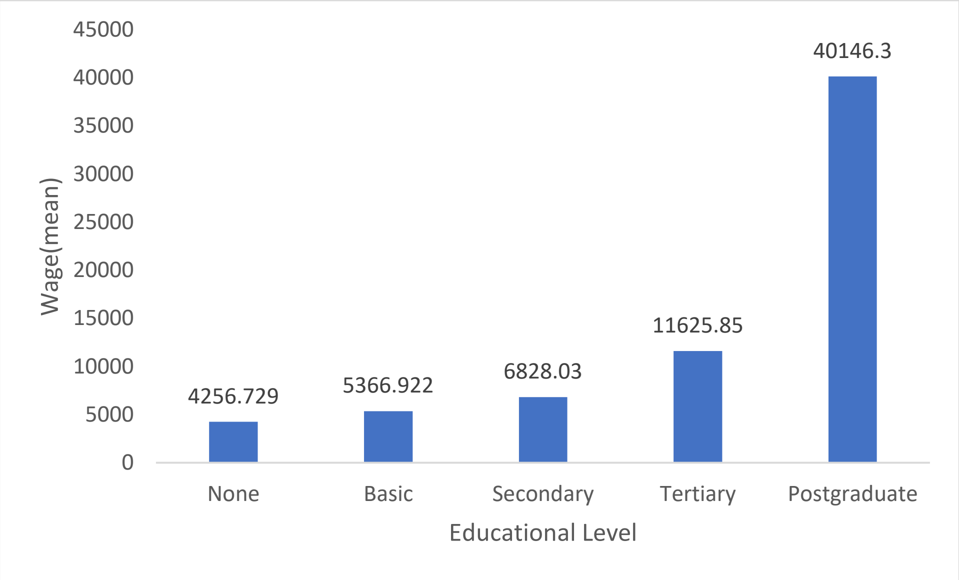


Figure 1: Association between education level and wage

Education inequality and wages

There appears to be an association between education inequality and wages. The study observed this association between education Gini and wage using Ghana Living Standards Survey data (2012/2013). The districts in Ghana were sorted based on those with low and high average years of schooling. The education Gini and wages for districts with low average years of schooling were then compared. The same analysis was done for districts with high average years of schooling. Due to the differences in the units of measurement which obscures the clear observance of the association of the two variables, percentiles for education and wages were used to enhance the comparability of the variables. Figure 2A and 2B present the graphs of districts with low average years of schooling, showing their education Gini and their corresponding wage levels.

Generally, it could be observed that districts with high inequality levels are associated with low wages and vice versa. Districts with high Gini record low wages and those with low Gini record high wages. This suggests an inverse relationship between the variables. For instance, Amansie West's education Gini belonged to the 20th percentile, but its wage was in the 60th percentile.

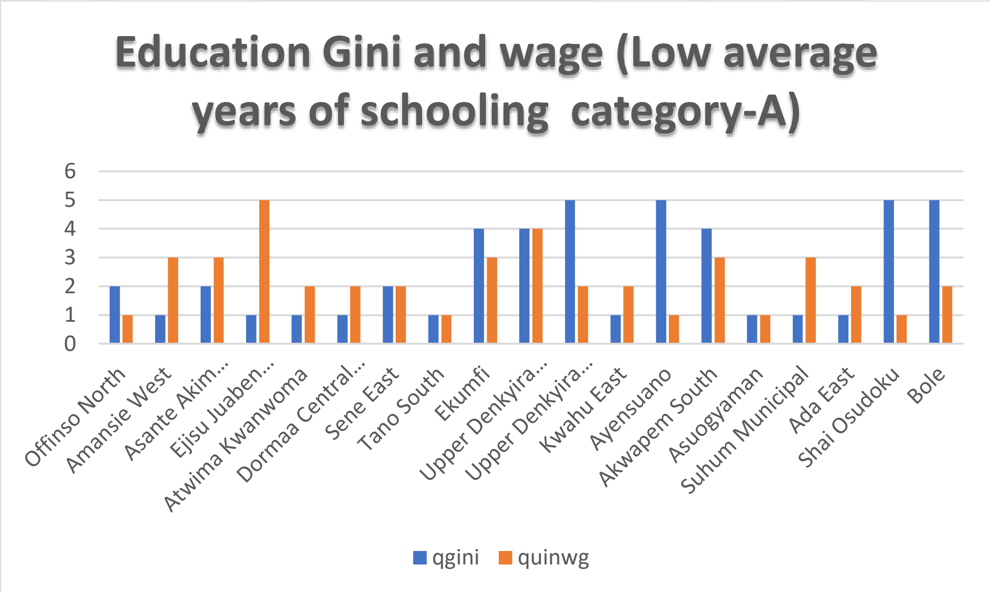


Figure 2A: Association between education Gini and wage (districts with low average years of schooling)
Source: Based on Ghana Living Standards Survey data (2012/2013)

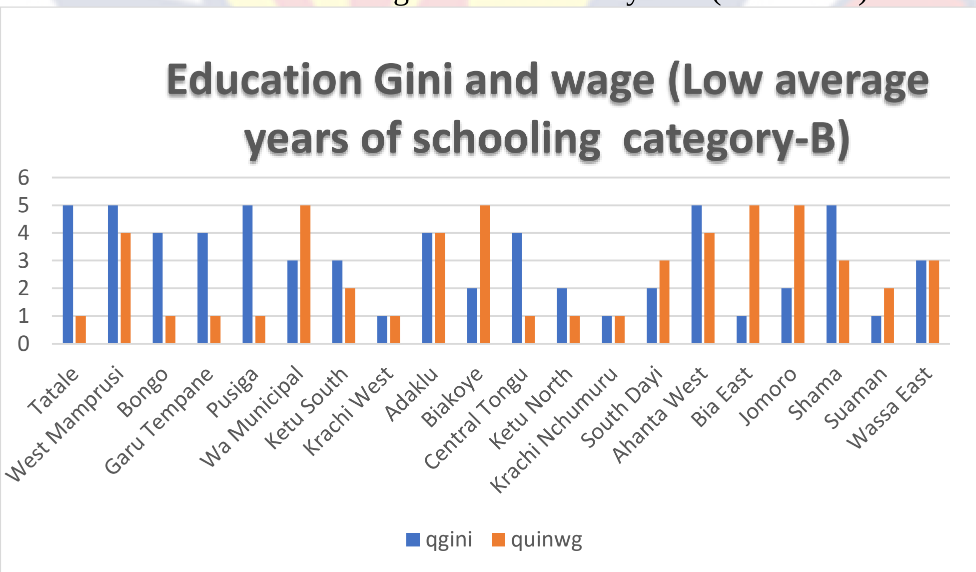


Figure 2B: Association between education Gini and wage (districts with low average years of schooling)
Source: Based on Ghana Living Standards Survey data (2012/2013)

Similarly, Figures 3A and 3B present the graphs of the Gini percentile and wage percentiles for districts with high average years of schooling. Generally, apart from Lower Maya and Sagnerigu, it can be observed that there is an inverse relationship between the variables in Figure 3A. Again, for figure 3B, except for Wassa Amenfi Central and Karaga, all the districts with low Gini had high wage. For instance, Wassa Amenfi West had a 20th percentile Gini but wage was in 80th percentile.

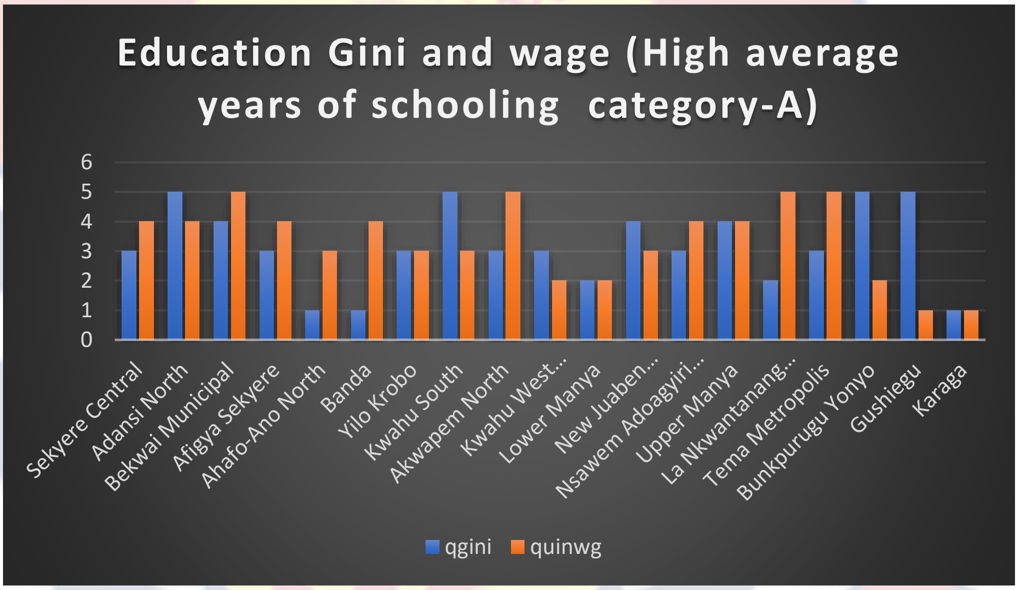


Figure 3A: Association between education Gini and wage (districts with high average years of schooling)

Source: Based on Ghana Living Standards Survey data (2012/2013)

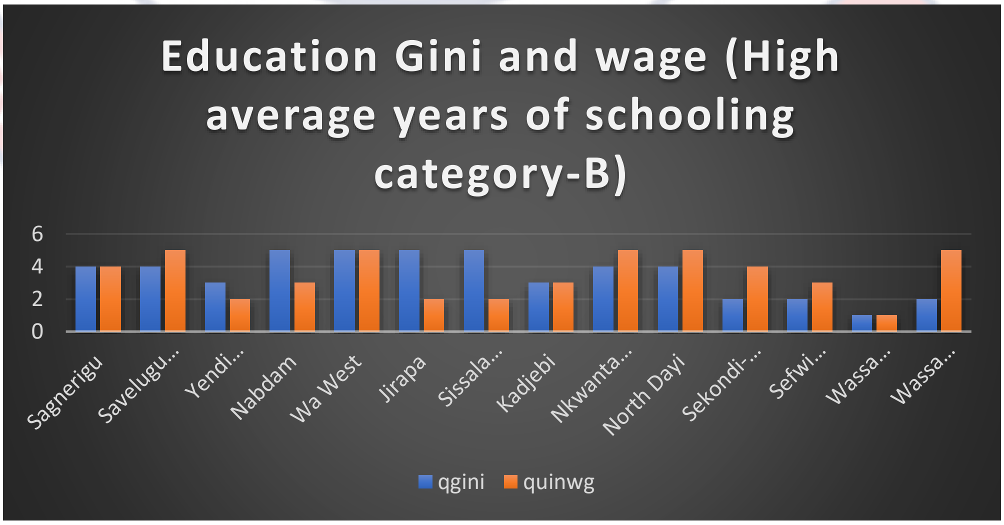


Figure 3B: Association between education Gini and wage (districts with high average years of schooling)

Source: Based on Ghana Living Standards Survey data (2012/2013)

Nature of Gender and Employment in the labour market of Ghana

Ghana's total employment to population ratio (Figure 4A) has been falling in the Fourth Republic and youth employment has suffered the most (Figure 4B). Total employment to population ratio, for instance, was about 71% from 1990 to 1993 but has never been able to achieve those feet since those years. In recent years (2016 to 2018), total employment to total population is about 65%, indicating that relative employment to population has fallen in the fourth republic. In spite of this general fall, male employment has always performed better than female employment. The male employment to population ratio is the highest for each of the years in the last three decades in Ghana's history. Figure 4A suggests that being a male enhances your chances of securing employment in Ghana. Male employment to male population for the period 1990 to 1993 was about 74% while that of female was about 68%, reflecting a difference of six percentage points. Recent (2016 to 2018) figures put the difference at eight percentage points since the ratio of total male employment to total male population is about 69% while that of females was about 61%. These suggest that the worsening employment to population ration in the Fourth Republic has widened the employment inequalities in the Ghanaian labour market.

Figure 4B shows that the youth employment to youth population in Ghana, for close to three decades reminiscent that of the total employment. Total youth employment to total youth population was about 53% from 1990 to 1992 against a recent (2016 to 2018) fall to 38%. But the magnitude of the fall for youth employment (15%) is more than double that of total employment (6%). Youth male employment to youth male population from 1990 to 1992 was about 54% while that of the youth female was about 52%, reflecting a difference of 2%. On the recent (2016 to 2018) data, the youth employment (about 40%) and youth female employment (about 35%) depicts a worsened difference of five percentage points.

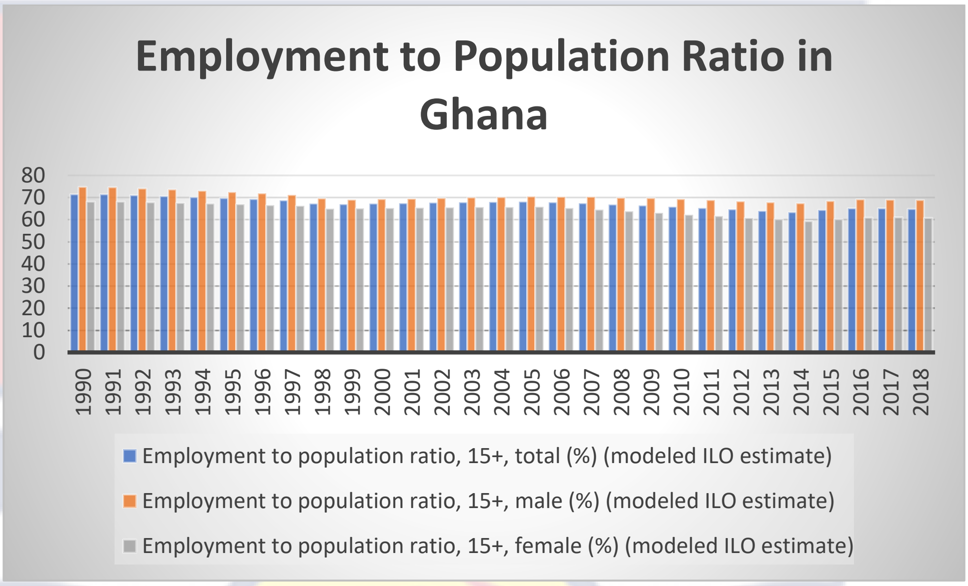


Figure 4A: Employment to population ratio

Source: Based on data taken from the African Development Indicators (2020)

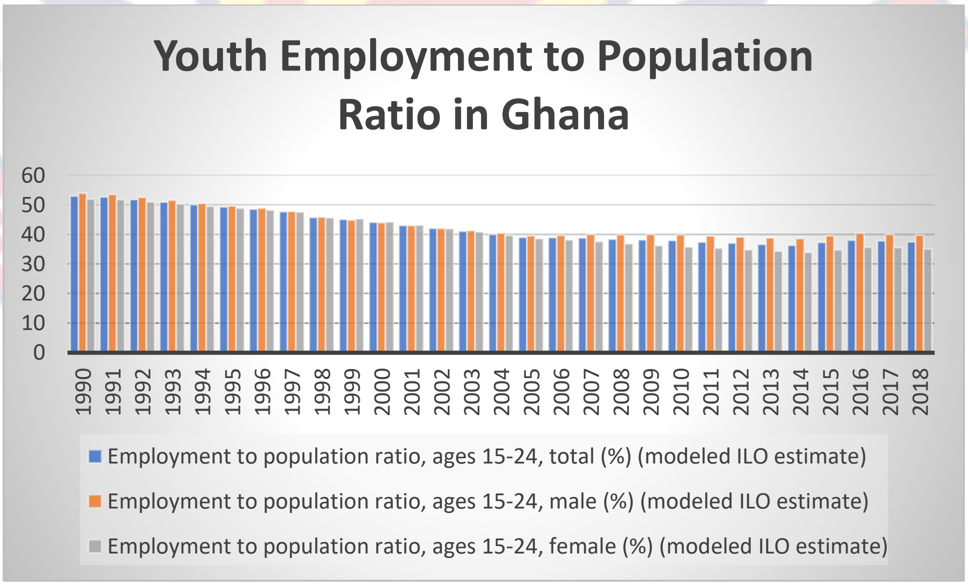


Figure 4B: Youth Employment to population ratio.
Source: Based on data taken from the African Development Indicators (2020)

Gender and Labour Force Participation in Ghana

Figures 5A, 5B and 5C present graphs on labour force participation with particular emphasis on female labour force participation. According to the World Bank (2020), the labour force comprises people aged 15 and older who supply labour for the production of goods and services during a specified period. It includes people who are currently employed and people who are unemployed but seeking work as well as first-time job-seekers. Not everyone who works is included, however. Unpaid workers, family workers, and students are often omitted, and some countries do not count members of the armed forces. Labour force size tends to vary during the year as seasonal workers enter and leave.

Figure 5A depicts that labour force in Ghana remained fairly constant (at about 75% of the population) for the years 1990 to 1999 and starting declining consistently from 2000 to its current level of 68%. The observations from the male and female labour forces do not deviate significantly from that of the total labour force. The Figures show that labour supply to the Ghanaian labour market has been male dominated for close to the past three decades. This probably explains why employment is also male dominated. The exclusion of the possibility of a cultural antecedent to the labour dynamics in the Ghanaian labour market may limit the extent of our appreciation of the conditioning factors of the structure of the labour market of Ghana. Traditionally, working to cater for family and society is considered the direct responsibility of males and not females.

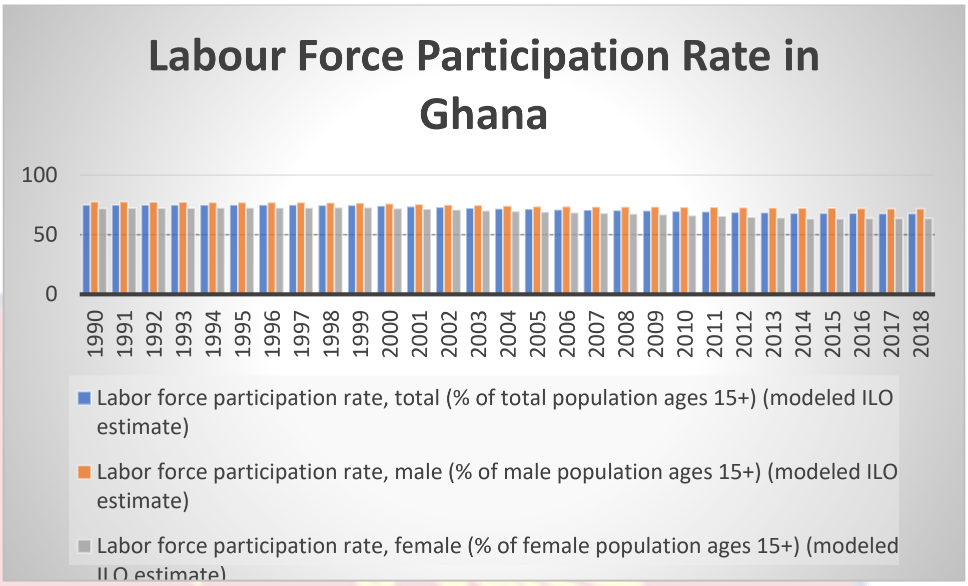


Figure 5A: Labour Force Participation Rate in Ghana

Source: Based on data taken from the African Development Indicators (2020)

Figures 5B and 5C reinforce the observation that the labour force improved from period 1990 to 1999 but fell drastically from 2000 to 2014 before showing signs of a recovery which is still below 2012 levels. Figure 5C corroborates the results in Figure 5B when the relationship between female and male labour forces were observed. Consistently, the proportion of female labour force in male labour force fell from 2000 to 2014. These observations suggest that Ghana has done little directly to accommodate female participation in her labour market and the extent of gender labour market inequality has worsened. The approach to resolving this issue begins with an understanding of the conditioning factors of labour market inequality before any appropriate policy directions could be preferred.

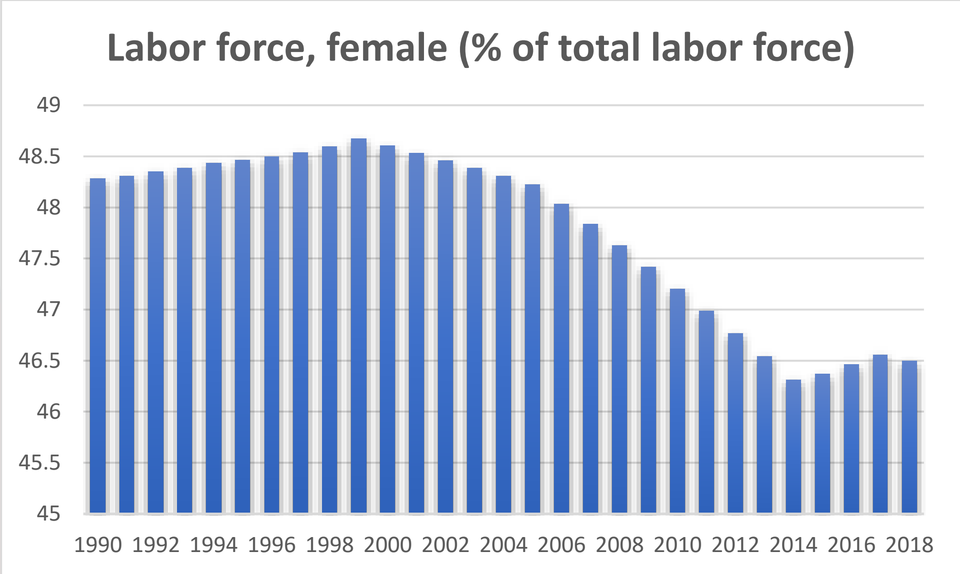


Figure 5B: Female Labour Force Participation Rate in Ghana
Source: Based on data taken from the African Development Indicators (2020)

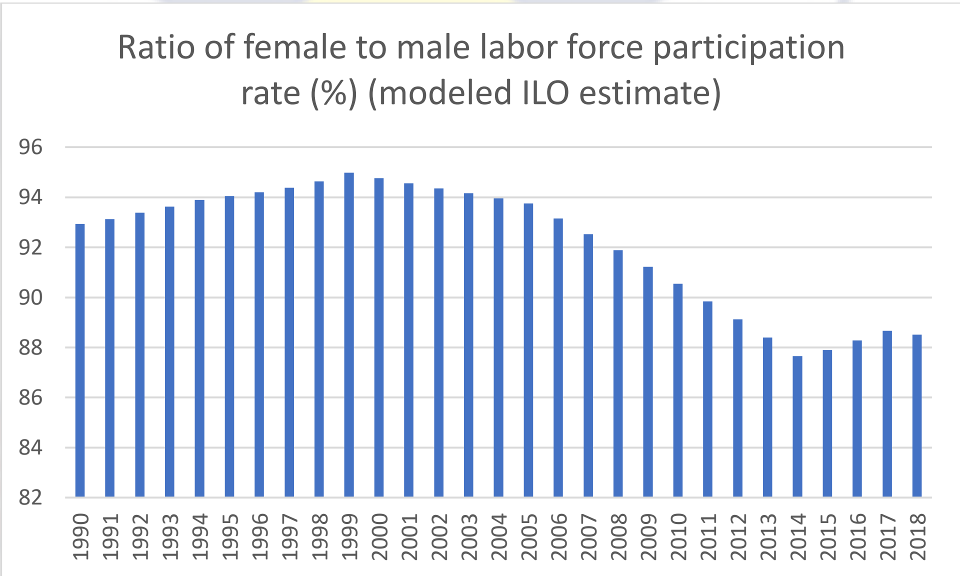


Figure 5C: Female to Male Labour Force Participation Rate in Ghana
Source: Based on data taken from the African Development Indicators (2020)

Education, Gender and Labour Force Participation in Ghana

Figures 6A, 6B and 6C present graphs on gender differences in labour force participation when levels of education are factored in the data. The World Bank classifies these educational levels into basic, intermediate and advanced according to the International Standard Classification of Education (ISCED, 2011). According to ISCED (2011), basic education comprises primary education and lower secondary education while intermediate education comprises upper secondary or post-secondary non-tertiary education. Advanced education, on the other hand, comprises short-cycle tertiary education, a bachelor's degree or equivalent education level, a master's degree or equivalent education level, or a doctoral degree or equivalent education level. Thus, the labour force with basic education, for instance, is the percentage of the working age population with a basic level of education who are in the labour force.

From Figures 6A, 6B and 6C, it is observed that education may increase labour force participation and reduce gender labour force inequality. The total labour force with basic education rose from 67% in 2005 to 76% in 2012 before falling gradually to 62% in 2016. The male and female components exhibited a similar pattern but with a closing difference between male and female components. The gap between male and female labour forces with basic education was about five percentage points in 2005 but reduced to about one percentage point in 2016. Similar observations were made for the gap between male and female labour forces in Figure 6B with intermediate education but with a reduced magnitude of gap reduction. The gap reduced from 14% in 2005 to 7% in 2016. Figure 6C presents a slightly different picture of the labour force with educational background. In 2005, there appears to be no difference in the participation between male and female labour forces with advanced education but this has dissipated with time. In 2016, the difference was obvious. This notwithstanding, labour force with advanced education increases labour force participation for all categories. In all, generally, even with education, labour force participation in the Ghanaian market has reduced but education appear to have ameliorated the gap between males and females.

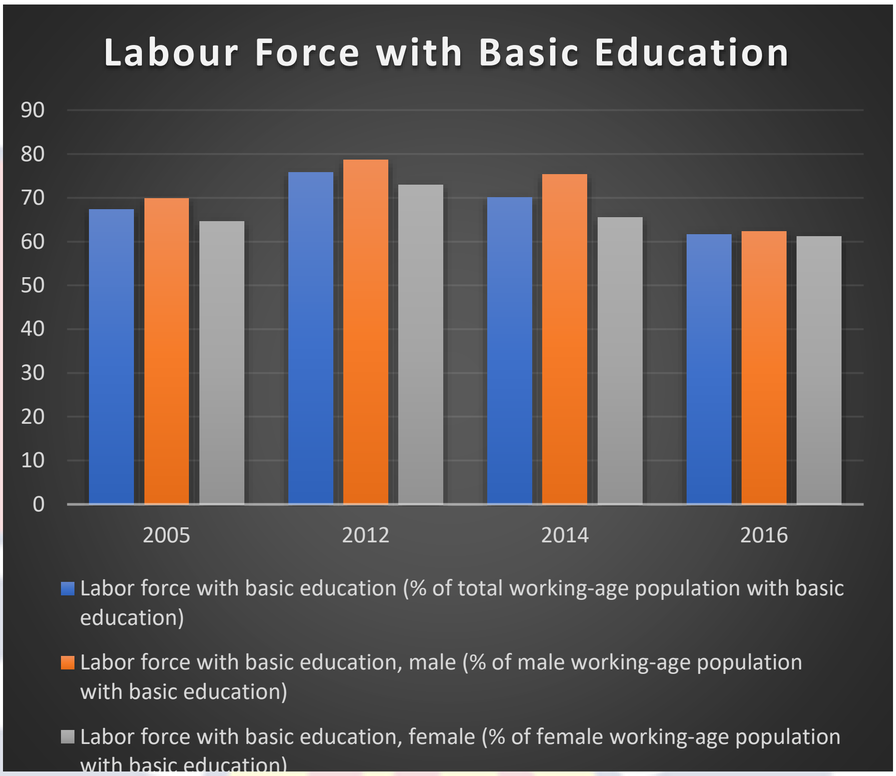


Figure 6A: Labour force with basic education.

Source: Based on data taken from the African Development Indicators (2020)

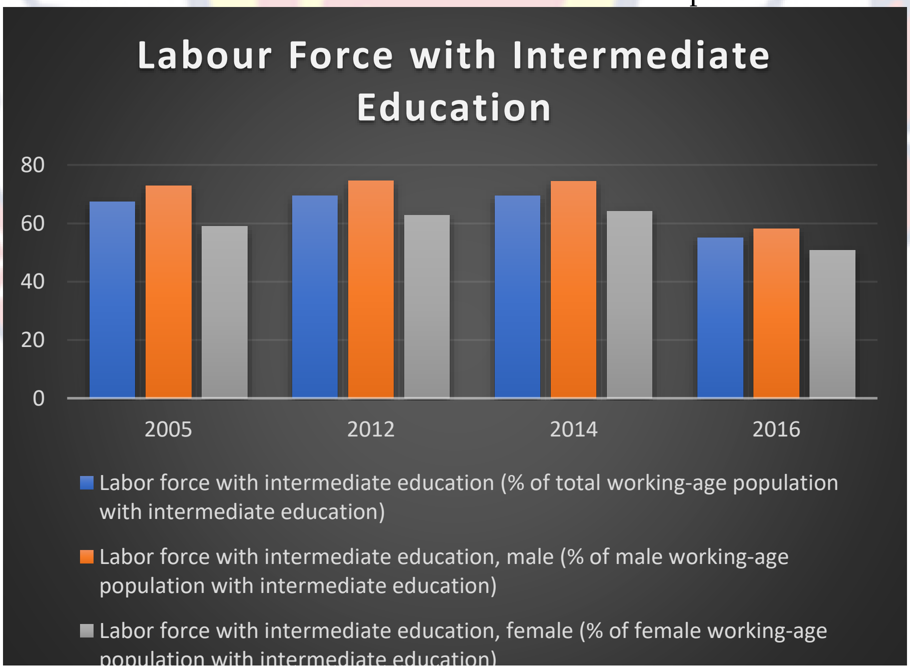


Figure 6B: Labour force with basic and intermediate education.
Source: Based on data taken from the African Development Indicators (2020)

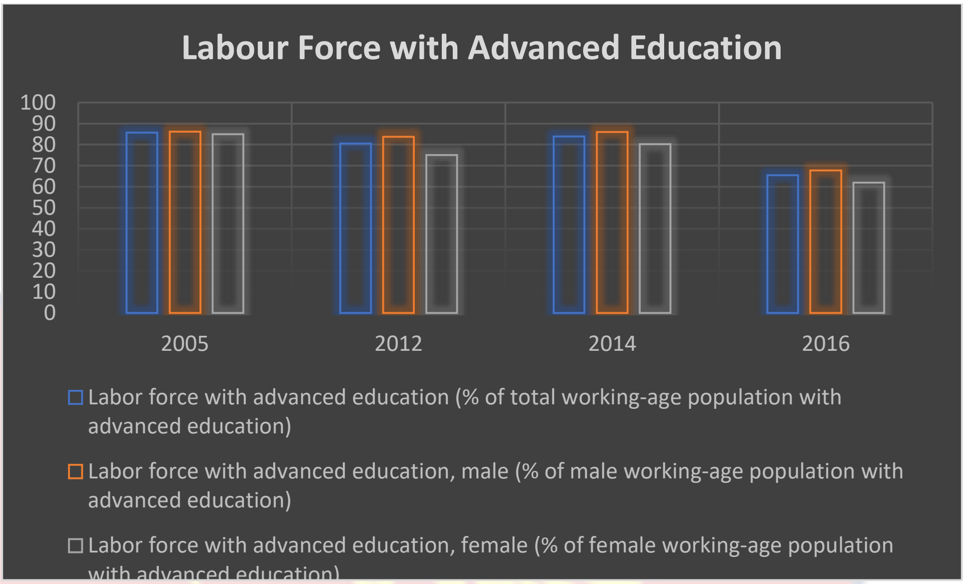


Figure 6C: Labour force with advanced education
Source: Based on data taken from the African Development Indicators (2020)

Problem Statement

Infrastructure inequality and academic performance

Over the years, discussions on how best to improve students' academic performance have remain prominent in education literature. Various attempts, thus, have been made to estimate an education production function that captures the factors that influences academic performance. Infrastructural matters such as the call for equitable and quality infrastructure in line with SDG 4 have also been assuming some attention (UN, 2016; Calderon & Serven, 2014; OECD, 2012).

Ghana, like most nations, has been diligently pursuing the SDGs on education and inequality. Despite the strives made in access (Blampied, et. al., 2018), Ghana is still struggling with regards to the provision of equitable and quality educational infrastructure, that improves student outcomes. Although the strives made in access to education are laudable, much attention should be shifted to the equity and quality of education infrastructure. This is because continual pressure on the limited infrastructure could have a severe toll on teaching and learning and most probably on academic performance. Equitable provision of infrastructure could go a long way to improve the quality of education.

There is, however, a seemingly mixed discussion on the inputs of the educational process that affect student outcomes. While some empirical studies have advocated for improved quality in educational infrastructure, others proffer of them having very little if any impact on educational outcomes. There have therefore been inconclusive results on the effect of educational infrastructure on academic performance. (Crampton, 2007; Jones & Zimmer, 2001; Earthman & LeMasters, 1997; Hanushek, 1989; 1986).

Several reasons have been given to explain the academic performance of students in Ghana. These factors include; the qualification of teachers (Agyeman, 1993), favourable working conditions, infrastructure and teaching and learning material (Etsey, 2005), among others. Ansong et al. (2018) also studied the impact of infrastructure, human, and financial resources on enrolment in Junior high school, while Gyan et al. (2014) examined the factors accounting for the poor performance and drop out of JHS students in Ghana. But none of these studies has considered how previous performance impacts current performance or attempted grouping infrastructure to find the effect of the variations in the distribution of infrastructure on academic performance.

Therefore, firstly, the study sought to contribute to the discussion by estimating an education production function for Ghana and in assessing the impact of infrastructure on academic performance. The study focused on an educational production function to explore the resource needs of the districts in

Ghana and their corresponding effect on student outcomes. This would answer pertinent questions on the nature of resource provision in the educational system. It also helps track the progress made by Ghana on education and inequality.

Secondly, there has been little discussion on the effect of previous performance in examination on current performance in Ghana. Therefore, to initiate this academic discourse, past performance of the various districts in BECE could be related to current performance to bring to light the consistency of this relationship with performance indicators in other fields.

The effect of unequal distribution of education infrastructural on academic performance is yet to receive attention in empirical literature. In a resource constraint country like Ghana the educational resources usually do not commensurate the required level. Again, the few available infrastructure may not be uniformly distributed in Ghana, thus some (75 districts) being classified as deprived districts (MoE/EMIS, 2016). Researchers have failed to critically examine the variation in the distribution of infrastructure across the districts in Ghana and its effect on students' academic performance. So thirdly, through the use of district level data, the study explored these variations in the distribution of infrastructure across Ghana and its impact on academic performance. This was done by estimating the infrastructure level of the districts and relating the various levels of infrastructure to academic performance. Fourthly, except for a few isolated nation-wide studies, most educational research rely on small samples, hampering the ability to generalize findings.

This study could have a massive impact on policy discussions on public funding for education and the equitability of distribution of educational resources. The study seeks to answer the following questions: 1) what are the drivers of academic performance in Ghana? 2) does academic performance follow a dynamic process? 3) what is the effect of infrastructural inequality on academic performance Basic Schools in Ghana?

Education inequality and labour returns

An inquiry into how disparities in education impact the distribution of earnings is of great significance in a developing country like Ghana, where there are perceptions of a reeling income gap. Though the levels and trends of educational attainment and their indicators, have been mainly well researched, the study of educational inequality has received much less attention in the literature in Ghana. However, the distribution of education across the population is key in explaining the disparities in earnings. High levels of educational inequality would likely worsen the disparities in earnings.

This study builds on the work of Appiah-Kubi (2003), Senadza (2012) and Baffour (2016). Appiah-Kubi investigated the trend of education inequality between 1987 and 1999 and also the average years of schooling among males and females. In the same vein, Senadza studied the gender and spatial distribution of educational attainment through the estimation of the education Gini index and the average years of schooling for males and females and also across the regions in Ghana. This study on the other hand sought to estimate the education Gini across the districts in Ghana and further assess the effect of educational inequality on earnings.

Baffour (2016) studied the relationship between the level of education and earnings of urban workers in the Ghana for the years 1998/99 and 2005/6 using quantile regression. This study differed from Baffour (2016) as it investigated the disparities in the level of education across the districts but also assessed its ramifications on earnings. Again, GLSS 6 and GLSS 7 data used for the study offers a more recent set of data and hence provides a more current information on the level of education inequality in the country. The study estimated the education Gini for 2012/2013 as well as 2016/2017. Heckman technique was used to determine the effect of education inequality on earnings due to the possibility of omitted variable biases. Again, quantile regression was estimated to assess the effect of the educational attainment on the distribution of earnings.

Gender-wage gap analysis: the moderating role of culture

Gender differences in labour returns, irrespective of labour efforts, protract global inequality which is inimical to civilization. Income inequality has ordinarily been linked to higher crime rates, varying educational achievements, and lower levels of psychological well-being (Pickett & Wilkinson, 2010), lower levels of socio-economic mobility (Dabla-Norris et al., 2015; Krueger, 2012; OECD, 2011), income inequality explains cross-cultural differences in self-enhancement better than individualism/collectivism (Loughnan et al., 2011), health and social outcomes (Sanchez-Rodrıguez et al., 2019), organizational performance (Park & Kim, 2017) and increasing poverty levels of the vulnerable in society which includes women and children. Also, given that gender inequality may reduce economic development and the potential for inequality issues to demotivate vulnerable groups, the productivity of developing economies is likely to plummet if gender wage gap issues are not addressed.

Numerous empirical works on gender-wage gap has concentrated on estimating the size of the gap and assessing whether the nature of the gap is homogenous across the wage distribution without considering whether behavioural factors could help explain gender wage differentials. Baah-Boateng (2014) indicated that occupational sex segregation in the labour market of Ghana had generally been falling but this decline did not affect the existence of gender-wage differentials in the Ghanaian market. Nix et al. (2015) earlier reported a relatively stable gender-wage gap for the self-employed in Ghana across the wage distribution at 30% suggesting the existence of differentials in the gender-wage gap across sectors even in the same country. Acheampong (2018) concluded, from a descriptive study, that discrimination against females in the labour market of Ghana is common due to institutional factors that militate against female education, training and employment. Even though cultural and traditional factors were considered potential contributory factors to labour market discriminations, they were not subjected to empirical investigation.

The need to understand the gender wage gap from a cultural background (collectivism and individualism) is essential because the possibility of societal traditions, values and norms to influence inequality cannot be farfetched. The dichotomy in the cultural ideologies of collectivism and individualism on the rewards of effort may affect the extent to which income inequality is ingrained in society. Collectivists believe that return to effort is a social good. This belief may accommodate or dispel inequality depending on how labour markets in collectivists societies interprets it. Collectivism may reduce inequality if returns are distributed equally among all labour forces that contributed to it basically because it is a social good, even though such a distribution may not be equitable. On the hand, collectivism may increase inequality where the view of return to effort as a social good is interpreted to mean that even where income inequalities exist in the labour market, eventually, the beneficiaries will use it for the benefit of all so there is nothing to worry about, after all. Individualism promotes non-conformance to group dictates. It considers rewards to labour to belong to the individual that generated it. This view may widen or close the gender wage gap. Individualism may create an enabling environment that ensures that rewards commensurate efforts irrespective the gender. Despite these conflicting cultural positions on income inequality, very few developed economy studies have considered it empirically and the results have been conflicting. An understanding of the culture gender wage gap nexus may probably shed light on the origins of the gender wage gap.

Nikolaev et al. (2017) opined that individualistic societies are likely to produce reduced gender inequality. Davies and Williamson (2019) add that gender equality is enhanced in an individualistic society. Also, Cao (2019) advances that income inequality and concentration of wealth among the rich is common in collectivist societies. These findings are contrary to the traditional view that it is rather collectivism that promotes equality while individualism supports inequality and this position is largely supported by Hammar (2019) , Adjaye-Gbewonyo (2017) and Farelly (2017).

The contribution of developing economies, especially Africa, to this exciting and developing area of research is virtually non-existing. Africa is rich in culture but the behavioural economics and finance literature has little contribution from the continent (Agyei et al., 2020; Agyei, 2018; Pirttilä-Backman et al., 2004). Meanwhile, the existing studies were either interested in explaining financial wellbeing or firm performance from a collectivist or individualistic cultural ideological perspective or gaining an understanding of these cultural ideologies. Ghana is an epitome of developing economies that face various forms of labour market inequalities and needs data to undertake such a study. Figures 4, 5 and 6 demonstrate that labour market inequalities exist even when the labour force possess some form of education. The rich household data, the Ghana Living Standards Survey (GLSS) of the Ghana Statistical Service, covers wages, religious affiliation, and other relevant gender wage gap explanatory factors that makes the study's application to Ghana relatively easier.

This study contributes to the paucity of empirical evidence on how informal structures like culture can help explain the gender wage gap. The study further assesses whether the cultural effect along the wage distribution frontier is the same for all quantiles.

Purpose of the study

The purpose of this study was to assess the relationship between inequalities and returns to education in Ghana.

Objectives of the study

The objectives of the study were to:

1. assess the effect of infrastructural inequality on student academic performance in Ghana.
2. examine the effect of education inequality on wages in Ghana.
3. examine the effect of gender inequality on wages in Ghana.
4. ascertain the moderating role of culture in the gender inequality-labour returns nexus.

Hypotheses

1. H_0: infrastructural inequality has no effect on student academic performance in basic schools in Ghana.

   H_1: infrastructural inequality has an effect on student academic performance in Basic schools in Ghana.
2. H_0: education inequality has no effect on wages in Ghana.

   H_1: education inequality has an effect on wages in Ghana.
3. H_0: gender inequality has no effect on wages in Ghana.

   H_1: gender inequality has an effect on wages in Ghana.
4. H_0: culture does not moderate the relationship between gender inequality and wage in Ghana.

   H_1: culture moderates the relationship between gender inequality and labour returns in Ghana.

Conceptual framework

Figure 7 presents a graphical picture of how the research objectives were pursued. Objective one shows that infrastructure inequality influences academic performance. Previous year's performance also affects current years academic performance. The control variables that explain the relationship between inequality and academic performance are infrastructure, learning materials, class size and the gender parity index. The first objective is based on the education production function that sees educational resources as inputs that churn out the output of academic performance. The study identifies two channels through which infrastructure may influence academic performance. They are: continuous learning and motivation.

Infrastructure facilitates continuous academic activity by ensuring that there are little or no disruptions in academic work. This encourages or increases the confidence of students. In effect, continuous learning will enhance the coverage of the syllabus. Students would be well prepared and are likely to pass their exams. Those with little or without educational infrastructure are likely to have disruptions in academic work. For instance, in times of poor weather conditions, teaching and learning must halted because there is no classroom or existing classrooms may not be conducive.

Again, poor seating or writing places will affect concentration of students for academic work. These disruptions will not allow the coverage of the syllabus. Students will be ill-prepared for the exams, and performance will likely be low. The uncertainty related to the learning process may demotivate learners.

Infrastructure quintiles are used as a measure of infrastructure inequality. Academic performance is regressed on infrastructure quintiles. Top quintiles are associated with a conducive learning environment that will ensure continuous learning and motivate students by increasing their confidence to learn and perform in examinations. Low quintiles are associated with disruptions in academic work. These disruptions will not allow coverage of the syllabus. The students will be demotivated from learning, and this may affect their performance in the examination.

Objective two is built on the argument that education inequality directly impacts labour returns. The relationship between inequalities and labour returns is conditioned on an environment where work experience, work experience squared, location, sex, region, training and marital status have been controlled for. The second objective was based on the human capital theory that deems more years of schooling as an indicator of productivity. Inadequate educational attainment among the active population is a major constraint on capabilities with consequences for productivity. Education inequality can be destructive to productivity per worker leading to reduced associated labour returns. This will work through reduction in human capital. Human capital will be low, productivity will be low and hence earnings will be low. Secondly, education inequality could impact labour returns through the incentive or motivation channel. Differences in education can demotivate persons with lower years of schooling from exploring avenues of contributing to productivity. If excessive recognition is given to those with more years of schooling, it may put the less or uneducated into inactivity.

Thirdly, education inequality can lead to instability or volatility in productivity and reduce labour returns. Random shocks will result in reduction in workers' marginal productivity and wages fluctuating over time. Productivity is likely to be volatile because of unassured productivity. The production system is not guaranteed of the same level of output from the next person to be engaged.

The consequence is that the risk-averse will be willing to settle for lower average earnings in return for a steady wage offered by risk-neutral entrepreneurs. The lower steady wage may be accepted to avoid periods of unemployment or unstable hours of work, hence, earnings may deteriorate.

Fourthly, through the signalling theory, the labour market may consider inequality a negative signal to the labour market by interpreting it as market inefficiency. Thereby casting doubt on the associated returns to each level of education. An imperfect labour market plays a role in linking higher inequality to lower earnings

The objective three also suggests that gender inequality has a direct relationship with labour returns, while objective four proposes that this relationship could be strengthened or weakened due to the cultural orientation of the labour market.

The wage gap between men and women occurs because the position of men and women are different. Firstly, the gap could result from the rigidities in the labour market (Olsen & Walby, 2004). The higher proportion of males in an occupation is associated with higher wages. Male dominance in the labour market could lead to discrimination. Female labour market participation percentage point is lower than men (ILO, 2019). The concentration of women in occupations with higher proportions of female workers. Females face more interruption in employment because of childcare and family care. Interruption to human capital acquisition reduces the potential stock of human capital, thereby reducing productivity and earnings. Direct discrimination and preferences in the labour market and motivation may also aggravate the situation. If women who participants in the labour market are less likely to find work than their male counterparts, they could be demotivated from participating in the labour market.

Lastly, the study assessed the moderating role of culture on the gender-wage-gap analysis due to the potential differences in how collectivists and individualists are likely to consider inequality and the contagion effect of culture.

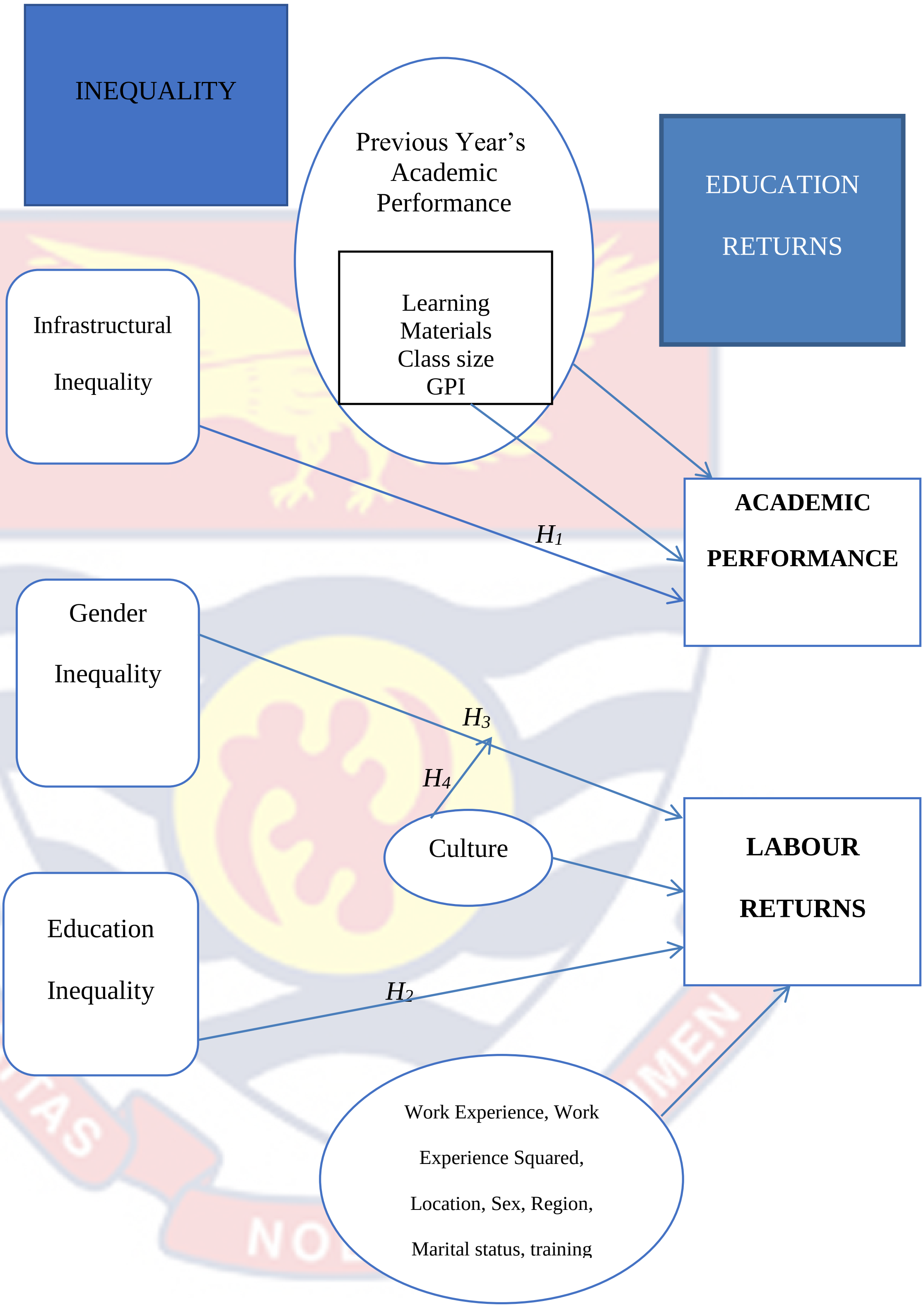


Figure 7: Conceptual framework
Source: Author's Construct

Significance of the study

The study offers important theoretical and empirical insights for policymakers and practitioners. The study provides policy makers with a platform to make decisions to improve the general education level, reduce economic and gender inequality to improve wellbeing of people and help Ghana achieve the SDGs 4, 5 and 10.

The study serves as a reference material to the Ministry of Education (MoE) and the Ghana Education Service (GES). It offers these policy makers a basis to make decisions on the general education level. It provides a fair indication of infrastructure and education inequalities in the country and how they impact academic performance and labour returns. It would also inform government policy decisions on public funding of education and how these funds are allocated to various districts by the Ministry of Education.

Again, the findings on the dynamic nature of performance would inform teachers and school heads about the effect of past performance on current performance. This would inform the measures to ensure continued academic excellence in the various districts across the country.

Furthermore, it gives indication to the international organization such as UNDP and UNESCO as to the strives made by Ghana on some aspects of Sustainable Development Goals (SDGs) 4, 5 and 10 that deals with education, gender and economic inequalities. It would inform these bodies on the support Ghana give to enable achieve these goals.

Also, it offers an education production function for the education system in Ghana and contributes to the discussion on the requisite inputs for conceptualising the education production function. It would also be a basis for further studies. That is, it would encourage further research in this field.

Delimitations of the study

Although, there are several returns to education, the study specifically focused on students' academic performance and labour returns (earnings). The study was limited to infrastructure, education and gender inequalities out of the several forms of inequality. Again, academic performance refers to pass rate in Mathematics, Science, English language and Social Studies. Also, the level of aggregation for objectives 1 (effect of infrastructure inequality on academic performance) was at the district level while that of objectives 2 (educational inequality and labour returns), objective 3 (gender and labour returns) and objective 4 (gender wage gap as well as the moderating role of culture in the gender inequality and labour returns) were at the individual level.

Limitations of the study

This study used quantitative method, so social and behavioural phenomenon were not captured. Besides that, for objective one, the data used was a district level data and so school context and student input variables may not have been addressed by the study. These individual and school specific-factors were not captured due to the nature of the data.

Definition of terms

The main terms and variables are defined based on how they were operationalised in the study.

Inequality is an indication of discrimination and disparity in opportunity or outcomes between groups.

Return to education are the gains from investment in education.

Education is the educational attainment or the number of years of schooling

Infrastructure refers to educational resources required for teaching and learning. In the scope of this study, it consists of classrooms, seating place, writing place, toilet and water.

Academic performance refers to the total number of candidates who passed the BECE English, Mathematics, Social Studies and Science out of the number of candidates who sat the examination.

Labour returns is a measure of the wage or earnings attributable to labour.

Culture reflects the belief, value and standards of a group of people. Culture is operationalised as the religious culture (collectivism and individualism) of the society.

Organisation of the study

Chapter one discussed the general background to the study. It included problem statement, objectives, hypotheses, purpose of study, significance of the study, delimitation, limitations, organisation of the study and the conceptual framework. Chapter two was an empirical study that focused on the determination of the drivers of academic performance in Ghana as well as the effect of infrastructure inequality on academic performance in Ghana. Empirical Chapter three covered educational inequality and labour returns. Empirical Chapter four assessed the gender wage gap as well as the moderating role of culture in the gender inequality and labour returns nexus. Chapter five provided the summary, conclusion and recommendations.

CHAPTER TWO

INFRASTRUCTURE INEQUALITY AND ACADEMIC PERFORMANCE

Introduction

Quality education remains the desire of global organizations and nations across the world. This is primarily due to the view that education is the foundation of development and growth. Thus, several efforts have been geared towards improving access to education in order to ensure that all children have equal opportunity to go to school to obtain the requisite knowledge and skills. Some successes have duly been chalked on the target of increasing access to education. For instance, in Ghana, gross enrolment increased by about 124% at Kindergarten, 111% at Primary, 88% at Junior High School, and 51% at Senior High School over the period 2008 and 2016 (Blampied, et. al., 2018). Most developing countries such as Ghana are, however, still battling with a trade-off between the pursuit of increase in access and enhancing the quality of education (Averett & McLennan, 2004). Despite the strides made in the educational sector, the provision and distribution of infrastructure remains a challenge in developing countries like Ghana which impedes the pursuit of quality education (Ministry of Finance (MoF), 2018). The attention, hence, ought to be now turned towards providing quality infrastructure that commensurate access to education.

Researchers in economics education have often estimated education production function to define the factors that determine academic performance (Tran., & Gershenson, 2021; Hanushek, 2020; Cascio, & Schanzenbach, 2016). This is because, as an educational output, academic performance requires inputs. These inputs are educational resources or the aiding factors in the educational process such as infrastructure, class size, teaching and learning materials (Averett & McLennan, 2004). Education infrastructure has remained an integral component of the education process. This informs the commitment toward providing adequate and quality infrastructure to aid the process.

Governments and international entities acknowledge the need for investment in educational resources in an attempt to achieve the utmost gains in education for all children. Since infrastructure is largely considered a public good (United Nations (UN), 2016), education infrastructure continually, make up a large portion of government expenditure. But there is a fiery debate on whether increasing resources in schools boost student outcomes.

The results from the existing empirical literature on the link between education infrastructure and academic performance are mixed (Greenwald et al., 1996). Some studies have shown no relationship between the quality of education infrastructure and academic performance (Levine & Lezotte, 1990; Purkey & Smith, 1983; Hanushek, 1989; 1986; Edmonds, 1982). This assertion has, however, been refuted by recent literature (Barrett et al., 2019; Uline & Tschannen-Moran, 2008). These studies that recommend more investment in education infrastructure, have shown a positive relationship between the school's physical environment and academic performance of students (Barrett et al., 2019; Salary, Holliday et al., 2018; Earthman, 2017). It is believed that education infrastructure could enhance teaching and learning and academic performance (Simons et al., 2010; Asiabaka, 2008; Lyons, 2001). The discussion on infrastructure is, therefore, considered very crucial in the enquiry of learning outcomes. The quality of education infrastructural facility could create a conducive learning environment that improves the teaching and learning process.

Based on the aforementioned argument, it is suggested that attention needs to be accorded to educational infrastructure since failure to create and maintain optimum learning environments could undermine other efforts (such as quality of teachers, provision of learning materials etc.) that boost education outcomes (Nepal, 2016; Vendiver, 2011). The infrastructure that spurs up the educational system such as classrooms, seating places, potable water, toilet facilities would likely motivate students towards learning (Akomolafe & Adesua, 2016) and improve learning outcomes.

However, there are disparities in the distribution of infrastructure (UN, 2016), with some communities and schools lagging behind in terms of the distribution of infrastructure. These disparities may impact academic performance of students in these communities. To achieve academic performance, there should be equitable distribution of educational resources (Levacic & Vignoles, 2002).

The call for equity and quality in the educational system has been a global agenda. The United Nations, through the Sustainable Development Goals (SDGs), requires nations to "ensure inclusive and equitable quality education and promote lifelong learning opportunity for all". And one of the indicators of this objective is to build and upgrade inclusive education facilities to ensure effective learning environments for all (UN, 2016, 2015). This reiterates the important role equitable infrastructure is deemed to perform in the educational process. Thus, equity is given a lot of prominence in the pursuit of the key principle of ensuring that "no one is left behind". This entails a reduction of inequalities among groups and communities in countries. Again, it is proposed that equity must go hand in hand with quality, as it has been maintained that highly performing educational system are those that combine equity to quality (Organisation for Economic Co-operation and Development (OECD), 2012).

Ghana's desire to improve education quality has led to a number of brilliant education policies but not without implementation challenges. The Accelerated Development Plan for Education (1951), The Education Act of 1961, the Kwapong Education Committee of 1967, the Dzobo education committee of 1972, the Education Commission's report in 1986 on Basic Education, and PNDC Law 42 of 1983 were all efforts to improve education in Ghana (Osafo-Acquah & Asamoah-Gyimah, 2009). In 1995, the Free Compulsory Universal Basic Education (FCUBE) was introduced to ensure access to education by all children. This has led to an increase in enrolment rates at the primary level. Again, gender parity at the primary school level has appreciated massively (UN, 2017). Also, in 2018, the NPP government instituted the free senior high school education policy in the quest to increase access to education. Although, some successes have been chucked, there still remain challenges hindering these policies the full achievement. For instance, pupil to classroom ratio is high in some parts of Ghana and low in others (MoE, 2018). Inadequate infrastructure coupled with the uneven distribution of existing infrastructure may not only help explain the academic performance in general but also the differences in performance across districts. Consequently, quality and equitably distribution of educational infrastructure could condition academic performance in our districts across Ghana.

Even though Ghana has been relentless in the pursuit of education for all and reduction of all forms of inequality (UN, 2016; Calderon & Serven, 2014; OECD, 2012), the success made so far in terms of access to education (Blampied, et. al., 2018) does not commensurate that of equitable distribution of educational infrastructure. Equitable provision of infrastructure could go a long way to improve the quality of education ins spite of the fact that empirical studies have shown inconclusive results on the effect of educational infrastructure on academic performance. (Crampton, 2007; Jones & Zimmer, 2001; Earthman & LeMasters, 1997; Hanushek 1989; 1986).

Empirical evidence on the relationship between infrastructural inequality and academic performance has been largely inconclusive. The mixed empirical results on the infrastructure and academic performance nexus could be attributed to the general neglect of recognizing academic performance as a dynamic process as well as the non-consideration of infrastructure inequality's effect on academic performance. Existing studies (Agyeman, 1993; Etsey, 2005; Ansong et al., 2018; Gyan et al., 2014) have largely relied on static models when performance is generally considered to follow a dynamic process (Agyei et al., 2020; Tchamyou, 2018; Sonnentag & Frese, 2012; Sturman, 2007; Devadoss & Foltz, 1996).

Evidence exists to suggest that academic performance may follow a dynamic process. The information contained in the relationship between previous performance and current performance may assist in understanding the motivations or conditioning factors of academic performance for policy decisions. This study further argues that the likelihood of academic performance initiatives having delayed effect is real. It is less debatable that the consequences of some academic policy initiatives take time to evolve and knowledge of the lag period could assist in future policy initiatives. For instance, infrastructure policy initiatives may have a delayed effect on academic performance. Also, policy implementers' commitment to new policies may be low or non-existing at the initial stages because of inadequate knowledge of the policy requirement. Thus, assessing whether performance follows a partial adjustment process would assist policy makers knowing the speed of adjustment of academic performance policy initiatives on current levels of academic performance. This would complement the predominant existing knowledge from static academic performance models.

For instance, a cursory look at the performance of students in BECE (Maths, Science, English and Social Studies) across the districts in Ghana has shown surges as well as falls in their trends at various points in time (Ghana Statistical Service, 2018). These changes may be due to the desire to either maintain good previous performance or improve on poor previous performance. The changes in the academic performance over the years, therefore, require an interrogation when consideration is being given to an education production function for Ghana.

Furthermore, knowledge on the effect of the distribution of infrastructure on academic performance is non existing. Considering the constraints faced by the Ghanaian economy overtime, educational infrastructure is hardly evenly distributed. Indeed, some districts are classified as deprived districts (MoE/EMIS, 2016) in terms of education infrastructure. Ascertaining the implication of such deprivation would be informing. This would answer pertinent questions on the nature of resource provision in the educational system. It also helps track the progress made by Ghana on education and inequality.

This chapter uses a large, unique district-level data to assess the dynamic relationship between education infrastructure inequality and academic performance in Ghana. The study sought to answer the following questions: 1) what are the drivers of academic performance in Ghana? 2) does academic performance follow a dynamic process? and 3) what is the effect of infrastructural inequality on the academic performance of basic schools in Ghana?

Literature Review

Theoretical Review

Education production function

The Production function is one of the basic microeconomics principles that provides a description of the functional relationship between inputs and output. A production function typically explores the inputs (such as land, labour and capital) that yield maximum amount of output. Its extension to education has for many years been one of the major research focuses of quantitative education researchers, particularly education economists where schooling is conceptualised as a production process.

The education production function is a theoretical framework that describes the relationship between inputs (such as educational infrastructure, teacher quality, class size, instructional materials, and student characteristics) and outputs (such as student achievement or educational attainment) in the educational system.

Various studies have employed the production functions mainly to assess the key drivers of student achievement (Bishop & Woßmann, 2004; Cooper & Cohn, 1997; Greenwald et al., 1996; Douglas & Sulock, 1995; Chizmar & Zak, 1983). This is based on the assertion that, there are various factors that influence the individual students' educational output. These factors may rightly be seen as the inputs to the production of education.

One of the earliest studies on input-output analysis was the Coleman Report (Coleman,1966) which sought to investigate the relationship between the school inputs and students' academic performance. This report that assessed the equality of educational opportunity, paved the way for several studies on the education production function (Hanushek., 1998; 1979; Monk, 1989; Hanushek & Kain, 1972; Bowles, 1970). The Coleman report concluded that social and family characteristics were the predominant factors determining students' academic performance and not the quality of educational resources. It showed educational resources to have an insignificant effect on students' academic performance. This study has had a significant impact on education policy, subjective of the opinion that increasing funding on schools will not improve student achievement (Averett & McLennan, 2004). This has spurred up researches either refuting or supporting the Coleman report. The education production function, therefore, is a form of estimation that seeks to determine a statistical relationship between educational resources (e.g. infrastructure) and measures of student outcome like academic performance (Harris, 2010).

Empirical Review

Infrastructure and academic performance

Although some studies measure student outcome by student attitude (Besterfield-Sacre et al., 2001; Wong et al., 1997) and continuation or dropout rates (Worrell, & Hale, 2001; Levy, 1971), it is commonly measured by test scores (Ramli & Zain, 2018; Earthman, 2017; Levacic et al., 2005; Averett & McLennan, 2004; Hanushek & Luque, 2003; Earthman & LeMasters, 1997; Hanushek, 1979). Grade or pass rate in examination is often used as an objective measure of academic performance.

Some earlier studies accord little credence to the role of infrastructure in promoting academic performance. They either found infrastructure to have no statistically significant effect on academic performance (Levine & Lezotte, 1990; Purkey & Smith, 1983; Edmonds, 1982) or failed to consider infrastructure as a determinant of academic performance (Scheerens,1997; Cotton, 1995; Sammons et al., 1995). Others argued that there is no strong relationship between educational infrastructure and performance (Hanushek, 1981, 1986, 1989, 1991, 1995, 1997; Hanushek & Luque, 2003; Hanushek et al., 1996).

Most empirical researches recently have reported a positive association between the physical environment and student learning outcomes (Barrett et al., 2019; Earthman, 2017; Duarte et al., 2011; Cash & Twiford, 2010 Earthman et al.; 1996). Murillo and Roman (2011), for instance, studied the effect of school infrastructure on the academic performance of primary education students in Latin America and confirmed that educational infrastructure such as water, electricity impacted the achievement of primary education students in Latin America with varying impact across countries. Earthman et al. (1996) also established a statistically positive effect of education infrastructure on standardized tests in many cities and states in the United States. Uline and Tschannen-Moran (2008) offered proof of a positive relationship between the quality of school facilities and student performance in English and mathematics tests. Infrastructure aids academic performance by providing a conducive and friendly teaching and learning environment for effective teaching and learning (Khumalo & Mji, 2014).

The quality of education infrastructure, has also been considered to have health, security, and psychological ramifications. The students' health, safety and mental state inform their learning experiences and academic performance (Barrett et al., 2019).

There have been calls to integrate infrastructure into all education production models. In addition, arguments have been made in favour of increasing investment in educational resources so as improve student outcomes (Murillo & Roman, 2011; Greenwald et al.,1996). It is, therefore, essential to investigate the effect of infrastructure on academic performance by determining an education production function for Ghana.

Inequality and academic performance

Disparities in the distribution of educational facilities explain the differences in returns to education (Bowles 1970). Some research works have considered interrogating geographical differences while analysing the relationship between educational infrastructure and academic performance (Dustmann et al., 2003; Feinstein & Symons, 1999; Gamoran & Long, 2006; Heinesen & Graversen, 2005; Levacic, 2012; Levacic´ & Vignoles, 2002; Steele et al., 2007; Vignoles et al., 2000). It has been argued that the location of a country, for instance, determines the effect educational resources would have on the educational process. Glewwe, (2002), found that while infrastructure may have a weak to strong impact on academic performance in developing countries, in the developed world, it may not necessarily enhance academic performance.

Again, it has been noted that students in schools with better educational resources are more likely to get higher scores in the examination. Those in elite schools with better facilities are believed to have advantage over their colleagues in less-endowed schools as they have more learning opportunities (Baker et al., 2002; Chiu & Khoo, 2005). This indicates that providing equal opportunities across groups and locations could help in ensuring improved overall student achievement for a country. A study into the state of infrastructure inequality and its possible effect on academic performance is, therefore, not misplaced.

Other determinants of academic performance

Class size

Pupil-to teacher ratio is often used as a proxy for class size (Higgins, 2009; Greenwald et al., 1996;). Others have asserted in some education literature that pupil-teacher ratio and class size may not totally be identical since pupil-teacher ratios are usually lower than the actual class size in schools (Akerhielm, 1995; Boozer & Rouse, 2001). However, data on the pupil-teacher ratio are usually more readily available than the exact class size. Therefore, pupil-to teacher ratio is often used in education production function models as a measure of class size. Most especially when the study in question is at district level or national level, obtaining data on the actual class size in schools becomes extremely difficult, hence the use of pupil-to-teacher ratio as alternative for class size.

Class size is probably one of the principal determinants of academic performance. Small class size is normally associated with better performance. It is argued that small classes could improve peer relationhips (Averett & McLennan, 2004). Also, smaller classes enhance the teaching and learning process by improving student commitment to studies and reducing disciplinary problems (Bouguen et al., 2017; Siraj-Blatchford et al., 2016; Blatchford et al., 2007). It has been reasoned that, like any kind of public good, a classroom could experience problems relating to congestion and other negative externalities that would hinder a successful teaching and learning process as well as student performance (Bouguen et al., 2017). There is therefore the need to assess the optimal class size that will help promote academic performance.

Conversely, some studies have reported that smaller class sizes do not always improve academic performance (Hanushek & Woessmann, 2017; Bishop and Woßmann, 2004; Gundlach *et al*., 2001; Hanushek, 1999; Hoxby, 2000b;). Hanushek & Woessmann opined that class may be a significant factor only in cases where teacher quality is low.

Furthermore, there is the assertion that large class size in some instances, could have a good impact on academic performance as it promotes peer learning and competition (Dobbelsteen et al., 2002; Lazear, 1999).

Gender parity index

Gender parity index (GPI) indicates the ratio of female to male values for a given variable (UNESCO, 2022). GPI in education refers to the ratio between female gross enrollment and male gross enrollment (World Bank, 2022). A GPI of 1 denotes parity between the genders, above 1 is an indication of disparity in favour of girls and below 1 indicates girls are more disadvantaged than boys in learning opportunities. Gender parity varies across nations depending on the course or subject, educational level etc. Research has shown that boys out number girls in many developing countries (ICEF, 2000). It has also been found that at the lower grades, boys perform better than girls in numeracy while girls surpass boys in literacy (Maliyamkono & Ogbu, 1999).

Research Methods

The main aim of this study was to assess whether infrastructural inequality influences academic performance in Ghana. The study further assessed whether academic performance differed at various infrastructure distribution levels (Infrastructure Quintile levels).

Research Philosophy

This section describes the research philosophy which forms the basis for the choice research design. A philosophical perspective underpins the decisions on the methodology and research design. The philosophy describes what is perceived as truth, reality and knowledge by the researcher. It is an indication of the beliefs and values that guide the design of and the collection and analysis of data in a research study, these choices complementing philosophical principles (Junjie & Yingxin, 2022; Ryan, 2022; Ryan, 2018).

According to Saunders (2009), philosophies are belief systems and assumptions about the development of knowledge. The philosophy specifies the ontological, epistemological, and methodological basis underlying a field of study.

The positivist philosophy forms the basis of this study. Positivism originates from the principles of empiricism, positivists value objectivity and testing hypothesis. Ontology concerns the nature of existence. It relates to the values a researcher holds about what can be known as real and what is believed to be factual. Ontologically, the positivists espouse existence of reality and are driven by immutable natural laws and mechanisms (Scotland, 2012; Crotty, 1998). Positivists maintain the belief that there are facts that can be proven, and propound that reality is the same for each person and observation and measurement tell us what that reality is (Schrag, 1992).

Epistemology deals with the nature of knowledge which emphasises the relationship between the knower and known. Epistemology is our belief about how we may come to know the world (Junjie & Yingxin, 2022; Ryan, 2022; Ryan, 2018). Epistemologically, objectivistic view is held by the positivist. Objectivity is key feature of a scientific inquiry where the researcher does not exert influence on the study (Creswell, 2009). This is where the interest is factual and value-free. Positivism hence, embraces an empiricist epistemology (Ryan, 2018; Breen & Darlaston-Jones, 2010).

Methodology deals with the range of approaches used to gather data which serves as basis for drawing inferences and interpretation. Methodologically, the positivist aims at explaining cause and effect relationships as its main tenet and therefore generalisation and replicability become possible (Coe, 2017; Creswell, 2009).

The choice of research philosophy and design was informed by the problem and objectives of a study. The study adopted the positivist philosophy as it sought to contribute to knowledge from an objective perspective by building on existing knowledge on returns to education and the forms of inequality that may impede the realisation of returns to education using quantitative methods and, examining relationships objectively.

Research Design

The study falls in the domain of explanatory research design. Explanatory research design concerns the exploration and understanding of the relationships between different variables or factors. It is ordinarily used to investigate cause and effect relationships and provide explanations for observed phenomena.

Explanatory research often employs quantitative methods, such as surveys, experiments, and statistical analysis, to collect and analyze data. These methods allow for the measurement of variables and statistical testing of hypotheses (Rahi, 2017).

A quantitative approach in research is a systematic and structured method of investigating a phenomenon through the collection and analysis of numerical data. This approach is characterised by its emphasis on objective measurement, statistical testing of hypotheses, and the use of quantifiable variables to draw conclusions and make inferences (Flick, 2020; Apuke, 2017).

In line with explanatory research design and quantitative approach, the provided an explanation of the causal relationship between inequality and returns to education.

Data source and data management

The study relied on annual district-level data on basic education from 2010 to 2016 from the Ghana Statistical Service. The data issued in 2018 to track the progress in Ghana's basic level education across districts. The data consists of information on enrolment from kindergarten to Junior High School, pupil to teacher ratios, access to textbooks, infrastructure as well as Basic Education Certificate Examination (BECE) pass rate. A panel arrangement was made with the data to show the distribution of the variables across the districts over the study period. The data was on all the 216 districts in Ghana as of that period. However, Talensi and Nandom were merged, bringing the total number of districts studied to 215. This was necessitated by the fact that per the available data from GSS, the two districts were combined from 2010 to 2012 but were split from 2013 to 2016. Since the data for the first three years could not be practically separated, combining the two districts for all periods was almost natural.

Principal Component Analysis

The study sought to represent each of the individual infrastructure, and the performance in the various subjects by creating one measure for infrastructure and one measure of academic performance. The Indexes were generated using Principal component analysis. The variables used in estimating the indexes were distinctive and relatively large (for all districts across 7 years).

Principal Component Analysis (PCA) is a statistical technique that is commonly used to reduce the dimensionality of large datasets. It is a linear transformation method that finds the underlying structure in the data by identifying the most important variables or features that contribute the most to the variance of the data. PCA is particularly useful when dealing with high-dimensional datasets, as it allows us to represent the data in a lower-dimensional space while still retaining most of the information (Jolliffe & Cadima, 2016). It is, therefore, a useful tool for data simplification and reduction without considerable loss of information (Abdi & Williams, 2010; Wold, 1987).

The basic idea behind PCA is to transform the original data into a new coordinate system, where the axes are aligned with the directions of maximum variance in the data. These new axes, called principal components, are orthogonal to each other and are sorted by their corresponding variance, so that the first principal component represents the direction with the highest variance in the data, the second principal component represents the second-highest variance, and so on. The number of principal components retained determines the amount of variance retained in the data.

PCA involves several steps, including centering the data, computing the covariance matrix, finding the eigenvectors and eigenvalues of the covariance matrix, and finally projecting the data onto the new principal component axes. The eigenvectors of the covariance matrix represent the directions of maximum variance in the data, while the eigenvalues represent the amount of variance explained by each principal.

The rule that is usually applied to PCA, is the Kaiser rule that states that only principal components with variances or eigen values greater than 1 should be retained. This rule ensures that all principal components with less information are repudiated (Kaiser, 1974; 1960). Jolliffe (2002) also suggests that the cut-off of between 70% and 90% for the total variation, will be ideal. This will help preserve most of the information in variables.

Infrastructure was measured as an aggregated variable which included classrooms, seating places, writing places, schools with access to toilet and schools with access to drinking water. While academic performance comprised performance in Mathematics, English, Social Studies and Science.

Quintile

One of the simplest ways of examining equity in education is using quintiles. A quintile refers to "a fifth of a population" (Fry et al., 2014). Quintiles are statistical values that divide a set of observations into five equal parts, with each part representing 20% of the total sample. In other words, they are a method of dividing a distribution of data into five equal groups, each representing 1/5th of the total population or sample.

Quintiles are commonly used in the analysis of numerical data, such as income, test scores, or other continuous variables. The first quintile represents the lowest 20% of the data, the second quintile represents the next 20%, and so on, with the fifth quintile representing the highest 20% of the data. Quintiles, in effect divide data into five equal parts and are useful for understanding the distribution of a variable in a population or sample.

For instance, infrastructure index scores could be grouped into quintiles. The lowest quintile would mean a district has a low-quality infrastructure, while a highest quintile matches a higher quality infrastructure. This affords opportunity to investigate how equitable the distribution of infrastructure is and its effect on academic performance. When academic performance is better for districts in higher infrastructure quintile then, there is a display of the impact inequality in the distribution of infrastructure has on performance in examination.

The infrastructure index generated was used to ascertain the infrastructure quintile each district falls into. Thus, each of the districts was assign a quintile based on their score for the infrastructure index. The infrastructure quintile, therefore, serves as a relative measure of the distribution of infrastructure across the districts in the country. There was the estimation of the impact of quintile cohorts on academic performance across districts in Ghana.

ANOVA

Analysis of variance (ANOVA) formulated by Fisher (1973) is a statistical technique used to test for significant differences among the means of two or more groups. It can be used to compare means between different groups or to analyse the effects of multiple independent variables on a dependent variable.

ANOVA works by decomposing the total variability in a dataset into two components: the variability between groups and the variability within groups. The between-group variability is the variance in the means of the groups, while the within-group variability is the variance within each group.

The basic idea of ANOVA is to compare the ratio of the between-group variance to the within-group variance. If the between-group variance is significantly larger than the within-group variance, it suggests that there are significant differences between the groups. Conversely, if the within-group variance is much larger than the between-group variance, it suggests that the groups are relatively similar.

There are several types of ANOVA, including one-way ANOVA, which is used when there is only one independent variable, and factorial ANOVA, which is used when there are multiple independent variables. A One-way ANOVA was used in the study to determine whether there was difference in mean of academic performance and the distribution levels of infrastructure.

The study used the model by Brandt (2014).

Let

$$n = \sum_{i=1}^{t} n_i \tag{1}$$

$$\bar{x}_i = \frac{1}{n_i}\sum_{j=1}^{n_i} x_{ij} \tag{2}$$

Mean of total sample

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{t}\sum_{j=1}^{n_i} x_{ij} = \frac{1}{n}\sum_{i=1}^{t} n_i\,\bar{x}_i \tag{3}$$

Sum of squares

$$Q = \sum_{i=1}^{t}\sum_{j=1}^{n_i}(x_{ij} - \bar{x})^2 = \sum_{i=1}^{t}\sum_{j=1}^{n_i}(x_{ij} - \bar{x}_i + \bar{x}_i - \bar{x})^2 \tag{4}$$

$$= \sum_{i=1}^{t}\sum_{j=1}^{n_i}(x_{ij} - \bar{x})^2 + \sum_{i=1}^{t}\sum_{j=1}^{n_i}(\bar{x}_i - \bar{x})^2 + 2\sum_{i=1}^{t}\sum_{j=1}^{n_i}(x_{ij} - \bar{x}_i)(\bar{x}_i - \bar{x}) \quad (5)$$

$$Q = \sum_{i=1}^{t}\sum_{j=1}^{n_i}(x_{ij} - \bar{x})^2 = \sum_{i=1}^{t} n_i(\bar{x}_i - \bar{x})^2 + \sum_{i=1}^{t}\sum_{j=1}^{n_i}(x_{ij} - \bar{x})^2 \quad (6)$$

$$Q = Q_A + Q_B \quad (7)$$

Q_A denotes the sum of squares between the groups obtained from classification A while Q_B constitutes a sum over the sums of squares within group. Q is the decomposition into a sum of two sums of squares relating to the variation of means within the classification A and the variation of measurements within the groups (Brandt, 2014).

Generalised Method of Moments

The first objective sought to assess the effect of infrastructure inequality on academic performance. For objective 1, the researcher sought to further subject the proposition that the past performance of a school or district has the potential to influence the current performance of schools/districts because of the desire to either maintain the good previous performance or improve on poor previous performance. This suggests that performance could be autoregressive. Thus, the model used to achieve objective 1 was expressed as follows:

$$API_{it} = \phi_0 API_{it-1} + \phi_1 InfraI_{it} + \phi_2 P2T_{it} + \phi_3 P2T^2{}_{it} + \phi_4 LMI_{it} + \phi_5 GPI_{it} + \gamma_t + \chi_{it} \quad (8)$$

Where, API_{it}, is academic performance at the basic level for district i at time t; API_{it-1} is previous years academic performance; $InfraI_{it}$ which is the Infrastructure Quintiles is a measure of infrastructural inequality for district i in time t; $P2T_{it}$ is pupil to teacher ratio or the class size of district i in time t; LMI_{it} is a measure of learning material (i.e. Mathematics, English or Science textbook) for district i in time t; GPI_{it} is gender parity index of district i in time t; γ_t is the time-specific variable; and $x_{it}$is the white noise.

Separate estimations were done to ascertain the subject specific-effect of infrastructure inequality on academic performance. Accordingly, equation 8 was applied to the individual subject areas using performance in the particular subject as the dependent variable—performance in Mathematics (PerfM), performance in English (PerfEng), performance in Science (PerfSci) and performance in Social Studies (PerfSS).

Equation 8 basically says that the conditioning factors for current performance include past performance, infrastructure inequality, pupil to teacher ratio (class size), learning materials (textbooks) and gender parity index. The inclusion of the lag dependent variable allows for assessing whether academic performance of basic schools at the district level is auto-distributive but raises a number of estimation challenges. The inclusion of the lag dependent variable creates an endogeneity condition which violates the assumption by both the fixed and random effects models that the explanatory variables are strictly exogenous. This makes the Ordinary Least squares (OLS), fixed-effects general least squares (GLS) and the random effects GLS inappropriate for estimating equation 8. The traditional transformation may not yield consistent results because it does not take account of the potential correlation between the lag-dependent variable and the white noise (Hsiao, 1986). Arellano and Bond (1991) propose that for a regression model like equation 8, efficient and consistent results could be achieved by first differencing the model to wipe out the school-specific variables and then using the previous years' lags and some exogenous variables as instruments in a general method of moments (GMM) estimation. Unfortunately, however, Roodman (2009a, 2009b) argue that the approach recommended by Arellano and Bond (1991) could introduce some biases especially for small samples.

The GMM systems approach provided by Roodman (2009a, 2009b) and used in recent dynamic panel estimations (Boateng et al., 2018; Asongu & Nwachukwu, 2016a; Roodman, 2009a & Roodman 2009b Baltagi, 2008; Love & Zicchino, 2006) is known to offer consistent and unbiased estimations that do not suffer the weaknesses that are inherent in the Arellano and Bond (1991) approach. The Roodman approach has the advantages of allowing researchers to observe cross sectional variations; controlling for unobserved heterogeneity as well as accounting for endogeneity by using instrumental variable approach; correcting for biases in the difference estimator; reducing overidentification and accounting for cross-sectional dependence (Doyle, 2017). The model can be written as follows:

$$API_{it} = \gamma_0 + \gamma_1 API_{it-\tau} + \sum_{h=1}^{5} \gamma_h W_{h,it-\tau} + \theta_i + \mu_t + \varepsilon_{it}. \tag{9}$$

$$API_{it} - API_{it-\tau} = \gamma_1 (API_{it-\tau} - API_{it-2\tau}) + \sum_{h=1}^{5} \gamma_h (W_{h,it-\tau} - W_{h,it-2\tau}) + (\mu_t - \mu_{t-\tau}) + \varepsilon_{it-\tau}, \tag{10}$$

Where API is the academic performance of district i in time t; γ_0 is a constant; W is a vector of control (infrastructure inequality, pupil to teacher ratio, learning materials(textbooks) and gender parity index); τ represents the coefficient of autoregression which is one for the specification, $\mu_t$is the time-specific constant, θ_i is the district-specific effect, and $\varepsilon_{it}$the error term.

Post-estimation and diagnostic tests

The study considered the explanatory indicators defined as suspected endogenous or predetermined and only time-invariant variables were considered to be strictly exogenous (Boateng et al., 2018; Asongu & Nwachukwu, 2016; Roodman, 2009b). The diagnostic statistics conducted included autocorrelation tests, test of exogeneity of the instruments used and the assumption that the strict exogenous variables influence the dependent variable.

Autocorrelation, also known as serial correlation, occurs when the error terms in a regression model are correlated over time. In GMM, it's crucial to ensure that the errors are not correlated, as correlated errors can lead to inefficient or biased parameter estimates. If the model is correctly specified, the second order autocorrelation (AR (2)) should not be significant.

The results from Sargan overidentification test was used in support of strict exogeneity of the time invariant variables. The Sargan-Hansen test assesses whether the set of instruments used in your model is uncorrelated with the residuals. If the test's p-value is sufficiently high (indicating no correlation between instruments and residuals), it suggests that the instruments are exogenous and the GMM model is well-specified.

Definition of variables and Expected signs

The variables used to examine the effect of infrastructure inequality on academic performance are defined in Table 2.

Table 2: Definition of variables and Expected signs

VARIABLE	DEFINITION	EXPECTED SIGN
PerfM	Performance in Mathematics: ratio of the total number of candidates who passed the BECE Mathematics and the number of candidates who sat the examination;	
PerfEng	Performance in English: the ratio of total number of candidates who passed the BECE English and the number of candidates who sat the examination;	
PerfSS	Performance in Social Studies: ratio of the total number of candidates who passed the BECE Social Studies and the number of candidates who sat the examination;	
PerfSci	Performance in Science: ratio of the total number of candidates who passed the BECE Science and the number of candidates who sat the examination	
API	Academic Performance Index: Is an index constructed using principal component analysis from the performance in BECE Mathematics, English, Science and Social Studies. The index is constructed for district *i* in time *t*;	
Seatratio	Seating place: It is measured as ratio of number of seating places to number of pupils for district *i* in time *t*	Positive
Writeratio	Writing place: It is measured as ratio of number of writing places to number of pupils for district *i* in time *t*	Positive
Classratio	Classroom: It is measured as ratio of total number of classrooms (less the number of classrooms that must undergo	Positive

	major repairs) to number of pupils in district *i* in time *t* ;	
Waterratio	Water: This is measured as ratio of the number of basic schools with access to drinking water to total number of basic schools in district *i* in time *t;*	Positive
Toiletratio	Toilet: It is measured as the ratio of number of basic schools with toilet to drinking water to total number of basic schools in district *i* in time *t*	Positive
InfraI	It is an infrastructure index constructed using principal component analysis from five infrastructure variables. They include classrooms, seating place, writing place, toilet and water. The index is constructed for district *i* in time *t;*	Positive
Mathtbk	Mathematics Textbook: It is the average number of students to a Mathematics textbook for districts *i* in time *t*;	Negative
Engtbk	English Textbook: It is the average number of students to an English textbook for districts *i* in time *t*;	Negative
Scitbk	Science Textbook: It is the average number of students to a Science textbook for districts *i* in time *t*;	Negative
P2Tratio	Pupil-to-teacher ratio: This is the ratio of total enrolment of pupils in schools and the total number of teachers for districts *i* in time *t*;	Negative
GPI	Gender parity index: This is a ratio of female enrolment and male enrolment for district *i* in time *t;*	Indeterminate

Results and Discussion

This section focuses on the analysis of the effect on infrastructure inequality on academic performance. It begins with the presentation of the descriptive statistics. It also comprises the reporting of the results of the empirical study and then discussion of the findings. Infrastructure index and performance index were derived from various educational infrastructure and performance in the core subjects in BECE examinations, respectively.

Principal Component Analysis

PCA method was used to transform a relatively five set of correlated infrastructure variables into an uncorrelated variable. This was done for the various years (2010-2016). From Appendix A1, the first and second components had Eigen value greater than 1. In line with Kaiser (1974;1960), therefore, the first and second components are retained. As shown in A1, the components are made up of five items, comprising seating place ratio, writing place ratio, classroom ratio, drinking water ratio and toilet ratio. The Rho for all the years were greater than 0.50 (between 0.6553 and 0.7543) This is therefore an indication that the infrastructure index generated contains more than 50% of the information of the variables

A performance index was generated using the performance in BECE core subjects such as Mathematics, English, Social Studies and Science. Appendix A2, shows Component 1 as the only component with an Eigen value greater than 1 for all the years. Appendix A2, presents the four items that constitute academic performance index. They are percentage who passed in Mathematics, English, Social Studies and Science. The Rho for all the years were greater than 0.50 (between 0.8952 and 0.9447) This is therefore an indication that the infrastructure index generated contains about 90% or more of the characteristics of the original performance variables.

Figure 8 shows a presentation of the trend of infrastructure index over the years 2010 to 2016. The figure generally shows a gradual increase in infrastructure over the period. It was relatively low (although increasing) between 2010 and 2012 while it stagnated in 2012. There was however, a steady rise in infrastructure index from 2013 to 2016 and it further, experienced a dip in 2016. The stagnation and the downtrend in 2012 and 2016 interestingly coincided with election years. This seems to suggest that educational infrastructure suffer in election years.

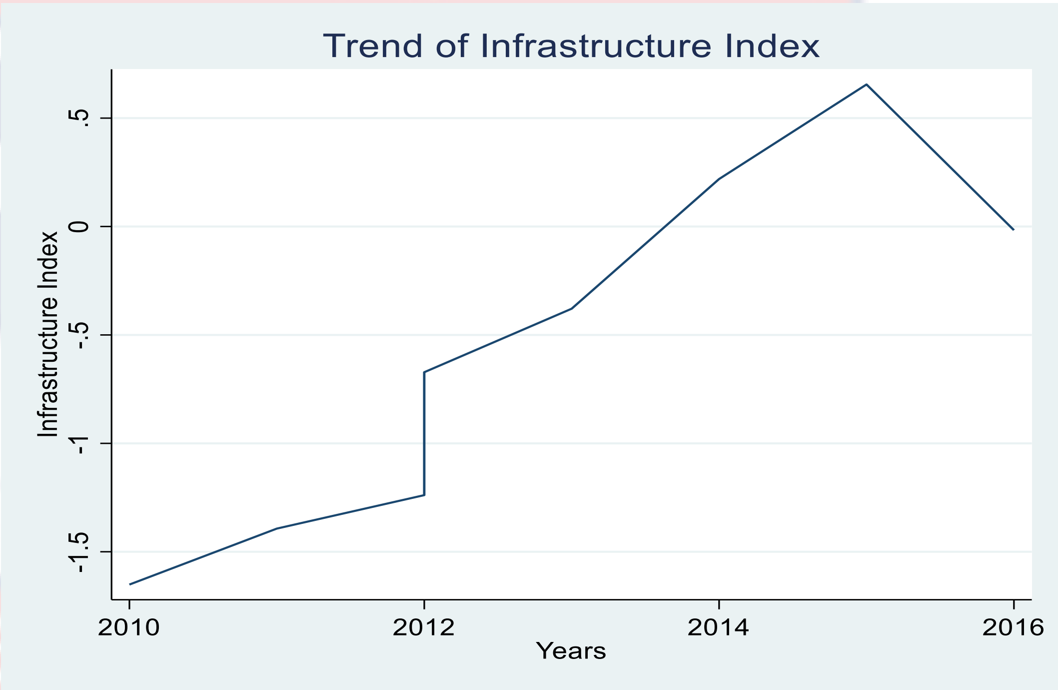


Figure 8: Trend of Infrastructure Index (2010-2016)

Source: GSS Education Data, 2018

The infrastructure index generated was categorised into quintiles (infrastructure quintiles). The study used these infrastructure quintiles to show the variation in the distribution of infrastructure across the districts and thus served as a measure of infrastructure inequality. It ranged from Quintile 1 with the lowest quality educational infrastructure, Quintile 2, Quintile 3, Quintile 4, through to Quintile 5 that has the highest quality of infrastructure.

Figures 9 and 10 and Appendix A3 show the infrastructure and academic performance indexes across the districts in Ghana for 2016. The maps show vast variations in the distribution of infrastructure across the districts in Ghana. The infrastructure index was high in the middle and southern belts of the country as compared to the northern part. Districts like Berekum Municipal, Asante-Akim North, Ga East Municipal, Ashaiman Municipal, West Akim Municipal, Akwapim North Municipal, Akwapim South, Adenta Municipal, East Akim Municipal, Upper Manya Krobo, Obuasi Municipal, Ekumfi, Abura-Asebu–Kwamankese and Cape Coast Metropolitan all had high infrastructure index indicating the high quality of educational infrastructure in these districts. Conversely, districts like Pusiga, Krachi-Nchumuru, East Mamprusi, Mion, Kpandai, Offinso North, Tolong, Binduri North Gonja, Bia, Nanumba North, Pru and West Mamprusi are some of the districts with the lowest quality of infrastructure. Figure 10 also reflects the academic performance at the district level. Krachi West, Tatale-Sangule, Binduri, North Gonja, Upper Manya Krobo, Nanumba North, Gushiegu, Nandom, Pusiga, Saboba, Nadowli-Kaleo, Chereponi, West Mamprusi, Lawra, Krachi East and Sissala East.were among the worst performing districts in the country. The results show that most of the districts in Northern Regions of the country lag behind in terms of their performance in the BECE.

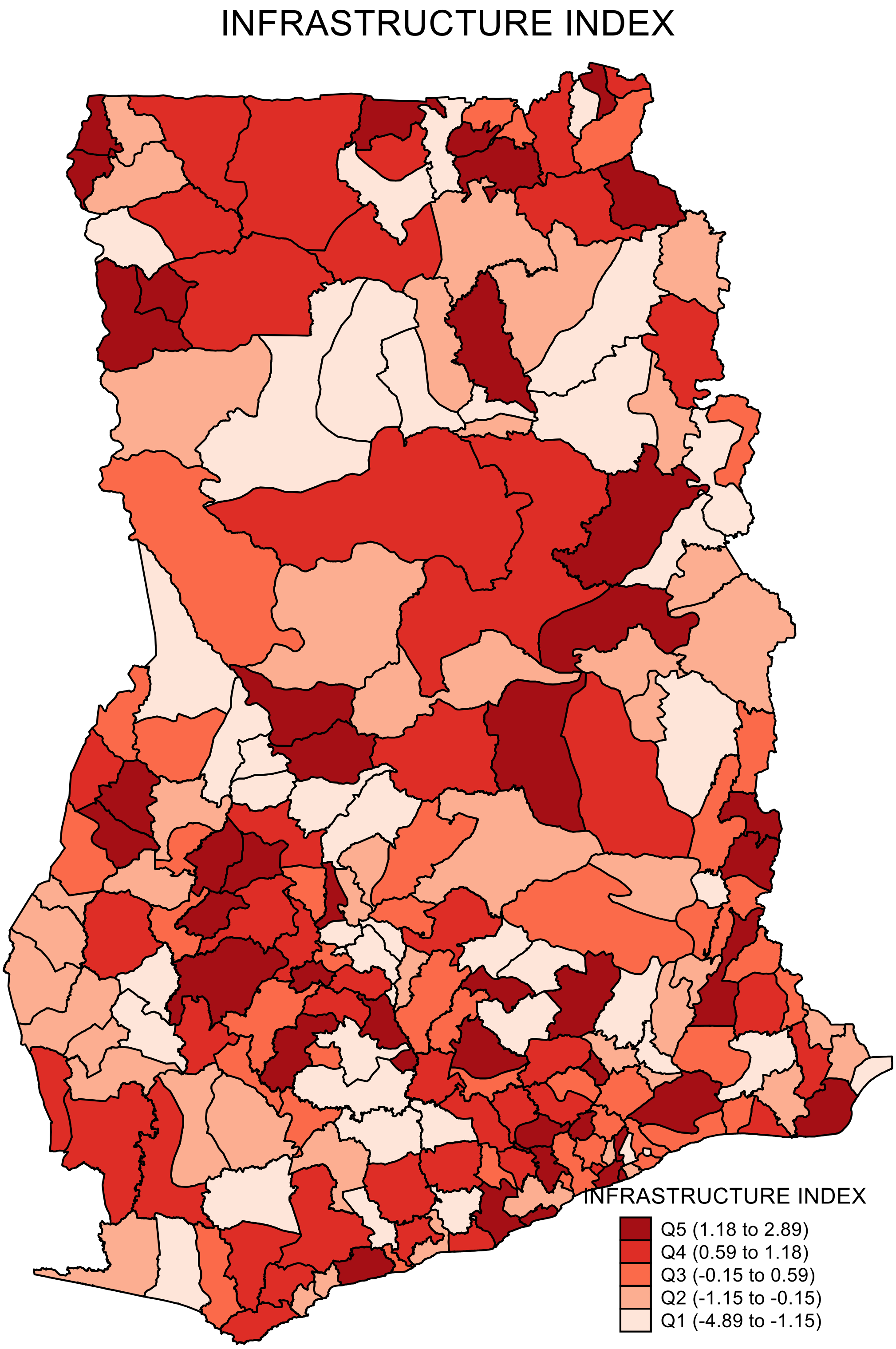


Figure 9: Map of Ghana showing infrastructure index across the districts in Ghana for 2016

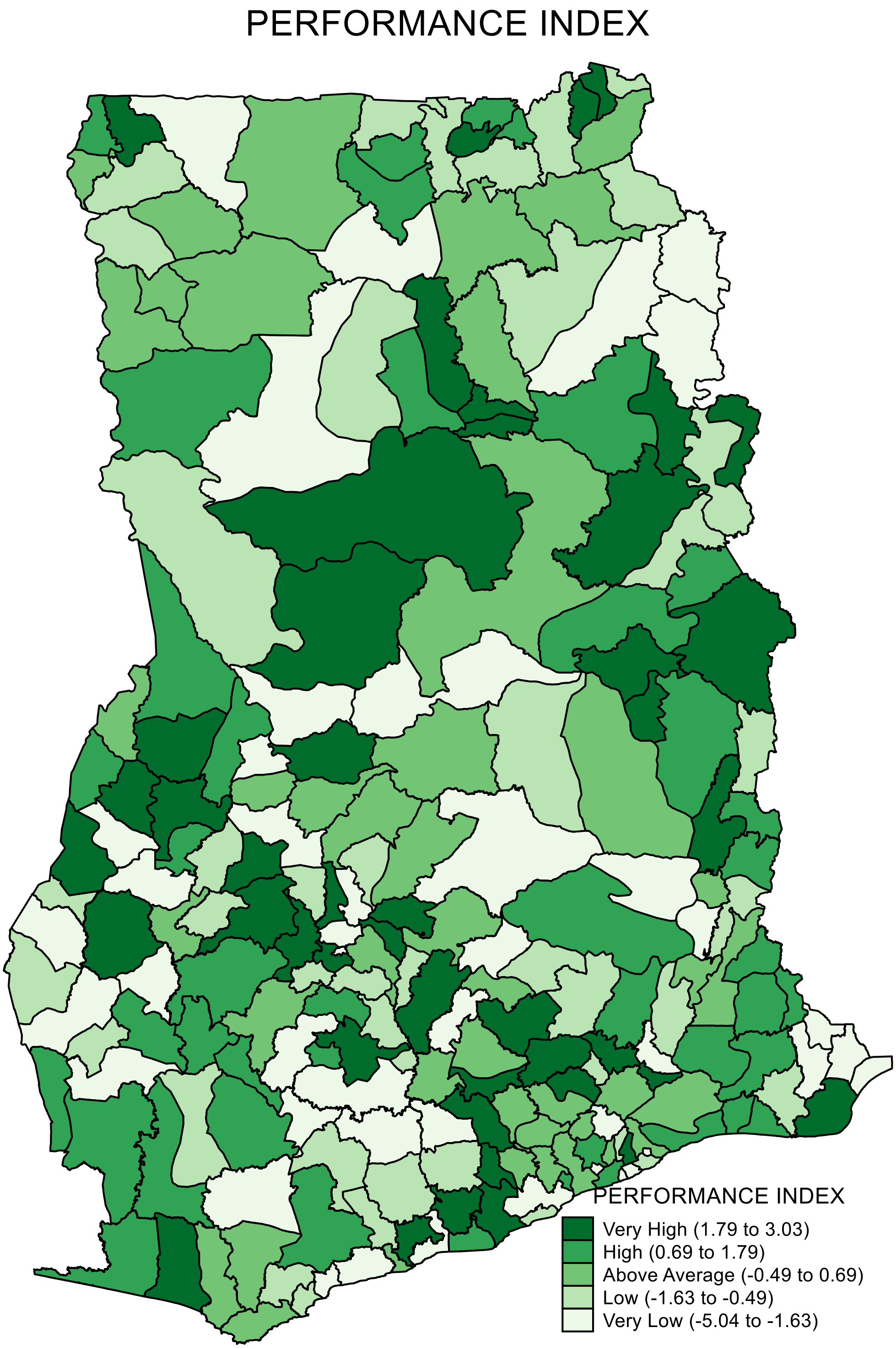


Figure 10: Map of Ghana showing Academic index across the districts in Ghana for 2016

Descriptive Statistics

The descriptive statistics on the variables used for the study are presented in Table 3. Table 3 shows the panel descriptive statistics derived using the xtsum command in Stata. It has overall, between and within descriptive statistics.

The overall and within statistics measured over a district-year observation was represented by N (eg. N=1334). The between statistics were estimated over 215 districts (n=215) whiles the average number of years a district was observed is denoted by T-bar (eg. T-bar=6.20465). The table also shows the average value of variables across all districts as well their minimum, maximum and standard deviations. The minimum represents the lowest value whiles the maximum denotes the highest value across districts. (Al- Ahdal, et al., 2020).

The pass rates in BECE Mathematics (PerfM), English (PerfEng), Social Studies (PerfSS) and Integrated Science (PerfSci) have been presented in Table 3. PerfM had an overall mean of approximately 0.665 (66.5%) and varied between a minimum of 0.128 (12.8%) and maximum of 1 (100%) with a standard deviation of 0.207. This is an indication of high variation in the performance in BECE Mathematics across the districts. Further, Table 3 indicates the average performance in Mathematics to be higher than English (63.7%), Social Studies (65.9%) and Science (66.2%) with the performance in BECE English recording the lowest mean pass rate. These relatively high means suggest that on average, the districts performed well in all subjects. Again, performance in English (2.9%) was the lowest minimum pass rate when compared with Mathematics (12.8%), Social Studies (15.1%) and Integrated

Science (14.2%). And Social Studies had the best minimum score among all four subjects. For all the subjects, the variation between the minimum and the maximum were wide. This attest to the fact the academic performance in the four subjects is associated with huge disparities across the districts of Ghana. Academic Performance Index (API) consistently had a wide range as well (between -5.64 and 5.04).

Furthermore, there was disparity in the distribution of desk and chairs across the districts in the country. The mean of Seatratio was 0.8197 with a minimum of 0.0043 and a maximum of 1. This implies that on average there were 1.22 (1/0.8197), or approximately 2 pupils to a seat. The Seatratio had wide range between as high 232.56 (1/0.0043) or 233 pupils to a seat. This shows that whereas serious inadequacy of seat in some districts, others had enough seats for every pupil.

Also, the mean of Writeratio was 0.8307 with a minimum of 0. 0479 and a maximum of 6.8778. This suggests that on average there were 1.20 (1/0.8307), or approximately 2 pupils to a writing desk. The Writeratio had wide range between as high 20.88 (1/0. 0479) or 21 pupils to a desk and 0.1453 (1/6.8778). This shows that whereas serious inadequacy of desks in some districts, others had enough desks for every pupil.

The average of Classratio was 0 0212 with a minimum of 0.0072 and a maximum of 0.0801. This implies that on average there were 47.16 (1/0.0212), or approximately 48 pupils to a classroom. The Classratio had wide range between as high as 138.88 (1/0.0072) or 139 pupils to a classroom and as low as 12.48 (1/0.0801) or 13 pupils to a classroom.

The Waterratio had an average of 0.4045 with a minimum of 0 and a maximum of 2.1757. This means that averagely, only 40.5% of schools out of the total number of schools in a district had access to water. Again, some had no source of water while some districts had 217.6% which imply that some adequate water supply.

The Toiletratio had an average of 0 4637 with a minimum of 0 and a maximum of 1.6782. This means that averagely, only 46.4% of schools out of the total number of schools in a district had access to toilet facility. Again, some had no source of toilet while some districts had 167.8% implying that some appropriate toilet facilities.

Infrastructure Index (InfraI) which ranged between -5.4230 and 6.2548 was an indication of the quality of aggregate educational infrastructure. The smaller InfraI, the lower the quality of educational infrastructure and the bigger InfraI, the higher the quality of educational infrastructure.

Table 3 again, shows the access to textbooks in schools across the districts in Ghana. On the average, there were 2 pupils to an English textbook and three pupils to a Mathematics and Science textbook. The inadequacy of textbooks was portrayed by the maximum number of 73, 71 and 61 pupils to an English, a Mathematics and a Science textbook respectively.

The pupil to teacher ratio (P2Tratio) had a mean of about 17 students to a teacher. In some districts there were about 3 (2.49) pupils to a teacher while in others it is almost 61 (60.9) pupils to a teacher. Gender Parity Index (GPI) had an average of 86.3%. This shows that on the average there were more boys than girls in basic schools in Ghana. There was a minimum of 31.4% to a maximum of 162.3% girls to boys in a district.

Table 3: Summary Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
PerfM	overall	.6654579	.2073842	.1280521	1	N = 1334
	between		.1630127	.3081555	.9894718	n = 215
	within		.1308266	.1630442	1.092422	T-bar = 6.20465
PerfEng	overall	.6365131	.1902948	.0298013	1	N = 1328
	between		.1361944	.2770519	.9539303	n = 215
	within		.1349267	.1957403	1.040023	T-bar = 6.17674
PerfSS	overall	.6586479	.1896981	.1513836	1	N = 1323
	between		.1373903	.3060345	.9693234	n = 215
	within		.1331195	.1609829	1.039998	T-bar = 6.15349
PerfSci	overall	.6622045	.1869591	.1421595	1	N = 1327
	between		.1383007	.320179	.9759907	n = 215
	within		.1276983	.1917052	1.047843	T-bar = 6.17209
API	overall	1.82e-09	1.822405	-5.644176	5.039521	N = 1311
	between		1.56577	-3.87954	3.724625	n = 215
	within		.9618454	-4.575513	3.447201	T-bar = 6.09767
Seatratio	overall	.819742	.1744396	.0043465	1	N = 1364
	between		.1341329	.3232667	1	n = 215
	within		.1157602	.0834148	1.163634	T-bar = 6.34419
Writeratio	overall	.830724	.2751542	.0479817	6.877789	N = 1351
	between		.1830388	.3079154	1.831114	n = 215
	within		.2084151	-.0554766	5.877399	T-bar = 6.28372
Classratio	overall	.0212562	.0058348	.0072406	.0801909	N = 1358
	between		.0048223	.0100449	.0388841	n = 215
	within		.0034922	.0069479	.0656909	T-bar = 6.31628
Waterratio	overall	.4045577	.2669309	0	2.175743	N = 1357
	between		.1270386	.0680949	.7482539	n = 215
	within		.2360797	-.2243779	1.832046	T-bar = 6.31163
Toiletratio	overall	.4637822	.2153197	0	1.678218	N = 1362

	between		.1024518	.1354402	.7178409	n = 215
	within		.1905179	-.121483	1.424159	T-bar = 6.33488
InfraI	overall	9.76e-10	1.464196	-5.423042	6.254864	N = 1345
	between		1.230963	-4.428328	2.369512	n = 215
	within		.8485942	-3.502616	3.885352	T-bar = 6.25581
Mathtbk	overall	2.092824	2.318948	0	70.11321	N = 1029
	between		1.1205	1.083034	15.78757	n = 215
	within		2.025981	-11.72361	56.41846	T-bar = 4.78605
Engtbk	overall	1.957248	2.340292	0	72.86275	N = 1029
	between		1.109755	1.004858	16.15752	n = 215
	within		2.053278	-12.36252	58.66247	T-bar = 4.78605
Scitbk	overall	2.112222	2.058883	0	60.91803	N = 1029
	between		1.071742	.9488653	13.91955	n = 215
	within		1.756319	-9.761227	49.11071	T-bar = 4.78605
P2Tratio	overall	16.86922	5.554812	2.496021	60.83908	N = 1357
	between		5.028732	9.855083	47.11537	n = 215
	within		2.699251	4.018344	37.68014	T-bar = 6.31163
GPI	overall	86.31666	13.80679	31.43204	162.3086	N = 1370
	between		12.93532	48.41842	119.5248	n = 215
	within		5.224239	49.16196	137.6389	T-bar = 6.37209

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Multicollinearity Test

Table 4 shows pairwise correlation matrix used to test for multicollinearity. The correlation coefficients were high between the infrastructure variables (classroom, writing place, seating place, toilet and water) as well as the performance in respective subjects. Due to the multicollinearity concerns, individual variables were introduced one at a time. As a result, five models were estimated.

Table 4: Correlation Matrix

	PerfM	PerfEng	PerfSS	PerfSci	API	Seatratio	Writeratio	Classratio	Waterratio	Toiletratio	InfraI	Mathtbk	Engtbk	Scitbk	P2Tratio	GPI
PerfM	1.000															
PerfEng	0.738	1.000														
	0.000															
PerfSS	0.850	0.795	1.000													
	0.000	0.000														
PerfSci	0.870	0.802	0.846	1.000												
	0.000	0.000	0.000													
API	0.834	0.767	0.816	0.843	1.000											
	0.000	0.000	0.000	0.000												
Seatratio	-0.017	0.097	0.047	0.043	-0.000	1.000										
	0.526	0.000	0.089	0.123	0.995											
Writeratio	-0.035	0.028	0.003	0.005	-0.049	0.615	1.000									
	0.203	0.297	0.910	0.841	0.078	0.000										
Classratio	0.148	0.307	0.191	0.194	0.136	0.312	0.189	1.000								
	0.000	0.000	0.000	0.000	0.000	0.000	0.000									
Waterratio	-0.272	-0.216	-0.273	-0.262	0.004	-0.068	-0.031	-0.090	1.000							
	0.000	0.000	0.000	0.000	0.878	0.012	0.250	0.000								
Toiletratio	-0.295	-0.203	-0.283	-0.288	-0.060	0.037	0.058	-0.034	0.747	1.000						
	0.000	0.000	0.000	0.000	0.029	0.165	0.031	0.202	0.000							
InfraI	-0.052	0.122	0.013	0.020	0.032	0.741	0.595	0.546	0.311	0.373	1.000					
	0.056	0.000	0.627	0.469	0.243	0.000	0.000	0.000	0.000	0.000						
Mathtbk	0.018	-0.010	-0.013	0.009	-0.016	-0.117	-0.075	-0.076	0.098	0.051	-0.090	1.000				
	0.565	0.736	0.673	0.756	0.603	0.000	0.015	0.014	0.001	0.100	0.003					
Engtbk	0.017	-0.018	-0.020	0.011	-0.010	-0.092	-0.062	-0.059	0.068	0.015	-0.070	0.965	1.000			
	0.587	0.557	0.507	0.709	0.739	0.003	0.047	0.055	0.027	0.619	0.025	0.000				
Scitbk	0.021	-0.009	-0.007	0.015	-0.014	-0.125	-0.099	-0.069	0.043	-0.017	-0.114	0.953	0.964	1.000		
	0.493	0.773	0.816	0.630	0.649	0.000	0.001	0.027	0.161	0.584	0.000	0.000	0.000			
P2Tratio	-0.129	-0.170	-0.115	-0.135	-0.118	-0.132	-0.122	-0.331	0.110	0.054	-0.178	0.175	0.151	0.193	1.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.000	0.000	0.000	0.000		
GPI	0.123	0.238	0.179	0.168	0.166	0.098	0.011	0.199	0.039	0.031	0.178	-0.099	-0.090	-0.098	-0.355	1.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.672	0.000	0.150	0.241	0.000	0.001	0.003	0.001	0.000	

Discussion of Empirical Results

The study sought to find out the effect of the disparity in distribution of infrastructure on academic performance. Firstly, an estimation was done to determine whether academic performance differed at Infrastructure Quintile levels. There was also an estimation to find the factors accounting for performance in each of the four subjects (Mathematics, English, Science and Social Studies) as well as an aggregated performance index.

ANOVA

There was an estimation to assess whether academic performance differed based on the Infrastructure Quintile levels using one-way Anova. The results in Table 5 shows that there was a statistically significant difference in performance in Mathematics between the Infrastructure Quintile levels with $F(4, 1304) = 2.33$ at $\rho = 0.0544$. The between group sum of squares was .3971 with 4 degrees of freedom while the within group is 55.6318 with a degree of freedom of 1304. The total sum of squares was 56.0289 with a 1308 degree of freedom. There was a statistical difference in performance in English ($F(4, 1298) = 6.18$; $\rho = 0.0001$) and Integrated Science ($F(4, 1297) = 2.53$; $\rho = 0.0389$) based on the Infrastructure Quintile levels. However, performance in Social Studies and the aggregated Academic Performance API did not differ at the Quintile levels.

Table 5: Comparison between academic performance and Quintiles using One-way ANOVA

		Sum of squares	df	Mean squares	F	Sig.
MATHEMATICS	Between groups	.3971	4	.0993	2.33	0.0544
	Within groups	55.6318	1304	.0427		
	Total	56.0289	1308	.0428		
ENGLISH	Between groups	.8856	4	.2214	6.18	0.0001
	Within groups	46.5270	1298	.0358		
	Total	47.4126	1302	.0364		
SOCIAL STUDIES	Between groups	.2294	4	.0574	1.59	0.1732
	Within groups	46.6111	1296	.0359		
	Total	46.8405	1300	.0360		
INTEGRATED SCIENCE	Between groups	.3515	4	.0879	2.53	0.0389
	Within groups	45.0273	1297	.0347		
	Total	45.3788	1301	.0349		
API	Between groups	11.7995	4	2.9499	0.89	0.4677
	Within groups	4244.5749	1284	3.30574		
	Total	4256.3744	1288	3.30463		

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Generalised Method of Moments

This section sought to achieve the objective of ascertaining the relationship between infrastructure inequality and academic performance. The estimations were done based on system GMM estimation technique proposed by Roodman (2009a). The diagnostic statistics conducted, as reported in Table 6 included autocorrelation tests, test of exogeneity of the instruments used and the assumption that the strict exogenous variables influence the dependent variable. The diagnostic tests show that the estimated models are effective in explaining the relationship between infrastructure and academic performance.

Infrastructural inequality and academic performance

The performance in BECE Mathematics, English, Social Studies and Science and their determinants are shown in Table 6. Model 1 to 4 represents performance in Mathematics, English, Social Studies and Science respectively whiles Model 5 represents an aggregation of performance in the four subjects.

Infrastructure Index (InfraI) was split into Quintile 1 through to Quintile 5 representing the lowest quality of educational infrastructure to the highest quality of infrastructure respectively. For the system GMM estimation, the base category for infrastructure quintile was Quintile 1. The lowest three quintiles had significant results for Model 1 to 4 but only Quintile 2 was significant for Model 5. Only English language recorded significant results at Quintile 5. The coefficient for Quintile 2 and Quintile 3 increased at increasing returns for Models 1 to 4. So was the case in Quintile 4 for Model 1 (Mathematics). However, Quintile 4 for Models 2, 3 and 4 increased at a decreasing rate.

The top quintiles having a higher coefficient than the lowest quintile (Quintile 1), seems to point to the existence of infrastructure inequality. Top quintiles were associated with higher performance in the various subjects than Quintile 1. Interestingly however, the middle quintile had the greatest coefficient for all Models except for Model 1.

Also, for Mathematics, previous academic performance had a significant positive relationship with performance in Mathematics confirming the findings of Zakariya (2020). This suggests that a district's previous performance in

Mathematics would likely influence subsequent performance. The story was the same for all other subjects. Among the individual subjects, Science recorded the highest coefficient (0.238) as a percentage change in previous year's performance in Science caused approximately 24% improvement in current year's performance. This is followed by English (0.234) Mathematics (0.206) and Social Studies (0.179). This could be accounted for by the zeal to improve performance that leads to increase in the amount of effort put in preparing for examination.

The pupil to teacher to ratio (P2T ratio) had a significantly inverse relationship with performance in all four subjects. An increase in P2T ratio induced a 5.39, 5.34, 4.78 and 3.83 percentage fall in performance in Mathematics, English, Social Studies and Science respectively. This implies that a smaller class size aids the performance in mathematics. This falls in line with the findings that education returns are higher when pupil to teacher ratio is low (Card & Krueger, 1992). This relationship could be attributed to the fact that the teachers gain control of the class are able to effectively monitor each student, hence improving their performance (Bouguen et al., 2017; Blatchford, 2016). But the argument is whether a smaller size would not reduce competition among students. That is, if a smaller class size would always lead to an increase in performance in Mathematics.

The results also show that, as squared of pupil to teacher ratio ($P2T^2$) increases, performance in BECE increases in all subjects. This suggests that, the class size may not always have a negative relationship with performance. At a point, the relationship becomes positive, in that, large class size could increase performance (Dobbelsteen et al., 2002; Lazear, 1999). The quandary however, is the optimal class size that improves performance. The positive relationship between a larger class size and performance could be explained by the opportunity of peer tuition since students may learn from each other. Also, a larger class size may increase competition in the class, thereby improving their performance in examination. The number of students to a textbook ratio had no significant effect on performance in all subjects.

In addition, the only subject that recorded a significant relationship between gender parity index (GPI) and academic performance was English. GPI was inversely related to performance in English as shown by model 2 of Table 6. Although some literature such as White (2003) perceives performance in English to be the gendered in nature with girls outperforming boys, this results suggests that as ratio of girls to boys increases, academic performance in English decreases. It implies that the composition of students in the English class could have relevant implication on the performance in English. The large presence of girls in a class, could subdue the competition in the class. In that, as a result of the dominance of the girls, the boys would be suppressed and they may not be able to put their best efforts that would improve performance.

Table 6: Regression Results on the infrastructure inequality and academic performance

VARIABLES	(1) PerfM	(2) PerfEng	(3) PerfSS	(4) PerfSci	(5) API
L. PerfM	0.206*** (0.0690)				
L. PerfEng l		0.234*** (0.0724)			
L. PerfSS			0.179*** (0.0668)		
L. PerfSci e				0.238** (0.116)	
L.API					0.918*** (0.0804)
Mathtbk	-0.00695 (0.0129)				-0.163 (0.169)
Engtbk		-0.00613 (0.0116)	0.00844 (0.0172)		0.111 (0.279)
Scitbk				0.000824 (0.0123)	-0.00548 (0.233)
InfraI (Base: Quintile1)					
Quintile 2	0.0771*** (0.0260)	0.0547** (0.0224)	0.0902*** (0.0226)	0.0836*** (0.0278)	0.377** (0.173)
Quintile 3	0.105*** (0.0288)	0.0821*** (0.0232)	0.120*** (0.0256)	0.0992*** (0.0304)	0.252 (0.202)
Quintile 4	0.107*** (0.0292)	0.0613** (0.0261)	0.110*** (0.0259)	0.0812** (0.0326)	0.0343 (0.204)
Quintile 5	0.0474 (0.0346)	0.0305 (0.0280)	0.0567* (0.0294)	0.0508 (0.0375)	0.0397 (0.240)
P2T	-0.0539*** (0.00918)	-0.0534*** (0.0153)	-0.0478*** (0.00864)	-0.0383* (0.0199)	-0.0148 (0.0239)

$P2T^2$	0.00146***	0.00144***	0.00132***	0.00108**	0.000450
	(0.000251)	(0.000386)	(0.000240)	(0.000494)	(0.000362)
GPI	0.000725	-0.00199*	-0.000256	0.00157	0.00438
	(0.00109)	(0.00118)	(0.00113)	(0.00288)	(0.00697)
Constant	0.912***	1.121***	0.906***	0.655**	-0.260
	(0.135)	(0.182)	(0.128)	(0.329)	(0.787)
AR(1)[p-value]	0.000	0.000	0.000	0.000	0.000
AR(2)[p-value]	0.104	0.219	0.219	0.157	0.105
Sargan OIR	0.009	0.144	0.144	0.025	0.207
Hansen OIR	0.147	0.156	0.156	0.110	0.132
DHT for Instruments					
(a)GMM Instruments for levels					
H excluding group	0.041	0.022	0.022	0.005	0.131
Diff(null, H=exogenous)	0.512	0.673	0.673	0.852	0.265
(b) IV(years, eq(diff))					
H excluding group	0.125	0.146	0.146	0.121	0.117
Diff(null, H=exogenous)	0.563	0.369	0.369	0.200	0.498
Fisher	8.65***	7.69***	10.06***	4.11***	333.77***
Instrument	35	39	35	32	45
Observations	956	946	942	947	924
Number of Districtcode	215	215	215	215	215

Source. Authors' estimation based on GSS Education Statistics Data (2018).

Significant level: *** p<0.01, ** p<0.05, * p<0.1. Standard errors are in parenthesis. Where DHT is Difference in Hansen Test for Exogeneity of Instruments' Subsets. Diff: Difference. OIR: Over-identifying Restrictions Test. PerfM is performance in Mathematics; PerfEng is performance in English, PerfSS is performance in Social Studies and PerfSci is performance in Integrated Science. P2T is measure of the class size (pupil-to-teacher ratio); $P2T^2$ represents squared of pupil-to-teacher ratio; GPI represents gender parity index; Mathtbk is the number of students to Mathematics textbook, Engtbk is the number of students to English textbook, Scitbk is the number of students to Science textbook whereas InfraI represent Infrastructure Index.

Conclusion

The discussion on the factors that influence the instructional process have evolved over time. There have however, been inconclusive results on the drivers of academic performance. This study sought to provide an empirical assessment of the components of the educational function in Ghana. In doing so, the study analysed the effect of previous performance on current performance through the use of five separate models in a dynamic panel framework. Also, the disparities in the distribution of infrastructure and its eminent impact on academic performance was also investigated.

The study established that previous academic performance, infrastructure, pupil-to-teacher ratio, learning materials and gender parity index had relationship with academic performance. Previous academic performance generally positively impacted academic performance. This result is conditioned on the fact that good performance may breed the desire for improvement, thereby improving performance. There is therefore the need for school authorities to adopt cautious measures geared at maintaining or improving performance. The composition of students was generally not significant apart from the case in English where, GPI was inversely related to performance A small class size was also, associated with better academic performance. This notwithstanding, it was also shown that a relatively larger class size could be beneficial, hence, the need to ascertain the optimal class size.

Overall, infrastructure index positively affected performance in examination. It was established that, a higher infrastructure index for a district, would improve academic performance. This portrays the difference between the academic performance of districts with high quality infrastructure and those with low quality infrastructure. Thus, the results reiterate the need for to manage the disparities in the distribution of educational infrastructure in the country. Equity in the distribution of educational infrastructure across schools and districts therefore, is a prerequisite for overall improvement in the quality of education in the country.

CHAPTER THREE

EDUCATION INEQUALITY AND LABOUR RETURNS

Introduction

Education is viewed as an essential determining factor for labour returns. This is because educational level is often associated with a corresponding wage in the labour market. Studies on the rate of return of investment in education previously asserted that returns to education for the primary level was comparatively higher to succeeding levels of education (Psacharopoulos, 1994). Recent studies however, are portraying changing patterns in returns in education as shown by higher returns for higher education (Patrinos, 2019; Montenegro & Patrinos, 2014; Kingdon & Patrinos, 2010). The estimated benefit of schooling, calls for the offering of equal educational opportunities to all individuals in order to promote social returns and most importantly private returns to education in the form earnings. Regardless, there may be disparities in the distribution of education that may impact earnings of individuals in a country. The presence of such education inequalities may inhibit the reasonable distribution of earnings.

Educational investment is regarded as an essential tool in contributing to economic equality or earnings (World Bank, 2018). The investments in education are thus part of government policies on ensuring more equitable distribution of income in the labour market. It is argued that as the supply of highly-paid, skilled labour increases, in relation to the supply of unskilled labour, the laws of demand and supply will cause wage differentials to decrease leading to a more equitable distribution of income (Patrinos, 2019).

The role of education in enhancing productivity and possibly labour returns forms the basis for the pursuit of higher education. It calls for an appraisal of the costs and the expected benefit of education by the individual pursing education. If the benefit exceeds the cost, individuals will pursue higher education and fail to pursue higher education if the benefit is less than the cost. Some theories attempt to offer explanation for the causal relationship between education and earnings. Theories like the human capital and the signalling hypothesise the explicit channel through which education affects earnings. Education has often been used as a proxy for measuring human capital (Barrera-Osorio, & Bayona-Rodríguez, 2019; López Castellano, García-Quero, & García-Carmona, 2019; Quiggin, 1999). Human capital theorists argue intuitively that education confers productivity-enhancing human capital on an individual, and that the increased productivity then ensures increased earnings in the labour market (Kjelland, 2008). According to the neoclassical theory, disparities in income is predominantly as a result of the unequal investment into the human capital of a nation. This is based on the premise that additional schooling will enhance individual productivity and then a higher human capital would result in a higher earning.

On the other hand, signalling theory offers a counter argument that education only reflects inherent human capital. It is the embedded human capital that increases productivity and eventually result in higher wages (Kjelland, 2008). This school of thought hence posits that higher wages reflect the relationship between education and unobserved ability (Arteaga, 2017).

The various schools of thought divergent, all confirms education plays a vital role in labour market considerations. Thus, workers who are more educated would be highly preferred to the non-educated (Castellano, et al, 2019). Individuals with higher education are more likely to be employed as compared to the non-educated. In transitioning, it is anticipated that individuals who are educated would hold higher positions in their various fields of work whether private or public, because they have a competitive advantage over the non-educated. (Schultz, 1961). Schultz argued that, any form of education has a positive effect on the cognitive abilities of individual thus they appreciate things better than that of the un-educated. Educational attainment is therefore considered a key source of labour market opportunities and earnings.

Equal access to education is deemed a means to improve educational attainment and thus, is mostly considered as fundamental human right and is a requirement for an individual's wellbeing. Nevertheless, there are gaps created unequitable distribution of educational opportunities that may impede the realisation of this right to education for all individuals (Thomas et al., 2001).

When individual abilities are assumed to be normally distributed, then, skewness in the distribution of educational opportunities would make many people to be worse off. Equitable education opportunities would enhance redistribution of income and improve the labour returns of most individuals. Equitable education opportunities could boost individual wellbeing and could subsequently have a ripple effect social welfare (Thomas et al., 2001).

Education Gini is considered as one of the many indicators of welfare and it is usually used in the determination of the level variations in the distribution of educational opportunities in a country. There are a number of studies (Banzragch, Mizunoya, & Bayarjargal, 2019; Qian, & Smyth 2008; Thomas et al., 2001) that have estimated the education Gini. These studies mostly examined the relationship education Gini has with average educational attainment.

This study however, estimates the education Gini index as a measure of attainment in education and ascertains the effect of disparities in educational attainments on labour returns across the districts in Ghana. An inquiry into how disparities in education impact the distribution of earnings is of great significance in a developing country like Ghana where there are perceptions of a reeling income gap. Though the levels and trends of educational attainment as well as their indicators have largely been well researched, the study of educational inequality has received much less attention in the literature in Ghana. An appreciation of the distribution of education across the population is very key in explaining the disparities in earnings. High levels of educational inequality would likely worsen the disparities in earnings.

This study builds on the work of Appiah-Kubi (2003), Senadza (2012) and Baffour (2016) by generating district-level education Gini and assessing its effect on earnings using GLSS 6 and 7 that provide recent information on education inequality and earnings nexus. Furthermore, the uniqueness of this study is enhanced by the use of Heckman estimation technique and quantile regressions which allows for the control of omitted variable biases and the assessment of the effect of education inequality on earnings across the various distribution properties of earnings.

Literature Review

Theoretical Review

The theories underlying this study are the human capital theory and signalling or screening theory. Even though both the human capital and signalling theory agree that education influences earnings, they differ on the grounds of the channel of effects. Human capital theory highlights the role of education as enhancing the productive capacities of individuals and thus employment prospects and earnings, whiles the signalling theory considers education as an indicator of the productive capacity of individuals and aid in employment opportunities and earnings.

Human Capital Theory

Human capital theory is an economic concept that explains how investments in education, training, and other forms of human capital can lead to increased productivity and economic growth. The theory suggests that individuals and societies can benefit from investing in the education and training of their people, as this will increase the knowledge and skills of the workforce and make them more productive (Acheampong, 2018; Olaniyan & Okemakinde, 2008). This theory has been used to explain a variety of economic phenomena, including income inequality, the gender pay gap, and the role of education in economic development.

Human capital is considered as the accumulation of “skills and knowledge that influence productivity of individuals” (Barrera-Osorio & Bayona-Rodríguez, 2019). Schultz (1961) likens human capital to a property. It is seen as an underlying source of economic productivity (Romer, 1990). The theory assumes that individuals invest in education until the marginal gain in productivity is equal to the marginal cost (Schultz, 1961). With this, people with higher abilities should have a higher salary than those who do not. Investment in education should therefore increase labour returns as the labour increases productivity.

The model of human capital does not presume that labour units are homogeneous, but one of its important components is the assumption of non-homogeneous labour units. They hypothesise that people vary in terms of the form and level of skill they have. A rational explanation for the wage differentials could be situated in the differentials in skills (Arulampalam et al., 2005). Different levels of educational attainment are associated with their corresponding skills. The Human capital theorist are hence very explicit on the skills imbued through education (Tan, 2014). It is argued that education aids in nurturing cognitive skills, improving efficiency and thus enhancing the productivity of individuals (Schultz, 1961).

The productivity of employees is greatly influenced by their level of education; in other words, better educated employees produce more than less educated ones. (Castellano et al., 2019). There is therefore positive correlation between education and earnings (Tan, 2014). Higher educated individuals are more likely compared to non-educated individuals to get employment. The labor force with higher levels of education has an advantage over the others. (Schultz, 1961).

In essence, Schultz (1961) contended that education in any form improves a person's cognitive ability and as a result enhance appreciation of issues better than the un-educated. Increasing knowledge and abilities is a fundamental idea in the theory of human capital. A person's employability, earning potential, and productivity grow as the value of their human capital rises (Nussbaum, 2010).

The theory further reveals the flexibility of labour in the labour market. For instance, if an individual with enough knowledge and skills in a variety of different fields, loses their job they can seek for another job due to the skills they possess. In order to dependently or independently create these values, learning through education and training can be an important element in terms of defining the concept of human capital. Considering that experiences can be included as a category of knowledge, the human capital is synonym of knowledge embodied in an individual (Nussbaum, 2010).

In conclusion, with education and training, the individual gains knowledge and skills, or human capital (Ngcwangu, 2015). His or her productivity at work will grow as a result of these abilities. (Tan, 2014). As an individual's earnings in the perfect labour market are based on their productivity, this improved productivity will result in the individual receiving a higher wage (Nussbaum, 2010). As a result, individuals would invest in education up until the point at which the private benefits outweighed the private costs. Education and training are deemed as investments made by rational individuals in order to boost their productivity and incomes (Castellano et al., 2019). In this vane, education and training should be emphasised because there is a positive correlation between education and earnings (Tan, 2014).

The implication of the human capital therefore is that, in cases of occurrence of variations in the educational opportunities across a population, the less educated will be denied the opportunity to build up the necessary human capital. This will inform their employability in the labour market. Hence the need to assess the level of education inequality in the country and the bearing it has on earnings.

Signalling theory

Signalling theory is a concept from economics and sociology that describes how individuals use signals to convey information to others. The theory suggests that in certain situations, individuals have an incentive to send signals that reveal information about themselves or their actions, and that these signals can be used by others to make decisions or to form judgments.

In signalling theory, a signal is any action or characteristic that conveys information to others. For example, a college degree can be seen as a signal of a person's intelligence and dedication.

The theory postulates that, people have different levels of inherent abilities but no easy way to present it to potential employers. Hence, using education as a signal in the employment process will cause employers to depend on this information when less otherwise is known about the applicant (Rinne & Zhao, 2010). Signalling theory suggests that workers can effectively communicate their skills to prospective employers through education. As a result, people with higher ability levels use education to acquire the education signals that enable them to advance into positions of high status and high pay. Education signals merely act as a beneficial market function rather than imparting skills.

Education is a screening process that identifies people who are more talented and therefore more productive. Talents and skills are perceived to be intrinsic and individuals who are more talented attain higher levels of education, than those who are less talented. Employers are interested in individuals with prospective abilities in the labour market (Arrow, 1973; Spence, 1973). People's educational qualifications such as a degrees or diplomas act as an indicator or proxy for possible abilities (Sweetland, 1996). Without such a signalling or screening mechanism as schooling, there is a risk of under-allocating the talented, which would distort the labour market. The employer may use qualification as a screening mechanism even in the presence of other screening tools provided it is cheaper than any other device (Sweetland, 1996).

Besides, employees prefer to be identified since they will receive compensation appropriate to their skills. Hence, there will be persistent demand for education by individuals. This theory contends that education serves purposes other than increasing people's abilities and production. The ability of the educational system to discover possible productive future employees is the relationship between education and employment. It is asserted that if education serves as a signal, then within a group, the signal can be associated with an individual’s position in the distribution of education (Kroch & Sjoblom, 1994).

This goes to show in the event of uneven distribution of educational opportunities, some individuals may be disadvantaged in the sense those individuals with low opportunities may have low level educational qualification. As a result, these individuals may not be selected because of the signal that they give in the labour market. Improving educational opportunities for all individuals will therefore go a long way to enhance economic equality.

Empirical reviews

Education inequality and labour returns

Burgess et al. (2019) investigated the impact of selective education system on earnings inequality in which school assignment was based on initial test scores. The study used a large, representative household panel survey to compare adult earnings inequality of those growing up under a selective education system with those educated under a comprehensive system in England. It was a large longitudinal panel study following approximately 40,000 households in the UK which begun in 2009. The study employed OLS and unconditional simultaneous quantile regressions methods for analyzing the data. Controlling for a range of background characteristics and the location of the respondents, there was an extensive and significant different between the wage distributions and individuals who grew up in selective schooling areas. The total effect sizes portrayed earnings gap. This was explained and attributed mainly to differences across schooling systems. This depicted inequality in education and labour outcomes.

Palomino et al. (2019) estimated the importance of attained education and occupational category as mediating channels in the generation of inequality of opportunity in 26 European countries. The study used the Intergenerational Transmission modules in 2005 and 2011 from the European Union Statistics on Income and Living Conditions. The study found that the attained level of education channelled up to 30 percent of total inequality of opportunity, with important differences across Europe. Mediating inequality of opportunity by attained education, occupation explained less than five per cent of inequality of opportunity in most countries understudied. Additionally, the relevance of education as a channel for inequality of opportunity was negatively correlated with the share of the population that attains tertiary levels of education.

Golley and Kong (2018) investigated trends in China's inequality in education. The study focused mainly on the contribution of 'inequality of opportunity' to the trends in educational inequality. The study utilised the China Biannual Longitudinal Family Panel Studies survey for 2010 and 2012. The authors measured the inequality in individual educational outcomes which was measured by using years of schooling in aggregate form and for each of 10 birth cohorts. Multiple regressions were run to identify the key determinants of trends in China's inequality in education. The variables were classified as 'circumstances' that individuals have no control over, and which revealed important variations in the magnitude and significance of key determinants across birth cohorts. The results of the study were afterward used to calculate the share of 'inequality of opportunity' in overall educational inequality. The study found that lack of equal opportunity for Chinese people with regard to their educational outcomes was basically from the divisive education system.

Lam et al. (2015) decomposed quantity and price to understand changes in earning inequality to assert that human capital models imply that both the distribution of education and returns to education affect earnings inequality. The study provided theoretical and empirical analysis of the interactions between schooling inequality, returns to schooling and earnings inequality. The authors focused on the relationship between inequality in schooling and inequality in earnings and how the changes in returns to schooling affect earnings inequality when returns differ by schooling level. They derived new analytical results that guided the empirical analysis of changes in earnings inequality in Brazil and South Africa. The study found that both countries had reduced schooling inequality, only Brazil translated those into declines in earnings inequality. In South Africa, rising returns to schooling at the top level have offset equalising changes in the schooling distribution.

Golley and Kong (2013) investigated the trends in intergenerational patterns of educational attainment of those born in China between 1941 and

1990. The study employed survey conducted on the 2008 Rural–Urban Migration in China and Indonesia. The study found that intergenerational correlation was lower in rural areas and among migrants than in urban populations. According to the study, the higher mobility observed in rural areas and among migrant populations were as a result of the fact that the majority of these children completed only junior high school (inequality in education), with some children in the youngest cohorts moving down the education ladder relative to their parents. Conversely, the urban children seemed to mimic the level of education of their parents. According to the study, persistence intergenerational transmission of education at high levels in urban areas coupled with mobility for both upward and downward, in rural areas was likely to aggravate China's rural–urban disparity. The study recommended policies to focus on the underlying gaps in education opportunities and the improvement in education of the rural and migrant populations.

Checchi and van De Werfhorst (2018), using a country-cohort approach, investigated the effects of educational dispersion on incomes inequality (both in terms of student test scores and overall educational attainment). The study was premised on the neo-classical economic theory portrays a positive association between skill inequality (as measured in student test scores) and earnings inequality. It suggests that inequality in educational attainment was more important than skills inequality in the prediction of earnings inequality. The study used educational policies as instruments, and found that causal effects of skills inequality and educational attainment inequality suggests a simple human capital model and hence not sufficient in explaining rising earnings inequalities. Nevertheless, skills inequality appeared a more important predictor of earnings inequality than educational attainment inequality. Some educational policy reforms such as public preschool provision or introducing standardized tests led to reduced educational dispersions, and thereby reduced earnings inequality in adulthood.

In a slightly different approach, Ayentimi et al. (2020) explored the effect of a selective education system in which school assignment was based on initial test scores on earnings inequality using a large, representative household panel survey, the study compared adult earnings inequality of those growing up under a selective education system with those educated under a comprehensive system in England. After controlling for background characteristics and current location, the wage distribution for individuals who grew up in selective schooling areas was found to be substantially and significantly more unequal. This was largely due to the differences across the schooling system. Hence educational inequality may affect wage distribution.

Research Methods

The empirical study sought to estimate the impact education inequality has on earnings. The education Gini was used as an indication of the level of disparity in the distribution of education while labour returns, captured as earnings, reflected the profitability of the investment in a certain level of education. A quantile regression and a Heckman selection model were then used to analyse the effect of education inequality on earning.

Education Gini Index

The education Gini index is a measure of the degree of inequality in educational attainment within a country. It is based on the Gini coefficient, which is a widely used measure of income inequality.

The education Gini index measures the distribution of years of education among the population. It ranges from 0 to 1, with 0 indicating perfect equality (i.e., everyone has the same number of years of education) and 1 indicating perfect inequality (i.e., one person has all the years of education and everyone else has none).

The education Gini index is calculated by plotting the cumulative share of the population against the cumulative share of years of education, and then calculating the area between the Lorenz curve (the actual distribution) and the line of perfect equality. The resulting number is the education Gini index (Thomas et al., 2001; Deaton 1997).

A higher education Gini index means that there is more inequality in education. This can have important social and economic implications, as individuals with less education may have fewer opportunities and lower earning potential.

There have been a number of measurements of education Gini such as the use of enrolment in schools (Sheret, 1988 & 1982; Maas & Criel, 1982) and education finance (Ter Weele, 1975). Thomas et al. (2001), however, proposes educational attainment as the most appropriate measure of education Gini. The use of educational attainment is based on the argument that enrolment only measures access to education and thus may not be a good indicator of the stock of human capital. In effect, education Gini is measured as "the ratio to the mean (average years of schooling) of half of the average schooling deviations between all possible pairs of people" (Thomas et al., 2001).

The formula used by Deaton (1997) and Thomas et al. (2001) is adopted in calculating the education Gini coefficient in this study.

$$Gini = \frac{1}{\mu N(N-1)} \sum_{i>j} \sum_{j} \left| y_i - y_j \right| \quad (11)$$

Where,

Gini is the education Gini index;

μ is the mean of the variable (e.g., grade completed);

N is the total number of observations; and

y_i and y_j are years of schooling attained by individuals.

Heckman Estimation

Heckman (1976) two-step estimation, is a statistical technique used to address the issue of omitted variable or sample selection bias in econometric analysis. Sample selection bias arises when the sample used in the analysis is not randomly selected from the population of interest, which can lead to biased estimates of the parameters of interest. When there cannot be random and independent observation of variables, the problem of endogeneity is created (Hill et. al, 2021). There may also be issues of truncation where although both treated and untreated variables exist, only the treated outcomes are observed. In such instances where selectivity is inevitable, the use of ordinary least squares (OLS) regression will be inappropriate as the model will be inconsistent and biased. The Heckman two-step method tends to offer an alternative approach to resolve endogeneity concerns in sample selection bias situations (Wolfolds & Siegel, 2019; Marchenko & Genton, 2012).

The Heckman two-step estimation involves two main steps. In the first step, a model is estimated for the selection process, which is the process that determines whether an observation is included in the sample or not. The selection process is modelled using a probit model, which is a type of regression model that estimates the probability of an observation being selected.

In the second step, the outcome equation is estimated using a regression model that includes the selection indicator and the variables of interest. The selection indicator is the inverse Mills ratio or Heckman's lambda (Wolfolds & Siegel, 2019; Verbeek, 2000), which is a term derived from the probit model and represents the probability of selection conditional on the observed variables.

The Heckman correction accounts for sample selection bias by adjusting the coefficients of the outcome equation using the inverse Mills ratio. This adjustment ensures that the estimates of the coefficients are consistent and unbiased, even when the sample is not randomly selected (Marchenko & Genton, 2012).

Selection problems occur in a wide range of applications in econometrics. Prominent examples are the estimation of wage equations and consumer expenditures. For example, when trying to estimate the returns to schooling on the wage rate, one has the problem that some individuals who have received schooling do not work. Those people will have an offered wage below their reservation wage. If schooling has a positive influence on wages, people with little schooling will on average have a lower offered wage and therefore a lower employment rate than those with many years of schooling. As a consequence, one will only observe the wages of those people with few years of schooling who receive comparatively high wage offers. This is the problem of sample selection.

Again, when personal reservation income is higher than the offered wages, Individuals may choose not to work for these low wages making the sample of wages biased upward (StataCorp., 2017).

The "result of this problem is that simple OLS regression of wages on years of schooling will lead to downward-biased estimates, because the sample (working people) is unrepresentative of the population one is interested in" (all people who have received schooling) (Puhani, 2000)

The study adopts the wage equation used in Puhani (2000).

$$y_{1i}^{*} = x_{1i}' \beta_1 + u_{1i} \tag{12}$$

$$y_{2i}^{*} = x_{2i}' \beta_2 + u_{2i} \tag{13}$$

The errors, u_{1i} and u_{2i}, are assumed to follow a bivariate normal distribution. Consider that selection occurs such that y_{1i}^{*} and y_{2i}^{*} are the observed variables, where:

$$y_{1i} = y_{1i}^{*} \qquad if \;\; y_{2i}^{*} > 0$$

$$y_{1i} = 0 \qquad if \; y_{2i}^{*} \leq 0 \tag{14}$$

Equation 12 represents the outcome (wage) model. Equation 13 portrays a probit-type selection equation that describes the propensity to work or to have an observed wage. In principle, the variables y_1^{*} and y_2^{*} are unobserved, whereas y_1 is observed. One of the x_1' variables may be years of schooling. As economists we will be interested in the wage difference an extra year of schooling pays in the labour market. Yet we will not observe a wage for people who do not work (Puhani, 2000)

Using the distributional assumptions, that $u_{1i} = pu_{2i} + e_i$ Heckman then replaces the error term to rewrite the data-generating process as:

$$y_{1i} = x_i\beta + pu_{2i} + e_i \tag{15}$$

A regression of y_{1i} on x_i would then omit the selection effect. However, Heckman uses the property of a normally distributed variable to derive the inverse Mills ratio in Equation 16:

$$E(u_i \mid u_i > -x) = \lambda(x) = \frac{\phi(x)}{\Phi(x)} \tag{16}$$

Finally, Heckman plugs this λ in to get:

$$y_{1i} = x_i\beta + p\frac{\phi(x)}{\Phi(x)} + e_i \tag{17}$$

$$y_{1i} = x_i\beta + p\lambda_i + e_i \tag{18}$$

Thus, researchers can estimate the outcome equation, y_{1i} on x_i, as long as the inverse Mills ratio is also included as a covariate. Estimation of the inverse Mills ratio comes from a regression of the first-stage selection equation, using a probit regression of selection on covariates (y_{1i} on x_i,) (Wolfolds & Siegel, 2019). λ is the hazard ratio or reciprocal of the Mill's ratio (Nawata & Nagase, 1996). The Heckman's lambda is included in the regression to control for the influence of unobserved characteristics of the variables. The regression coefficient of the control factor is an indicator for the covariance of the error terms.

The Heckman two-step approach is also based on the assumption that the selection equation and the conditional equation are related to each other through their error terms. When there is no relation between the error terms there is no need to perform a Heckman two step approach as there is no sample selection bias and an OLS regression will give unbiased estimators. For such a model, the bottom line in STATA output gives a value for ρ (rho) with associated p-value. This ρ is a likelihood ratio indicating the correlation between the error terms of the equations in Heckman model.

Heckman (1979) discusses the implications of ρ being exactly 1 or 0, together with the implications of other possible covariance relationships among the model's determinants (StataCorp, 2017).

In accordance with the Mincerian wage equation, the study assesses how education, work experience, work experience square, gender, region (Li, Wu & Xing (2018), marital status (Zang, 2019) contributed to differences in earnings.

In the syntax for Heckman, the dependent variable and regressors for the underlying regression model to be fitted to determine whether the dependent is observed or unobserved (selected or not selected). The study assumed that the wage is a function of education Gini, work experience, experience squared gender, location, region and marital status as shown in Equation 19. Whereas, the likelihood of working (the likelihood of the wage being observed) is a function of education Gini, work experience, experience squared, gender, location, region and marital status.

These variables specified in the select option (Equation 20) are assumed to determine whether the dependent variable is observed (the selection equation).

Thus, we fit the model as follows:

$$wage = \beta_0 + \beta_1 GINI + \beta_2 \text{work\_}exper + \beta_3 \text{work\_}exper2 + \beta_4 \text{ gen} + \beta_5 \text{loc} + \beta_6 reg + \beta_7 marr + u_1 \quad (19)$$

and we assumed that wage is observed if

$$wage = \gamma_0 + \gamma_1 GINI + \gamma_2 \text{work}_{exper} + \gamma_3 \text{work}_{exper2} + \gamma_4 \text{ gen} + \gamma_5 \text{loc} + \gamma_6 reg + \gamma_7 marr + \gamma_8 hhsize + \gamma_9 M\_Ed + u_{i2} \quad (20)$$

Where,

β_0, γ_0 = intercept; β_1 to β_7, and γ_1 to $\gamma_{9,}$ = the coefficients of the explanatory variables; $GINI$ = education Gini; $work\_exper$ = work experience; $work\_exper$ 2= experience squared

gen = gender; loc = location (rural or urban); reg= region; $marr$= marital status, $hhsize$ is household size and M_Ed is mother's education.

Quantile Regression

Quantile regression is a statistical technique used to estimate the conditional distribution of a response variable given a set of predictors. It is a method that goes beyond traditional regression techniques that focus only on estimating the conditional mean of the response variable. Unlike the ordinary least squares (OLS) regression and related methods, which presupposes that the associations between independent and dependent variables are the same at all levels, quantile regression offers an insight into the relationships between variables outside of the mean of the data by estimating one or more conditional quantiles (Koenker & Hallock, 2001).

In quantile regression, the conditional distribution is estimated at different quantiles, such as the median or the 75th percentile. This allows for a more complete picture of the relationship between the predictors and the response variable. Quantile regression can be particularly useful when the conditional distribution of the response variable is not symmetric or when there are outliers in the data.

The technique works by estimating the conditional quantile function of the response variable, given the predictor variables. The conditional quantile function gives the value of the response variable that separates the lowest p% of observations from the highest (1-p)% of observations, where p is the quantile being estimated. This is done by minimizing the sum of the absolute deviations between the observed values and the estimated quantile values (Hansen, 2018).

The quantile regression function estimates the conditional quantile of the response variable given the predictor variables. It can be written as:

$$Q(y|x) = x'B \quad (21)$$

where Q(y|x) is the conditional quantile of y given x, x is a vector of predictor variables, B is a vector of coefficients to be estimated, and ' represents the transpose operation. The goal of quantile regression is to estimate the values of B that minimize the sum of the absolute deviations between the observed values of y and the estimated quantiles.

Quantile regression is useful when the relationship between the response variable and predictor variables is not well described by the mean. It can be used to estimate the entire conditional distribution of the response variable, rather than just one summary statistic like the mean. It is also robust to outliers, as it minimizes the absolute deviations instead of the squared deviations used in OLS regression.

Furthermore, it is imperative to address the problem of sample selection associated with economic models. Sample selection bias occurs when the sample used to estimate a regression model is not representative of the population of interest. This can happen when the sample is selected based on some criteria that are related to the dependent variable, resulting in a non-random sample. For example, in a study of wages, the sample may be restricted to employed individuals, which could result in biased estimates of the wage distribution.

When sample selection bias is present, standard quantile regression estimates can be biased and inconsistent (Munoz & Siravegna, 2020). One way to address this is to use a method called sample selection quantile regression (SSQR), SSQR extends the standard quantile regression framework by allowing for sample selection bias in the estimation of the conditional quantiles (Arellano & Bonhomme, 2017).

The SSQR, basically, is to model both the selection mechanism and the quantile regression function simultaneously. Specifically, SSQR assumes that there are two equations: one for the selection mechanism and one for the quantile regression function. The selection equation models the probability of being selected into the sample as a function of the observed covariates, and the quantile regression equation models the relationship between the response variable and the covariates for the selected sample.

Empirical Results

Workers in the labour market are remunerated based on their knowledge and the competencies as well as work experienced gathered during their working life. These skills and experiences make up the human capital of workers and also serve as a signal for higher remuneration. The earnings function by Mincer (1974; 1958), captures this relationship. This study modelled the impact of education on earnings. It also portrayed the effect the differentials in educational attainment across the districts in Ghana have on earnings. The study employed individual data drawn from GLSS6 (2012/2013) and GLSS7 (2016/2017) data from the Ghana Statistical Service.

Descriptive Statistics

The descriptive statistics for the year 2012/2013 are shown in Table 7A, 7B and 8. Over the study period, average wage was at 3738.913 Ghana cedis but with wide dispersion as shown in Table 7A. While some individuals received no income, others had as high as 1,225,800 Ghana cedis. This brings to light the huge disparities in the wage distribution of individuals in the country. There were also variations in the distribution of work experience of individuals over the period. The average hours of worked for wage or salary was about 44 but some recorded a minimum of 1 and a maximum of 120 hours. This to some extent, reflects the huge variation in wages as individuals with more hours are likely to be associated with higher wages. The number of years of schooling ranges between 0 and 16 years with an average of 10 years.

An observation of Table 7A also shows the average wage for 2016/2017 (32607.52) is lower than that of 2012/2013 (3738.913). Although there is still dispersion in individual wages, the range for 2016/2017 was wider as compared to 2012/2013. The minimum and maximum for 2016/2017 were 0 and 1728000 respectively. There were also variations in the distribution of work experience of individuals over the period. The average hours of work per about 41 but some recorded with a minimum of 1 and a maximum of 168 hours. This to some extent, reflects the huge variation in wages as individuals with more hours are likely to be associated with higher wages. The average years of schooling remained around 10 years. The number of years of schooling ranges between 0 and 18years.

Table 7B, offers an overview of the categorical variables used in the study. For 2012/2013, Table 7B shows that males (71.77%) were more than females (28.23%). This implies that, the rate of participation of males in labour market as captured by the study is likely be higher than females. Rural dwellers were 11% more than those in the urban areas. While majority of the study population were from Ashanti region (11.82%). Also, greater percentage (71.62%) of individual's level of education is the Basic level. This implies that a vast majority of the working population terminated their education at the basic level. Again, most of individuals (67.5%) were married.

Table 7B also, offers an overview of the categorical variables for 2016/2017. Males were still more (68.83%) than females (31.17%). But representation of female is higher than 2012/2013. The urban settlers were 42.96% whiles rural dwellers were 57.04%. Again, Ashanti region form majority of the study population with from 12.38%. The percentage of individuals with basic level of education was the 37.72%, secondary level was 17.42%, tertiary was 10.87% while a considerable section (33.98%) of the population had no education. Majority of individuals (64.09%) were married for 2016/2017.

Table 8 shows the statistical differences in wages of male and females as well as between workers in urban and rural areas. For the period 2012/2013, the mean wage differential between male and female was 40.6% in favour of males. Due to the fact that the sturdy population had predominantly more males than females, the wage differential perhaps should not come as a surprise. On the analysis of average wage between individuals in urban and rural area in

Ghana, it is shown that, the mean wage in urban areas was higher with a wage differential of 48.4%.

For 2016/2017, the mean wage differential between male and female was 28944.23 Ghana cedis representing 69.5% difference in favour of the male. This is wider than the wage differential in 2012/2013 (45.85%). This rise in wage differentials could be an indication of the continuing challenges in the labour market for females. It was again shown that the mean wage in urban areas was 31176.33 (61.8%) more than the mean wage in rural areas.

Table 7A: Summary Statistics- (Continuous variables using GLSS R6 and R7)

	2012/2013					2016/2017				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
WAGE_PID	16,696	3738.913	16837.43	0	1225800	14,009	32607.52	94238.11	0	1728000
work_exp	14,301	43.42584	20. 201	1	120	10,965	41.0782	19.18497	1	168
exp2	14,301	2293.843	2010.874	1	14400	10,965	2055.444	1911.959	1	28224
Years of schooling	11,478	9.219899	3.527	0	16	9,878	9.111	3.999	0	18

Source: Authors Construct based on GLSS 6 and GLSS 7 data

Table 7B: Summary Statistics categorical variables (using GLSS R6 and R7)

		2012/2013				2016/2017			
Variables	Descriptives	Freq.	Percent	Cum.	Total Obs	Freq.	Percent	Cum.	Total Obs
Gender					16,707				14,009
	Male	11,991	71.77	71.77		9,643	68.83	68.83	
	Female	4,716	28.23	100.00		4,366	31.17	100.00	
Locality					16,707				14,009
	Urban	7,433	44.49	44.49		6,018	42.96	42.96	
	Rural	9,274	55.51	100.00		7,991	57.04	100.00	
Region					16,707				14,009
	Greater Accra	1,923	11.51	11.51		1,398	9.98	9.98	
	Central	1,600	9.58	21.09		1,318	9.41	19.39	
	Western	1,705	10.21	31.29		1,331	9.50	28.89	
	Volta	1,567	9.38	40.67		1,367	9.76	38.65	
	Eastern	1,788	10.70	51.37		1,395	9.96	48.60	
	Ashanti	1,974	11.82	63.19		1,735	12.38	60.99	
	Brong Ahafo	1,615	9.67	72.86		1,318	9.41	70.40	
	Northern	1,699	10.17	83.03		1,409	10.06	80.46	
	Upper East	1,443	8.64	91.66		1,371	9.79	90.24	
	Upper West	1,393	8.34	100.00		1,367	9.76	100.00	
Education					11,433				9,878
	None	108	0.94	0.94		3,357	33.98	33.98	
	Basic	8,188	71.62	72.56		3,726	37.72	71.70	
	Secondary	1,862	16.29	88.85		1,721	17.42	89.13	
	Tertiary	1,275	11.15	100.00		1,074	10.87	100.00	
Marital Status					16,704				14,009
	Married	11,268	67.46	67.46		8,979	64.09	64.09	
	Divorced	1,781	10.66	78.12		1,478	10.55	74.64	
	widowed	1,905	11.40	89.52		1,798	12.83	87.48	
	single	1,750	10.48	100.00		1,754	12.52	100.00	

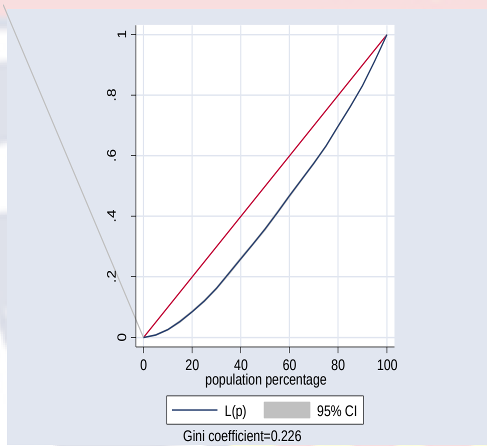
Table 8: Male -Female and Urban-Rural wage differential (using GLSS R6 and R7)

	2012/2013			2016/2017			2012/2013			2016/2017		
Groups	Male	Female	Combined	Male	Female	Combined	Urban	Rural	Combined	Urban	Rural	Combined
Obs	12,030	4,724	16,754	9,643	4,366	14,009	7,438	9,316	16,754	6,018	7,991	14,009
Mean	4225.1	2509.6	3741.4	41628.2	12683.9	32607.5	5118.9	2641.6	3741.4	50391.1	19214.8	32607.5
Std. Dev.	19093.5	8493.9	16813.7	106547.7	53352.3	94238.1	16739.1	16792.9	16813.7	117254.6	69271.6	94238.1
Diff (mean)			1715.5			28944.2			2477.268			31176.3
t			5.9			17.0			9.5005			19.6476
df			16752			14007			16752			14007
Pr			0.00			0.00			0.00			0.00

Source: Authors Construct based on GLSS 6 and GLSS 7 data

Estimation of Education Gini Index

The education Gini was generated using the distribution data on years of schooling of individuals in the various districts in Ghana. The education Gini was used as a measure of education inequality. Figures 11 and 12 display the Lorenz curve for 2012/2013 and 2016/2017. The graphs present a 5.8% increase (from 0.226 to 0.239) in Gini coefficient of education between 2012/2013 and 2016/2017. This is surprising considering the amount of investment in the educational sector.



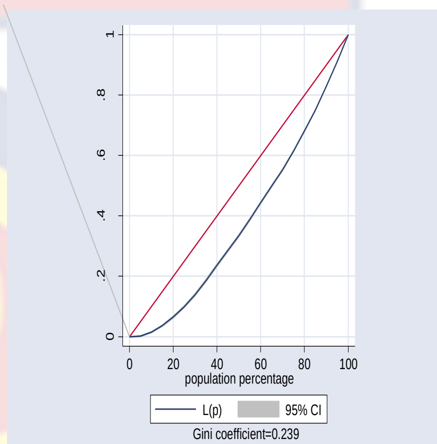


Figure 11: Lorenz curve Education Gini 2012/2013

Figure 12: Lorenz curve Education Gini 2016/2017

The education Gini indexes shown in Appendixes B1 and B2 permit an observation of the changes in education inequality in various districts in Ghana over the period 2012/2013 and 2016/2017. While the education Gini in some districts saw an increased, it declined in other districts. Between 2012/2013 and 2016/2017, some districts like Komenda-Edina-Egyafo-Abirem, Cape Coast Metropolis, Ga East, AMA, KMA, Jomoro, Sekondi-Takoradi, Tarkwa Nsuem Municipal, Sefwi Bibiani-Ahiwaso Bekwai etc. had their education Gini lowered. For instance, there was a drop from 0.234 to 0.192, 0.232 to 0.209, 0.217 to 0.213 and 0.211 to 0.200 in Sekondi-Takoradi, Cape Coast Metropolis, AMA and KMA respectively. On the other hand, districts such as Ellembelle, Mfantsiman, Yilo Krobo, Kwahu West Municipal, Bekwai Municipal, Bole, Chereponi etc. had their education Gini increasing. Chereponi for example had rapid increase from 0.045 to 0.452 over the five-year period. This is an indication of the rise in inequality in education in these districts.

Again, an examination of the distribution of education Gini across the districts reveals that the districts in the three Northern Regions (North, Upper East and Upper West) recorded relatively, the highest inequality over the period. The rankings in Appendix B1 shows that most of the last twenty districts with the high inequality in 2012/2013 were form these three regions. Similar result was reported in 2016/2017 as shown by Appendix B2.

Heckman Estimation

The Heckman two-step estimator was adopted to estimate the wage model for 2012/2013 and 2016/2017. Table 9 presents results on Heckman model for 2012/2013 and 2016/2017 in columns 1 and 2 respectively. The variable of interest, education Gini together with other exogeneous variables such as work experience, experience squared, marital status and location were used in determining labour returns. The Heckman model was adopted so as to control for individuals who do not work and thus have no wages.

Two models were run with Heckman selection regression in order to determine whether sample selection is a problem, the first stage estimated the probability of being in work, (the probability of being treated) or not. The first stage thus, estimates the participation in the labour market and the second is to estimate the effect of participation on wages.

The coefficient of lambda was significant for 2016/2017. This depicts a correlation between the error terms of the two equations in Heckman model. It was however not significant for 2012/2013. The lambda term for 2016/2017 was negatively signed – which suggests that the error terms in the selection and wage equations are negatively correlated. So (unobserved) factors that make participation more likely tend to be associated with lower wages. So (unobserved) factors that make more observable tend to be associated with lower values of our independent variables in the selection equation. The lambda thus confirms the right usage of the Heckman model.

From the wage equation, there is a negative relation between the education Gini index and wage for 2016/2017. This coefficients for education Gini suggest that education inequality is associated with lower wages. It is worth noting there was a change in the effect of education inequality on labour returns overtime. Education inequality was not significant (though negative) for 2012/2013. The significant results for 2016/2017 shows that education equality must be accorded the necessary attention in order to bring it to lowest level possible, as high education inequality stands to affect an individual's labour returns and welfare as a whole (Esping-Andersen, 2009; Breen & Jonsson 2005).

The results for 2012/2013 also show that females receive lower wages in labour market. Again, work experience tends to increase one's ability to add to wages earned even though excessive experience may be detrimental to the size of wages received. This may occur when there is no commensurate work for the level of experience gathered and this may force the acquirer of the experience to settle for what is available.

With the exception of the Western region that recorded higher wages for the years, all the other regions had lower wages as compared to the Greater Accra region. It is worth nothing that the three Northern regions had the lowest wages relative to that of Greater Accra region.

The results further indicated that single workers earned lesser wages than married workers while widowed workers received more wages. Married workers are generally considered to have much more responsibility because of the expectation of taking care of their families. This may motivate them to worker extra for more wages than single workers. So, the results do not imply discrimination against the unmarried but rather responsibility induced.

Table 9: Heckman Model

	(1) 2012/2013	(2) 2016/2017
lwg		
GINI	-0.00791	-0.839*
	(0.342)	(0.476)
work_exper	0.0123***	0.00398
	(0.00232)	(0.00301)
work_exper2	-0.0000634***	-0.0000986***
	(0.0000221)	(0.0000265)
Gender (base= Male)		
Female	-0.419***	-0.114
	(0.0368)	(0.0743)
Location(base= Urban)		
Rural	-0.604***	-0.0971
	(0.0558)	(0.0631)
Region (base= Greater Accra)		
Central	-0.345***	-0.134*
	(0.0882)	(0.0690)
Western	0.150***	0.0130
	(0.0544)	(0.0749)
Volta	-0.255***	-0.128
	(0.0592)	(0.0781)

Eastern	-0.208**	-0.0547
	(0.0819)	(0.0767)
Ashanti	-0.0205	-0.0409
	(0.0516)	(0.0628)
Brong Ahafo	-0.497***	0.0186
	(0.109)	(0.0876)
Northern	-0.866***	-0.280***
	(0.188)	(0.103)
Upper East	-0.667***	-0.210**
	(0.254)	(0.0974)
Upper West	-0.631***	0.104
	(0.188)	(0.100)
Marital status (base= Married)		
Divorced	-0.216***	-0.344***
	(0.0460)	(0.0681)
Widowed	-0.333***	-0.354***
	(0.0545)	(0.103)
Single	-0.241***	-0.360***
	(0.0420)	(0.0601)
_cons	8.037***	11.86***
	(0.136)	(0.192)
select		
GINI	-0.373	-0.685**
	(0.326)	(0.338)
work_exper	0.00340	0.0103***
	(0.00213)	(0.00217)
work_exper2	0.00000305	-0.0000529***
	(0.0000213)	(0.0000210)
Gender (base= Male)		
Female	0.0576	-0.568***
	(0.0358)	(0.0377)
Location (base= Urban)		
Rural	-0.308***	-0.499***
	(0.0279)	(0.0297)
Region (base= Greater Accra		
Central	-0.450***	-0.137**
	(0.0572)	(0.0598)
Western	0.0969	-0.300***
	(0.0597)	(0.0601)
Volta	-0.150**	-0.354***
	(0.0597)	(0.0600)
Eastern	0.504***	-0.373***
	(0.0658)	(0.0593)
Ashanti	0.135**	-0.235***
	(0.0571)	(0.0544)
Brong Ahafo	-0.585***	-0.516***
	(0.0553)	(0.0600)
Northern	-0.967***	-0.578***
	(0.0577)	(0.0660)
Upper East	-1.242***	-0.395***

	(0.0616)	(0.0688)
Upper West	-0.934***	-0.471***
	(0.0632)	(0.0713)
Marital status (base= Married)		
Divorced	-0.0576	-0.169***
	(0.0475)	(0.0515)
Widowed	-0.124**	-0.354***
	(0.0501)	(0.0613)
Single	-0.0802*	0.228***
	(0.0465)	(0.0437)
hhsize	-0.0246***	-0.0726***
	(0.00489)	(0.00611)
M_Ed	-0.000765	0.0174***
	(0.00361)	(0.00311)
_cons	1.104***	-0.0200
	(0.0978)	(0.103)
mills		
lambda	0.312	-0.427***
	(0.341)	(0.138)
N	13,280	10,965

Source: Author's estimation based on GLSS6 & GLSS7 Data
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Quantile Regression

The earnings function was estimated at three quantile points. The 10th, 50th and 90th percentiles of the distribution of wage were estimated. The primal variable of interest was education Gini so to assess the role the disparities in education plays in determining an individual's participation in the labour market and defining the labour returns. The results, as shown by Table 10 indicates that in 2012/2013, education Gini was positively related to earnings at the upper (90th) quantile. However, education Gini had an inverse relationship with earnings at the 10th and 50th quantile. For 2016/2017, education Gini was negatively related to earnings at all quantiles.

The results show that on the average education Gini exerts negative influence on wage. This implies that inequality on the average reduces wage rate. These results are an indication of quintessential impact that distribution of education has on wage. The benefits of schooling cannot be overemphasized (Patrinos, 2019; Montenegro, & Patrinos, 2014; Kingdon & Patrinos, 2010).

Again, the positive relationship at the 90th quantiles for 2012/2013 means that at the upper wage distributions tends to benefit from wage differentials. Basically, this result is contrary to the general view that inequality is detrimental to wage levels. This counter intuitive results could be due to the fact that, wage negotiations are generally done by upper-level executives (senior members). The results therefore show that these managers are more likely to benefit from wage inequalities.

For 2016/2017, education inequality and wage rate exhibited the expected results which indicated that inequality has a negative influence on wage levels across all wage distribution. This is consistent with the average of 2012/2013.

Also, there was evidence of difference between the wage of males and females. The results suggest that wage level of males was higher than females. This difference was greater at the lower quantile than at upper quantile. This implies that, among low-wage workers, women are likely to receive less wage. It also suggests that, when females enter higher wage brackets, it reduces the wage differential across gender.

Furthermore, the results suggest that there is improvement in the gender wage difference across the wage distribution between 2012/2013 and 2016/2017. Also, there was positive relationship between work experience and wages at all quantiles. This is an indication that workers with more job experience stand in a more advantageous position than those with little experience. To some extent however, excessive experience may to generate negative relationship with wage. This is in line with mincerian relationship between experience squared and wage.

Those in Rural areas received lower wages than those in urban areas. Expectedly, the Greater Accra region had higher wage than all the other regions. Those who are married also had higher wages than individuals who are widowed or single.

Table 10: Quantile Regression with Sample Selection

	2012/2013			(2016/2017)		
	q10	q50	q90	q10	q50	q90
GINI	-0.282	-0.308	0.164	-0.0858	-0.572	-0.974
Gender						
Male	-0.793	1.675	1.733	2.461	2.513	2.722
Female	-1.357	1.268	1.467	2.172	2.116	2.541
work_exper	0.0257	0.0120	0.00786	0.0241	0.00785	0.00135
work_exper2	-0.000182	-0.0000652	-0.0000305	-0.000283	-0.000155	-0.0000330
Location						
Urban	1.995	1.673	1.624	2.153	2.472	3.378
Rural	1.372	1.027	1.131	1.811	2.159	3.212
Region						
Greater Accra	1.174	0.919	0.396	0.903	0.270	0.578
Central	0.677	0.524	0.232	0.483	0.280	0.424
Western	1.025	1.125	0.551	0.547	0.288	0.660
Volta	0.519	0.689	0.362	0.344	0.141	0.438
Eastern	0.771	0.758	0.300	0.357	0.252	0.505
Ashanti	0.979	0.951	0.421	0.708	0.217	0.466
Brong Ahafo	0.198	0.415	0.205	0.597	0.228	0.377
Northern	-0.388	0.0484	-0.0242	-0.0297	-0.0978	0.394
Upper East	-0.0867	0.272	0.0408	0.251	0.152	0.466
Upper West	-0.447	0.145	0.278	0.480	0.521	0.508
Marital status						
Married	1.042	1.023	0.915	0.0336	1.692	1.360
Divorced	0.912	0.768	0.720	-0.418	1.318	1.031
Widowed	0.702	0.628	0.619	-0.217	1.031	0.972
Single	0.869	0.786	0.686	-0.0318	1.452	1.123
Constant	3.189	2.837	4.653	4.612	4.687	4.677
N	14298	14298	14298	10965	10965	10965

Source: Author’s estimation based on GLSS6 & GLSS7 Data

Conclusion

This chapter is an empirical investigation into whether education inequality influences the distribution of earnings. An education Gini was estimated using the educational attainment of individuals across the districts in Ghana over the years 2012/2013 and 2016/2017. The study provided empirical evidence of the nature of education inequality for 2012/2013 and 2016/2017. The study showed evidence of education inequality and the negative impact it has on earnings. The study analysed the distribution of wage across the different quantiles. The results show that on the average education Gini influenced wage negatively. In effect, this study showed that education influences earnings but inequality reduces the effect of education on earnings.

CHAPTER FOUR

GENDER WAGE GAP ANALYSIS IN GHANA: THE MODERATING ROLE OF CULTURE

Introduction

Gender-wage-gap analysis is a global economic issue that has received considerable attention because of its implications for poverty reduction, gender equality and women empowerment. The global rise in economic inequality in recent decades (Garcıa-Sanchez et al., 2020) exacerbates the difficulty in fighting crime, ensuring political stability, guaranteeing social and economic well-being of societies. In effect, the sustainability of global economies depends on getting gender disparity issues resolved because of its potential to affect developing, deploying and empowering one-half of the world's talent (World Economic Forum-WEF, 2020). In spite of this, WEF predicts that the global trend in gender disparity points to the fact that achieving equality would take about a century and that would require a major shift in the way emerging and developing economies handle gender-related labour market and financial disparity issues. Thus, developing attention towards addressing gender disparity issues in any part of the world implies pushing the world towards progress in resolving underutilization of human capital and ensuring socio-economic welfare.

The effect of gender gaps on economic growth is established in literature and argued from three main channels (Brosio et al., 2018): underutilization of talent of the underprivileged gender (OECD, 2012; McKinsey Global Institute, 2015; ILO 2017a; OECD, 2012); underinvestment in human capital, mainly from reduction in female human capital, which is a key growth catalyst (Blackden et al., 2006; Esteve-Volart, 2009);increasing women's decision making power (Slotsky, 2006); and given that women are more likely to invest in their children than men (Duflo 2003; 2012), denying women empowerment is equivalent to reducing the human capital base of future generations (Sen, 1990; Klasen & Wink, 2003). Cuberes and Teigneir (2016) concluded that gender gaps in entrepreneurship and workforce participation is responsible for losses in income and productivity across countries but with significant variations across regions. Klasen and Lamanna (2009) concluded that economic growth is harmed by gender gaps in education and employment.

Evidence exists in support of the fact that gender-wage gap is profound. On the bases of geographical locations, sex and age, substantial inequality exists in the global labour market in terms of access to work and work quality (International Labour Organisation –ILO, 2020). Also, the ILO (2020) reports that recent figures suggest that the level of income inequality is bigger than previously envisaged. Zhou and Nelson (2017) posit that a relatively high gender wage discrimination could be observed for some developing economies. For instance, Tharp et al., (2019) observed an unadjusted pay gap of 19% among financial planners. In the EU and in 2010 the unadjusted wage gap was reported as 15.3% (Boll et al., 2016). In Uganda, Sebaggala (2007) recorded the gap at 39%. In Germany, gender-wage gap exists even at labour market entrance at all percentiles of the wage rates (Behr & Theune, 2018). The gap is country specific and in some cases industry specific. Chauvel et al. (2019) argued that addition to educational attainment by females does little to reducing gender-wage gap even in situations where females had higher educational levels than their male counterparts. Also, increasing the participation of females in the market in Ghana does not lead to a reduction in the gender-wage gap. In spite of this within job gender wage discrimination is not significant (Petersen & Morgan, 1995). However, Weichselbaumer and Winter-Ebmer (2003) argued that wage differentials have fallen globally due primarily to better labour market endowments for females.

Compared to other developing regions, Africa benefits less from human capital in terms of its productivity effects and economic growth. Sub-optimal utilization of skills and qualifications of Africa's labour market could explain why the continent makes little progress towards increasing productivity, economic growth and losing the fight against poverty (AfDB, 2020). The effect of discrimination in the labour market on productivity, economic growth and poverty reduction is likely to be high in Africa than the rest of the world because of the relatively high levels of gender gaps in the labour market. The continent needs to swift and design targeted policies backed by empirical research to address the underutilization of its labour force and control labour market discriminations if it is to make progress towards the elimination of extreme poverty by 2030 (Sustainable Development Goal, SDG 1). Differences in institutional quality levels, labour market and cultural structures in Africa imply that country specific studies would offer an opportunity for proffering policies that are tailored to the needs of specific countries. Inter-country differences in the wage effects of observed skill prices and gender differences in selectivity (Gupta et al., 2001) may explain differences in gender-wage gap across countries.

Several factors have been put forward as conditioning factors for gender wage differentials. Education (Kyoore & Sulemana, 2019; Poot & Roskruge, 2013), gender discriminations in education (Sahoo & Klasen, 2018), sector (private or public) of engagement (Lassibille, 1998), family background (Castellano et al., 2018), experience (Dias et al., 2016), macroeconomic factors (like economic development, trade, foreign direct investment) (Bøler et al., 2017; Dias et al., 2016) and as argued in this research, culture. Work ethics and wage rates are likely to differ across cultural values that promote collectivism as against individualism.

Kyriacou (2015) and Hammar (2019) explain that collectivism promotes group cohesion, loyalty, and embeddedness of individuals in larger groups while individualism supports personal control, autonomy and individual accomplishments. Collectivist cultural values project that the reward to labour is a social good while individualist cultural ideology believes that reward to labour accrue to the individual that generated it. Thus, collectivism is argued to promote socialism while individualism promotes capitalism. If collectivist consider returns to labour as a social good then it could be argued that collectivism may widen gender-wage gap because of the belief that what belongs to one belongs to the broader society so there may not be the need to address gender-wage gap issues. This notwithstanding, collectivist ideology may reduce gender-wage gap since it could promote the idea that returns to labour which is considered as a social good could be shared equally irrespective of the differences in the efforts that generated it. Individualist cultural ideology support differentials in the reward for effort because of its support for capitalism. By extension this support for differentials may accommodate gender-wage gap conditions and help promote gaps in the labour market. In spite of this, individualist cultural ideology could reduce gender-wage gap because the effort of an individual will be rewarded to its measure irrespective of the gender that expensed the effort. The uncertainty surrounding the directional effect of collectivism and individualism cultural ideologies makes its empirical investigation imperative.

All forms of religion support assisting the poor, weak, and vulnerable in society but not with equal level of emphasis. The African traditional religion promotes collectivism even though adulteration from western culture and religion as well as globalization is gradually blurring the presence of collectivism. Increased image associated with the extent to which one is able to support her family and society and vice versa promote collectivism in African traditional religion against that of individualism. Muslims may generally be considered as collectivists because of their inclination to fight of all forms of societal inequalities. Stulz and Williamson (2003) explain that collectivism is a catholic ideology while individualism is a protestant ideology.

This study assesses whether cultural values of individualism and collectivism weakens or strengthens the gender wage gap analysis.

Gender differences in labour returns, irrespective of labour efforts, protract global inequality which is inimical to civilization (Pickett & Wilkinson, 2010; OECD, 2011; Krueger, 2012; Dabla-Norris et al., 2015; Loughnan, et al., 2011; Park & Kim, 2017; Sanchez-Rodrıguez et al., 2019). Also, given that gender inequality may reduce economic development and the potential for inequality issues to demotivate, vulnerable groups, the productivity of developing economies is likely to plummet if gender wage gap issues are not addressed. The existing numerous empirical works (Baah-Boateng, 2014; Nix et al., 2015; Acheampong, 2018) on gender-wage gap has concentrated on estimating the size of the gap and assessing whether the nature of the gap is homogenous across the wage distribution without consideration for assessing whether behavioural factors could help explain gender wage differentials. Even though Acheampong (2018) considered cultural and traditional factors to have potential contributory factors to labour market discriminations, they were not subjected to empirical investigation. This study contributes to the paucity of empirical evidence on how informal structures like culture can help explain the gender wage gap. The study further assesses whether the cultural effect along the wage distribution frontier is the same for all quantiles.

The rich household data, the Ghana Living Standards Survey (GLSS) of the Ghana Statistical Service covers wages, religious affiliation, and other relevant gender wage gap explanatory factors that makes the study's application to Ghana relatively easier.

Literature Review

Theoretical Literature Review

Human Capital Theory

Individuals and societies benefit, economically, from investment in people (Sweetland, 1996) through their enhanced contribution to development resulting from improved health care, nutrition and education. Schultz (1961) defines human capital as the accumulation of skills and knowledge that influence individual's productivity. This implies that investment in education is only abated when the marginal investment cost in education is equivalent to the marginal gain in productivity (Barrera-Osorio & Bayona-Rodríguez, 2019). Islam (2009) opine that the theory hypothesizes a concave education-earnings profile and diminishing returns to human capital production, but this view has been largely criticised (So¨derbom et al., 2004; Duraisamy, 2002; Nasir, 2002). The theory further posit that returns to education is based on the recognition of labour market of the experience and skills that an individual possesses at the point of entering the labour or at any point that the individual is being engaged on a job. The recognition of an individual's knowledge, experience and skill is priced as reward. Where the theory holds then the labour market must be able to appropriately identify and knowledge, experience and skill irrespective of who is offering that knowledge, experience or skill except there are anomalies. In other words, the existence of gender wage differentials in the labour markets suggest the inability of the labour market to efficiently price or knowledge, experience and skill due to other mitigating factors such as information asymmetry and possibly behavioural factors.

Cultural ideologies that are likely to accept, condone or encourage inequality may thwart the smooth pricing of labour in the market to reflect the positions of such cultural ideologies. The traditional view is that collectivist cultural ideologies promote equality while individualistic cultural ideologies promote inequality. Unfortunately, however, recent empirical findings have confused the traditional position with the conclusions that each of the cultural ideologies could promote or discourage inequality (Davies & Williamson, 2019; Cao, 2019; Nikolaev et al., 2017). Further empirical studies in the area especially at the country level and among developing economies will be necessary to offer a better understanding of how culture influences gender wage gap.

Signalling Theory

Due to information asymmetry, labour markets are unable to accurately determine the price of labour based on knowledge, experience, and skill. In view of this, salaries and wages are determined based on the extent of signal sent by the job seeker to the labour market (Hussey, 2012; Spence, 1973; Arrow, 1973; Stiglitz, 1975). Holding of educational qualifications such as diploma, degree, doctorate and professional qualification send signal to the market which is used in fixing the wage and salary of the job seeker. Concluded that the labour market recognises the signals sent to the market by prestigious universities even though these universities are not effective than other universities developing human capital (Barrera-Osorio & Bayona-Rodríguez, 2019). Signalling theory help explain how differences exists among individuals with different educational qualifications.

The labour market's ability to recognise relevant wage related signals in the fixing of wages should enable the market to deal with market imperfections. Wage discriminations in terms of race or gender for instance should not exist in a market that effectively processes relevant signals in wage determination. Thus, even with signalling theory the effect of behavioural factors in explaining wage discriminations in the labour market could be profound.

Conventional Glass Ceiling Hypothesis

The glass ceiling hypothesis has become popular in gender inequality studies especially relating to women's progression to the top in the corporate world and explaining gender wage differentials. The hypothesis is used to denote the presence of a barrier that prevents one, especially women, from earning a higher pay when one is due. The presence of glass ceiling in labour markets may stifle innovation, demotivate workers and reduce productivity of lower-level workers, especially women. Thus, glass ceilings, visible or invisible, need to be identified and removed. The presence of glass ceilings transcends labour markets (Dang et al., 2014; Agier & Szafarz, 2013).

Empirical Review

Nordman et al. (2009) revealed that even though ethnic and gender gaps exist in the labour markets of six West African countries (Abidjan, Bamako, Cotonou, Dakar, Lome, Niamey and Ouagadougou), gender gaps are relatively bigger. Gender-wage gap in both public and private sectors decreases when employee characteristics are controlled for (Castagnetti & Giorgetti, 2018) suggesting that ability to control for relevant gender-wage nexus conditioning factors could reduce or help explain the gap. In spite of this, Blau and Kahn (2003) insist that gender wage gap persist even after controlling for related observable characteristics. Nix et al. (2015) argue that discrimination in the labour market is influenced by country-specific factors and that one set of factors cannot condition the gender-wage gap of all countries. Labour market conditions are not independent of existing societal values and institutions. In this study, it is argued that through the contagion effect, labour markets may be influenced by the dominant cultural beliefs of the society as well as educational levels.

Culture and Gender-wage gap

Enhanced independence and career opportunities for women as well as associated attraction to education has been made possible largely because of cultural progress and female emancipation (European Commission, 2009). Boserup (1970) concluded that differences in gender wage gap in the southern and northern part of India could be attributed to differences in labour force participation in these regions which in turn is motivated by cultural differences in restrictions on extent of women participation in economic activity. Westerners are more likely to be individualistic while easterners are likely to be collectivist (Loughnan, et al., 2011; Boucher, 2010; Heine & Hamamura, 2007). Even though traits of individualism and collectivism could be found in every race and religion, collectivism appears to be more common in Africa, among Catholics and Muslims (Pirttilä-Backman et al., 2004).

Conventionally, collectivism is associated with lesser inequality while individualism increases inequality. Peetz (2010) concluded that collective values are strong in modern times as they were in the past and could be nurtured to strengthen labour unions. Jiang et al. (2019) provided support for the conventional view that collectivism reduces inequality. In China, they report that smaller compensation gap was observed for companies with Chairpersons from collectivist societies than chairpersons from individualist societies. Basabe and Ros (2005) reported that power distance and collectivism are correlated with low social development and income differences. Collectivism is key to explaining women's business ownership (Bullough, Renko, Abdelzaher, 2014). Hammar (2019) argues using global survey data covering several individuals and countries that individualism ideology significantly reduces individual preferences for income redistribution. Adjaye-Gbewonyo (2017) argues that income inequality widens in the presence of individualistic cultural values. Farrelly (2017) adds that strengthening individualism through political support and public policy is associated with increase in inequality, insecurity and demands on workers.

Nikolaev et al., (2017) argue that net income inequality is lower in individualistic societies challenging the conventional view that income inequality is higher in societies that promote individualistic values than those that promote collectivist values. They explain that such an observation is possible because people in individualistic societies are not only interested in the immediate needs but also support inclusive institutions that lead to respect for the rights, liberties, and well-being of all members of society. In line with previous findings that suggested respect for the rule of law, protection of private property and strong democratic institutions are common features of individualistic societies (Nikolaev & Salahodjaev, 2017, 2016; Kyriacou, 2016), and the fact that individualistic societies are less corrupt but more accommodative of minority interest (Thornhill & Fincher, 2014; Allik & Realo, 2004; Kyriacou, 2015; Jha & Panda, 2017), individualism may reduce income inequality. Davies and Williamson (2019) argue that gender equality is enhanced in a society with individualism values as against collectivist values because individualism enhances recognition of women's goals and choices through the promotion of autonomy and self-determination which are not gender specific. On the other hand, collectivist values may promote inequality and encourage acceptance of it through confining women's goals to their social obligations. Individualism increases the satisfaction of societies through the open societies channel that promote tolerance, trust, civic engagement, and minimization of materialistic pressure (Krys et al., 2019). Cao (2019) revealed similarly that income inequality and concentration of wealth among the richest in society is associated with collectivist societies. McMurray (2018) concluded that policies aimed at reducing gender gap could target addressing cultural dimensions such as reducing power distance, uncertainty avoidance, masculinity as well as promoting individualism in the affected societies. Binder (2018) explain that individualism ensures significantly more income redistribution and lower after-tax income inequality and this relationship is much more profound in higher-income countries. Davies and Williamson (2019) concluded from World Values Survey data that individualism promotes equality in employment, income, education, and political leadership.

Education and labour returns

Education is arguably considered as the most important component of human capital because it enhances the productive capacity of individuals. Both the human capital theory and the signalling theory place value on education as a key factor that drives returns to labour. Higher education is associated with favourable individual attitudes towards gender inequality (Kyoore & Sulemana, 2019). Low returns to education reduce female labour participation (Kanjilal-Bhaduri, & Pastore, 2017). Nordman and Roubaud (2009) observed that significant differences exist in the relative returns to female education than that of male education and these differences favour females. Zhou and Nelson (2017) posit that returns to better education favour women than men. Sahoo and Klasen (2018) assert that gender disparity in labour market outcomes is influenced by gender discriminations in education that occur at early stages of life. In Zambia, Nielsen (2000) argued that gender wage discrimination is prevalent with full-time employed females who have completed primary school or junior secondary school. Individualism and additions to formal education reduce the positive relationship between volunteerism and wages and this relationship could be negative depending on the magnitude of individualism and additions to formal education (Duerrenberger & Warning, 2018).

Source of education faces some form of discrimination especially where the source of education is different from the labour market in which the beneficiary human capital is being applied. Poot and Roskruge (2013) argue that returns to education is higher in the native country of receiving the education than in a foreign country. This other form of discrimination in the labour market show how internationally foreign education may be discriminated against in another country. In most developing countries the origin of the foreign education (developed economy as against developing or underdeveloped) influence the extent of this kind of discrimination.

Glass Ceiling or Sticky Floors

Empirical evidence offer support for not only the glass ceiling but also sticky floors. Gorth (2015) investigated the gender-wage gap across the wage distribution of manufacturing firms and concluded that the gap reduces at higher wage distributions but is wider at lower levels offering support for sticky floors and the presence of different mechanisms for influencing wage differentials of low and high paid workers. de la Rica, Dolado and Llorens (2008) revealed that gender wage gap is not the same for gender groups with different educational backgrounds. Based on the glass ceiling hypothesis, they argue that the gender-wage gap is higher for gender groups belonging to the higher educated category while the gap decreases for gender groups in the lower education bracket.

Agyire-Tettey et al. (2018) revealed that returns to entrepreneurship in Africa faces gender-based discrimination for lower earners and there exists gender bias against female entrepreneurship returns for some African countries. On the contrary, Hultin (2003) found a glass escalator for males in female dominated work environment suggesting that males appear favoured in their career progress in a female dominated career. Females were not found to be disadvantaged in what is normally referred to as the glass ceiling. Morgan (1998) advises that multi-cohort longitudinal design should be used to investigate glass ceiling hypothesis involving discrimination against women.

Other Determinants of gender wage gap

In addition to culture and education, other existing studies have concluded that demographic factors, sector of engagement, experience and labour market structure also condition gender wage gap analysis. Ñopoet al. (2011) concluded that socioeconomic and job characteristics help explain disparities in gender wage gaps around the world. Castellano et al. (2018) contend that the effect of family background on gender inequality is bigger than that of gender equality policies.

Lassibille (1998) investigated whether gender differences in returns to education could be explained by the sector of engagement. The results show that women's private returns to education is higher than that of men but the public sector records higher gender-wage differentials than the private sector. Experience explains a greater portion of the gender wage gap (Dias, Joyce & Parodi, 2016). Using macroeconomic data, Oostendorp (2004) concluded that evidence exists to suggest that increasing economic development, trade and foreign investment, sometimes lead to narrowing occupational wage gap for developed and developing economies. Bøler, Javorcik, and Ulltveit-Moe (2017) associated widening of gender wage gap to engaging in exports. They argue that in Norway, the gender wage gap of exporters is 3 percentage points larger than non-exporters.

Mahajan and Ramaswami (2016) argued that the analysis of gender wage gap may be incomplete if it does not factor in labour market structure such as the supply of female labour relative to that of male and the relative female wages to male wages. Their assertion was based on the fact that in India, the effect of female labour supply on female wages is profound even though similar results were not observed on male wages. Similarly, the results suggested that male labour supply significantly influenced both male wages and female wages.

Research Methods

Three main objectives motivated this empirical study: 1) ascertaining whether discrimination still exists in the labour markets of Ghana using recent data; 2) assessing whether culture moderates the gender wage gap analysis; and 3) evaluate whether glass ceiling or sticky floor hypothesis apply to the labour market of Ghana. Objective 1 was analysed using Blinder-Oaxaca (1973) decomposition while objective 2 was estimated with Heckman model and the quantile regression was used for the third objective.

Gender Wage Discrimination and Blinder-Oaxaca Decomposition

The Blinder-Oaxaca decomposition explains the differences across groups (Shita et al, 2019; Sen, 2014; Jann, 2008; O'Donnell et al, 2008). The Blinder (1973) and Oaxaca (1973) decomposition technique is popular in studies that assess gender wage differential. The two groups of interest are male and female and the outcome variable is wage. The Blinder-Oaxaca decomposition first estimates the male wage and female wage regressions using the equations below.

$$\ln(Y_{WM}) = X_{WMi}\beta_{WM} + \mu_{WMi} \tag{22}$$

$$\ln(Y_{WF}) = X_{WFi}\beta_{WF} + \mu_{WFi} \tag{23}$$

Where Y_{WM} and Y_{WF} are the male and female wages respectively. X is a set of explanatory variables; β_{WM} and β_{WF} capture the intercept and the slope parameters for the male wage and female wage equations respectively; μ_{WMi} and μ_{WFi} are the respective error terms.

Blinder-Oaxaca (1973) present two main types of decompositions, the twofold and the threefold. The twofold decomposition is commonly used in studies that assess the presence or otherwise of discrimination among groups. It assumes that in determining the contribution of the differences in the predictors there is some non-discriminatory coefficients vector that should be considered. This results in the twofold decomposition that adds a third equation to the above two equations which takes the following form:

$$E(ln(Y_{WM})) - E(\ln(Y_{WF})) = [E(X_{WM}) - E(X_{WF})]\beta^{*} + [E(X_{WM})(\beta_{WM} - \beta^{*}) + E(X_{WF})(\beta^{*} - \beta_{WF})] \tag{24}$$

Where: $E(ln(Y_{WM})) - E(\ln(Y_{WF}))$ is the mean wage difference between male and female; $[E(X_{WM}) - E(X_{WF})]\beta^{*}$is the portion of the wage gap which is explained by differences in the wage conditioning factors of male and female which is considered as the endowment effect or the explained component; the portion of the wage gap that is attributed to the unexplained component or the structural effect is captured in the second term of the right-hand side of Equation 24, $[E(X_{WM})(\beta_{WM} - \beta^{*}) + E(X_{WF})(\beta^{*} - \beta_{WF})]$. This part of the wage gap is often assigned to discrimination in the labour market even though it could also reflect the effect of some omitted variables.

The threefold decomposition assumes that three different components explain the wage gap between males and females; group differences in the predictors (endowment effect), differences in the coefficients including the coefficient of the intercept (unexplained component or structural effect), and the interaction between the endowment effect and the structural effect. The inclusion of the interaction term is based on the assumption that differences in the endowment effect and the structural effect coexist simultaneously. The basic form of the threefold decomposition could be written as follows:

$$E(ln(Y_{WM})) - E(\ln(Y_{WF})) = [E(X_{WM}) - E(X_{WF})]\beta_{WF} + [E(X_{WF})(\beta_{WM} - \beta_{WF})] + [E(X_{WM}) - E(X_{WF})(\beta_{WM} - \beta_{WF})] \quad (25)$$

Where $E(ln(Y_{WM})) - E(\ln(Y_{WF}))$, is the explained and $[E(X_{WM}) - E(X_{WF})]\beta_{WF}$ is the endowment effect. $[E(X_{WF})(\beta_{WM} - \beta_{WF})]$ is used to measure the differences in the coefficients including that of the intercept while $[E(X_{WM}) - E(X_{WF})(\beta_{WM} - \beta_{WF})]$ is used to capture the simultaneous effect of the endowment and the coefficient effects.

The decomposition in Equations 24 and 25 were done from the point of view of females based on the informed assumption that generally females are discriminated against in the labour market. In other words, the coefficients of the Female group are used to weight the group differences in the predictors in order to ascertain the endowment effect. Impliedly, the endowment component is used to gauge the expected change in the mean wage outcome of Females if

Females had the male predictor values. Also, the weighting of the difference in coefficients in the second component by the predictor values of Females assesses the expected change in the mean wage outcome of Females if Females had the coefficients of Males.

Heckman Model in Culture and Gender Wage Gap Analysis

Randomness and experimentation are important in establishing causal relationships (Angrist & Pischke, 2008) but it is possible for a sample not to have been randomly taken. The Heckman model was developed in order to partly deal with the issue of sampling bias and because of the possible presence of selection on unobservables (Zimran, 2019). It is also appropriate when the outcome variable is not fully observed (Sarvašová et al., 2018; Greene, 2011; Sartori, 2003). The problem of sampling bias needs attention partly because of the possibility of inaccurate relationship about an outcome variable and its explanatory variables. Insignificant relationships may be erroneously reported as significant and vice versa, in a biased sample situation (Certo et al., 2016). Furthermore, where the data is truncated, a situation where the outcome variable is not observed for all observed explanatory variables, the Heckman model may also be used.

According to Sarvašová et al. (2018) the application of Heckman model is multi-disciplinary. The model has application in Economics (Christofides et al., 2013; Lennox et al., 2012), health (Hoornbeek et al., 2015; Liu & Waite, 2014), education (Andrabi et al., 2013; Winters et al., 2012), political science (Vance & Ritter, 2014), strategic management (Certo, et al., 2016) and conservation (Sarvašová et al., 2018).

The study assesses returns to education in Ghana and postulates that higher education may lead to higher labour returns. If the study finds that returns to higher education is relatively low, it may be partially due to the number of graduates who are either unemployed or have taken up some activities that do not measure up to their qualifications in order to survive their temporary unemployment condition. Also, in order to account for the fact that earnings that is observed for all the sample may not be a random sample of earnings for the entire population (Poot & Roskruge, 2013), the Heckman (1979) model was used to deal with any possible sampling bias that may be present in the sample.

Quantile Regression for Glass Ceiling Determination

To assess whether wage rates are sticky at lower wage distributions and the presence of a glass ceiling in Ghana, based on recent data, a modified quantile regression method was used. Regression coefficients generated at the conditional mean may be biased for outcome variables, such as the wages recorded by the GLSS 7, with outliers. Quantile regression has the ability to present robust results in the presence of outliers because it allows for the derivation of coefficient estimates for the dependent variable (wages) at its various conditional distributions (Koenker & Bassett Jr., 1978; Koenker & Hallock 2001; Okada & Samreth 2012; Asongu et al. 2017; Boateng et al. 2018). Waldman (2018) argued that in situations where classical assumptions of linear models such as homoscedasticity and Gaussian distribution cannot be achieved, quantile regression is relatively better than classical methods because of its ability to generate regression estimates at the specified percentiles. Koenker and Bassett (1978) specifies the basic form quantile model as follows:

$$Q_{\tau}(y|X) = X\beta_{\tau}, \tag{26}$$

Where, $Q_{\tau}(y|X)$ is the percentile (0.10, 0.25, 0.50, 0.75, and 0.90) of the dependent variable, wages, X is covariate matrix (education, culture, marital status, experience, region of work) and β_{τ} is the coefficient of the covariates to be estimated for each quantile of interest.

In order to estimate the wage differentials of the various quantiles, the study used the recently propounded estimation technique by Rios-Avila (2020) that builds on the works of Firpo et al. (2018), Firpo and Pinto (2016) and Firpo et al. (2009). The model combines the features of Blinder-Oxaca decomposition approach and recentered influence functions (RIF). The basic form of the model as developed by Rios-Avila (2020) could be written as follows:

$$\Delta_{\mu} = \underbrace{\bar{X}^{1'}(\hat{\beta}_1 - \hat{\beta}_c)}_{\Delta\mu_s^p} + \underbrace{(\bar{X}^1 - \bar{X}^c)'\hat{\beta}_c}_{\Delta\mu_s^e} + \underbrace{(\bar{X}^c - \bar{X}^0)'\hat{\beta}_0}_{\Delta\mu_x^p} + \underbrace{\bar{X}^{c'}(\hat{\beta}_C - \hat{\beta}_0)}_{\Delta\mu_x^e} \tag{27}$$

Where, the components $\Delta\mu_s^p + \Delta\mu_s^e$ is the aggregate wage structure effect of the Blinder-Oaxaca model, whereas $\Delta\mu_x^p + \Delta\mu_x^e$ is the aggregate composition effect. These two components are further decomposed into a pure wage structure $\Delta\mu_s^p$ and pure composition effect $\Delta\mu_x^p$ plus two components that can be used to assess the overall fitness of the model. $\Delta\mu_s^e$ is the reweighting error that is used to evaluate the quality of the re-weighting strategy and is expected to go to 0 in large samples. A large significant reweighting error implies that the counterfactual is not well identified and that the specification of the probit or logit model used for the estimation of reweighting factors may need to be modified. $\Delta\mu_x^e$ is the specification error and is used to assess the quality of the model specification and the RIF approximation. A large and significant specification error may be an indication that the RIF regression is misspecified or that the RIF is providing a poor approximation to the distributional statistic μ.

According to Christofides et al. (2013), glass ceiling exists if the difference between 90th percentile wage gap and the reference gap is at least two percentage points. A sticky floor effect is concluded to exist if the difference between the 10th percentile wage gap and the reference gap is at least two percentage points.

Results and Discussion

Gender-Wage Discrimination

The results in Table 11 presents the estimation results on the first objective in this chapter which seeks to assess whether discrimination exists in the labour market of Ghana when culture has not been factored into the analysis. Column 1 of Table 11 reports the results on whether differences exist in the wages of male and females while Columns 2 and 3 presents the results on the factors that account for the explained and unexplained components of the differences respectively.

The results show that the mean wage of male was 8.1 while that of female was 7.6 resulting in a statistically significant wage gap between male and female of 0.475. Impliedly, the Ghanaian labour market rewards the male gender about 6 percent (0.475/8.1*100) more than the female gender. Also, it could be explained that only about 20% (0.094/0.475*100) of the differences between male and female wages could be explained by differences in observable characteristics such as work experience, location, region of work, marital status, etc.

From Column 2 of Table 11, it could be observed that significant factors that could assist females to reduce the wage gap include experience, region of work, location, training, marital status, and education level. The results indicate that there is a positive relationship between work experience and wages at the significance level of 1%. This suggests that the labour market recognizes and rewards relevant work experience and that differences in experience of male and female job seekers significantly account for differences in their wages, a position also espoused by Dias et al. (2016). Thus, closing the gender-wage gap in Ghana, partly depends on closing the experience gap between male and female. This may be difficult to achieve if work place conditions do not support female experience gathering process. Additionally, the results suggest that there is no evidence in support of the fact that excessive experience may be detrimental to wage differentials.

Using the Greater Accra Region as a base, the study reports evidence in support of the fact that, at 1% significant level, working in Northern, Upper East and Upper West regions of Ghana reduces one's wages. On the other hand, those who work in Central and Ashanti have the potential to increase their wages. This suggests that wage differentials could be explained by inequity in quality job opportunities across the regions of Ghana. Also, the results indicate that compared to urban areas, working in a rural area hampers one's chances of earning a good pay. This is reflected in the negative and significant (at 1%) relationship between working in a rural area and wage level. The relatively lower level of wage returns of rural workers probably explain the persistence of rural poverty suggesting that equitable wage policies for rural and urban settlers could help ameliorate gender wage differentials. Furthermore, and quite surprisingly, the results suggest that a person who receives no training may earn more compared to someone who received training. This result appears counter-intuitive but may reflect the Ghanaian labour market condition of not offering wage reward for in-service training. Individuals are generally likely to benefit from wage increment after training when they change jobs.

The results on the relationship between marital status and wage is positive. Compared to married persons, the relationship between divorced and widowed persons and wage differentials was significant at the 1 and 5 percent conventional levels respectively. This implies that wage levels increase with one being divorced or a widow. Reduced family responsibility that increases available working hours of such persons as well as inherent desire to work hard and earn more to communicate their financial self-sufficiency probably account for the positive relationship. The relationship between education and wage gap is positive and significant at 1%. Comparatively, persons with secondary and tertiary qualifications earn more than those with basic education. In other words, differences in educational qualification of male and female help explain differences in wages between male and female. This suggests that the wage differences between male and female could be closed by facilitating the female education enhancement (Zhou & Nelson, 2017). The results sit well with arguments that suggests that education is a sure way of facilitating economic empowerment (Kyoore & Sulemana, 2019).

Table 11: Two-fold Oaxaca Decomposition

VARIABLES	(1) BO overall	(2) explained	(3) unexplained	(4) BOcul overall	(5) explained	(6) unexplained
group_1	8.097***			8.098***		
	(0.0158)			(0.0158)		
group_2	7.623***			7.622***		
	(0.0292)			(0.0292)		
difference	0.475***			0.475***		
	(0.0332)			(0.0332)		
explained	0.0936***			0.0926***		
	(0.0247)			(0.0248)		
unexplained	0.381***			0.383***		
	(0.0379)			(0.0379)		
work_exp		0.0371***	-0.342***		0.0370***	-0.343***
		(0.00928)	(0.0988)		(0.00927)	(0.0988)
exp2		-0.0113	0.136**		-0.0113	0.137**
		(0.00785)	(0.0551)		(0.00784)	(0.0552)
Basic		-0.000113	-0.285		-0.000270	-0.279
		(0.0108)	(0.183)		(0.0108)	(0.183)
Secondary		0.0110	-0.0777**		0.0110	-0.0766**
		(0.00686)	(0.0368)		(0.00685)	(0.0369)
Tertiary		0.0334***	-0.0568**		0.0339***	-0.0552**
		(0.00851)	(0.0261)		(0.00857)	(0.0261)
No Training		0.00607***	0.166		0.00624***	0.175
		(0.00205)	(0.180)		(0.00205)	(0.182)
Individualism					-0.000845	0.0626
					(0.00122)	(0.0675)
Central		0.00579**	-0.00298		0.00584**	-0.00325

		(0.00254)	(0.0118)		(0.00256)	(0.0118)
Western		0.000963	0.0423***		0.000944	0.0427***
		(0.000930)	(0.0140)		(0.000927)	(0.0140)
Volta		0.00474	0.00895		0.00476	0.00934
		(0.00315)	(0.0140)		(0.00316)	(0.0141)
Eastern		0.00131	0.000567		0.00132	4.70e-05
		(0.00254)	(0.0170)		(0.00256)	(0.0170)
Ashanti		0.00195	0.0146		0.00203	0.0147
		(0.00229)	(0.0187)		(0.00229)	(0.0187)
Brong Ahafo		-0.00183	0.0267**		-0.00183	0.0268**
		(0.00265)	(0.0122)		(0.00266)	(0.0122)
Northern		-0.0131***	-0.00354		-0.0135***	-0.00382
		(0.00290)	(0.00490)		(0.00293)	(0.00489)
Upper East		-0.00455***	-0.00486		-0.00451***	-0.00449
		(0.00171)	(0.00463)		(0.00171)	(0.00463)
Upper West		-0.00672***	0.00942		-0.00667***	0.00998*
		(0.00228)	(0.00600)		(0.00227)	(0.00602)
Rural		-0.0503***	0.0104		-0.0501***	0.0132
		(0.00637)	(0.0268)		(0.00635)	(0.0269)
Divorced		0.0467***	-0.0596***		0.0464***	-0.0597***
		(0.0129)	(0.0176)		(0.0129)	(0.0176)
Widowed		0.0277**	-0.0150		0.0274**	-0.0146
		(0.0131)	(0.0110)		(0.0131)	(0.0110)
Single		0.00482	-0.00524		0.00477	-0.00520
		(0.00295)	(0.0150)		(0.00292)	(0.0150)
Constant			0.818***			0.736**
			(0.315)			(0.328)
Observations	7,965	7,965	7,965	7,961	7,961	7,961

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

Gender-Wage Gap and Culture

The study further extended the discussion on gender-wage-gap analysis to include culture which is an attempt to assess whether cultural orientations in the lines of collectivism and individualism play a role in the level of gender-wage discrimination in the Ghanaian labour market. Columns 4, 5 and 6 of Table 11 report such results. Column 4 does not depict any significant difference between the mean wage of male and that of female when culture is controlled for (Male, 8.098; Female, 7.622) and when culture is omitted (Male, 8.098; Female, 7.623). Similarly, the difference in the wages of male and female (0.475) was the same for the two models. In spite of these, the proportion of the explained portion of the wage gap increased when culture was controlled for, probably underscoring the important role of culture in explaining gender wage differentials. It could be observed that about 23.16% (0.110/0.475*100) of the differences between male and female wages could be explained by differences in observable characteristics such as work experience, location, region of work, marital status, etc, as against the reported 20% when culture was omitted. Impliedly, culture generally reduces the level of wage discrimination against women in the labour market.

The result of the study was largely the same as the one without culture variables. The relationship between culture and wage gap was insignificant. This implies that our measures of cultural values (based on religious beliefs) are not deeply engrained in the labour market conditions in Ghana. In other words, collectivism and individualism cultural ideologies, as reflected in religion, should be less considered in explaining gender-wage gap conditions in Ghana. Based on these findings, the study further assessed whether general wage levels are influenced by religious cultural ideologies even though little was found in the case of gender wage gap analysis. The results are reported in Table 12 below.

Education, Culture and Wages in Ghana

Tables 12A to 12C and Appendices C1 to C2 provide the results on the determinants of wage levels in Ghana using the Heckman selection model. The results cover whether culture and education influence wage levels and whether culture moderates the relationship between gender and wages. Table 12A contains the regression results with no cultural variable. Tables 12B to 12C contain the regression results with interaction of the female gender with the individualism and collectivism variables developed based on religious affiliation. Similar results have been presented for the male gender in Appendices C2 and C3. The results depict consistently that work experience, gender, cultural ideologies, marital status, location, region of work, and education are prominent in explaining wage size in general.

From Tables 12A to 12C, females are generally paid lesser than males in Ghana and this is significant at 1 percent and consistent for all the females models estimated. The results reiterate the fact that females do not enjoy equitable treatment in terms of the amount of pay they receive for work done in the Ghanaian labour market. Also, work experience gathered increases one's ability to add to their wages earned even though excessive experience may be detrimental to the size of wages received. This may occur when there is no commensurate work for the level of experience gathered and may force the acquirer of the experience to settle for what is available. The results further indicated that divorced, widow and single workers earned lesser wages than married workers. Married workers are generally considered to have much more responsibility because of the expectation of taking care of their families. This may motivate them to work extra hours or take on additional responsibility for more wages than single workers. So, the results may not imply discrimination against the unmarried but rather reflect wage differential occasioned by the drive to earn more which is consequential to responsibilities imposed on married persons. In effect, the results corroborate previous findings that demographic factors explain wage differentials (Castellano et al., 2018). The findings from the relationship between education and general wage size indicate that higher educational attainment is associated with higher wages. Comparatively, basic level and secondary level education offer acquirers lesser wages than tertiary education achievers. The fact that secondary school achievers exhibit a positive relationship with wages while that of basic school achievers is negative is also instructive even though the two results are insignificant. The results suggest that returns to education, in the form of wages, graduate with the level of education.

Furthermore, the results indicate that citizens in rural areas generally earn lesser than their counterparts in urban areas, at the conventional 1% significant level. This could be evidenced by the relatively low level of working opportunities in rural areas, concentration of both renowned private and public institutions in urban areas and relatively bigger markets for urban areas. Also, the results suggest that working outside Greater Accra Region is associated with accepting a wage cut. Apart from workers in Ashanti and Western Regions, all other workers in other regions significantly earn a reduced wage when compared with that of Greater Accra. The high standard of living in Accra and attraction of well-paid jobs to the region because of the privilege of being the capital of Ghana as well as its associated opportunities offered to businesses could be cited as contributing factors.

The introduction of the cultural variables in Tables 12B to 12C and Appendices C1 to C2 show that religious cultural ideologies marginally influence general wage levels. Tables 12B to 12C and Appendices C2 to C3 which report the effect of individualism on the female wage and male wage models, respectively, show that individualism cultural ideology influence wages positively albeit at the 10 percent significant level. Self-belief, self-reliance, hard work, the opportunity for individual recognition for efforts encourage persons with individualistic ideologies to work hard and generate returns for themselves primarily. Again, in an environment that supports individualistic ideologies, individuals are better motivated to deploy their potentials because of their self-interest. Thus, workers who exhibit individualistic ideologies are more likely to increase their wages. Furthermore, it is observed from Table 12B that even though the coefficient of the female variable remained negative and significant at 1 percent after the introduction of the individualism cultural variable, the absolute value of the coefficient had improved (from 0.357 in Table 12A to 0.285 in Table 12B). In addition, given that the interaction variable is negative but insignificant at any of the conventional levels, the results reiterate the positive effect of individualism on wages in Ghana. Apparently, a female that leaves in an environment that supports the pursuit of self-interest against the common good is better positioned to minimise discrimination against women with respect to wages. Results from the other control variables were consistent with that of Table 12A.

Table 12C reports the results from the female model after considering the introduction of the collectivism cultural variable. The following interesting observations are made from Table 12C. Firstly, it is observed that the relationship between collectivism and wage is negative and significant at 10%. Impliedly, the promotion of cultural ideologies that suggest that returns to effort should be seen as a common good can discourage individual income generating effort, may encourage laziness and minimise average income levels of the society. Secondly, the results depicts that the introduction of the collectivism variable has increased the coefficient of the female variable from -0.357 in Table 12A to -0.378 in Table 12C. The reason could be that in a collectivist society, little or minimal effort could be attached to dealing with inequalities since the wealth of individuals are generally deemed to belong to the entire society. The consummation of this ideology is also likely to breed laziness which can demotivate the efforts needed to increase one's returns. Consequently, it could be argued that female wages could be worsened in the presence of collectivist ideologies. Lastly, the results depict a positive but insignificant relationship between the interaction term and wages suggesting the potential to leverage collective ideology for improvement in female wages, given certain conditions. Thus, the result does not offer support for the conventional view that collectivism reduces income inequality (Jiang et al., 2019).

Appendices C1 and C2 report a positive but insignificant relationship between all the cultural variables (individualism and collectivism) and wages. This may be an indication of the strong cultural influence of the male gender in the labour market because of the unique responsibilities expected of males in societies of most emerging economies. However, from Appendix C2, it is apparent that the relationship between the interaction variable of collectivism and male is negative but insignificant. The results of all the other variables exhibited consistent relationship with wages as reported in Table 12A.

Table 12A: Heckman selection model -- two-step estimates (without culture)

lwage	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
work_exp	.023	.004	5.93	0	.015	.03	***
exp2	-.001	0	-7.51	0	-.001	0	***
Gender (base: Male)	0	.	.	.	.	.	
Female	-.357	.044	-8.13	0	-.443	-.271	***
Educational level(base: none)	0	.	.	.	.	.	
basic	-.025	.161	-0.15	.877	-.34	.29	
secondary	.244	.164	1.48	.139	-.079	.566	
tertiary	1.019	.171	5.98	0	.685	1.353	***
Received Training (base: yes)	0	.	.	.	.	.	
no	-.489	.09	-5.45	0	-.665	-.313	***
Marital status(base: married)	0	.	.	.	.	.	
divorced	-.162	.055	-2.96	.003	-.269	-.054	***
widowed	-.192	.074	-2.57	.01	-.337	-.046	**
single	-.377	.053	-7.06	0	-.482	-.273	***
Location(base: Urban)	0	.	.	.	.	.	
Rural	-.547	.056	-9.72	0	-.657	-.437	***
Region (base: Greater Accra)	0	.	.	.	.	.	
Central	-.588	.124	-4.75	0	-.83	-.345	***
Western	.055	.059	0.93	.352	-.061	.171	
Volta	-.475	.072	-6.55	0	-.617	-.333	***
Eastern	-.06	.097	-0.62	.538	-.25	.131	
Ashanti	.049	.064	0.76	.447	-.077	.174	
Brong Ahafo	-.717	.144	-4.97	0	-.999	-.434	***
Northern	-1.078	.222	-4.85	0	-1.514	-.643	***
Upper East	-.943	.268	-3.52	0	-1.468	-.417	***
Upper West	-1.025	.234	-4.38	0	-1.483	-.567	***
Constant	8.365	.206	40.59	0	7.961	8.769	***
female	.042	.041	1.02	.306	-.038	.122	
Educational level(base: none)	0	.	.	.	.	.	

basic	-.033	.143	-0.23	.819	-.313	.248	
secondary	.059	.148	0.40	.691	-.231	.348	
tertiary	.183	.15	1.22	.222	-.111	.478	
work_exp	-.003	.003	-1.02	.307	-.01	.003	
exp2	0	0	-1.26	.209	0	0	
Received Training (base: yes)	0	.	.	.	.	.	
no	-.163	.082	-1.98	.048	-.324	-.002	**
Marital status(base: married)	0	.	.	.	.	.	
divorced	-.014	.053	-0.27	.788	-.119	.09	
widowed	-.114	.066	-1.72	.086	-.243	.016	*
single	-.152	.05	-3.06	.002	-.249	-.055	***
Location(base: Urban)	0	.	.	.	.	.	
Rural	-.2	.032	-6.35	0	-.262	-.139	***
Region (base: Greater Accra)	0	.	.	.	.	.	
Central	-.458	.059	-7.78	0	-.573	-.343	***
Western	-.004	.059	-0.07	.946	-.12	.112	
Volta	-.167	.062	-2.70	.007	-.288	-.046	***
Eastern	.421	.064	6.55	0	.295	.547	***
Ashanti	.16	.059	2.73	.006	.045	.275	***
Brong Ahafo	-.536	.058	-9.23	0	-.65	-.422	***
Northern	-.803	.07	-11.53	0	-.939	-.667	***
Upper East	-.944	.071	-13.25	0	-1.084	-.805	***
Upper West	-.821	.074	-11.14	0	-.966	-.677	***
hhsize	-.017	.006	-2.69	.007	-.03	-.005	***
Constant	1.364	.174	7.83	0	1.022	1.705	***
lambda	1.421	.523	2.72	.007	.396	2.447	***

Mean dependent var	7.979	SD dependent var	1.261
Number of obs	10440	Wald chi2(20)	996.910***

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

Table 12B: Heckman selection model -- two-step estimates (with individualism culture as interaction)

lwage	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
work_exp	.023	.004	6.04	0	.015	.03	***
exp2	-.001	0	-7.56	0	-.001	0	***
female	-.285	.088	-3.25	.001	-.456	-.113	***
individualism	.094	.049	1.93	.054	-.001	.189	*
indivifemale	-.093	.092	-1.02	.309	-.273	.087	
Educational level(base: none)	0	.	.	.	.	.	
basic	-.02	.159	-0.13	.9	-.331	.291	
secondary	.246	.163	1.51	.131	-.073	.564	
tertiary	1.024	.169	6.07	0	.693	1.355	***
Received Training (base: yes)	0	.	.	.	.	.	
no	-.481	.088	-5.45	0	-.654	-.308	***
Marital status(base: married)	0	.	.	.	.	.	
divorced	-.159	.054	-2.94	.003	-.265	-.053	***
widowed	-.187	.073	-2.55	.011	-.331	-.043	**
single	-.371	.053	-7.04	0	-.474	-.268	***
Location(base: Urban)	0	.	.	.	.	.	
Rural	-.536	.054	-9.93	0	-.642	-.43	***
Region (base: Greater Accra)	0	.	.	.	.	.	
Central	-.578	.121	-4.78	0	-.815	-.341	***
Western	.058	.059	0.98	.326	-.057	.173	

Volta	-.468	.071	-6.61	0	-.607	-.329	***
Eastern	-.071	.095	-0.75	.455	-.257	.115	
Ashanti	.047	.064	0.74	.456	-.077	.172	
Brong Ahafo	-.697	.139	-5.01	0	-.969	-.424	***
Northern	-1.065	.218	-4.88	0	-1.493	-.637	***
Upper East	-.903	.258	-3.50	0	-1.41	-.397	***
Upper West	-.982	.223	-4.41	0	-1.419	-.546	***
Constant	8.287	.217	38.26	0	7.863	8.712	***
female	.092	.077	1.20	.231	-.059	.243	
individualism	.104	.039	2.69	.007	.028	.18	***
indivifemale	-.065	.083	-0.79	.428	-.227	.096	
work_exp	-.003	.003	-0.99	.322	-.01	.003	
exp2	0	0	-1.27	.205	0	0	
Educational level(base: none)	0	.	.	.	.	.	
basic	-.027	.143	-0.19	.848	-.308	.254	
secondary	.065	.148	0.44	.659	-.224	.355	
tertiary	.191	.15	1.27	.204	-.104	.485	
hhsize	-.018	.006	-2.75	.006	-.03	-.005	***
Received Training (base: yes)	0	.	.	.	.	.	
no	-.161	.083	-1.95	.051	-.323	.001	*
Marital status(base: married)	0	.	.	.	.	.	
divorced	-.013	.053	-0.24	.81	-.117	.092	
widowed	-.112	.066	-1.69	.091	-.242	.018	*
single	-.152	.05	-3.06	.002	-.249	-.055	***
Location (base: Urban)	0	.	.	.	.	.	

Rural	-.193	.032	-6.09	0	-.255	-.131	***
Region (base: Greater Accra)	0	.	.	.	.	.	
Central	-.458	.059	-7.77	0	-.574	-.343	***
Western	.003	.059	0.05	.963	-.114	.119	
Volta	-.16	.062	-2.59	.01	-.282	-.039	***
Eastern	.42	.064	6.53	0	.294	.547	***
Ashanti	.167	.059	2.84	.005	.052	.282	***
Brong Ahafo	-.527	.058	-9.04	0	-.641	-.413	***
Northern	-.811	.07	-11.63	0	-.948	-.674	***
Upper East	-.927	.072	-12.94	0	-1.068	-.787	***
Upper West	-.793	.075	-10.61	0	-.94	-.647	***
Constant	1.267	.178	7.13	0	.919	1.616	***
lambda	1.362	.509	2.68	.007	.365	2.36	***

Mean dependent var	7.979	SD dependent var	1.261
Number of obs	10435	Wald chi2(20)	1025.676***

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

Table 12C

Heckman selection model -- two-step estimates (with collectivism culture as interaction)

lwage	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
work_exp	.023	.004	6.04	0	.015	.03	***
exp2	-.001	0	-7.56	0	-.001	0	***
female	-.378	.046	-8.22	0	-.468	-.288	***
collectivism	-.094	.049	-1.93	.054	-.189	.001	*
collecfemale	.093	.092	1.02	.309	-.087	.273	
Educational level(base: none)	0	.	.	.	.	.	
basic	-.02	.159	-0.13	.9	-.331	.291	
secondary	.246	.163	1.51	.131	-.073	.564	
tertiary	1.024	.169	6.07	0	.693	1.355	***
Received Training (base: yes)	0	.	.	.	.	.	
no	-.481	.088	-5.45	0	-.654	-.308	***
Marital status(base: married)	0	.	.	.	.	.	
divorced	-.159	.054	-2.94	.003	-.265	-.053	***
widowed	-.187	.073	-2.55	.011	-.331	-.043	**
single	-.371	.053	-7.04	0	-.474	-.268	***
Location (base: Urban)	0	.	.	.	.	.	
Rural	-.536	.054	-9.93	0	-.642	-.43	***
Region (base: Greater Accra)	0	.	.	.	.	.	
Central	-.578	.121	-4.78	0	-.815	-.341	***
Western	.058	.059	0.98	.326	-.057	.173	

Volta	-.468	.071	-6.61	0	-.607	-.329	***
Eastern	-.071	.095	-0.75	.455	-.257	.115	
Ashanti	.047	.064	0.74	.456	-.077	.172	
Brong Ahafo	-.697	.139	-5.01	0	-.969	-.424	***
Northern	-1.065	.218	-4.88	0	-1.493	-.637	***
Upper East	-.903	.258	-3.50	0	-1.41	-.397	***
Upper West	-.982	.223	-4.41	0	-1.419	-.546	***
Constant	8.381	.203	41.34	0	7.984	8.779	***
female	.027	.044	0.60	.548	-.06	.114	
collectivism	-.104	.039	-2.69	.007	-.18	-.028	***
collecfemale	.065	.083	0.79	.428	-.096	.227	
work_exp	-.003	.003	-0.99	.322	-.01	.003	
exp2	0	0	-1.27	.205	0	0	
Received Training (base: yes)	0	.	.	.	.	.	
no	-.161	.083	-1.95	.051	-.323	.001	*
Marital status(base: married)	0	.	.	.	.	.	
divorced	-.013	.053	-0.24	.81	-.117	.092	
widowed	-.112	.066	-1.69	.091	-.242	.018	*
single	-.152	.05	-3.06	.002	-.249	-.055	***
Location (base: Urban)	0	.	.	.	.	.	
Rural	-.193	.032	-6.09	0	-.255	-.131	***
Region (base: Greater Accra)	0	.	.	.	.	.	
Central	-.458	.059	-7.77	0	-.574	-.343	***
Western	.003	.059	0.05	.963	-.114	.119	
Volta	-.16	.062	-2.59	.01	-.282	-.039	***
Eastern	.42	.064	6.53	0	.294	.547	***

Ashanti	.167	.059	2.84	.005	.052	.282	***
Brong Ahafo	-.527	.058	-9.04	0	-.641	-.413	***
Northern	-.811	.07	-11.63	0	-.948	-.674	***
Upper East	-.927	.072	-12.94	0	-1.068	-.787	***
Upper West	-.793	.075	-10.61	0	-.94	-.647	***
Educational level(base: none)	0	.	.	.	.	.	
basic	-.027	.143	-0.19	.848	-.308	.254	
secondary	.065	.148	0.44	.659	-.224	.355	
tertiary	.191	.15	1.27	.204	-.104	.485	
hhsize	-.018	.006	-2.75	.006	-.03	-.005	***
Constant	1.371	.175	7.86	0	1.029	1.714	***
lambda	1.362	.509	2.68	.007	.365	2.36	***

Mean dependent var	7.979	SD dependent var	1.261
Number of obs	10435	Wald chi2(20)	1025.676***

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

Determinants of Wages using Quantile Regression

In Table 13 and Appendix C3, the study reports on whether there is the possibility of a glass ceiling or a sticky floor in the assessment of gender-wage gap in Ghana. Also, it contains an assessment of whether the explanatory factors for wage levels in Ghana vary across the wage distribution. The full regression results are reported for the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles in Appendix C3 while the summary of the quantile gender-wage gap results and the determination of the glass ceiling and sticky floor results are contained in Table 12. The 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles are considered as the lower, upper lower, middle, upper middle and upper wage levels respectively.

The results show that differences between the wages of male and female were negative and significant at 1% in favour of males and across the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} quantiles. This indicates that females are discriminated against in terms of wages across all the quantiles of interest suggesting that female workers earning wages in the quantiles of the wage distribution suffer reduction in their wages relative to their male counterparts. The results in C3 suggest that discrimination against women in the labour market is affected by regional developmental gaps, rural urban developmental gaps, access to tertiary education and training of females in their various fields of endeavour. Also, the study revealed that all the differences between the gender-wage gaps at the 10^{th} and 90^{th} quantiles were more than 2 percentage points as suggested by Christofides et al. (2013). Thus, we conclude that the labour market of Ghana has sticky floors and glass ceiling. Impliedly, persons discriminated against at the lower levels of the wage distribution are prevented from progressing to the higher levels to enjoy enhance wages and conditions of service. Given that favouritism and unfairness are common in the labour markets of Ghana, persons at the lower levels of the wage distribution who are not highly connected to influential superiors will remain stuck at their positions. Similarly, the tendency for women to progress to the top is also low given the gender imbalance at top management level and at the board level. In effect, while the results from Table 13 corroborate earlier results reported in Table 12 that discrimination exists in the Ghanaian labour market, the study further reveals evidence in support of either the glass ceiling or sticky floor hypothesis.

Table 13: Blinder-Oaxaca RIF-decomposition (Reweighted): lnWage and Summary of Quantile Evidence on Sticky Floors and Glass Ceiling

						Sticky floor		Glass ceiling	
	Q10	**Q25**	**Q50**	**Q75**	**Q90**	**10-25**	**10 - 50**	**90-75**	**90-50**
Female	6.0980***	6.8366***	7.6705***	8.4977***	9.2565***				
	[0.0465]	[0.0390]	[0.0349]	[0.0395]	[0.0464]				
Counter	6.3374***	7.1850***	7.9678***	8.7062***	9.4191***				
	[0.0464]	[0.0388]	[0.0321]	[0.0312]	[0.0439]				
Male	6.5638***	7.3591***	8.1486***	8.8881***	9.5134***				
	[0.0289]	[0.0227]	[0.0191]	[0.0187]	[0.0232]				
Total Difference	-0.4658***	-0.5225***	-0.4781***	-0.3904***	-0.2569***	0.1217	0.0265	0.5198	0.86122
	[0.0547]	[0.0451]	[0.0398]	[0.0437]	[0.0519]				
ToT_Explained	-0.2264***	-0.1741***	-0.1808***	-0.1819***	-0.0943**				
	[0.0526]	[0.0428]	[0.0360]	[0.0354]	[0.0479]				
ToT Unexplained	-0.2394**	-0.3484***	-0.2974***	-0.2085***	-0.1626				
	[0.1070]	[0.0882]	[0.0761]	[0.0835]	[0.1051]				

Note: Standard errors in parenthesis. *, **, and *** denote significant levels at 10%, 5% and 1%, respectively.

The definition of 'glass ceiling' follows that of Christofides et al. (2013) which is defined to exist if the difference between 90th percentile wage gap and the reference gap is at least two percentage points. A 'sticky floor' effect is defined to exist if the difference between the 10th percentile wage gap and the reference gap is at least two percentage points.

The results on whether differences exist across the various wage distributions in terms of their explanatory factors reveal that education improves the wages of all workers across the wage distribution. The higher coefficients recorded for the tertiary education variable across all the distributions suggest that higher education is associated with higher wage returns across all quantiles reiterating the potency of education in fighting poverty, inequality and social marginalisation. This result sits well with existing findings reported in this Chapter as well as previous empirical findings (such as Kyoore & Sulemana, 2019; Kanjilal-Bhaduri, & Pastore, 2017; Nordman & Roubaud, 2009). The results on the effect of work experience, training and marital status were largely consistent with previously reported results, they are wage catalyst. On regions, the results show that across quantiles and with the exception of Eastern and Ashanti regions, workers in other regions other than Greater Accra generally earn less. The results further indicate that rural workers earn lesser than urban workers irrespective of the wage distribution.

Conclusion

In this Chapter, the study assessed whether cultural values of collectivism and individualism play a role in explaining gender wage differentials. The study specifically assessed whether gender wage gap exists in the Ghanaian labour market; the role of culture in the wage-gap analysis and whether a glass ceiling or sticky floor exists in the labour market of Ghana. The results confirm the existence of wage discrimination against women in Ghana and observe that such discrimination is deep seated since it persists across the wage distribution. The results further suggest that education reduces inequality and increases the wages of acquirers. But workers in Northern, Upper East and Upper West regions receive lesser wages when compared with that the Greater Accra Region in Ghana. The study further found support for the assertion that wages are responsive to the cultural orientation of the worker and the worker's cultural environment. Thus, the study found support in favour of the human capital and signalling theories as well as the conventional sticky floor and glass ceiling hypotheses, based on data from the Ghanaian economy.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Introduction

This chapter presents the summary, conclusion and recommendations for the three empirical works undertaken in thematic area of the inequality and labour returns. The chapter begins with the summary of the entire work, followed by the conclusion and then recommendations.

Summary

The key outcome of education comprises academic performance and labour returns. Academic performance and labour returns give a clear indication of fruition linked to the educational system. However, the existence of various forms of inequality in the educational sector and the labour market may impede the achievement of these desired educational returns. Inequalities such infrastructure, education and gender inequality may curtail realisation of the benefit to be derived from education.

The purpose of this study was therefore, to ascertain the effect of inequalities on educational returns in Ghana. Specifically, the study tested for: 1) whether infrastructural inequality influences academic performance in Ghana 2) the possibility of a relationship between education inequality and labour returns 3) the effect of gender inequalities on labour returns in Ghana and 4) whether culture moderates the relationship between gender inequalities and labour returns.

The study had five chapters. Chapter one offered an introduction to the study. It discussed the background to the study including stylised facts about some key variables, the problem statement, objectives of the study hypotheses and the scope and limitations.

Chapter two was an empirical chapter on the first objective that assessed the effect of infrastructural inequality on student academic performance. The Education Statistics data (2018) by the Ghana Statistical Service was used for the study. The study employed ANOVA and Dynamic General Methods of Moments technique in assessing objective. It estimated whether academic performance differed at various infrastructure distribution levels (Infrastructure Quintile levels) and the relationship the level of infrastructure had with academic performance.

The first empirical chapter found that there was a statistically significant difference in performance in Mathematics, English and Science at the Infrastructure Quintile levels. However, performance in Social Studies did not differ at the Quintile levels. It again established that top quintiles having a higher coefficient (academic performance) than the lowest quintiles for the various subjects, pointing to the existence of infrastructure inequality. This also shows that the quality of infrastructure significantly impacts academic performance. Also, previous academic performance had a significant positive relationship with performance in Mathematics, English, Science and Social Studies. The P2T ratio had a significantly inverse relationship with academic performance in all four subjects. This is an indication that a smaller class size aids the performance in mathematics. The number of students to a textbook ratio had no significant effect on performance in all subjects. GPI was inversely related to academic performance in English. This implied that, as the ratio of girls to boys increases, performance in English decreases.

Chapter three was the second empirical chapter on the second objective that sought to examine the effect of education inequality on labour returns in

Ghana. The sixth and seventh of GLSS (2012/2013 and 2016/2017) were used to assess objective two. An education Gini was generated and Heckman estimation was used to assess the impact of education inequality on labour returns.

The second empirical study saw the emergence of two key findings. Firstly, there was a negative relation between the education Gini index and wages suggesting that education inequality is associated with lower wages. Secondly, an examination of the distribution of education Gini across the districts revealed that the districts in the three Northern Regions (North, Upper East and Upper West) recorded relatively, the highest inequality over the period.

Chapter four was the last empirical paper that covered objectives three and four. It examined the effect of gender inequality on labour returns in Ghana as well as assessing the moderating role culture plays in the relationship between gender inequality and labour returns in Ghana.

Employing the round six of GLSS (2012/2013), the Blinder-Oaxaca decomposition, Heckman estimation and quantile regression were used to analyse the third and fourth specific objectives.

Three key findings emanated from chapter four. First, the results confirm the existence of wage discrimination against women in Ghana and observe that such discrimination is deep seated since it persists across the wage distribution. Second, the study also found support for the assertion that wages are responsive to the cultural orientation of the worker and the worker's cultural environment. Third, the study found support in favour of the human capital and signalling theories as well as the conventional sticky floor and glass ceiling hypotheses.

Conclusion

The purpose of the study was to assess the effect inequalities have on returns to education. Based on the findings from the first empirical study, it can be concluded that infrastructure inequality has a negative effect on academic performance. The second conclusion is based on the second empirical chapter. It is concluded that education inequality influences labour returns. Thirdly, it is concluded that gender wage exists in the labour market and also conventional sticky floor and glass ceiling hypotheses holds in Ghana. Fourthly it is concluded that that wages are responsive to the cultural orientation of the worker and the worker's cultural environment.

Recommendations and Policy Implications

Based on the findings and conclusions of the study, the following recommendations and policies are suggested.

1. In order ensure equitable distribution of educational infrastructure and resolve infrastructural challenges in deprived areas, the Ministry of Education (MoE) should prioritise the provision of educational infrastructure. Educational infrastructure developments should be prioritised in favour of deprived districts in order to bridge the infrastructural gap.
2. The combine effect of all the infrastructure positively impacted academic performance. This suggest that certain minimum amount of all infrastructure is required for all schools in the country in order to achieve the desired academic performance. The (MoE) and Metropolitan, Municipal and District Assemblies (MMDAs) should ensure the provision of all the key education infrastructure like classrooms, seating and writing places, water and toilet facilities.

3. Heads of basic schools and MMDAs must be encouraged to pursue sustained academic performance. This could be achieved by encouraging students to guard against complacency and the institution of incentive schemes to motivate teachers. Reward schemes could be put in place motivate teaching and learning in districts with low quality infrastructure.
4. The government through the MoE could pursue education inequality reduction policies. Policy to improve on level of education must be targeted at both the formal and informal sectors of education. This will ensure balance in pursuit of reducing illiteracy levels in the economy in order to bridge the gap in educational opportunity for individuals across all the districts in Ghana. Improved access and educational opportunity for all through the free education policies, offering of short courses, on-line tuition etc could help minimise the education disparities and increase the average years of schooling for all individuals in the country.
5. There should be targeted programmes to support female work place progression. Gender wage discriminations in Ghana could be ameliorated by providing support systems that facilitate female education and opportunities for advancement at the work places. Affirmative actions by Ministry of Gender and Social Justice and International organisations such as United Nations Development Programme as well as mentorship schemes by organisations may facilitate this process. There could be targeted female management training and continuous professional development programmes in order to break any form of glass ceiling.
6. Efforts to address gender wage differentials must be directed at re-orienting our general cultural beliefs on the roles of females in our societies and

harness female economic empowerment. The Ministry of Employment and Labour Relations must promote and sensitise on the need for the pay and promotion to be based on individual experience and capabilities.

Further Studies

Further studies need to be conducted to investigate the effect of variations school level infrastructure on academic performance. Other studies would also be needed to assess individual specific factors that impacts academic performance. Again, a qualitative study that would investigate social and behavioural aspects of the relationship between inequality and returns to education would be of much relevance. Also, culture was defined narrowly from the religious perspective. Expanding the definition of culture to include other dimensions and testing their effect on the gender wage gap analysis would help enrich the literature.

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APPENDICES

A1: Principal component analysis for infrastructure

2010

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.14821	.599464	0.4296	0.4296
Comp2	1.54874	.592487	0.3097	0.7394
Comp3	.956256	.75786	0.1913	0.9306
Comp4	.198395	.049994	0.0397	0.9703
Comp5	.148401		0.0297	1.0000
Number of obs	165			
Rho	0.7394			

Source: Authors’ Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
Seatratio	0.5185	0.4491	.1101
Writeratio	0.4549	0.5055	.1598
Classratio	0.2574	0.0985	.8427
Waterratio	0.4387	-0.5539	.1115
Toiletratio	0.5153	-0.4757	.07901

Source: Authors’ Construct based on GSS Education Statistics Data (2018)

2011

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.33947	.981005	0.4679	0.4679
Comp2	1.35846	.634632	0.2717	0.7396
Comp3	.72383	.373826	0.1448	0.8844
Comp4	.350004	.121765	0.0700	0.9544
Comp5	.228238		. 0.0456	1.0000
Number of obs	162			
Rho	0.7396			

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
Seatratio	0.4938	0.4763	.1214
Writeratio	0.4007	0.6138	.1126
Classratio	0.4055	-0.2701	.5163
Waterratio	0.4304	-0.4133	.3346
Toiletratio	0.4959	-0.3907	.2173

Source: Authors' Construct based on GSS Education Statistics Data (2018)

2012

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.01156	.74648	0.4023	0.4023
Comp2	1.26508	.586733	0.2530	0.6553

Comp3	.678346	.0361707	0.1357	0.7910
Comp4	.642175	.239335	0.1284	0.9194
Comp5	.40284		. 0.0806	1.0000
Number of obs	164			
Rho	0.6553			

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
Seatratio	0.2939	0.6059	.3618
Writeratio	0.2035	0.6809	.3301
Classratio	0.5078	-0.1003	.4687
Waterratio	0.5093	-0.3800	.2955
Toiletratio	0.5958	-0.1211	.2673

Source: Authors' Construct based on GSS Education Statistics Data (2018)

2013

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.40132	1.03118	0.4803	0.4803
Comp2	1.37014	.716815	0.2740	0.7543
Comp3	.653326	.290749	0.1307	0.8850
Comp4	.362577	.149942	0.0725	0.9575
Comp5	.212635		0.0425	1.0000
Number of obs	213			
Rho	0.7543			

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
Seatratio	0.4865	-0.4824	.1129
Writeratio	0.4130	-0.5899	.1137
Classratio	0.4307	0.2775	.4491
Waterratio	0.3920	0.4734	.3239
Toiletratio	0.5036	0.3439	.229

Source: Authors' Construct based on GSS Education Statistics Data (2018)

2014

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.14046	.701789	0.4281	0.4281
Comp2	1.43867	.600796	0.2877	0.7158
Comp3	.837871	.430036	0.1676	0.8834
Comp4	.407835	.232663	0.0816	0.9650
Comp5	.175171		. 0.0350	1.0000
Number of obs	214			
Rho	0.7158			

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
Seatratio	0.6014	-0.2447	.1397
Writeratio	0.6038	-0.1557	.1847
Classratio	0.3585	-0.2767	.6147

Waterratio	0.2119	0.6653	.2671
Toiletratio	0.3166	0.6298	.2147

Source: Authors' Construct based on GSS Education Statistics Data (2018)

2015

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.99006	.514699	0.3980	0.3980
Comp2	1.47536	.635423	0.2951	0.6931
Comp3	.839935	.380605	0.1680	0.8611
Comp4	.45933	.224009	0.0919	0.9529
Comp5	.235321		0.0471	1.0000
Number of obs	213			
Rho	0.6931			

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
Seatratio	0.6322	-0.1074	.1875
Writeratio	0.6327	-0.1187	.1826
Classratio	0.3565	-0.3023	.6123
Waterratio	0.1564	0.6551	.3182
Toiletratio	0.2201	0.6737	.234

Source: Authors' Construct based on GSS Education Statistics Data (2018)

2016

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.05458	.529743	0.4109	0.4109
Comp2	1.52484	.708642	0.3050	0.7159
Comp3	.816198	.370852	0.1632	0.8791
Comp4	.445346	.286315	0.0891	0.9682
Comp5	.159031		0.0318	1.0000
Number of obs	214			
Rho	0.7159			

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
Seatratio	0.6491	0.0845	.1235
Writeratio	0.6345	0.0743	.1644
Classratio	0.4191	-0.2283	.5597
Waterratio	0.0106	0.6543	.347
Toiletratio	-0.0186	0.7121	.2261

Source: Authors' Construct based on GSS Education Statistics Data (2018)

A2: Principal component analysis for academic performance

2010

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.2285	2.76231	0.8071	0.8071
Comp2	.466188	.298396	0.1165	0.9237
Comp3	.167792	.0302701	0.0419	0.9656
Comp4	.137522		. 0.0344	1.0000
Number of obs	154			
Rho	0.9237			

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
PerfM	0.4944	0.5640	.0627
PerfEng	0.4739	0.6966	.04868
PerfSS	0.5155	0.2596	.1107
PerfSci	0.5151	-0.3595	.08328

Source: Authors' Construct based on GSS Education Statistics Data (2018)

2011

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.05736	2.53407	0.7643	0.7643

Comp2	.523292	.258008	0.1308	0.8952
Comp3	.265283	.111217	0.0663	0.9615
Comp4	.154067		. 0.0385	1.0000
Number of obs	158			
Rho	0.8952			

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
PerfM	0.4919	-0.5906	.07777
PerfEng	0.4621	0.7820	.02715
PerfSS	0.5102	-0.1923	.1848
PerfSci	0.5332	0.0511	.1296

Source: Authors' Construct based on GSS Education Statistics Data (2018)

2012

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.30923	2.91224	0.8273	0.8273
Comp2	.396989	.194652	0.0992	0.9266
Comp3	.202336	.110888	0.0506	0.9771
Comp4	.0914482		0.0229.	1.0000
Number of obs	166			
Rho	0.9266			

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
PerfM	0.5199	-0.3387	.06011
PerfEng	0.4606	0.8433	.01551
PerfSS	0.5074	0.0009	.1482
PerfSci	0.5100	-0.4174	.07001

Source: Authors' Construct based on GSS Education Statistics Data (2018)

2013

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.43678	3.16698	0.8592	0.8592
Comp2	.2698	.10511	0.0675	0.9266
Comp3	.16469	.0359579	0.0412	0.9678
Comp4	.128732		0.0322	1.0000
Number of obs	213			
Rho	0.9266			

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
PerfM	0.5016	-0.5242	.06123
PerfEng	0.4840	0.8254	.01098
PerfSS	0.5080	-0.0734	.1118
PerfSci	0.5061	-0.1963	.1095

Source: Authors' Construct based on GSS Education Statistics Data (2018)

2014

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.40013	3.11449	0.8500	0.8500
Comp2	.285641	.125157	0.0714	0.9214
Comp3	.160484	.00674221	0.0401	0.9616
Comp4	.153742		. 0.0384	1.0000
Number of obs	208			
Rho	0.9214			

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
PerfM	0.5074	-0.2107	.112
PerfEng	0.4811	0.8485	.007528
PerfSS	0.5014	-0.4674	.08271
PerfSci	0.5096	-0.1312	.1119

Source: Authors' Construct based on GSS Education Statistics Data (2018)

2015

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.31664	2.98561	0.8292	0.8292
Comp2	.331029	.124311	0.0828	0.9119

Comp3	.206718	.0611012	0.0517	0.9636
Comp4	.145616		. 0.0364	1.0000
Number of obs	207			
Rho	0.9119			

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
PerfM	0.5104	-0.3758	.08915
PerfEng	0.4770	0.8362	.01379
PerfSS	0.5015	-0.3993	.113
PerfSci	0.5103	-0.0134	.1364

Source: Authors' Construct based on GSS Education Statistics Data (2018)

2016

Principal components/correlation

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.49359	3.2084	0.8734	0.8734
Comp2	.285186	.159183	0.0713	0.9447
Comp3	.126004	.0307838	0.0315	0.9762
Comp4	.09522		. 0.0238	1.0000
Number of obs	214			
Rho	0.9447			

Source: Authors' Construct based on GSS Education Statistics Data (2018)

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
PerfM	0.4983	-0.5516	.04566
PerfEng	0.4820	0.7778	.01595

PerfSS	0.5064	-0.2878	.08066
PerfSci	0.5128	0.0892	.07896

Source: Authors' Construct based on GSS Education Statistics Data (2018)

A3: List of Infrastructure Index and Performance index of districts in Ghana (for 2016)

Districtcode	Districtname	Region	Infrastructure Index	Rank
1	Adansi North	Ashanti	-0.02	124th
2	Adansi South	Ashanti	-1.54	183rd
3	Afigya-Kwabre	Ashanti	-2.26	197th
4	Ahafo-Ano North	Ashanti	0.75	76th
5	Ahafo-Ano South	Ashanti	-0.57	149th
6	Amansie Central	Ashanti	0.63	83rd
7	Amansie West	Ashanti	-0.24	136th
8	Asante-Akim Central Municipal	Ashanti	1.73	17th
9	Asante-Akim North	Ashanti	2.45	2nd
10	Asante-Akim South	Ashanti	0.80	69th
11	Asokore-Mampong Municipal	Ashanti	0.69	82nd
12	Atwima-Kwanwoma	Ashanti	-0.90	164th
13	Atwima-Mponua	Ashanti	-2.36	201st
14	Atwima-Nwabiagya	Ashanti	-1.54	181st
15	Bekwai Municipal	Ashanti	-0.83	160th
16	Bosome-Freho	Ashanti	-0.53	147th
17	Bosomtwe	Ashanti	0.59	87th
18	Ejisu-Juaben Municipal	Ashanti	-0.80	158th
19	Ejura-Sekyedumase	Ashanti	-1.02	169th
20	Kumasi Metropolitan	Ashanti	0.92	63rd
21	Kumawu	Ashanti	0.46	97th
22	Kwabre East	Ashanti	0.70	81st
23	Mampong Municipal	Ashanti	-2.21	195th

24	Obuasi Municipal	Ashanti	1.87	11th
25	Offinso Municipal	Ashanti	-3.26	211th
26	Offinso North	Ashanti	-3.09	210th
27	Sekyere-Afram Plains	Ashanti	0.37	107th
28	Sekyere Central	Ashanti	0.39	102nd
29	Sekyere East	Ashanti	0.30	112th
30	Sekyere South	Ashanti	-0.11	129th
31	Asunafo North Municipal	Brong Ahafo	-0.65	151st
32	Asunafo South	Brong Ahafo	0.45	98th
33	Asutifi	Brong Ahafo	0.26	113th
34	Asutifi South	Brong Ahafo	-1.54	184th
35	Atebubu-Amantin	Brong Ahafo	-0.84	162nd
36	Banda	Brong Ahafo	1.13	45th
37	Berekum Municipal	Brong Ahafo	2.89	1st
38	Dormaa East	Brong Ahafo	-1.54	182nd
39	Dormaa Municipal	Brong Ahafo	0.71	80th
40	Dormaa West	Brong Ahafo	1.27	40th
41	Jaman North	Brong Ahafo	0.31	111th
42	Jaman South	Brong Ahafo	-1.19	175th
43	Kintampo North Municipal	Brong Ahafo	-0.58	150th
44	Kintampo South	Brong Ahafo	1.05	50th
45	Nkoranza North	Brong Ahafo	0.37	108th
46	Nkoranza South Municipal	Brong Ahafo	-1.15	174th
47	Pru	Brong Ahafo	-2.66	203rd
48	Sene East	Brong Ahafo	-0.15	130th
49	Sene West	Brong Ahafo	-0.89	163rd
50	Sunyani Municipal	Brong Ahafo	0.07	121st
51	Sunyani West	Brong Ahafo	-1.75	187th
52	Tain	Brong Ahafo	-1.42	179th
53	Tano North	Brong Ahafo	-0.29	137th

54	Tano South	Brong Ahafo	-2.25	196th
55	Techiman Municipal	Brong Ahafo	-2.97	209th
56	Techiman North	Brong Ahafo	1.78	16th
57	Wenchi Municipal	Brong Ahafo	-1.24	176th
58	Abura - Asebu - Kwamankese	Central	1.85	13th
59	Agona East	Central	1.03	52nd
60	Agona West Municipal	Central	0.51	94th
61	Ajumako-Enyan-Essiam	Central	0.57	90th
62	Asikuma - Odoben - Brakwa	Central	0.15	118th
63	Assin North Municipal	Central	0.95	62nd
64	Assin South	Central	1.09	47th
65	Awutu-Senya	Central	0.86	67th
66	Awutu Senya East Municipal	Central	-1.43	180th
67	Cape Coast Metropolitan	Central	1.84	14th
68	Effutu Municipal	Central	1.38	30th
69	Ekumfi	Central	1.86	12th
70	Gomoa East	Central	1.23	42nd
71	Gomoa West	Central	1.36	32nd
72	Komenda-Edina-Eguafo-Abrem Municipal	Central	0.43	99th
73	Mfantseman Municipal	Central	1.48	25th
74	Twifo Atti - Mokwa	Central	0.51	93rd
75	Twifo Hemang - Lower Denkyira	Central	0.87	66th
76	Upper Denkyira East Municipal	Central	1.09	48th
77	Upper Denkyira West	Central	0.24	114th
78	Akwapim North Municipal	Eastern	2.20	6th
79	Akwapim South	Eastern	2.06	7th
80	Akyemansa	Eastern	1.02	53rd

81	Asuogyaman	Eastern	0.80	70th
82	Atiwa	Eastern	1.43	28th
83	Ayensuano	Eastern	1.18	44th
84	Birim Central Municipal	Eastern	1.36	31st
85	Birim North	Eastern	1.48	26th
86	Birim South	Eastern	1.25	41st
87	Denkyembour	Eastern	1.64	21st
88	East Akim Municipal	Eastern	1.92	9th
89	Fanteakwa	Eastern	1.31	37th
90	Kwaebibirem	Eastern	1.65	20th
91	Kwahu Afram Plains North	Eastern	0.85	68th
92	Kwahu Afram Plains South	Eastern	0.80	71st
93	Kwahu East	Eastern	1.65	19th
94	Kwahu South	Eastern	0.99	55th
95	Kwahu West Municipal	Eastern	0.98	59th
96	Lower Manya Krobo Municipal	Eastern	0.57	91st
97	New Juaben Municipal	Eastern	1.32	36th
98	Nsawam - Adoagyire Municipal	Eastern	1.33	34th
99	Suhum Municipal	Eastern	1.56	24th
100	Upper Manya Krobo	Eastern	1.87	10th
101	Upper West Akim	Eastern	1.70	18th
102	West Akim Municipal	Eastern	2.21	5th
103	Yilo Krobo Municipal	Eastern	0.10	119th
104	Accra Metropolitan	Greater Accra	0.90	65th
105	Ada West	Greater Accra	0.55	92nd
106	Adenta Municipal	Greater Accra	2.02	8th
107	Ashaiman Municipal	Greater Accra	2.30	4th
108	Dangme East	Greater Accra	0.95	61st

109	Ga Central Municipal	Greater Accra	0.38	103rd
110	Ga East Municipal	Greater Accra	2.42	3rd
111	Ga South Municipal	Greater Accra	0.47	96th
112	Ga West Municipal	Greater Accra	-0.21	134th
113	Kpone - Katamanso	Greater Accra	0.05	122nd
114	La Dade-Kotopon Municipal	Greater Accra	-0.02	125th
115	La-Nkwantanang-Madina	Greater Accra	1.33	35th
116	Ledzokuku-Krowor Municipal	Greater Accra	1.64	22nd
117	Ningo - Prampam	Greater Accra	1.35	33rd
118	Shai - Osudoku	Greater Accra	0.76	74th
119	Tema Metropolitan	Greater Accra	0.09	120th
120	Bole	Northern	1.48	27th
121	Bunkpurugu - Yunyoo	Northern	-1.76	188th
122	Central Gonja	Northern	-1.01	168th
123	Chereponi	Northern	-2.01	194th
124	East Gonja	Northern	-0.56	148th
125	East Mamprusi	Northern	-3.82	214th
126	Gushiegu	Northern	-1.79	189th
127	Karaga	Northern	-2.34	199th
128	Kpandai	Northern	-3.36	212th
129	Kumbungu	Northern	-1.69	185th
130	Mamprugo-Moaduri	Northern	0.05	123rd
131	Mion	Northern	-3.67	213th
132	Nanumba North	Northern	-2.74	204th
133	Nanumba South	Northern	-1.10	172nd
134	North Gonja	Northern	-2.82	206th
135	Saboba	Northern	-0.81	159th
136	Sagnerigu	Northern	-0.37	140th
137	Savelugu-Nanton Municipal	Northern	-0.68	153rd

138	Sawla-Tuna-Kalba	Northern	0.23	115th
139	Tamale Metropolitan	Northern	-1.05	171st
140	Tatale-Sangule	Northern	-0.37	139th
141	Tolong	Northern	-2.86	208th
142	West Gonja	Northern	0.48	95th
143	West Mamprusi	Northern	-2.58	202nd
144	Yendi Municipal	Northern	-1.15	173rd
145	Zabzugu	Northern	0.38	104th
146	Bawku Municipal	Upper East	-1.95	193rd
147	Bawku West	Upper East	-0.03	126th
148	Binduri	Upper East	-2.82	207th
149	Bolgatanga Municipal	Upper East	-0.20	132nd
150	Bongo	Upper East	-0.92	166th
151	Builsa North	Upper East	-2.28	198th
152	Builsa South	Upper East	0.63	84th
153	Garu-Tempane	Upper East	0.20	116th
154	Kassena Nankana Municipal (East)	Upper East	-1.94	192nd
155	Kassena Nankana West	Upper East	-1.82	190th
156	Nabdam	Upper East	-0.79	156th
156	Talensi	Upper East	-0.79	157th
157	Pusiga	Upper East	-4.89	216th
158	Daffiama-Bussie-Issa	Upper East	-0.22	135th
159	Jirapa	Upper East	-0.43	142nd
160	Lambussie Karni	Upper East	-0.43	141st
161	Lawra	Upper East	0.76	75th
162	Nadowli-Kaleo	Upper East	1.02	54th
163	Nandom	Upper East	-0.47	144th
164	Sissala East	Upper East	0.98	58th
165	Sissala West	Upper East	0.77	73rd

166	Wa East	Upper East	0.99	56th
167	Wa Municipal	Upper East	-0.84	161st
168	Wa West	Upper East	0.91	64th
169	Adaklu	Volta	1.12	46th
170	Afadzato South (Afadjato)	Volta	-1.27	177th
171	Agotime-Ziope	Volta	1.80	15th
172	Akatsi North	Volta	-0.52	146th
173	Akatsi South	Volta	1.29	39th
174	Biakoye	Volta	0.58	89th
175	Central Tongu	Volta	0.39	101st
176	Ho Municipal	Volta	1.04	51st
177	Ho West	Volta	-0.72	154th
178	Hohoe Municipal	Volta	-0.10	128th
179	Jasikan	Volta	0.59	88th
180	Kadjebi	Volta	-1.32	178th
181	Keta Municipal	Volta	1.42	29th
182	Ketu South Municipal	Volta	0.31	110th
183	Ketu North	Volta	-0.95	167th
184	Kpando Municipal	Volta	0.75	77th
185	Krachi East	Volta	-1.91	191st
186	Krachi-Nchumuru	Volta	-4.51	215th
187	Krachi West	Volta	-1.04	170th
188	Nkwanta North	Volta	-2.34	200th
189	Nkwanta South	Volta	-0.20	133rd
190	North Dayi	Volta	-0.67	152nd
191	North Tongu	Volta	0.17	117th
192	South Dayi	Volta	-1.75	186th
193	South Tongu	Volta	-0.32	138th
194	Ahanta West	Western	0.36	109th
195	Aowin	Western	0.96	60th

196	Suaman	Western	0.74	78th
197	Bia	Western	-2.80	205th
198	Bia East	Western	-0.75	155th
199	Sefwi Bibiani-Ahwiaso-Bekwai	Western	0.71	79th
200	Bodi	Western	0.99	57th
201	Ellembelle	Western	1.06	49th
202	Jomoro	Western	1.58	23rd
203	Juaboso	Western	0.38	105th
204	Wassa East	Western	0.61	86th
205	Mpohor	Western	0.40	100th
206	Nzema East Municipal	Western	0.77	72nd
207	Prestea-Honi Valley	Western	-0.18	131st
208	Sefwi-Akontombra	Western	-0.49	145th
209	Sefwi-Wiawso	Western	0.63	85th
210	Sekondi-Takoradi Metropolitan	Western	1.21	43rd
211	Shama	Western	1.30	38th
212	Tarkwa Nsuaem Municipal	Western	0.38	106th
213	Wasa-Amenfi East	Western	-0.45	143rd
214	Wasa-Amenfi Central	Western	-0.91	165th
215	Wasa-Amenfi West	Western	-0.08	127th

Districtcode	Districtname	Region	Performance Index	Rank
1	Adansi North	Ashanti	2.81	9th
2	Adansi South	Ashanti	0.43	97th
3	Afigya-Kwabre	Ashanti	1.80	43rd
4	Ahafo-Ano North	Ashanti	1.47	59th
5	Ahafo-Ano South	Ashanti	-0.98	149th
6	Amansie Central	Ashanti	-0.32	123rd
7	Amansie West	Ashanti	1.93	39th
8	Asante-Akim Central Municipal	Ashanti	0.07	110th
9	Asante-Akim North	Ashanti	1.46	62nd
10	Asante-Akim South	Ashanti	0.65	89th
11	Asokore-Mampong Municipal	Ashanti	-0.37	126th
12	Atwima-Kwanwoma	Ashanti	2.70	12th
13	Atwima-Mponua	Ashanti	1.46	61st
14	Atwima-Nwabiagya	Ashanti	1.89	40th
15	Bekwai Municipal	Ashanti	0.70	86th
16	Bosome-Freho	Ashanti	1.14	70th
17	Bosomtwe	Ashanti	0.75	83rd
18	Ejisu-Juaben Municipal	Ashanti	-0.68	140th
19	Ejura-Sekyedumase	Ashanti	2.84	6th
20	Kumasi Metropolitan	Ashanti	1.38	65th
21	Kumawu	Ashanti	0.63	90th
22	Kwabre East	Ashanti	0.69	87th
23	Mampong Municipal	Ashanti	-0.78	142nd
24	Obuasi Municipal	Ashanti	3.03	1st
25	Offinso Municipal	Ashanti	1.45	63rd

26	Offinso North	Ashanti	-1.52	169th
27	Sekyere-Afram Plains	Ashanti	2.05	37th
28	Sekyere Central	Ashanti	2.61	15th
29	Sekyere East	Ashanti	1.48	57th
30	Sekyere South	Ashanti	1.09	74th
31	Asunafo North Municipal	Brong Ahafo	1.63	53rd
32	Asunafo South	Brong Ahafo	2.61	16th
33	Asutifi	Brong Ahafo	1.47	58th
34	Asutifi South	Brong Ahafo	1.76	45th
35	Atebubu-Amantin	Brong Ahafo	-0.35	125th
36	Banda	Brong Ahafo	2.33	23rd
37	Berekum Municipal	Brong Ahafo	2.89	4th
38	Dormaa East	Brong Ahafo	1.81	42nd
39	Dormaa Municipal	Brong Ahafo	0.57	92nd
40	Dormaa West	Brong Ahafo	2.74	11th
41	Jaman North	Brong Ahafo	-0.49	130th
42	Jaman South	Brong Ahafo	2.43	19th
43	Kintampo North Municipal	Brong Ahafo	-1.62	172nd

44	Kintampo South	Brong Ahafo	-1.70	176th
45	Nkoranza North	Brong Ahafo	0.81	81st
46	Nkoranza South Municipal	Brong Ahafo	2.77	10th
47	Pru	Brong Ahafo	1.66	49th
48	Sene East	Brong Ahafo	0.16	108th
49	Sene West	Brong Ahafo	-2.68	196th
50	Sunyani Municipal	Brong Ahafo	2.68	13th
51	Sunyani West	Brong Ahafo	1.37	66th
52	Tain	Brong Ahafo	-1.39	163rd
53	Tano North	Brong Ahafo	1.47	60th
54	Tano South	Brong Ahafo	0.22	106th
55	Techiman Municipal	Brong Ahafo	1.08	75th
56	Techiman North	Brong Ahafo	-0.27	122nd
57	Wenchi Municipal	Brong Ahafo	0.48	94th
58	Abura - Asebu - Kwamankese	Central	-1.07	152nd
59	Agona East	Central	-1.50	168th
60	Agona West Municipal	Central	-0.25	121st

61	Ajumako-Enyan-Essiam	Central	-1.64	174th
62	Asikuma - Odoben - Brakwa	Central	1.63	51st
63	Assin North Municipal	Central	1.16	69th
64	Assin South	Central	1.08	76th
65	Awutu-Senya	Central	-0.41	128th
66	Awutu Senya East Municipal	Central	2.05	35th
67	Cape Coast Metropolitan	Central	-0.52	131st
68	Effutu Municipal	Central	-0.64	136th
69	Ekumfi	Central	0.99	79th
70	Gomoa East	Central	0.56	93rd
71	Gomoa West	Central	-1.57	171st
72	Komenda-Edina-Eguafo-Abrem Municipal	Central	-1.34	160th
73	Mfantseman Municipal	Central	-0.70	141st
74	Twifo Atti - Mokwa	Central	1.49	56th
75	Twifo Hemang - Lower Denkyira	Central	-1.18	157th
76	Upper Denkyira East Municipal	Central	3.00	2nd
77	Upper Denkyira West	Central	2.62	14th
78	Akwapim North Municipal	Eastern	-0.06	116th
79	Akwapim South	Eastern	-1.42	164th
80	Akyemansa	Eastern	0.36	102nd
81	Asuogyaman	Eastern	-0.59	135th
82	Atiwa	Eastern	-0.02	113th
83	Ayensuano	Eastern	0.34	104th
84	Birim Central Municipal	Eastern	-0.58	134th
85	Birim North	Eastern	2.82	8th

86	Birim South	Eastern	1.00	78th
87	Denkyembour	Eastern	-0.01	112th
88	East Akim Municipal	Eastern	-1.04	150th
89	Fanteakwa	Eastern	-1.74	177th
90	Kwaebibirem	Eastern	2.10	31st
91	Kwahu Afram Plains North	Eastern	-0.86	144th
92	Kwahu Afram Plains South	Eastern	1.85	41st
93	Kwahu East	Eastern	-1.20	158th
94	Kwahu South	Eastern	-0.39	127th
95	Kwahu West Municipal	Eastern	0.24	105th
96	Lower Manya Krobo Municipal	Eastern	-1.36	161st
97	New Juaben Municipal	Eastern	0.74	84th
98	Nsawam - Adoagyire Municipal	Eastern	0.36	103rd
99	Suhum Municipal	Eastern	0.45	96th
100	Upper Manya Krobo	Eastern	-3.81	212th
101	Upper West Akim	Eastern	-2.14	183rd
102	West Akim Municipal	Eastern	-1.43	165th
103	Yilo Krobo Municipal	Eastern	1.63	50th
104	Accra Metropolitan	Greater Accra	1.79	44th
105	Ada West	Greater Accra	-0.22	119th
106	Adenta Municipal	Greater Accra	2.08	34th
107	Ashaiman Municipal	Greater Accra	1.94	38th

108	Dangme East	Greater Accra	-0.05	114th
109	Ga Central Municipal	Greater Accra	2.59	17th
110	Ga East Municipal	Greater Accra	2.24	26th
111	Ga South Municipal	Greater Accra	1.71	48th
112	Ga West Municipal	Greater Accra	2.34	22nd
113	Kpone - Katamanso	Greater Accra	2.05	36th
114	La Dade-Kotopon Municipal	Greater Accra	1.49	55th
115	La-Nkwantanang-Madina	Greater Accra	2.28	24th
116	Ledzokuku-Krowor Municipal	Greater Accra	1.54	54th
117	Ningo - Prampam	Greater Accra	0.20	107th
118	Shai - Osudoku	Greater Accra	-1.16	155th
119	Tema Metropolitan	Greater Accra	1.32	67th
120	Bole	Northern	-1.66	175th
121	Bunkpurugu - Yunyoo	Northern	1.75	46th
122	Central Gonja	Northern	0.06	111th
123	Chereponi	Northern	-3.29	205th
124	East Gonja	Northern	-0.65	138th
125	East Mamprusi	Northern	-0.64	137th
126	Gushiegu	Northern	-3.78	210th
127	Karaga	Northern	-2.46	190th

128	Kpandai	Northern	2.37	21st
129	Kumbungu	Northern	2.19	28th
130	Mamprugo-Moaduri	Northern	0.42	98th
131	Mion	Northern	-1.44	166th
132	Nanumba North	Northern	-3.78	211th
133	Nanumba South	Northern	2.88	5th
134	North Gonja	Northern	-3.99	213th
135	Saboba	Northern	-3.38	207th
136	Sagnerigu	Northern	-0.94	148th
137	Savelugu-Nanton Municipal	Northern	-2.83	199th
138	Sawla-Tuna-Kalba	Northern	-0.80	143rd
139	Tamale Metropolitan	Northern	-1.13	153rd
140	Tatale-Sangule	Northern	-4.68	215th
141	Tolong	Northern	0.67	88th
142	West Gonja	Northern	-2.35	188th
143	West Mamprusi	Northern	-3.11	204th
144	Yendi Municipal	Northern	-0.65	139th
145	Zabzugu	Northern	0.48	95th
146	Bawku Municipal	Upper East	-2.54	191st
147	Bawku West	Upper East	-0.91	146th
148	Binduri	Upper East	-4.10	214th
149	Bolgatanga Municipal	Upper East	-1.32	159th
150	Bongo	Upper East	-2.33	187th
151	Builsa North	Upper East	-1.63	173rd
152	Builsa South	Upper East	-1.39	162nd
153	Garu-Tempane	Upper East	-1.80	179th
154	Kassena Nankana Municipal (East)	Upper East	-1.54	170th
155	Kassena Nankana West	Upper East	-2.84	200th

156	Nabdam	Upper East	-2.63	193rd
156	Talensi	Upper East	-2.63	194th
157	Pusiga	Upper East	-3.59	208th
158	Daffiama-Bussie-Issa	Upper West	-1.75	178th
159	Jirapa	Upper West	-2.32	186th
160	Lambussie Karni	Upper West	-2.79	198th
161	Lawra	Upper West	-3.09	203rd
162	Nadowli-Kaleo	Upper West	-3.38	206th
163	Nandom	Upper West	-3.66	209th
164	Sissala East	Upper West	-2.93	201st
165	Sissala West	Upper West	-2.28	184th
166	Wa East	Upper West	1.10	72nd
167	Wa Municipal	Upper West	-0.54	132nd
168	Wa West	Upper West	-2.38	189th
169	Adaklu	Volta	-0.12	117th
170	Afadzato South (Afadjato)	Volta	-0.34	124th
171	Agotime-Ziope	Volta	-2.30	185th
172	Akatsi North	Volta	-1.45	167th
173	Akatsi South	Volta	-1.07	151st
174	Biakoye	Volta	0.61	91st
175	Central Tongu	Volta	-2.56	192nd
176	Ho Municipal	Volta	0.15	109th
177	Ho West	Volta	-1.80	180th
178	Hohoe Municipal	Volta	1.13	71st
179	Jasikan	Volta	0.37	101st
180	Kadjebi	Volta	-2.64	195th
181	Keta Municipal	Volta	-0.58	133rd
182	Ketu South Municipal	Volta	-0.15	118th
183	Ketu North	Volta	-1.87	182nd

184	Kpando Municipal	Volta	-0.24	120th
185	Krachi East	Volta	-2.94	202nd
186	Krachi-Nchumuru	Volta	0.92	80th
187	Krachi West	Volta	-5.04	216th
188	Nkwanta North	Volta	-2.72	197th
189	Nkwanta South	Volta	-1.84	181st
190	North Dayi	Volta	-0.91	147th
191	North Tongu	Volta	-1.16	154th
192	South Dayi	Volta	-0.88	145th
193	South Tongu	Volta	-1.16	156th
194	Ahanta West	Western	-0.43	129th
195	Aowin	Western	1.75	47th
196	Suaman	Western	0.73	85th
197	Bia	Western	1.09	73rd
198	Bia East	Western	2.13	30th
199	Sefwi Bibiani-Ahwiaso-Bekwai	Western	2.59	18th
200	Bodi	Western	2.09	33rd
201	Ellembelle	Western	0.40	100th
202	Jomoro	Western	1.63	52nd
203	Juaboso	Western	2.41	20th
204	Wassa East	Western	1.07	77th
205	Mpohor	Western	0.76	82nd
206	Nzema East Municipal	Western	1.43	64th
207	Prestea-Honi Valley	Western	2.09	32nd
208	Sefwi-Akontombra	Western	2.15	29th
209	Sefwi-Wiawso	Western	2.83	7th
210	Sekondi-Takoradi Metropolitan	Western	0.42	99th
211	Shama	Western	-0.06	115th

212	Tarkwa Nsuaem Municipal	Western	1.21	68th
213	Wasa-Amenfi East	Western	2.25	25th
214	Wasa-Amenfi Central	Western	2.92	3rd
215	Wasa-Amenfi West	Western	2.19	27th

Appendix B1: List of Districts in Ghana with their education Gini and Rank (GLSS 6)

District	GINI(R6)	Rank	District	GINI(R6)	Rank	District	GINI(R6)	Rank
Chereponi	0.045	1st	**Ketu North**	0.142	16th	**East Akim**	0.163	33rd
Ahafo Ano South	0.081	2nd	**Asante Akim North**	0.144	18th	**Asuogyaman**	0.164	34th
Nanumba South	0.094	3rd	**Jaman South**	0.145	19th	**Atwima Mponua**	0.167	35th
Offinso Municipal	0.101	4th	**Adansi North**	0.146	20th	**Ejisu Juaben**	0.168	37th
Assin South	0.107	5th	**Twifo-Heman-LowerDenkyira**	0.147	21st	**Atiwa**	0.169	38th
Upper Denkyira West	0.121	6th	**Kwahu East**	0.151	22nd	**Mpohor-Wassa East**	0.170	39th
Bosome Freho	0.121	6th	**Juabeso**	0.153	23rd	**Sekyere Central**	0.171	40th
Centra lGonja	0.125	8th	**Amansie West**	0.153	23rd	**Tano North**	0.171	40th
Agona East	0.130	9th	**West Akim**	0.155	25th	**Atwima Kwanwoma**	0.171	40th
Offinso North	0.134	10th	**Tain**	0.155	25th	**Bosomtwi**	0.173	43rd
Birim North	0.134	10th	**Ejura Sekye Dumasi**	0.158	27th	**Asante Akim South**	0.174	44th
Akyemansa	0.135	12th	**Dormaa Municipal**	0.159	28th	**Abura-Asebu-Kwamankese**	0.174	44th
Mampong Municipal	0.137	13th	**Aowin-Suaman**	0.159	28th	**Dormaa East**	0.174	44th
Upper Manya Krobo	0.140	14th	**Kwaebibirem**	0.160	30th	**Ketu South**	0.175	47th
Jasikan	0.141	15th	**Fanteakwa**	0.161	31st	**Techiman**	0.175	47th
Ahanta West	0.142	16th	**Krachi West**	0.162	32nd	**Berekum**	0.177	49th

District	GINI(R6)	Rank	District	GINI(R6)	Rank	District	GINI(R6)	Rank
North Dayi (Kpandu)	0.177	49th	**Savelugu Nanton**	0.196	69th	**Sefwi Bibiani-Ahiwaso Bekwai**	0.208	88th
Adansisouth	0.177	49th	**Adaklu Anyigbe**	0.197	70th	**Jomoro**	0.208	88th
Asikuma-Odoben-Brakwa	0.181	52nd	**Kintampo**	0.197	70th	**North Tongu**	0.209	90th
WassaWest	0.182	53rd	**Obuasi Municipal**	0.198	72nd	**Akwapim South**	0.209	90th
NkoranzaNorth	0.183	54th	**Birim Central Municipal**	0.199	73rd	**Prestea/Huni Valley**	0.210	92nd
AsunafoNorth	0.185	55th	**Dagbe West**	0.199	73rd	**Sene**	0.210	92nd
TanoSouth	0.187	56th	**Sawla-Tuna-Kalba**	0.200	75th	**SouthTongu**	0.210	92nd
NkwantaNorth	0.189	57th	**Kintampo South**	0.201	76th	**KMA**	0.211	95th
Bia	0.189	57th	**Kwahu North**	0.202	77th	**Jaman North**	0.211	95th
BirimNorth	0.190	59th	**Upper Denkyira East**	0.202	77th	**Krachi East**	0.211	95th
Kadjebi	0.191	60th	**East Gonja**	0.202	77th	**Assin North**	0.212	98th
Sefwi Wiaso	0.191	60th	**Nkoranza South**	0.203	80th	**South Dayi**	0.213	99th
Ajumanku-Enya-Essiam	0.192	62nd	**Hohoe**	0.204	81st	**West Mamprusi**	0.214	100th
Asunafo South	0.193	63rd	**Nkwanta South**	0.205	82nd	**Gomoa West**	0.215	101st
Afigya Kwabre	0.193	63rd	**Akwapim North**	0.205	82nd	**Tarkwa/Nsuem**	0.215	101st
Awutu Senya	0.194	65th	**Kwahu West**	0.207	84th	**Ashaiman**	0.216	103rd
Sekyere Afram Plains	0.194	65th	**Suhum-Kraboa-Coaltar**	0.207	84th	**Lower Manya Krobo**	0.216	103rd

Atwima Nwabiagya	0.195	67th	**Agona West**	0.207	84th	**Gushiegu**	0.217	105th
Bekwai Municipal	0.196	68th	**Ellembelle**	0.207	84th	**Biakoye**	0.217	105th

District	GINI(R6)	Rank	**District**	GINI(R6)	Rank	**District**	GINI(R6)	Rank
Ledzekuku/Krowor	0.217	105th	**Sekondi - Takoradi**	0.234	129th	**Wa East**	0.257	149th
AMA	0.217	105th	**SekyereSouth**	0.234	129th	**Tamale**	0.258	152nd
Wenchi	0.218	109th	**Sunyani Municipal**	0.235	131st	**Kasena Nankana East**	0.258	152nd
AtebubuAmantin	0.220	110th	**Bawku West**	0.236	132nd	**Nanumba North**	0.258	152nd
Yendi	0.220	110th	**Pru**	0.238	133rd	**Zabzugu-Tatale**	0.263	155th
KwabreEast	0.221	112th	**Nzema East**	0.241	134th	**Garu Tempane**	0.264	156th
AmansieCentral	0.221	112th	**Saboba**	0.241	134th	**Tolon Kumbugu**	0.265	157th
YiloKrobo	0.221	112th	**Asutifi**	0.241	134th	**Lawra**	0.266	158th
WassaAmenfi	0.221	112th	**Tema**	0.242	137th	**Sissala West**	0.266	158th
Weija (Ga South)	0.222	116th	**West Gonja**	0.242	137th	**Bolgatanga**	0.268	158th
Ga East	0.222	116th	**Talensi Nabdam**	0.245	139th	**Wa West**	0.273	161st
GomoaEast	0.223	118th	**Ga West**	0.245	139th	**SekyereEast**	0.275	162nd
Ahafo-AnoNorth	0.223	118th	**Bole**	0.246	141st	**Sissala East**	0.275	162nd
Sefwi Akontombra	0.224	120th	**Shama**	0.246	141st	**Builsa**	0.276	164th
Mfantsiman	0.225	121st	**Wa Municipal**	0.247	143rd	**Dangbe East**	0.280	165th
Keta Municipal	0.226	122nd	**Efutu**	0.249	144th	**Bongo**	0.289	166th
New Juaben Municipal	0.228	123rd	**Bawku Municipal**	0.251	145th	**Nadowli**	0.293	167th
Karaga	0.228	123rd	**Kpandai**	0.252	146th	**East Mamprusi**	0.296	168th

Ho	0.232	125th	**Kasena-NankaniWest**	0.253	147th	**Jirapa**	0.309	169th
CapeCoast	0.232	125th	**Bunkpurugu Yonyo**	0.256	148th	**Lambussie Karnit**	0.361	170th
Adenta	0.232	125th	**Komenda-Edina-Egyafo-Abirem**	0.257	149th	**Population**	0.226	
Sunyani West	0.233	128th	**Akatsi**	0.257	149th			

Appendix B2: List of Districts in Ghana with their education Gini and Rank (GLSS 7)

District	GINI(R7)	Rank	District	GINI(R7)	Rank	District	GINI(R7)	Rank
Zabzugu-Tatale	0.070	1st	**Kwahu East**	0.140	16th	**Suaman**	0.166	30th
Mamprugu Moagduri	0.072	2nd	**Atwima Mponua**	0.141	17th	**Ahafo-Ano North**	0.166	30th
Dormaa West	0.072	2nd	**Nzema East**	0.142	18th	**Tano South**	0.167	33rd
Kumbumgu	0.074	4th	**Amansie West**	0.143	19th	**Krachi Nchumuru**	0.168	34th
Kwabre East	0.090	5th	**Offinso Municipal**	0.147	20th	**West Akim Municipal**	0.170	35th
Ada East	0.097	6th	**Sefwi Bibiani-Ahiwaso Bekwai**	0.148	21st	**Suhum Municipal**	0.172	36th
Ada West	0.125	7th	**Kpong Katamanso**	0.148	21st	**Sunyani West**	0.172	36th
Saboba	0.129	8th	**Sekyere Afram Plains**	0.148	21st	**Techiman North**	0.173	38th
Akatsi North	0.133	9th	**Asunafo South**	0.153	24th	**Jasikan**	0.173	38th
Asikuma-Odoben-Brakwa	0.135	10th	**Karaga**	0.157	25th	**Wassa Amenfi Central**	0.175	40th

Krachi West	0.136	11th	**Kpandu Municipal**	0.158	26th	**Kwahu Afram Plains North**	0.175	40th
Bodi	0.138	12th	**Asuogyaman**	0.159	27th	**Atiwa**	0.176	42nd
Atwima Kwanwoma	0.138	13th	**Ejisu Juaben Municipal**	0.164	28th	**Jaman North**	0.176	42nd
Adansi south	0.139	14th	**Banda**	0.165	29th	**Obuasi Municipal**	0.176	42nd
Dormaa Central Municipal	0.140	15th	**Jaman South**	0.166	30th	**Hohoe Municipal**	0.177	45th
Bia East	0.177	45th	**Sefwi Akontombra**	0.189	63rd	**Afigya Kwabre**	0.202	80th
Juabeso	0.178	47th	**Birim Municipal**	0.189	63rd	**Sene East**	0.202	80th
Debkyembour	0.178	47th	**Ho West**	0.190	65th	**Birim South**	0.202	80th
Mion	0.179	49th	**La Dade Kotopon Municipal**	0.190	65th	**Techiman Municipl**	0.202	80th
Krachi East	0.179	49th	**Ga East**	0.192	67th	**Kpandai**	0.203	84th
Atwima Nwabiagya	0.179	49th	**Sekondi- Takoradi**	0.192	67th	**Ahafo Ano South**	0.204	85th
Dormaa Municipal	0.182	52nd	**Berekum Municipal**	0.193	69th	**Tano North**	0.205	86th
Jomoro	0.183	53rd	**Sawla-Tuna-Kalba**	0.195	70th	**Komenda-Edina-Egyafo-Abirem**	0.205	86th
Ketu North	0.184	54th	**Amansie Central**	0.195	70th	**Biakoye**	0.205	86th

Wassa Amenfi East	0.184	54th	**Lower Manya**	0.195	70th	**La Nkwantanang Madina Municipal**	0.206	89th
South Dayi	0.185	56th	**Sunyani Municipal**	0.195	70th	**Ga Central Municipal**	0.206	89th
Nkoranza South	0.186	57th	**Asante Akim Central Municipal**	0.196	74th	**Cape Coast Metropolis**	0.209	91st
Tarkwa Nsuem Municipal	0.186	57th	**Adenta Municipal**	0.197	75th	**Afadzato South**	0.209	91st
Bosumtwi	0.186	57th	**Sekyere East**	0.198	76th	**Kadjebi**	0.209	91st
Akye Mansa	0.186	57th	**Asutifi North**	0.200	77th			
Offinso North	0.187	61st	**K M A**	0.200	77th			
Birim North	0.188	62nd	**Wassa Amenfi West**	0.201	79th			

Nsawem Adoagyiri Municipal	0.209	91st	**Yendi Municipal**	0.217	107th	**Ashaiman Municipal**	0.223	119th
Kintampo South	0.209	91st	**North Tongu**	0.217	107th	**Yilo Krobo**	0.225	121st
Bia West	0.210	96th	**Efutu Municipal**	0.218	109th	**Ningo Prampram**	0.226	122nd
Kwahu West Municipal	0.211	97th	**Akwapem North**	0.219	110th	**North Gonja**	0.226	122nd
Afigya Sekyere	0.212	98th	**Kintampo North Municipal**	0.219	110th	**Kasena-Nankani West**	0.226	122nd
AMA	0.213	99th	**Fanteakwa**	0.220	112th	**Sekyere Central**	0.227	125th
Asunafo North Municipal	0.213	99th	**East Akim**	0.220	112th	**Tain**	0.227	125th

Ketu South	0.214	101st	**Kwaebibirem**	0.221	114th	**Asante Akim North**	0.228	127th
Wassa East	0.215	102nd	**Tema Metropolis**	0.221	114th	**Sefwi Wiaso**	0.229	128th
Wa Municipal	0.215	102nd	**Agotime Ziope**	0.221	114th	**Ewutu Senya**	0.230	129th
Sene West	0.216	104th	**South Tongu**	0.222	117th	**Assin North Municipal**	0.230	129th
Ga South Municipal	0.216	104th	**Aowin**	0.222	117th			
Abura-Asebu-Kwamankese	0.216	104th	**Ga West**	0.223	119th			
Ledzekuku/Krowor	0.230	129th	**Ekumfi**	0.243	145th	**Upper West Akyem**	0.257	162nd
Upper Manya	0.231	132nd	**Atebubu Amantin**	0.244	148th	**Nkwanta North**	0.257	162nd
Ajumanku-Enyan-Essiam	0.231	132nd	**Prestea/Huni Vally**	0.244	148th	**Adaklu**	0.257	162nd
Agona West Municipal	0.231	132nd	**Central Tongu**	0.245	150th	**New Juaben Municipal**	0.260	166th
Asokore Mampong Municipal	0.232	135th	**Nkoranza North**	0.245	150th	**Asante Akim South**	0.261	167th
Savelugu Nanton	0.232	135th	**Twifo Ati Morkwa**	0.245	150th	**Garu Tempane**	0.262	168th
Agona East	0.232	135th	**Bongo**	0.245	150th	**Gomoa East**	0.264	169th
Assin South	0.233	138th	**Ewutu Senya East Municipal**	0.246	154th	**Bolgatanga Municipal**	0.264	169th
Akwapim South	0.234	139th	**Nadowli Kaleo**	0.246	154th	**Nkwanta South**	0.264	169th
Akwapem South	0.235	140th	**Sagnerigu**	0.246	154th	**Gomoa West**	0.265	172nd
Bosome Freho	0.236	141st	**Upper Denkyira East Municipal**	0.249	157th	**Keta Municipal**	0.266	173rd
North Dayi	0.236	141st	**Bekwai Municipal**	0.250	158th	**Bawku West**	0.266	173rd
Central Gonja	0.237	143rd	**Binduri**	0.251	159th	**Nanumba North**	0.268	175th

Tamale Metropolis	0.240	144th	**Sekyere Aram Plains North**	0.252	160th	**Shai Osudoku**	0.269	176th
Ho Municipl	0.243	145th	**Mampong Municipal**	0.253	161st	**Twifo-Heman-Lower Denkyira**	0.271	177th
Mfantsiman	0.243	145th	**Sissala West**	0.257	162nd	**Kasena Nankana East**	0.272	178th
Adansi North	0.273	179th	**Asutifi South**	0.308	197th			
Kwahu South	0.273	179th	**Wa West**	0.310	199th			
Ahanta West	0.274	181st	**Bawku Municipal**	0.315	200th			
West Gonja	0.274	181st	**West Mamprusi**	0.315	200th			
Ayensuano	0.277	183rd	**Daffiama Bussie**	0.316	202nd			
East Gonja	0.285	184th	**East Mamprusii**	0.320	203rd			
Wenchi Municipal	0.286	185th	**Upper Denkyira West**	0.331	204th			
Talensi	0.288	186th	**Bunkpurugu Yonyo**	0.332	205th			
Lawra	0.289	187th	**Jirapa**	0.346	206th			
Pru	0.292	188th	**Tolon**	0.348	207th			
Builsa North	0.295	189th	**Nanumba South**	0.356	208th			
Shama	0.296	190th	**Pusiga**	0.358	209th			
Builsa South	0.299	191st	**Nandom**	0.361	210th			
Lambussie Karnit	0.299	191st	**Tatale**	0.376	211th			
Ellembelle	0.299	191st	**Wa East**	0.378	212th			
Bole	0.301	194th	**Nabdam**	0.388	213th			
Akatsi South	0.305	195th	**Chereponi**	0.452	214th			
Gushiegu	0.306	196th	**Population**	0.239				
Sissala East	0.308	197th						

Appendix C1: Heckman selection model -- two-step estimates (Male model with individualism culture as interaction)

lwage	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
work_exp	.023	.004	6.04	0	.015	.03	***
exp2	-.001	0	-7.56	0	-.001	0	***
male	.285	.088	3.25	.001	.113	.456	***
individualism	0	.081	0.01	.996	-.158	.159	
indivimale	.093	.092	1.02	.309	-.087	.273	
Educational level(base: none)	0	.	.	.	.	.	
basic	-.02	.159	-0.13	.9	-.331	.291	
secondary	.246	.163	1.51	.131	-.073	.564	
tertiary	1.024	.169	6.07	0	.693	1.355	***
Received Training (base: yes)	0	.	.	.	.	.	
no	-.481	.088	-5.45	0	-.654	-.308	***
Marital status(base: married)	0	.	.	.	.	.	
divorced	-.159	.054	-2.94	.003	-.265	-.053	***
widowed	-.187	.073	-2.55	.011	-.331	-.043	**
single	-.371	.053	-7.04	0	-.474	-.268	***
Location(base: Urban)	0	.	.	.	.	.	
Rural	-.536	.054	-9.93	0	-.642	-.43	***
Region (base: Greater Accra)	0	.	.	.	.	.	
Central	-.578	.121	-4.78	0	-.815	-.341	***
Western	.058	.059	0.98	.326	-.057	.173	
Volta	-.468	.071	-6.61	0	-.607	-.329	***

Eastern	-.071	.095	-0.75	.455	-.257	.115	
Ashanti	.047	.064	0.74	.456	-.077	.172	
Brong Ahafo	-.697	.139	-5.01	0	-.969	-.424	***
Northern	-1.065	.218	-4.88	0	-1.493	-.637	***
Upper East	-.903	.258	-3.50	0	-1.41	-.397	***
Upper West	-.982	.223	-4.41	0	-1.419	-.546	***
Constant	8.003	.218	36.66	0	7.575	8.431	***
male	-.092	.077	-1.20	.231	-.243	.059	
individualism	.039	.074	0.52	.603	-.107	.184	
indivimale	.065	.083	0.79	.428	-.096	.227	
work_exp	-.003	.003	-0.99	.322	-.01	.003	
exp2	0	0	-1.27	.205	0	0	
During last 5 yrs ~t	0	.	.	.	.	.	
no	-.161	.083	-1.95	.051	-.323	.001	*
Marital status (base: married)	0	.	.	.	.	.	
divorced	-.013	.053	-0.24	.81	-.117	.092	
widowed	-.112	.066	-1.69	.091	-.242	.018	*
single	-.152	.05	-3.06	.002	-.249	-.055	***
Location (base: Urban)	0	.	.	.	.	.	
Rural	-.193	.032	-6.09	0	-.255	-.131	***
Region (base: Greater Accra)	0	.	.	.	.	.	
Central	-.458	.059	-7.77	0	-.574	-.343	***
Western	.003	.059	0.05	.963	-.114	.119	
Volta	-.16	.062	-2.59	.01	-.282	-.039	***
Eastern	.42	.064	6.53	0	.294	.547	***
Ashanti	.167	.059	2.84	.005	.052	.282	***
Brong Ahafo	-.527	.058	-9.04	0	-.641	-.413	***
Northern	-.811	.07	-11.63	0	-.948	-.674	***

Upper East	-.927	.072	-12.94	0	-1.068	-.787	***
Upper West	-.793	.075	-10.61	0	-.94	-.647	***
Educational level (base: none)	0	.	.	.	.	.	
basic	-.027	.143	-0.19	.848	-.308	.254	
secondary	.065	.148	0.44	.659	-.224	.355	
tertiary	.191	.15	1.27	.204	-.104	.485	
hhsize	-.018	.006	-2.75	.006	-.03	-.005	***
Constant	1.359	.189	7.19	0	.989	1.73	***
lambda	1.362	.509	2.68	.007	.365	2.36	***
Mean dependent var		7.979	SD dependent var			1.261	
Number of obs		10435	Wald chi2(20)			1025.676***	

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

Appendix C2: Heckman selection model -- two-step estimates (Male model with collectivism culture as interaction)

lwage	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
work_exp	.023	.004	6.04	0	.015	.03	***
exp2	-.001	0	-7.56	0	-.001	0	***
male	.378	.046	8.22	0	.288	.468	***
collectivism	0	.081	-0.01	.996	-.159	.158	
collecmale	-.093	.092	-1.02	.309	-.273	.087	
Educational level (base: none)	0	.	.	.	.	.	
basic	-.02	.159	-0.13	.9	-.331	.291	
secondary	.246	.163	1.51	.131	-.073	.564	
tertiary	1.024	.169	6.07	0	.693	1.355	***
Received	0	.	.	.	.	.	

Training (base: yes)							
no	-.481	.088	-5.45	0	-.654	-.308	***
Marital status (base: married)	0	.	.	.	.	.	
divorced	-.159	.054	-2.94	.003	-.265	-.053	***
widowed	-.187	.073	-2.55	.011	-.331	-.043	**
single	-.371	.053	-7.04	0	-.474	-.268	***
Location (base: Urban)	0	.	.	.	.	.	
Rural	-.536	.054	-9.93	0	-.642	-.43	***
Region (base: Greater Accra)	0	.	.	.	.	.	
Central	-.578	.121	-4.78	0	-.815	-.341	***
Western	.058	.059	0.98	.326	-.057	.173	
Volta	-.468	.071	-6.61	0	-.607	-.329	***
Eastern	-.071	.095	-0.75	.455	-.257	.115	
Ashanti	.047	.064	0.74	.456	-.077	.172	
Brong Ahafo	-.697	.139	-5.01	0	-.969	-.424	***
Northern	-1.065	.218	-4.88	0	-1.493	-.637	***
Upper East	-.903	.258	-3.50	0	-1.41	-.397	***
Upper West	-.982	.223	-4.41	0	-1.419	-.546	***
Constant	8.003	.204	39.22	0	7.603	8.403	***
male	-.027	.044	-0.60	.548	-.114	.06	
collectivism	-.039	.074	-0.52	.603	-.184	.107	
collecmale	-.065	.083	-0.79	.428	-.227	.096	
Educational level(base: none)	0	.	.	.	.	.	
basic	-.027	.143	-0.19	.848	-.308	.254	
secondary	.065	.148	0.44	.659	-.224	.355	
tertiary	.191	.15	1.27	.204	-.104	.485	

work_exp	-.003	.003	-0.99	.322	-.01	.003	
exp2	0	0	-1.27	.205	0	0	
Received Training (base: yes)	0	.	.	.	.	.	
no	-.161	.083	-1.95	.051	-.323	.001	*
Marital status (base: married)	0	.	.	.	.	.	
divorced	-.013	.053	-0.24	.81	-.117	.092	
widowed	-.112	.066	-1.69	.091	-.242	.018	*
single	-.152	.05	-3.06	.002	-.249	-.055	***
Location (base: Urban)	0	.	.	.	.	.	
Rural	-.193	.032	-6.09	0	-.255	-.131	***
Region (base: Greater Accra)	0	.	.	.	.	.	
Central	-.458	.059	-7.77	0	-.574	-.343	***
Western	.003	.059	0.05	.963	-.114	.119	
Volta	-.16	.062	-2.59	.01	-.282	-.039	***
Eastern	.42	.064	6.53	0	.294	.547	***
Ashanti	.167	.059	2.84	.005	.052	.282	***
Brong Ahafo	-.527	.058	-9.04	0	-.641	-.413	***
Northern	-.811	.07	-11.63	0	-.948	-.674	***
Upper East	-.927	.072	-12.94	0	-1.068	-.787	***
Upper West	-.793	.075	-10.61	0	-.94	-.647	***
hhsize	-.018	.006	-2.75	.006	-.03	-.005	***
Constant	1.398	.178	7.86	0	1.049	1.747	***
lambda	1.362	.509	2.68	.007	.365	2.36	***
Mean dependent var		7.979	SD dependent var			1.261	
Number of obs		10435	Wald chi2(20)			1025.676***	

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

Appendix C 3: Blinder-Oaxaca RIF-decomposition (Reweighted)

Q10

Dependent variable: lnWage						
lwage	**Coef.**	**Std. Err.**	**z**	**P>z**	**[95% Conf.**	**Interval]**
Overall						
Female	6.097973	0.046454	131.27	0.000	6.006926	6.18902
Counterfactual	6.337372	0.046353	136.72	0.000	6.246521	6.428222
Male	6.563775	0.028919	226.97	0.000	6.507095	6.620456
ToT difference	-0.4658	0.05472	-8.51	0.000	-0.57305	-0.35855
ToT_Explained	-0.2264	0.05259	-4.31	0.000	-0.32948	-0.12333
ToT_Unexplained	-0.2394	0.106989	-2.24	0.025	-0.44909	-0.0297
Explained						
Total	-0.2264	0.05259	-4.31	0.000	-0.32948	-0.12333
Pure_explained	-0.33028	0.140194	-2.36	0.018	-0.60505	-0.0555
Specif_err	0.103873	0.124438	0.83	0.404	-0.14002	0.347766

Pure_explained						
work_exp	-0.01641	0.020456	-0.8	0.423	-0.0565	0.023685
exp2	0.003719	0.011179	0.33	0.739	-0.01819	0.02563
Individualism	0.000861	0.001895	0.45	0.650	-0.00285	0.004574
Central	-0.00893	0.005531	-1.61	0.106	-0.01977	0.001913
Western	0.000296	0.001918	0.15	0.878	-0.00346	0.004055
Volta	-0.02151	0.01152	-1.87	0.062	-0.04409	0.001065
Eastern	0.00044	0.004215	0.1	0.917	-0.00782	0.008702
Ashanti	-0.00754	0.005035	-1.5	0.134	-0.0174	0.002331
Brong Ahafo	-0.00239	0.006586	-0.36	0.717	-0.01529	0.010522
Northern	0.031359	0.008192	3.83	0.000	0.015303	0.047415
Upper East	0.00802	0.004829	1.66	0.097	-0.00144	0.017485
Upper West	0.023005	0.006868	3.35	0.001	0.009544	0.036466
No Training	-0.00204	0.002451	-0.83	0.404	-0.00685	0.00276
Rural	0.053546	0.013193	4.06	0.000	0.027688	0.079403
Divorced	-0.14588	0.066345	-2.2	0.028	-0.27592	-0.01585

Widowed	-0.22787	0.121058	-1.88	0.060	-0.46514	0.009395
Single	-0.00372	0.002372	-1.57	0.117	-0.00837	0.000929
Basic	-0.00601	0.035326	-0.17	0.865	-0.07524	0.063233
Secondary	0.000504	0.023946	0.02	0.983	-0.04643	0.047438
Tertiary	-0.00973	0.013821	-0.7	0.481	-0.03682	0.017359
Specif_err						
work_exp	-0.16878	0.158003	-1.07	0.285	-0.47845	0.140904
exp2	-0.00061	0.093721	-0.01	0.995	-0.1843	0.183081
Individualism	-0.25429	0.098508	-2.58	0.01	-0.44736	-0.06122
Central	-0.02408	0.020987	-1.15	0.251	-0.06521	0.017056
Western	0.021639	0.014949	1.45	0.148	-0.00766	0.050938
Volta	0.044109	0.025587	1.72	0.085	-0.00604	0.094258
Eastern	-0.00371	0.023119	-0.16	0.873	-0.04902	0.041602
Ashanti	-0.01704	0.025601	-0.67	0.506	-0.06722	0.033133
Brong Ahafo	0.042822	0.019217	2.23	0.026	0.005157	0.080487
Northern	0.010484	0.004144	2.53	0.011	0.002361	0.018606

Upper East	0.001925	0.00505	0.38	0.703	-0.00797	0.011823
Upper West	0.007821	0.004139	1.89	0.059	-0.00029	0.015934
No Training	-0.17157	0.132566	-1.29	0.196	-0.4314	0.088253
Rural	0.037906	0.040296	0.94	0.347	-0.04107	0.116885
Divorced	0.032028	0.060375	0.53	0.596	-0.08631	0.150362
Widowed	0.154868	0.10837	1.43	0.153	-0.05753	0.367268
Single	-0.01227	0.015341	-0.8	0.424	-0.04234	0.017798
Basic	-0.5463	0.376877	-1.45	0.147	-1.28497	0.192361
Secondary	-0.09795	0.065129	-1.5	0.133	-0.2256	0.0297
Tertiary	-0.0637	0.048745	-1.31	0.191	-0.15924	0.031836
_cons	1.110578	0.547702	2.03	0.043	0.037103	2.184054
Unexplained						
Total	-0.2394	0.106989	-2.24	0.025	-0.44909	-0.0297
Reweight_err	-0.00657	0.027197	-0.24	0.809	-0.05987	0.046738
Pure_Unexplained	-0.23283	0.105511	-2.21	0.027	-0.43963	-0.02603

Pure_Unexplained						
work_exp	0.664585	0.366736	1.81	0.07	-0.0542	1.383374
exp2	-0.26241	0.22033	-1.19	0.234	-0.69425	0.169429
Individualism	0.1534	0.233811	0.66	0.512	-0.30486	0.611662
Central	0.050238	0.040252	1.25	0.212	-0.02865	0.12913
Western	-0.04673	0.039633	-1.18	0.238	-0.12441	0.030954
Volta	-0.04	0.047456	-0.84	0.399	-0.13301	0.053016
Eastern	-0.0095	0.055196	-0.17	0.863	-0.11768	0.098681
Ashanti	0.049172	0.056724	0.87	0.386	-0.062	0.160349
Brong Ahafo	-0.06115	0.040819	-1.5	0.134	-0.14116	0.018849
Northern	-0.00141	0.0144	-0.1	0.922	-0.02963	0.026815
Upper East	0.015163	0.006759	2.24	0.025	0.001916	0.028411
Upper West	-0.01369	0.019205	-0.71	0.476	-0.05134	0.023946
No Training	0.185612	0.390017	0.48	0.634	-0.57881	0.950031
Rural	-0.01047	0.09001	-0.12	0.907	-0.18689	0.165947
Divorced	0.199417	0.078914	2.53	0.012	0.044749	0.354086

Widowed	0.099236	0.068794	1.44	0.149	-0.0356	0.234069
Single	0.016277	0.048566	0.34	0.738	-0.07891	0.111465
Basic	0.632067	0.833984	0.76	0.449	-1.00251	2.266645
Secondary	0.140456	0.139912	1	0.315	-0.13377	0.414679
Tertiary	0.067056	0.096679	0.69	0.488	-0.12243	0.256543
_cons	-2.06015	1.230968	-1.67	0.094	-4.4728	0.352501
Reweight_err						
work_exp	-0.00087	0.004123	-0.21	0.834	-0.00895	0.007214
exp2	0.004207	0.013227	0.32	0.75	-0.02172	0.030132
Individualism	-0.0051	0.004992	-1.02	0.307	-0.01488	0.004682
Central	0.00067	0.008569	0.08	0.938	-0.01613	0.017464
Western	-0.00031	0.002147	-0.14	0.886	-0.00452	0.003899
Volta	0.006426	0.006981	0.92	0.357	-0.00726	0.020109
Eastern	-0.00237	0.005901	-0.4	0.687	-0.01394	0.009191
Ashanti	-0.00384	0.005421	-0.71	0.479	-0.01446	0.006789
Brong Ahafo	0.000669	0.002268	0.29	0.768	-0.00378	0.005115

Northern	-0.00097	0.001871	-0.52	0.604	-0.00464	0.002697
Upper East	0.000732	0.002181	0.34	0.737	-0.00354	0.005006
Upper West	-0.00315	0.002295	-1.37	0.17	-0.00765	0.001349
No Training	-0.00403	0.004174	-0.97	0.335	-0.01221	0.004153
Rural	0.004235	0.008254	0.51	0.608	-0.01194	0.020413
Divorced	-0.00016	0.00895	-0.02	0.986	-0.0177	0.01738
Widowed	0.003704	0.010249	0.36	0.718	-0.01638	0.023791
Single	-0.00023	0.003676	-0.06	0.951	-0.00743	0.006978
Basic	-0.01092	0.01439	-0.76	0.448	-0.03913	0.01728
Secondary	0.001923	0.009531	0.2	0.840	-0.01676	0.020604
Tertiary	0.002813	0.00438	0.64	0.521	-0.00577	0.011397
No of Obs: Female						1990
No of Obs: Counter						5971
No of Obs: Male						5971
Sample Mean: RIF q (10)						6.5639

Blinder-Oaxaca RIF-decomposition (Reweighted), Q25

Dependent variable: lnWage						
lwage	**Coef.**	**Std. Err.**	**z**	**P>z**	**[95% Conf.**	**Interval]**
Overall						
Female	6.836592	0.038973	175.42	0.000	6.760207	6.912977
Counterfactual	7.184985	0.038769	185.33	0.000	7.109	7.260971
Male	7.359083	0.022745	323.55	0.000	7.314504	7.403662
ToT difference	-0.52249	0.045124	-11.58	0.000	-0.61093	-0.43405
ToT_Explained	-0.1741	0.042778	-4.07	0.000	-0.25794	-0.09025
ToT_Unexplained	-0.34839	0.088234	-3.95	0.000	-0.52133	-0.17546
Explained						
Total	-0.1741	0.042778	-4.07	0.000	-0.25794	-0.09025
Pure_explained	-0.22572	0.088595	-2.55	0.011	-0.39936	-0.05207
Specif_err	0.051619	0.071376	0.72	0.470	-0.08828	0.191514
Pure_explained						
work_exp	-0.02576	0.016881	-1.53	0.127	-0.05885	0.007323

exp2	0.003848	0.011401	0.34	0.736	-0.0185	0.026193
Individualism	0.000242	0.001308	0.18	0.854	-0.00232	0.002806
Central	-0.01219	0.006604	-1.85	0.065	-0.02514	0.00075
Western	-0.00075	0.001766	-0.42	0.671	-0.00421	0.002712
Volta	-0.02076	0.010569	-1.96	0.049	-0.04147	-4.7E-05
Eastern	0.000588	0.005631	0.1	0.917	-0.01045	0.011624
Ashanti	-0.00823	0.004926	-1.67	0.095	-0.01789	0.001424
Brong Ahafo	-0.00252	0.006917	-0.36	0.716	-0.01607	0.011043
Northern	0.022739	0.005439	4.18	0.000	0.012079	0.033399
Upper East	0.006092	0.00351	1.74	0.083	-0.00079	0.012972
Upper West	0.011249	0.004226	2.66	0.008	0.002967	0.019531
No Training	-0.00284	0.003157	-0.9	0.369	-0.00902	0.003352
Rural	0.067137	0.012994	5.17	0.000	0.041668	0.092605
Divorced	-0.14039	0.046464	-3.02	0.003	-0.23146	-0.04932
Widowed	-0.09438	0.07154	-1.32	0.187	-0.2346	0.045837
Single	-0.00412	0.002163	-1.91	0.057	-0.00836	0.000115

Basic	-0.01188	0.023712	-0.5	0.616	-0.05836	0.034591
Secondary	-0.00097	0.016099	-0.06	0.952	-0.03252	0.030586
Tertiary	-0.01282	0.010259	-1.25	0.212	-0.03293	0.00729
Specif_err						
work_exp	-0.16887	0.10731	-1.57	0.116	-0.37919	0.041456
exp2	0.034423	0.059802	0.58	0.565	-0.08279	0.151633
Individualism	0.062818	0.079239	0.79	0.428	-0.09249	0.218124
Central	-0.00293	0.014979	-0.2	0.845	-0.03229	0.02643
Western	-0.02721	0.01443	-1.89	0.059	-0.05549	0.001076
Volta	0.023623	0.019248	1.23	0.22	-0.0141	0.061349
Eastern	-0.01544	0.019421	-0.8	0.427	-0.05351	0.022622
Ashanti	0.009641	0.02032	0.47	0.635	-0.03019	0.049467
Brong Ahafo	0.018793	0.014275	1.32	0.188	-0.00919	0.046772
Northern	0.004572	0.00282	1.62	0.105	-0.00096	0.0101
Upper East	-0.01919	0.006219	-3.09	0.002	-0.03137	-0.007
Upper West	-0.00119	0.00243	-0.49	0.625	-0.00595	0.003576

No Training	-0.27848	0.118587	-2.35	0.019	-0.5109	-0.04605
Rural	-0.02311	0.030919	-0.75	0.455	-0.08371	0.037491
Divorced	0.061606	0.041979	1.47	0.142	-0.02067	0.143883
Widowed	0.00859	0.056637	0.15	0.879	-0.10242	0.119597
Single	-0.01456	0.011576	-1.26	0.208	-0.03725	0.008126
Basic	-0.07635	0.270789	-0.28	0.778	-0.60708	0.454391
Secondary	-0.02716	0.046561	-0.58	0.56	-0.11841	0.0641
Tertiary	-0.00729	0.034806	-0.21	0.834	-0.07551	0.06093
_cons	0.489306	0.40255	1.22	0.224	-0.29968	1.27829
Unexplained						
Total	-0.34839	0.088234	-3.95	0	-0.52133	-0.17546
Reweight_err	0.008482	0.028564	0.3	0.766	-0.0475	0.064467
Pure_Unexplained	-0.35688	0.084532	-4.22	0	-0.52256	-0.19119
Pure_Unexplained						
work_exp	0.477029	0.254967	1.87	0.061	-0.0227	0.976756

exp2	-0.17615	0.141638	-1.24	0.214	-0.45376	0.101453
Individualism	-0.1149	0.197883	-0.58	0.561	-0.50274	0.272943
Central	0.026137	0.033344	0.78	0.433	-0.03922	0.09149
Western	-0.00331	0.035759	-0.09	0.926	-0.0734	0.066774
Volta	-0.00768	0.037502	-0.2	0.838	-0.08118	0.065826
Eastern	0.032638	0.04729	0.69	0.49	-0.06005	0.125325
Ashanti	-0.01006	0.049372	-0.2	0.838	-0.10683	0.086703
Brong Ahafo	-0.03821	0.030971	-1.23	0.217	-0.09891	0.022493
Northern	0.00404	0.010686	0.38	0.705	-0.0169	0.024983
Upper East	0.019087	0.01228	1.55	0.12	-0.00498	0.043155
Upper West	-0.00309	0.012606	-0.25	0.806	-0.0278	0.021614
No Training	0.279098	0.324308	0.86	0.389	-0.35653	0.91473
Rural	0.04977	0.072629	0.69	0.493	-0.09258	0.192121
Divorced	0.080176	0.064712	1.24	0.215	-0.04666	0.207009
Widowed	0.088888	0.055016	1.62	0.106	-0.01894	0.196718
Single	0.02355	0.037224	0.63	0.527	-0.04941	0.096508

Basic	0.138246	0.692847	0.2	0.842	-1.21971	1.4962
Secondary	0.074961	0.116261	0.64	0.519	-0.15291	0.302829
Tertiary	0.017154	0.080159	0.21	0.831	-0.13995	0.174262
_cons	-1.31424	1.026785	-1.28	0.201	-3.32671	0.69822
Reweight_err						
work_exp	0.000138	0.001726	0.08	0.936	-0.00325	0.003521
exp2	0.003111	0.009481	0.33	0.743	-0.01547	0.021693
Individualism	0.001846	0.00271	0.68	0.496	-0.00347	0.007158
Central	0.000631	0.008073	0.08	0.938	-0.01519	0.016454
Western	0.000343	0.002382	0.14	0.886	-0.00433	0.005011
Volta	0.009453	0.008263	1.14	0.253	-0.00674	0.025648
Eastern	-0.00359	0.008817	-0.41	0.684	-0.02087	0.013692
Ashanti	-0.00213	0.003105	-0.69	0.493	-0.00822	0.003956
Brong Ahafo	0.003391	0.005336	0.64	0.525	-0.00707	0.013849
Northern	-0.00108	0.002075	-0.52	0.602	-0.00515	0.002985
Upper East	0.002426	0.007108	0.34	0.733	-0.01151	0.016357

Upper West	-0.0039	0.002482	-1.57	0.116	-0.00876	0.000966
No Training	-0.00595	0.006081	-0.98	0.328	-0.01787	0.005965
Rural	0.007362	0.014198	0.52	0.604	-0.02047	0.035191
Divorced	-0.00012	0.006639	-0.02	0.986	-0.01313	0.012893
Widowed	0.003932	0.010796	0.36	0.716	-0.01723	0.025091
Single	-0.00026	0.004147	-0.06	0.951	-0.00838	0.007871
Basic	-0.00364	0.007385	-0.49	0.622	-0.01811	0.010838
Secondary	0.000475	0.002577	0.18	0.854	-0.00458	0.005527
Tertiary	-0.00396	0.00659	-0.6	0.548	-0.01687	0.00896
No of Obs: Female						1990
No of Obs: Counterfactual						5971
No of Obs: Male						5971
Sample Mean: RIF q(25)						7.3592

Blinder-Oaxaca RIF-decomposition (Reweighted), Q50

Dependent variable: lnWage						
					[95%	
lwage	**Coef.**	**Std. Err.**	**z**	**P>z**	**Conf.**	**Interval]**
Overall						
Female	7.670478	0.034892	219.84	0.000	7.602092	7.738864
Counterfactual	7.967828	0.032102	248.21	0.000	7.90491	8.030746
Male	8.148609	0.019116	426.28	0.000	8.111144	8.186075
ToT difference	-0.47813	0.039785	-12.02	0.000	-0.55611	-0.40015
ToT_Explained	-0.18078	0.036022	-5.02	0.000	-0.25138	-0.11018
ToT_Unexplained	-0.29735	0.076118	-3.91	0.000	-0.44654	-0.14816
Explained						
Total	-0.18078	0.036022	-5.02	0.000	-0.25138	-0.11018
Pure_explained	-0.18742	0.063353	-2.96	0.003	-0.31159	-0.06325
Specif_err	0.006636	0.050526	0.13	0.896	-0.09239	0.105665
Pure_explained						

work_exp	-0.02891	0.014555	-1.99	0.047	-0.05744	-0.00039
exp2	0.00448	0.01316	0.34	0.734	-0.02131	0.030273
Individualism	0.000896	0.001302	0.69	0.491	-0.00166	0.003447
Central	-0.00783	0.004496	-1.74	0.082	-0.01664	0.000982
Western	-0.00275	0.002456	-1.12	0.263	-0.00756	0.002063
Volta	-0.01134	0.006532	-1.74	0.083	-0.02414	0.001461
Eastern	0.000354	0.003391	0.1	0.917	-0.00629	0.007
Ashanti	0.000987	0.003977	0.25	0.804	-0.00681	0.008782
Brong Ahafo	-0.00172	0.004746	-0.36	0.717	-0.01102	0.00758
Northern	0.012218	0.004166	2.93	0.003	0.004053	0.020382
Upper East	0.002983	0.002738	1.09	0.276	-0.00238	0.00835
Upper West	0.005132	0.003266	1.57	0.116	-0.00127	0.011534
No Training	-0.00273	0.003043	-0.9	0.370	-0.00869	0.003234
Rural	0.047603	0.00982	4.85	0.000	0.028357	0.06685
Divorced	-0.08651	0.033386	-2.59	0.010	-0.15194	-0.02107
Widowed	-0.07964	0.049144	-1.62	0.105	-0.17596	0.016685

Single	-0.00505	0.00229	-2.2	0.028	-0.00954	-0.00056
Basic	0.00052	0.019615	0.03	0.979	-0.03792	0.038964
Secondary	-0.00981	0.013614	-0.72	0.471	-0.0365	0.016869
Tertiary	-0.0263	0.012826	-2.05	0.040	-0.05144	-0.00116
Specif_err						
work_exp	-0.04743	0.08728	-0.54	0.587	-0.2185	0.123631
exp2	0.058859	0.047569	1.24	0.216	-0.03437	0.152092
Individualism	0.105457	0.061065	1.73	0.084	-0.01423	0.225142
Central	-0.01769	0.01231	-1.44	0.151	-0.04182	0.006432
Western	-0.0068	0.013547	-0.5	0.616	-0.03335	0.019751
Volta	-0.02267	0.017468	-1.3	0.194	-0.05691	0.011562
Eastern	-0.00813	0.016293	-0.5	0.618	-0.04006	0.023803
Ashanti	0.015875	0.020422	0.78	0.437	-0.02415	0.055902
Brong Ahafo	0.042777	0.014475	2.96	0.003	0.014407	0.071148
Northern	0.0003	0.00238	0.13	0.900	-0.00436	0.004965
Upper East	-0.00421	0.003368	-1.25	0.212	-0.01081	0.002394

Upper West	0.000187	0.001809	0.1	0.918	-0.00336	0.003732
No Training	-0.01978	0.174531	-0.11	0.910	-0.36185	0.322298
Rural	0.040796	0.025566	1.6	0.111	-0.00931	0.090904
Divorced	0.009175	0.028909	0.32	0.751	-0.04749	0.065835
Widowed	0.006747	0.03831	0.18	0.860	-0.06834	0.081833
Single	-0.00444	0.00989	-0.45	0.653	-0.02383	0.014941
Basic	-0.54105	0.253536	-2.13	0.033	-1.03797	-0.04413
Secondary	-0.06	0.043838	-1.37	0.171	-0.14592	0.02592
Tertiary	-0.05477	0.033706	-1.62	0.104	-0.12083	0.011291
_cons	0.513443	0.399242	1.29	0.198	-0.26906	1.295943
Unexplained						
Total	-0.29735	0.076118	-3.91	0.000	-0.44654	-0.14816
Reweight_err	0.007722	0.02378	0.32	0.745	-0.03889	0.05433
Pure_Unexplained	-0.30507	0.072494	-4.21	0.000	-0.44716	-0.16299
Pure_Unexplained						
work_exp	0.319455	0.200087	1.6	0.110	-0.07271	0.711617

exp2	-0.13501	0.104617	-1.29	0.197	-0.34005	0.070035
Individualism	-0.21362	0.160152	-1.33	0.182	-0.52752	0.10027
Central	0.01903	0.029932	0.64	0.525	-0.03964	0.077694
Western	-0.05007	0.033917	-1.48	0.140	-0.11654	0.01641
Volta	-0.01409	0.033277	-0.42	0.672	-0.07931	0.051133
Eastern	-0.00708	0.042117	-0.17	0.867	-0.08962	0.075473
Ashanti	-0.06798	0.050489	-1.35	0.178	-0.16693	0.03098
Brong Ahafo	-0.06643	0.027263	-2.44	0.015	-0.11986	-0.013
Northern	-0.00407	0.009265	-0.44	0.661	-0.02223	0.01409
Upper East	0.001193	0.009479	0.13	0.900	-0.01739	0.019772
Upper West	-0.00912	0.009344	-0.98	0.329	-0.02743	0.009196
No Training	-0.08134	0.355287	-0.23	0.819	-0.77769	0.615004
Rural	-0.06579	0.058868	-1.12	0.264	-0.18117	0.049591
Divorced	0.080419	0.055653	1.44	0.148	-0.02866	0.189497
Widowed	0.037101	0.04804	0.77	0.440	-0.05706	0.131259
Single	0.002612	0.031417	0.08	0.934	-0.05896	0.064188

Basic	0.938949	0.514964	1.82	0.068	-0.07036	1.948259
Secondary	0.150199	0.088456	1.7	0.090	-0.02317	0.323569
Tertiary	0.116039	0.061246	1.89	0.058	-0.004	0.236078
_cons	-1.25548	0.817585	-1.54	0.125	-2.85792	0.34696
Reweight_err						
work_exp	0.002367	0.007817	0.3	0.762	-0.01295	0.017688
exp2	0.002957	0.008917	0.33	0.740	-0.01452	0.020434
Individualism	0.003732	0.003517	1.06	0.289	-0.00316	0.010625
Central	0.000555	0.007099	0.08	0.938	-0.01336	0.014468
Western	-0.00022	0.001553	-0.14	0.886	-0.00327	0.002821
Volta	0.011272	0.009496	1.19	0.235	-0.00734	0.029883
Eastern	-0.00211	0.005212	-0.41	0.685	-0.01233	0.008101
Ashanti	0.001496	0.002451	0.61	0.542	-0.00331	0.006301
Brong Ahafo	-0.00073	0.001877	-0.39	0.699	-0.0044	0.002952
Northern	-0.00085	0.001639	-0.52	0.604	-0.00406	0.002362
Upper East	0.000718	0.002116	0.34	0.734	-0.00343	0.004866

Upper West	-0.00144	0.001156	-1.24	0.214	-0.0037	0.00083
No Training	-0.00349	0.003969	-0.88	0.380	-0.01127	0.004293
Rural	0.003558	0.006891	0.52	0.606	-0.00995	0.017063
Divorced	-0.00011	0.005937	-0.02	0.986	-0.01174	0.011528
Widowed	0.003339	0.009173	0.36	0.716	-0.01464	0.021317
Single	-0.00025	0.004084	-0.06	0.951	-0.00826	0.007751
Basic	-0.00958	0.012937	-0.74	0.459	-0.03494	0.015772
Secondary	0.000647	0.00329	0.2	0.844	-0.0058	0.007095
Tertiary	-0.00414	0.006196	-0.67	0.504	-0.01628	0.008007
No of Obs: Female						1990
No of Obs: Counter						5971
No of Obs: Male						5971
Sample Mean: RIF q(50)						8.1486

Blinder-Oaxaca RIF-decomposition (Reweighted), Q75

Dependent variable: lnWage						
lwage	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Overall						
Female	8.497699	0.03951	215.08	0.000	8.42026	8.575137
Counterfactual	8.706229	0.031236	278.72	0.000	8.645007	8.76745
Male	8.888112	0.018715	474.92	0.000	8.851431	8.924793
ToT difference	-0.39041	0.043719	-8.93	0.000	-0.4761	-0.30473
ToT_Explained	-0.18188	0.0354	-5.14	0.000	-0.25127	-0.1125
ToT_Unexplained	-0.20853	0.083544	-2.5	0.013	-0.37227	-0.04479
Explained						
Total	-0.18188	0.0354	-5.14	0.000	-0.25127	-0.1125
Pure_explained	-0.14634	0.058252	-2.51	0.012	-0.26051	-0.03217
Specif_err	-0.03554	0.044966	-0.79	0.429	-0.12367	0.052592
Pure_explained						
work_exp	-0.02939	0.014573	-2.02	0.044	-0.05795	-0.00082

exp2	0.003165	0.009352	0.34	0.735	-0.01516	0.021494
Individualism	0.000988	0.001323	0.75	0.455	-0.0016	0.00358
Central	-0.0035	0.002845	-1.23	0.219	-0.00908	0.002076
Western	-0.00383	0.003061	-1.25	0.211	-0.00983	0.002172
Volta	-0.0037	0.004278	-0.87	0.387	-0.01209	0.004684
Eastern	0.000159	0.00153	0.1	0.917	-0.00284	0.003158
Ashanti	0.003267	0.004317	0.76	0.449	-0.00519	0.011729
Brong Ahafo	-0.00043	0.001277	-0.33	0.738	-0.00293	0.002076
Northern	0.004474	0.004056	1.1	0.270	-0.00348	0.012423
Upper East	0.002581	0.002656	0.97	0.331	-0.00263	0.007788
Upper West	0.001956	0.003498	0.56	0.576	-0.0049	0.008812
No Training	-0.0028	0.003177	-0.88	0.378	-0.00902	0.003427
Rural	0.034094	0.008275	4.12	0.000	0.017875	0.050313
Divorced	-0.07289	0.02952	-2.47	0.014	-0.13075	-0.01504
Widowed	-0.03747	0.045821	-0.82	0.414	-0.12728	0.052341
Single	-0.00411	0.001955	-2.1	0.035	-0.00794	-0.00028

Basic	-0.00823	0.020329	-0.4	0.686	-0.04807	0.031619
Secondary	-0.00277	0.013914	-0.2	0.842	-0.03004	0.024503
Tertiary	-0.02792	0.013592	-2.05	0.040	-0.05456	-0.00128
Specif_err						
work_exp	-0.15781	0.082786	-1.91	0.057	-0.32007	0.004444
exp2	0.065098	0.043721	1.49	0.136	-0.02059	0.150789
Individualism	0.139593	0.056033	2.49	0.013	0.029771	0.249415
Central	-0.00712	0.01133	-0.63	0.530	-0.02933	0.015083
Western	0.01808	0.01536	1.18	0.239	-0.01202	0.048184
Volta	-0.00614	0.016669	-0.37	0.712	-0.03881	0.026527
Eastern	0.00853	0.015148	0.56	0.573	-0.02116	0.038218
Ashanti	0.021752	0.02046	1.06	0.288	-0.01835	0.061854
Brong Ahafo	0.026877	0.015504	1.73	0.083	-0.00351	0.057265
Northern	-0.0004	0.002126	-0.19	0.850	-0.00457	0.003764
Upper East	0.000204	0.002876	0.07	0.944	-0.00543	0.005841
Upper West	0.000789	0.001894	0.42	0.677	-0.00292	0.004501

No Training	-0.03274	0.169215	-0.19	0.847	-0.36439	0.298917
Rural	0.066328	0.024981	2.66	0.008	0.017367	0.115289
Divorced	-0.01891	0.024844	-0.76	0.447	-0.0676	0.029781
Widowed	0.00005	0.036243	0	0.999	-0.07098	0.071084
Single	-0.01015	0.009103	-1.12	0.265	-0.02799	0.007691
Basic	0.221274	0.205258	1.08	0.281	-0.18103	0.623573
Secondary	0.066383	0.036226	1.83	0.067	-0.00462	0.137385
Tertiary	0.047225	0.029076	1.62	0.104	-0.00976	0.104212
_cons	-0.48444	0.349374	-1.39	0.166	-1.1692	0.200318
Unexplained						
Total	-0.20853	0.083544	-2.5	0.013	-0.37227	-0.04479
Reweight_err	-0.00516	0.021864	-0.24	0.814	-0.04801	0.037694
Pure_Unexplained	-0.20337	0.08018	-2.54	0.011	-0.36052	-0.04622
Pure_Unexplained						
work_exp	0.436023	0.22102	1.97	0.049	0.002832	0.869214

exp2	-0.18194	0.113716	-1.6	0.110	-0.40482	0.040938
Individualism	-0.21653	0.175145	-1.24	0.216	-0.55981	0.12675
Central	0.01482	0.034189	0.43	0.665	-0.05219	0.081829
Western	-0.05104	0.039698	-1.29	0.199	-0.12885	0.026767
Volta	-0.00619	0.037133	-0.17	0.868	-0.07897	0.066584
Eastern	-0.01753	0.047314	-0.37	0.711	-0.11027	0.075201
Ashanti	-0.02273	0.059713	-0.38	0.704	-0.13976	0.094309
Brong Ahafo	-0.04558	0.031548	-1.44	0.148	-0.10742	0.01625
Northern	0.002245	0.01076	0.21	0.835	-0.01884	0.023334
Upper East	0.003685	0.011087	0.33	0.740	-0.01804	0.025415
Upper West	-0.00383	0.011456	-0.33	0.738	-0.02628	0.018623
No Training	-0.03185	0.538423	-0.06	0.953	-1.08714	1.023444
Rural	-0.10767	0.061971	-1.74	0.082	-0.22914	0.013787
Divorced	0.078433	0.062192	1.26	0.207	-0.04346	0.200327
Widowed	0.010111	0.054337	0.19	0.852	-0.09639	0.116609
Single	0.002744	0.035997	0.08	0.939	-0.06781	0.073297

Basic	0.345986	0.375843	0.92	0.357	-0.39065	1.082625
Secondary	0.045282	0.068674	0.66	0.510	-0.08932	0.17988
Tertiary	0.07856	0.051324	1.53	0.126	-0.02203	0.179153
_cons	-0.53637	0.813783	-0.66	0.510	-2.13135	1.05862
Reweight_err						
work_exp	0.000699	0.00258	0.27	0.786	-0.00436	0.005757
exp2	0.001256	0.003943	0.32	0.750	-0.00647	0.008984
Individualism	0.004684	0.00417	1.12	0.261	-0.00349	0.012856
Central	0.000241	0.003079	0.08	0.938	-0.00579	0.006275
Western	-0.00075	0.005168	-0.14	0.885	-0.01088	0.009382
Volta	0.003462	0.004078	0.85	0.396	-0.00453	0.011455
Eastern	-0.00047	0.001291	-0.36	0.717	-0.003	0.002062
Ashanti	0.002709	0.00375	0.72	0.470	-0.00464	0.010059
Brong Ahafo	-0.00184	0.00333	-0.55	0.580	-0.00837	0.004686
Northern	-0.00038	0.000748	-0.5	0.615	-0.00184	0.00109
Upper East	0.000273	0.000823	0.33	0.740	-0.00134	0.001887

Upper West	-0.00021	0.000777	-0.27	0.788	-0.00173	0.001313
No Training	-0.00369	0.004056	-0.91	0.363	-0.01164	0.00426
Rural	0.00147	0.002927	0.5	0.615	-0.00427	0.007206
Divorced	-0.00012	0.00671	-0.02	0.986	-0.01327	0.01303
Widowed	0.001706	0.004834	0.35	0.724	-0.00777	0.011181
Single	-0.00024	0.00381	-0.06	0.951	-0.0077	0.007232
Basic	0.002388	0.004155	0.57	0.565	-0.00576	0.010532
Secondary	-0.00143	0.007094	-0.2	0.840	-0.01533	0.012473
Tertiary	-0.01493	0.019659	-0.76	0.448	-0.05346	0.023603
No of Obs: Female						1990
No of Obs: Counter						5971
No of Obs: Male						5971
Sample Mean: RIF q(75)						8.8881

Blinder-Oaxaca RIF-decomposition (Reweighted), Q90

Dependent variable: lnWage						
lwage	**Coef.**	**Std. Err.**	**z**	**P>z**	**[95% Conf.**	**Interval]**
Overall						
Female	9.256464	0.046394	199.52	0.000	9.165533	9.347395
Counterfactual	9.419054	0.043947	214.33	0.000	9.332919	9.505189
Male	9.513351	0.023155	410.86	0.000	9.467969	9.558733
ToT difference	-0.25689	0.051851	-4.95	0.000	-0.35851	-0.15526
ToT_Explained	-0.0943	0.047907	-1.97	0.049	-0.18819	-0.0004
ToT_Unexplained	-0.16259	0.105115	-1.55	0.122	-0.36861	0.043432
Explained						
Total	-0.0943	0.047907	-1.97	0.049	-0.18819	-0.0004
Pure_explained	-0.08755	0.075272	-1.16	0.245	-0.23508	0.059984
Specif_err	-0.00675	0.056316	-0.12	0.905	-0.11713	0.103628
Pure_explained						
work_exp	-0.03155	0.016253	-1.94	0.052	-0.06341	0.000302

exp2	0.003549	0.010468	0.34	0.735	-0.01697	0.024065
Individualism	0.000442	0.001345	0.33	0.742	-0.00219	0.003077
Central	-0.00194	0.003061	-0.63	0.527	-0.00794	0.004065
Western	-0.0037	0.003379	-1.09	0.274	-0.01032	0.002923
Volta	-0.00355	0.00527	-0.67	0.500	-0.01388	0.006774
Eastern	9.36E-05	0.000908	0.1	0.918	-0.00169	0.001874
Ashanti	0.00155	0.005378	0.29	0.773	-0.00899	0.012091
Brong Ahafo	0.00019	0.000858	0.22	0.825	-0.00149	0.001873
Northern	0.004494	0.005037	0.89	0.372	-0.00538	0.014366
Upper East	0.005891	0.003022	1.95	0.051	-3.2E-05	0.011814
Upper West	-0.00057	0.004881	-0.12	0.908	-0.01013	0.009001
No Training	-0.00203	0.002667	-0.76	0.447	-0.00726	0.003199
Rural	0.028707	0.009129	3.14	0.002	0.010816	0.046599
Divorced	-0.04035	0.036826	-1.1	0.273	-0.11252	0.031832
Widowed	-0.01214	0.061574	-0.2	0.844	-0.13282	0.108546
Single	-0.0047	0.002253	-2.09	0.037	-0.00911	-0.00028

Basic	-0.02676	0.030965	-0.86	0.387	-0.08745	0.033925
Secondary	0.011319	0.020883	0.54	0.588	-0.02961	0.052248
Tertiary	-0.0165	0.013634	-1.21	0.226	-0.04322	0.010225
Specif_err						
work_exp	-0.20062	0.102849	-1.95	0.051	-0.4022	0.000966
exp2	0.090597	0.050044	1.81	0.070	-0.00749	0.188681
Individualism	0.123209	0.074566	1.65	0.098	-0.02294	0.269356
Central	-0.01164	0.016028	-0.73	0.468	-0.04305	0.019779
Western	-0.0142	0.020155	-0.7	0.481	-0.0537	0.025304
Volta	0.022723	0.029882	0.76	0.447	-0.03584	0.08129
Eastern	-0.01018	0.022338	-0.46	0.648	-0.05397	0.033597
Ashanti	-0.01671	0.02729	-0.61	0.540	-0.0702	0.036774
Brong Ahafo	0.000532	0.016403	0.03	0.974	-0.03162	0.032682
Northern	-0.00072	0.002971	-0.24	0.808	-0.00654	0.005102
Upper East	-0.00314	0.003295	-0.95	0.341	-0.00959	0.003321
Upper West	-0.00405	0.002582	-1.57	0.117	-0.00911	0.001015

No Training	-0.16849	0.259214	-0.65	0.516	-0.67654	0.339561
Rural	0.063725	0.032681	1.95	0.051	-0.00033	0.127779
Divorced	0.001337	0.029686	0.05	0.964	-0.05685	0.059521
Widowed	0.009402	0.048038	0.2	0.845	-0.08475	0.103556
Single	-0.0269	0.01062	-2.53	0.011	-0.04771	-0.00608
Basic	0.099233	0.30395	0.33	0.744	-0.4965	0.694965
Secondary	0.090875	0.0547	1.66	0.097	-0.01634	0.198085
Tertiary	0.101882	0.047397	2.15	0.032	0.008985	0.194779
_cons	-0.15362	0.520896	-0.29	0.768	-1.17456	0.867313
Unexplained						
Total	-0.16259	0.105115	-1.55	0.122	-0.36861	0.043432
Reweight_err	-0.02413	0.029056	-0.83	0.406	-0.08108	0.032817
Pure_Unexplained	-0.13846	0.099632	-1.39	0.165	-0.33373	0.056816
Pure_Unexplained						
work_exp	0.219941	0.278414	0.79	0.430	-0.32574	0.765623
exp2	-0.04072	0.149255	-0.27	0.785	-0.33325	0.251815

Individualism	-0.07944	0.217488	-0.37	0.715	-0.50571	0.346827
Central	-0.00687	0.041091	-0.17	0.867	-0.08741	0.073665
Western	-0.05068	0.046949	-1.08	0.280	-0.1427	0.041338
Volta	-0.01708	0.054265	-0.31	0.753	-0.12344	0.089277
Eastern	0.007241	0.062299	0.12	0.907	-0.11486	0.129344
Ashanti	0.003242	0.077222	0.04	0.967	-0.14811	0.154594
Brong Ahafo	-0.02823	0.038111	-0.74	0.459	-0.10293	0.046461
Northern	0.013438	0.016861	0.8	0.425	-0.01961	0.046484
Upper East	0.006792	0.013932	0.49	0.626	-0.02051	0.034099
Upper West	-0.00243	0.012257	-0.2	0.843	-0.02645	0.021593
No Training	-0.84246	0.934573	-0.9	0.367	-2.67419	0.989272
Rural	-0.09438	0.075952	-1.24	0.214	-0.24324	0.05448
Divorced	0.009923	0.077879	0.13	0.899	-0.14272	0.162563
Widowed	-0.01591	0.0698	-0.23	0.820	-0.15271	0.120897
Single	0.027167	0.045281	0.6	0.549	-0.06158	0.115915
Basic	0.75391	0.316219	2.38	0.017	0.134133	1.373688

Secondary	0.0702	0.067404	1.04	0.298	-0.06191	0.20231
Tertiary	0.000285	0.060639	0	0.996	-0.11857	0.119136
_cons	-0.07239	1.138903	-0.06	0.949	-2.3046	2.159814
Reweight_err						
work_exp	0.000266	0.001899	0.14	0.889	-0.00346	0.003988
exp2	0.000785	0.002977	0.26	0.792	-0.00505	0.00662
Individualism	0.003579	0.003589	1	0.319	-0.00345	0.010612
Central	0.000206	0.002638	0.08	0.938	-0.00496	0.005376
Western	-0.00022	0.001549	-0.14	0.888	-0.00325	0.002817
Volta	-0.00159	0.006612	-0.24	0.810	-0.01455	0.011373
Eastern	-0.00088	0.002372	-0.37	0.711	-0.00553	0.003771
Ashanti	-0.00068	0.002314	-0.3	0.767	-0.00522	0.003851
Brong Ahafo	-0.00046	0.002029	-0.22	0.823	-0.00443	0.003522
Northern	-0.00042	0.000884	-0.47	0.637	-0.00215	0.001316
Upper East	0.00095	0.002788	0.34	0.733	-0.00451	0.006414

Upper West	-0.00174	0.001463	-1.19	0.235	-0.0046	0.00113
No Training	-0.00398	0.00494	-0.81	0.420	-0.01366	0.0057
Rural	0.001009	0.002208	0.46	0.648	-0.00332	0.005336
Divorced	-5.4E-05	0.002957	-0.02	0.986	-0.00585	0.005743
Widowed	0.000148	0.001947	0.08	0.940	-0.00367	0.003964
Single	-0.00034	0.005488	-0.06	0.951	-0.0111	0.010417
Basic	-0.00334	0.006234	-0.54	0.592	-0.01556	0.00888
Secondary	-0.00117	0.005841	-0.2	0.842	-0.01261	0.010282
Tertiary	-0.01622	0.021692	-0.75	0.455	-0.05873	0.026299
No of Obs: Female						1990
No of Obs: Counter						5971
No of Obs: Male						5971
Sample Mean: RIF q(90)						9.5134