# UNIVERSITY OF EDUCATION, WINNEBA

# SCALE AND SCOPE ECONOMIES AND PRODUCTIVTY OF POLYTECHNIC HIGHER EDUCATION INSTITUTIONS IN GHANA AND GENDER EARNINGS GAP OF THEIR HIGHER NATIONAL DIPLOMA GRADUATES

**ISAAC ADDAI**

**2018**

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**ISAAC ADDAI**

**A THESIS IN THE DEPARTMENT OF SOCIAL STUDIES EDUCATION, FACULTY OF SOCIAL SCIENCE EDUCATION, SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY (SOCIAL STUDIES) IN THE UNIVERSITY OF EDUCATION, WINNEBA**

**OCTOBER, 2018**

## STUDENT'S DECLARATION

I, ISAAC ADDAI declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted either in part or whole, for another degree elsewhere.

SIGNATURE…….

DATE……..

## SUPERVISORS' DECLARATION

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of thesis as laid down by the University of Education, Winneba.

…… (Principal Supervisor)

Signature……..

Date……

…… (Co- Supervisor)

Signature……

Date……

# DEDICATION

This thesis is dedicated to my wife Bernice Boakye, and Children.

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Writing a Social Studies PhD thesis is meant to be a long and difficult journey, but needless to say, I had the support of numerous individuals in helping me through. Above all, I am grateful to my supervisors Professor Vijay Bhasin and Dr. Gershon Yawo Dake. Professor Mawutor Avoke of University of Education, Winneba offered me a lot of encouragement at the beginning of the study. He continued to be warm, friendly and approachable and gave very useful advice. Any time he meets me, he will ask: "Buddy, is the work progressing?" I would also like to thank Dr. Lawrence Odumah, Dr. Dadson Awunyo-Vitor and Dr. Hadrat Mohammed Yusif who kindly commented on previous versions of this thesis.

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## LIST OF ABBREVIATIONS

PHEIGs: The Ten Public Polytechnic Higher Education Institutions in Ghana

HEIs: Higher Education Institutions

TIs: Tertiary Institutions

TERC: Tertiary Education Rationalisation Committee

GOG: Government of Ghana

NAB: National Accreditation Board

NCTE: National Council for Tertiary Education

HND: Higher National Diploma

BTech: Bachelor of Technology

MDGs: The Millennium Development Goals

CES: Constant Elasticity of Substitution

FQCF: Flexible Quadratic Cost Function

TCF: Translog Cost Function

GetFund: The Ghana Education Trust Fund

STLF: Student Loan Trust Fund

TC: Total Cost

ATC: Average Total Cost

MC: Marginal Cost

Q: Output Level

OLS: Ordinary Least Squares

DEA: Data Envelopment Analysis

MPI: Malmquist Productivity Index

QR: Quantile Regression

SS: Social Studies

# ABSTRACT

This Social Studies thesis consists of four empirical studies on the public Polytechnic Higher Education Institutions in Ghana (PHEIGs). Using the flexible quadratic cost function model, the first empirical study examines economies/diseconomies of scale and scope of PHEIGs outputs. Product–specific diseconomies of scale are found at the Technician programme, Higher National Diploma, Bachelor of Technology and Research mean outputs. Global economies of scale, product-specific and global economies of scope at mean operating outputs are established. The second empirical study using Data Envelopment Analysis (DEA), reveal empirical evidence suggesting that 80 percent of the PHEIGs are technically efficient in productivity for the 2014-2015 calendar year, while the Malmquist Productivity Index (MPI) results indicate that the PHEIGs total factor productivities changes fall between 0.21 and 0.93 values suggesting that majority of the PHEIGs registered losses within the range of 7 percent to 89 percent in productivity, and the prevalence of technical inefficiencies in the range of 0 - 56 percent and little changes in distance from most productive scale size over the study period of 2010-2011 to 2014-2015. The value ranges also indicate that the PHEIGs do not operate at a homogeneous level of efficiency. The third empirical study examines the sources of PHEIGs Internally Generated Funds (IGFs) and established that 94 percent of the 32 items constituting the IGFs realised are additional cost to students indicating the continuation of the era of cost-sharing in Higher Education in Ghana disguised as IGFs. The fourth empirical study conducts a tracer study to determine the earnings structure and the gender earnings gap among PHEIGs 2013 Higher National Diploma graduates (HND) using the interval regression model and the Oaxaca decomposition models respectively. The phenomenon of an intra-class gender earnings gap is established in the Ghanaian labour market, suggesting that 2013 male HND graduates with sample 2013 female HND graduates average characteristics earn 44 percent more in monthly earnings than their female counterparts on average, ceteris *paribus*.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Overview

Increasing population, economic growth, strong social demand for quality Higher Education and the high priority by the Government of Ghana (GOG) to opening up access in post-secondary education have all fuelled the establishment of public Polytechnic Higher Education Institutions in Ghana (PHEIGs). The GOG in 1987, constituted a University Rationalisation Committee [URC] mandated to develop proposals for reforming the management, academic structure and funding of tertiary education in Ghana.

The Government of Ghana [GOG] immediately after the URC had submitted its report in 1991, issued a white paper spelling out reforms in the tertiary educational institutions in Ghana. The White Paper emphasise the importance and relevance of Polytechnic Education in the economic and scientific development of Ghana. Subsequently in 1993, after the promulgation of the Polytechnic Law in 1992 (PNDCL 321), the Polytechnics were upgraded to fully-fledged Higher Education Institutions (HEIs) status. In line with the GOG's policy, Polytechnic Education has become national in scope with each region having its own Polytechnic Institution.

The PHEIGs over the past decades have been motivated to revolutionise their traditional programmes they offered by adding to their portfolio of courses a wide range of academic and vocational qualifications to experience economies of scale (average costs decline with output) and scope (costs are higher for specialist providers) which arise in HEIs. The seminal Cohn, Rhine and Santos (1989) paper first introduce HEIs as multi-outputs organizations focusing more on

sophisticated measures of their scale and scope economies. Nelson and Hevert (1992), Dundar and Lewis (1995), Glass, McKillop and Hyndman (1995), Johnes (1996), Johnes (1997), Hasimoto and Cohn (1997), King (1997), Koshal and Koshal (2000) have conflicting conclusions regarding HEIs experiencing scale and scope economies. Enough knowledge is created in the area of HEIs scale and scope economies in the context of the western developed countries.

On the other hand, empirical knowledge on HEIs scale and scope economies in the context of developing countries and Africa is very meager and in the case of Ghana from accessible literature is non-existent to the best of the author's knowledge. The only cost analyses on PHEIGs by Nyarko (2011) after the PHEIGs attained Higher Education status in 1992 was based on accounting principles evaluating single outputs. However, such specifications of the costs function of PHEIGs are biased because PHEIGs are multiple output producing firms. Remarkably, there is no empirical study on the PHEIGs multi-outputs production since they attained the status of HEIs in 1992.

Linked to HEIs achieving scale and scope economies in recent times have been productivity ( an index of their output divided by an index of total input usage) efficiency for better performance in situation of declining public funding per student, massive growth in international student numbers, increasingly competitive markets for international and domestic fee-paying students, rising expenditures on infrastructure, heightened competition for research funding and academic expertise, development of international campuses and joint ventures, and increasing awareness of the interests of students, the community and other stakeholders, having Johnes (2006), Agasisti and Salemo (2007), and Johnes (2008) promoting the productivities and efficiencies studies.

Worthington and Lee (2008) for example examined the productivities and efficiencies in 35 Australian universities using non-parametric frontier techniques over the period 1998–2003. Using Malmquist Productivity Indices, they decomposed universities productivities into technical efficiencies and technological changes and their results indicate that annual productivity growth averaged 3.3% across all universities, with a range from 1.8% to 13.0%.

The PHEIGs have since 1992 been under pressure to provide their services as efficiently as possible, whilst undergoing huge changes in size and structure. With about 15,000 full-time enrolments (FTE) of students in 1992, the PHEIGs students FTE increased to 53,078 as at the end of the 2013/2014 calendar year (NCTE, 2015) and they increased their Higher National Diploma (HND) programmes to 31 and Bachelor of Technology (BTech) programmes to 10, NCTE (2015) in an environment of expanding multiple outputs. Remarkably nothing is known about the PHEIGs productivity growth, the spread of their productivity levels across their sector and whether there have been productivity improvements resulting from increase in efficiency, an increase in technology, or both in the light of these expansionary actions.

Linked to Ghana HEIs strategies of achieving scale and scope economies and productivity growth is the grappling issue of dwindling public funding. Historically, public Higher Education in Ghana was free, with the public purse covering tuition and students' living allowances, pedagogical and research infrastructure, buildings and staff costs. The rationale for state subsidisation of Higher Education, especially tuition, was based, inter alia, on the country's desire to create highly trained person power that could replace the departing colonial administrators, and also to ensure equity of access. Sawyerr (2001) asserts that, in

the welfare-dominated postcolonial period, it was argued that unless the state subsidised the highly expensive Higher Education system, many students would be unable to benefit from it and that formation of person power would be compromised.

However, The World Bank (1988; 1994) policy papers, together with the World Bank and IMF-assisted global re-orientation of economic policies from Keynesian economics to neo-liberalism, triggered major changes in Higher Education funding in Ghana. The coercive influence of the World Bank, expressed in structural adjustment programs favoured drastic reduction of state funding of social services, including Higher Education, leading to a change in the manner in which Higher Education was funded.

The World Bank wanted educational services to be brought into the market place, inter alia, through increased private provision and cost sharing (World Bank, 1988; 1994). According to Nyarko (2011), the Polytechnics were upgraded into HEIs without the necessary funding and other resources stating that Government expenditure per Polytechnic student in 1990 was US$ 168 as compared to US$ 2100 per University student. This actually fell to US$ 74 per Polytechnic student by 1998 during which time that of the University student fell to US$ 900. By 2005, as a result of the establishment of the GETFund, the situation had improved to about US$1000 per Polytechnic student as against US$ 2500 per university student. Girdwood (1999) also assert that the PHEIGs have received less adequate funding and stable support compared to the Ghanaian pubilc universities. Nyarko (2011) noted that, PHEIGs in 1998 received about 28% of financial funds requested from government. This percentage however increased to 58% in 2000 hovering around this figure for a long time till it

declined to 46%. For example, with a combined PHEIGs student population of 53,078, the PHEIGs were allocated GH₵ 150,571,282 out of a budget request of GH₵ 325,547,304 leaving a funding gap of 54 percent for the 2014-2015 calendar year, NCTE (2015). To narrow their funding gap, the PHEIGs have had to generate additional funding sources they referred to as 'Internally Generated Funds' (IGFs). However, there is no existing empirical study examining what constitutes the PHEIGs sources of IGFs and whether the IGFs are additional or disguised costs to students.

Closely linked to the PHEIGs strategies of achieving scale and scope economies, productivity growth and efficiency, bridging their funding gap is the employment and market earnings of their graduates. Since the PHEIGs became HEIs in 1992, it is their HND programmes that have been their backbone and as at the 2014-2015 calendar year, 97 percent of the PHEIGs students were pursuing HND programmes, NCTE Technical Report Committee (2014). But nothing is empirically known about how these HND investments generate rewards in the labour market. Information on the earnings of educated groups, in Sub-Saharan Africa is limited, Al-Samarrai, and Reilly (2008). Psacharopoulos and Loxley (1985); Narman (1992); Bennell and Ncube, (1993, 1994); Mayanja and Nakayiwa (1997) and Kaijage (2000); and Al-samarrai and Reilly (2008) are the very few tracer studies on graduate earnings conducted in Africa and all these studies did not consider the issue of gender earnings gap. Empirical evidence abounds that shows that gender earnings gap exists in both developed and developing countries, Blau, and Kahn (2003). Grey-Bowen and McFarlane (2010) established that gender earnings gap is in part cultural stemming from the belief that men are superior to women in terms of skills, leadership and managerial

abilities. Mandel and Shalev (2009) established the existence of an intra-class gender earnings gap which they explained as differences between male and female earnings located within the same class. The World Economic Forum's Global Gender Gap Index (2015) asserts that globally the gender earnings gap remains a stubborn problem. Remarkably, there is no existing empirical tracer study on the PHEIGs HND graduates examining their gender earnings gap.

The study is motivated by the Social Studies Social Demand Approach (SSSDA) for Polytechnic Education which refers to how to make the best use of limited resources allocated to Polytechnic Education in view of the priorities given to different sectors of education and the needs of the economy. The SSSDA involves various aspects of initiatives such as time, resources, and frameworks for the implementation of strategies for turning Polytechnic Education into a good demanded by consumers just like any other good. SSSDA is a means of gaining insight into policy, costs, efficiency and priorities of an educational sector. Abbott (2005) argues that SSSDA does not concern itself with the employment and related earning issues of graduates. The study overcome this limitation and explores the market earnings and gender earnings gap of the PHEIGs HND graduates.

## 1.2 Statement of the Problem

The recent increase in the PHEIGs technician, HND, BTech and Research multiple outputs as a post-secondary vocational training and degree awarding institutions are a result of Higher Educational Policy Strategy (HEPS) intended among other things to reduce the demand for four-year programs into the various

traditional universities, expand the educational opportunities especially for students from low socio-economic status who are from the rural areas of the country and to train the much needed mid-level manpower for the country.

The HEPS embarked upon by PHEIGs unfortunately have been undertaken with limited regard to issues of their multiple outputs costs and production efficiencies. The only cost analyses on PHEIGs by Nyarko (2011) after the PHEIGs attained Higher Education status in 1992 was based on accounting principles evaluating single output. However, such specifications of the cost function of PHEIGs are biased because PHEIGs are multiple outputs producing firms and the study did not attempt investigating also their multi-production efficiencies as HEIs. With about 15,000 full-time enrolments (FTE) of students in 1992, the PHEIGs students FTE have increased to 53,078 as at the end of the 2013/2014 calendar year (NCTE, 2015).

Expanding the PHEIGs multiple outputs requires knowledge of their scale and scope economies and production efficiencies as HEIs. Nothing is known in the PHEIGs regarding the existence of economies/diseconomies of scale and scope and production efficiencies for their multiple outputs as HEIs in Ghana. Are the PHEIGs cost of producing Technician, HND, BTech and Research jointly less than the cost of producing them separately? The PHEIGs as HEIs have since 1992 been expected to produce their multiple outputs as efficiently as possible. In an environment of expanding multiple outputs, does the PHEIGs productivity in the light of these expansionary actions exhibit efficiency and technical efficiency?

The HEPS embarked upon by PHEIGs which increase their HND programmes to 31 and BTech programmes to 10, NCTE (2015) appears to have been undertaken in an era of dwindling financial resources as subventions from

the Government of Ghana (GOG) the sole shareholder of PHEIGs continue to decrease. For example, in the 2013-2014 calendar year, the PHEIGs were allocated only GH₵ 150, 571, 282 out of a budget request of GH₵325,547,304 leaving a funding gap of 54 percent. With a combined student population of 53,078, the GOG subvention student capita per expenditure is GH₵ 2,836, NCTE Technical Report (2015).

To narrow the funding gap, PHEIGS increasingly have had to generate additional funding sources through new strategies. These additional funding sources are referred to as 'Internally Generated Funds' (IGFs). With only 46 percent funding from the GOG in the 2013-2014 calendar year and determined to bridge the funding gap in the subsequent calendar year, the PHEIGS expanded their IGFs generations in 2014-2015 calendar year. The question of interest are what are the sources of these expanded PHEIGs IGFs and do the PHEIGs Students, Lecturers and Administrators perceive these IGFs generated as being additional costs to students in an era deemed as no cost sharing in HEIs in Ghana?

The Millennium Development Goals (MDGs) were adopted by the General Assembly of the United Nations on 18th September, 2000 at the UN Millennium Summit (http://www.un.org/millennium/declaration/ares552e.pdf). Nearly 190 countries including Ghana have since signed up to the resolution. The eight goals, to be achieved by 2015 are linked to 18 targets, and these in turn to 48 indicators. Millennium Development Goal 3 (MDG3) aims to promote gender equality and empower women and eliminate gender earnings gap in non-agricultural sector. The GOG and individuals invest heavily in Polytechnic Education, but little is generally known about the extent to which these investments generate rewards in the Ghanaian labour market. This is of

particularly concern because 97 percent of the PHEIGs students population pursue HND programmes, NCTE (2014). What are the market returns of individuals who have invested in and graduated as HND graduates? Have gender earnings gap among HND graduates been eliminated as is expected of MDG3? Kara (2006) asserts that there is ample evidence that gendered earnings gap exists in multiple countries and in various sectors and the issue is not limited solely to underdeveloped or developing countries.

The attention on examined gender earnings gap among PHEIGs HND graduates in 2015 has merit and provides a basis to assess the magnitude of the earnings gap among PHEIGs HND graduates (cohorts) to determine if over time with economic development the gender earnings gap narrows as suggested by Polachek (2004) or is eliminated as is expected of MDG3 achievement in Ghana, albeit the World Economic Forum's Global Gender Gap Index (2015) assertion that the global gender gap remains a stubborn problem.

### 1.3 Purpose of Study

The first study using the flexible quadratic cost function (FQCF) examines the presence of scale and scope economies or diseconomies of PHEIGs production of their multiple outputs using their total cost comprising total recurrent expenditures of compensation and emoluments, and students (Technician, HND, BTech) full-time enrolments (FTE) as applied by Cohn, Rhine and Santos (1989), Hashimoto and Cohn (1997), Dundar and Lewis (1995), Koshal and Koshal (1999), Lenton (2008), Mamun (2012) and their Research expenditure as their multiple outputs from their five calendar years (2010-2011 to 2014-2015) panel data obtained from the NCTE. In common with most

estimates of cost functions in higher education, this specification does not explicitly include information about Lecturers salaries. Most estimates of cost functions of HEIs do not include such information, Johnes, Johnes and Thanassoulis (2008).

The second study purposes further to investigate and evaluate the PHEIGs productivity and efficiency over five calendar years (2010-2011 to 2014-2015) year on year using input-oriented Data Envelopment Analysis (DEA) Malmquist Productivity index (MPI) non-parametric approach as espoused by Färe, Grosskopf, Norris, and Zhang (1994), and Färe, and Zhang (1997) to decompose the PHEIGs productivity into change in efficiency which measures the PHEIGs as Decision Making Units (DMUs) using their existing resources efficiently and technology efficiency measures which indicates the outward shifts of PHEIGs production frontier over time. This study considers the PHEIGs Research expenditure as an input, as espoused by Worthington and Higgs (2011) and is added to the total cost to produce their Technician, HND, BTech multiple outputs.

The third study examines and catalogue the sources of PHEIGs IGFs using their cross-section 2014-2015 calendar year data obtained from the NCTE to ascertain the biggest and smallest PHEIGs IGFs per student capita, the contribution and amount of IGFs generated per institution using Scott (1990) document analysis model and a survey questionnaire data using Linacre (1995) data analysis framework to explore and report the perception of PHEIGs Students, Lecturers, and Administrators on whether the PHEIGs IGFs generated are additional costs to students in the form of cost sharing or not in an era deemed as cost sharing free in HEIs in Ghana.

The last convergent parallel mixed methods study converges or merges data from a purposive tracer-survey conducted on 2013 HND graduates in the 2015 labour market in Ghana using the Interval Regression Estimation Technique (IRET) to explore their monthly earnings categories and run a regression of respondents' monthly log earnings (*lnearns*) on their gender, whether respondent works in the informal sector or not (*sector*) , respondent's age (*age*), respondent's age squared (*age2*) whether respondent works as a mid-level employee (*midlevel*) or not, respondent's marital status (*marired*), whether respond holds HND Accountancy certificate, the most sought-after HND qualification (*acchnd*) or not and whether the respondent is a native (*regnat*) or not of the region where s/he is employed variables to estimate the Oaxaca (1973, 1984) earnings decomposition which allow overall average differential in earnings between two gender groups decomposed into a part attributable to differences in measured characteristics evaluated at the male returns and a part attributable to gender differences in returns evaluated at the mean set of female characteristics referred to as the endowment and treatment or discriminatory effects respectively in Social Studies (SS) under the earnings assumption of an equal treatment in the labour market.

## 1.4 Research Objectives

The study seeks as its objectives to:

i) Empirically examine the scale and scope economies of the public Polytechnic Higher Education Institutions in Ghana (PHEIGs) multiple outputs.

ii) Empirically examine the public Polytechnic Higher Education Institutions in Ghana (PHEIGs) Total Factor Productivity Changes and Technical Efficiencies

iii) Explore the strategies used by the public Polytechnic Higher Education Institutions in Ghana (PHEIGs) to bridge their funding gap and whether these constitute burden to students

iv) Conduct a tracer survey on the 2013 public Polytechnic Higher Education Institutions in Ghana (PHEIGs) HND graduates in order to explore the determinants of their gender earnings gap.

## 1.5 Research Questions

Following from the study objectives, the research questions for the study are:

i) What are the ray and product-specific scale and scope economies of the public Polytechnic Higher Education Institutions in Ghana (PHEIGs) multiple outputs?

ii) What are the public Polytechnic Higher Education Institutions in Ghana (PHEIGs) Total Factor Productivity Changes and Technical Efficiencies?

iii) How do the public Polytechnic Higher Education Institutions in Ghana (PHEIGs) bridge their funding gap and do the strategies they initiate constitute a burden to students?

iv) What are the determinants of the public Polytechnic Higher Education Institutions in Ghana (PHEIGs) 2013 HND graduates gender earnings gap?

## 1.6 Significance of the Study

From a higher education management policy viewpoint, the examination of scale and scope economies/diseconomies and productivity deal with issues of

accountability, value for money and cost control in an effort to identify the best way of achieving expansion in the PHEIGs outputs for best higher educational management practices and efficiency.

The third study also examines and recommends additional alternate funding sources (AFS) to PHEIGs managements and how it should be shared among stakeholders.

The tracer study contributes significant knowledge on the 2013 HND graduates market earnings which will encourage the PHEIGs managements to continue with the production of the HND outputs and also brings to the fore the prevalence of gender earnings gap in the 2013 HND graduates labour market necessitating more effort on the part of policy-makers to attenuate its effect.

Secondly, the study presents conclusions and recommendations that impinge on policy modelling and discourse on the PHEIGs in particular and the HE sector in Ghana in general.

### 1.7 Limitations of study

As economic theory suggests, competitive pressure will affect the organisational efficiency of a firm's production processes by forcing profit-maximising firms to strive constantly to produce more efficiently. In the context of PHEIGs the argument that such market-like mechanisms can be applied with equal force might not hold true for at least three reasons:

(i) The PHEIGs are completely publicly (GOG) financed and controlled;

(ii) And because PHEIGs are non-profit entities, the 'market-driven' cost-minimisation assumption for production might not be the primary behavioural objective; and

(iii) In the PHEIGs market, price information of inputs and outputs are most times difficult to obtain.

Lastly, the study is limited and focused only on the PHEIGs instead of the entire HE sector in Ghana.

## 1.8 Thesis Structure

The structure of the thesis is now outlined. Chapter one deals with the general introduction of the study. Chapter two deals with the literature review. Chapter three concerns itself with the research methodology. Chapter four deals with results of the studies and discuss the statistical estimates by highlighting the findings and the inferences made by establishing links to previous studies findings. Chapter five finally concludes the study by itemising the major research findings and indicate the contribution of the study to Economics Education and the relevance of the study. The conclusion and policy recommendations based on the current research findings and the relevance of the study are also spelt out in this chapter.

## 1.9 Definitions of Terms

Cost complementarities: In a multiproduct organization, cost complementarities exist when the marginal cost of producing one output is reduced when the output of another product is increased.

Economies of scale: Economies of scale in microeconomics, refers to the decrease in average cost (cost per unit) due to expansion of the scale for a single product type in an organization. If average cost is increasing, then marginal cost must exceed average cost and production then starts to exhibit diseconomies of scale.

Economies of scope: Economies of scope measure the cost savings accruing to firms producing two or more products jointly as against specializing in the production of a single output.

Heteroscedasiticty: The assumption that the disturbance variance is constant at each sample point is termed as homoscedasticity and the obverse condition where the disturbances are not the same at all points, is termed as heteroscedasiticty. The variance of the error term now varies across observations.

Multicollinearity: refers to increasing correlation between explanatory variables which inflate the standard error. multicollinearity is a question of degree and, even if present, may not be a problem for the estimates

Multiproduct–Organisations: PHEIGs are typical multiproduct - organisations since they usually tend to have a broader set of products, such as teaching, community services and academic research.

Social Studies: Is the integrated study of the social sciences which rely upon such disciplines as anthropology, economics, education, geography, history,

jurisprudence, philosophy, political science, psychology, religion sociology, ICT, as well as appropriate content studies of the humanities, statistics, mathematics and the natural sciences.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Background of Higher Education in Ghana

The introduction of HEIs in Ghana was the culmination of the struggles and protest of the nationalist movements. Based on England's colonial policies, access to higher education by the Africans was limited until the end of World War II. This was because the British colonial governor feared among other things, that the product of such HEIs especially the universities, would not only undermine the expatriate monopoly on higher government and business posts but also constitute a vanguard of nationalist agitators against the colonial status quo, which most of the officials believed would perpetuate itself indefinitely, Emudong (1997).

However, just after the end of World War II, the twentieth century witnessed an increased demand by African intellectuals for an African system of higher education on the continent. Leney (2003) asserted that there were serious talks about the development of higher education in the Gold Coast (now Ghana). The colonial government's attention however, was slowed until the increase of African membership at the legislative council. Under the Governorship of Sir Gordon Guggisberg, he revised the educational system by placing premium on higher education delivery in the then Gold Coast.

As debates over the creation of universities in Africa intensified, the British colonial government established commissions that studied the feasibility of a university system for Africa. Commission creation then became the hallmark of African higher education. As asserted by Daniel (1996, p.1), the history of

university education in the Gold Coast, now Ghana, is the history of education commissions, one for every few years, beginning with the Asquith Commission which was appointed by the Government of the United Kingdom in August 1943.

Another commission that gained the attention of Sir Gordon Guggisberg was the Phelps-Stokes Commission, which also recommended the creation of local universities, once the elementary and secondary schools were able to feed them with a sufficient number of students (Leney, 2003, p. 43). The system of education recommended by the commission was based on the European curriculum which was in sharp contrast to the Africanisation of the curricula.

The Phelps-Stokes Commission recommendation led to the creation of the Prince of Wales College of Achimota (Achimota College) in 1927, which became the citadel of the future university in Ghana, Leney (2003). Although, the Justice Asquith commission had earlier on recommended the establishment of local universities that will award London degrees as intermediate degree programs in the areas of arts and science, engineering, and economics but it never saw the light of day, Daniel (1996).

The Justice Asquith commission outlined the principles that should guide the establishment of universities in Africa and explored how universities in the UK could cooperate with institutions of higher education in the colonies including the Gold Coast, Daniel (1996). The first Higher education institution established in Ghana was the University College of Gold Coast in 1948 and later renamed the University of Ghana (UG) after independence in 1957.

### 2.1.1 National Council for Tertiary Education and the National Accreditation Board

As HEIs in Ghana, the PHEIGs are under the joint jurisdiction of the National Council for Tertiary Education (NCTE) and the National Accreditation Board (NAB). The NCTE was made responsible for the supervision and coordination of public and private sectors HEIs. The NCTE was established by Act 454 of the 1992 Constitution with the intent of operating with the vision of "Leading Tertiary Education to Greater Heights".

The NCTE strives to promote quality, equitable access, relevance, sustainable funding, good governance and management of excellence, in tertiary education that supports national development. The NCTE also publishes information on HEIs in Ghana.

As at January 2015, the NCTE was supervising and regulating ten public universities namely: University of Ghana, Kwame Nkrumah University of Science and Technology, University of Mines and Technology, University of Cape Coast, University of Education Winneba, University for Development Studies, University of Energy and Natural Resources, University of Health and Allied Sciences, University of Professional Studies, and Ghana Institute of Management and Public Administration, sixty-one private tertiary education institutions including three having their various charter and fifty-one degree, tutorial and distance learning private tertiary institutions.

Three private colleges of education and four private nursing institutions were also included. Additionally, 10 public polytechnics, two specialised institutions comprising the Ghana Institute of Journalism and Ghana Institute of Linguistics and 38 colleges of education were all supervised and regulated by the NCTE (NCTE Website, 5th February, 2015).

The NAB is also the government agency responsible for the maintenance of acceptable academic quality and standards; authorization of award of degrees through affiliated institutions and the establishment of equivalences of qualifications awarded by recognized institutions within and outside Ghana, Provisional National Defence Council (PNDC) (Law 217). NAB assesses institutions on the strength of the quality of instruction, faculty and of academic facilities. In line with this, tertiary level programmes can only be mounted and operated after being duly accredited and recognized by NAB.

## 2.2 Early Cost Studies in HEIs

The relationship between cost and higher education production was suggested as far back as in 1925. Bagley (1925) estimated the coefficient of correlation between the index of cost and production as 0.92, based on the number of graduates listed in *Who's Who* in 1924 and on the five types of expenditure for education in 1880.

Wallatt (1949) study suggests that an increase in the amount of money spent is followed by an increase in the quality of higher education. Bloom's (1956) study also confirmed the above relationship. Witmer (1972) found that expenditures in higher education had not reached the point of diminishing returns in America.

Cost functions provide important information for producers to achieve efficiency in production. In the case of HEIs, the question of economies of scale and scope has been debated for over half a century mostly in the western countries. But these debates were made intense in the very recent times by the

seminal paper of Cohn, Rhine and Santos (1989), and studies by Hashimoto and Cohn (1997), Koshal and Koshal (1995), Brinkman and Leslie (1986).

## 2.3 Cost Functions in HEIs

The cost concept is a classical concept in economics. The production frontier, also called the production possibility function specifies maximum output obtainable from all possible input combinations. The cost function relates the production and input prices in such a manner as to determine the minimum costs for some given level of output.

The average total cost (ATC) function is constructed by dividing the total cost (TC) function by the (Q). The marginal cost (MC) function is constructed by taking the first derivative of the TC function with respect to output.

In theory, economists assume that average cost (AC) and MC are quadratic which first decrease and then increase as output increases. However, Scherer's (1980) noted that the empirical evidence indicates that real cost curves decline initially as output increases and are then flat bottomed.

A review of Hopkins (1990) work on the evidence concerning higher education production function defines the production function as the process by which a College, Polytechnic or a University transforms inputs (typically labour and capital) into outputs. Specifying such a function is not easy because identifying all relevant inputs and outputs and expressing the mathematical inter relationships among them is a very complex task. The output measures must relate to the three important missions of higher education, namely, the

transmission of knowledge (teaching), the creation of knowledge (research), and the transmission of knowledge to society in general (community services).

Hopkins and Massy (1981) distinguish between intangibles (hard-to-measure) and tangibles (easy-to-measure) inputs and outputs in the higher education sector. Hopkins and Massy's (1981) characterisation of these two types of inputs and outputs are the most precise one available in the literature.

The tangible outputs specified by Hopkins and Massy (1981) are: student enrolment in courses, degrees awarded, research awards, articles and citations and services rendered to the general public. The intangible outputs are: quality of education obtained, quality of research performed, quality of services rendered, goodwill and reputation. It is easy to understand why it is difficult to specify the higher education production functions. These measures are lacking. The interaction between teaching and research is difficult to express mathematically.

As Hopkins (1990) points out it is important to note that a true production is based on the concept that maximum levels of output can be achieved for a given set of inputs. However, there are reasons to believe that higher education institutions have not been operating at near the efficient frontier of production possibilities. This means that if even the true production function can be specified, one would still be unable to estimate the model parameters from the given data set.

An excellent review of cost analysis in higher education institutions is given by Hoenack and Collins (1990). The essays of Hopkins (1990), James (1990), Brinkman (1990) and Hoenack (1990), are also very instructive in particular. Most cost analyses of HEIs undertaken in the recent decades were

based on simple computations of average historical costs. For example, direct costs of an academic department may be divided by the number of credit hours generated by faculty in the department to produce an average direct cost per credit hour. Similarly, total instruction cost for an institution may be divided by the number of full-time equivalents (FTE) to yield an average cost per FTE student. Usually average full costs (direct plus indirect) are not calculated.

## 2.4 Multi-Product Costs Structure of HEIs

Baumol Panzar and Willig (1982) pioneered the invention of a comprehensive set of cost analysis methods for multiproduct organizations, pointing out the three most frequently used functions: flexible quadratic cost function (FQCF), constant elasticity of substitution (CES) and hybrid translog cost function (HTCF). Baumol Panzar and Willig further states:

"By bringing the large enterprise firmly into the body of microeconomic theory, this volume makes a major contribution to the generalisation of microeconomic analysis. The world of single-product product firms with U-shaped average cost curves simply is not the world of reality. Industrial organisation has long awaited a theory dealing with the variety of outputs and prices and production processes that comprise our economy. This book begins the difficult transition to a theory of industrial organisation that can encompass the richness and breadth of actuality while retaining a strong under pinning in theory. Moreover, the fundamentally new theoretical concepts it explores permit, for the first time, an endogenous determination of industry structure," (Baumol Panzar and Willig 1988, p. 6).

This set of analyses methods have been widely applied in banking, transportation, public facilities, telecommunication, and health care, HEIs as well as many other multiproduct organisations.

The seminal Cohn, Rhine and Santos (1989) paper, which introduce HEIs as multi-product organizations and hence focus upon more sophisticated measures of economies of scale and scope occurred only 27 years ago in the United States of America (US). By using flexible quadratic cost function (FQCF) and employing data from a 1981-82 sample of 1,887 U.S. universities computed a multi-output cost function measuring both teaching and research outputs. Their study measures full-time-equivalent (FTE) enrolments as teaching output, and uses measures of research grant income as a proxy for research output.

Faculty salaries are included as a price factor. The statistical results of this pioneering study indicate overall economies of scale at output means in the whole sample. Calculations of product- specific economies of scale and scope generate conflicting reports for public and private institutions as economies of scope at private institutions and diseconomies of scope at public institutions. Their findings suggest that an important role is played by scale economies in the higher education sector.

De Groot, McMahon, and Volkwein (1991), with a sample of 147 research universities employed the hybrid translog cost function (HTCF) to compute three outputs. The variables they considered are FTE enrolments, of undergraduate and graduate students, and the number of research publication but no input price. Contrary to Cohn *et al.* (1989) they conclude that there is no difference in cost structure between public and private institutions. The degree of global economies of scale is also higher than in the former study.

Nelson and Hevert (1992) estimated a multi-product costs for 31 academic departments at the University of Delaware for the period 1979-83 using the

HTCF. The function contains four outputs (including a measure for research) as well as three input prices. They argue that, when controlling for average class size, the cost function is characterised by constant returns to scale and that no evidence of economies of scope can be found.

Dundar and Lewis (1995) used a four-output FQCF with no input prices to analyse the cost structure of 17 academic departments across US in 1985-86. All three faculty clusters (social science, engineering and health sciences show) overall and product specific economies of scale, as well as global and product-specific economies of scope for most of the four outputs.

Lewis and Dundar (1995) estimate a four-output FQCF in order to calculate the degree of economies of scale and scope for 186 college departments within the entire population of 28 universities in Turkey during 1991-92. The results show that overall economies of scale as well as global economies of scope are considerable for all three faculty clusters (social science, engineering, and health science).

Glass, McKillop and Hyndman (1995) uses a three output and two-input price using HTCF to analyse the cost structure of a sample of 61 universities during 1989. The statistical results show that overall and product-specific economies of scale are considerable. Notwithstanding, scope results generally suggest neither economies nor diseconomies.

Johnes (1996) uses a sample of 50 universities and a six-output FQCF in order to estimate economies of scale and scope. Product-specific economies of scale are present for only two of the six outputs considered; postgraduate education and research in science. Results are also consistent with global

economies of scope. In another study by the same author, Johnes (1997) estimates a four-output CES for 99 universities. This time he finds overall economies of scale, product-specific economies of scale for all outputs except undergraduate science programs and global diseconomies of scope.

A sample of 94 private universities in Japan for the year 1991 is analyzed by Hasimoto and Cohn (1997) in order to compute scale and scope economies. A three-output, no-input price FQCF is employed. The statistical results provide evidence of ray (overall) economies of scale as well as global and product specific economies of scope. Product specific economies of scale are shown for undergraduate and graduate teaching in relatively small universities and for research in relatively large universities.

King (1997) uses two years of pooled data from 61 instructional departments of a large Midwestern to estimate a HTCF. Statistical results show that there are economies of scale in the production of all three outputs considered: undergraduate education, graduate education, and research. All three types of inputs; tenured faculty, non-tenured faculty, and graduate assistants behave like substitutes, with the demand for tenured faculty being least elastic.

Koshal and Koshal (2000) estimate FQCF using data from 158 private and 171 public comprehensive universities in the US in 1990-91. The number of FTE undergraduate and graduate students and the level of faculty research funding constitute their measures of education and research outputs, respectively. The function does not contain input prices. When institutional quality is accounted for, the statistical results suggest that there are both economies of scale and scope in the sample data. However, product-specific economies of scope do not exist for

all output levels. On institutional quality however, the authors seem to confuse the quality inherent in the students with the quality of the university. All these aforementioned studies used cross section data in their various analyses.

## 2.5 Using Panel Data to Analyse Multi-product Cost Structure

The use of panel data to estimate the multi-product cost functions and the economies of scale and scope associated with teaching and research of HEIs are of very recent study. Johnes, Johnes and Thanassolis (2008) using panel data, collected three years 2000-2001 through 2002-2003 using random effects and stochastic frontier methods (SFM) to estimate returns to scale and scope of all 121 HEIs in England.

Sav (2011) was the first author to use panel data for U.S. public colleges and universities to estimate multi-product cost functions and the economies of scale and scope associated with teaching and research. The panel spans the academic years 2000-2001, 2003-2004, and 2006-2007. The proposed contributions were several as previous studies produces single year, cross-section estimates that are potentially biased due to unobservable individual and or time effects and again produce estimates based on analysis that extends to the 2006-2007 academic year where as the mainstream previous studies do not produce estimates beyond 1995-1996 in the U.S. Mamun (2012) also applying Stochastic Frontier Estimation (SFE) used a panel data for year 2002-2007 of public universities in Bangladesh to estimate the economies of scale and scope and input demand choice.

After the seminal paper Cohn, *et. al* (1989) application of the FQCF to the study of HEIs outputs which investigated the economies of scale and scope of US public and private HEIs, the majority of empirical studies on the economies of scale and scope of HEIs so far have adopted the FQCF (Lewis & Dundar, 1995; Koshal & Koshal 2001; Laband & Lentz, 2003; Sav, 2004, 2011; Cesar, 2006; Hou & Min, 2009) and it still remains researchers favourite with only a few exceptions adopting the CES (Johnes, 1997; Izadi Johnnes, Oskrochi, Crouchley, 2002) and the HTCF (de Groot et al., 1991; Glass, McKillop, & Hyndman, 1995; Nelson & Hevert, 1992; Stevens, 2005), while in the more recent literature stochastic frontier analysis (SFA) has been adopted (Johnes, 1996; Stevens, 2005; Johnes, Johnes, & Thanassoulis, 2008).

Very few researchers, Carlson (1975), Gray and Weldon (1978) have used linear programming techniques to measure costs efficiencies of higher education institutions. In such analyses, several assumptions have to be made in order to measure outputs precisely. Furthermore, this approach to cost analysis is very complex. This may be the reasons why very few researchers have attempted this type of analysis.

**2.6 Cost Studies on PHEIGs**

There have been very few cross-section cost studies on PHEIGs describing in very limited details the cost of providing Polytechnic education in Ghana (Nsiah-Gyabaah, 2005; Aryeetey, 2000; Presidents Educational Review Committee 2004; NCTE 2007; Nyarko 2011). According to Nyarko (2011), the

Polytechnics were upgraded into tertiary institutions without the necessary funding and other resources.

For example, Government expenditure per Polytechnic student in 1990 was US$ 168 as compared to US$ 2100 per University student. This actually fell to US$ 74 per Polytechnic student by 1998 during which time that of the University student fell to US$ 900. By 2005, as a result of the establishment of the GETFund, the situation had improved to about US$1000 per polytechnic student as against US$ 2500 per university student.

## 2.7 Productivity and Efficiency in HEIs in Ghana

In the context of HEIs, there has been increase in research on productivity and efficiency measurement, since the seminal work of Farrell (1958) by Johnes (2006), Agasisti and Salemo (2007), and Johnes (2008). The PHEIGs have since 1992, been under pressure to provide its services as efficiently as possible, whilst undergoing huge changes in its size and structure. In an environment of expanding student numbers it is important to understand as well the cost structures that underpin provision of these outputs and the potential for PHEIGs improved productivity. However, there has been no research conducted and published on the Ghanaian HEIs productivity and efficiency including that of the PHEIGs.

## 2.8 Background of Higher Education Financing in Ghana

Higher Education (HE) was traditionally free of charge in Ghana as they were regarded as non-profit entities from the colonial to the post independent era.

HE students admitted were entitled to free tuition and free lodging. However, fiscal budget constraints and developments in the 1970s first drew the GOG's attention to production cost estimation in Ghana HEIs and thereby for the very first time shifting some of the responsibilities to the students, albeit tuition remaining free.

Faced with diminishing financial resources, the GOG entered into contract with the Ghana Commercial Bank and agreed to provide students with loan of a specific amount, which would be repaid after graduation when students begin to work, Sawyerr (2001).

This was first introduced in 1971 but was suspended in less than a year of its operation owing to opposition from students and a military coup d'etat that ousted the government out of power but was reintroduced three years later. The purpose was to provide students with some income to defray expenses on books, living and other educational amenities enjoyed by the students.

Sawyerr (2001) noted that for the 11 years of its operation in 1982, a total of ¢33.5 million (US $ 375,560) was owed to the scheme by students. Of this, only ¢185,000 (US$2,074) was paid. This created a financial hitch for the Ghana Commercial Bank and coupled with the high level of inflation in the country, a new educational policy framework was necessary and the Social Security and the National Insurance Trust (SSNIT) was roped in to participate in the scheme.

With the growing problems of recovery and the increasing numbers of tertiary students, a new policy framework orchestrated with the World Bank, a major higher education influencer in the country was adopted once again. The World Bank (1988; 1994) policy papers, together with the IMF-assisted the

Ghanaian economy re-orientation of economic policies from Keynesian economics to neo-liberalism.

Funding HEIs in Ghana became a serious endeavour in the 1980s especially during the second phase of Ghana's Economic Recovery Program (ERP, 1987-89). In 1989, the government modified the student loan scheme to include all tertiary institution, a departure from the previous policy design to cater for only university students in full-time approved programs. The GOG was forced by economic difficulties and the influence and directives of the World Bank to introduce a quasi-market condition referred to as cost sharing in 1997.

## 2.9 The World Bank and Higher Education Funding In Ghana

Banya and Elu (2001), Brock-Utne (2003), Aina, Chachage and Annan-Yao (2004), Task Force on Higher Education and Society (2000) among others, have provided detailed analyses of the influence of the World Bank in the making of higher education funding policies in Africa. The World Bank's (1988) policy paper proffered several policy recommendations that were aimed at improving both the internal and external efficiency of higher education in Ghana. The suggested adjustments included increasing students to staff ratios, expanding access for part-time fee-paying students, and assigning to non-public sources the full cost for housing, food and other welfare services provided to staff and students. Perhaps the most significant recommendation was cost sharing (cost recovery).

The Sub-Saharan African governments were called upon to 'relieve the burden on public sources of financing higher education by increasing the participation of beneficiaries and their families' (World Bank, 1988, p. 77).

Overall, the paper set the stage for adjustments in public higher education funding in Ghana.

To reinforce the earlier 'prescriptions' of the 1988 policy paper, the World Bank produced another policy paper, World Bank (1994), which reinforced the Bank's earlier strict opposition towards public investment in higher education in Africa. The paper in the strongest terms argued that the extent of Sub-Saharan African central government's involvement in higher education has far exceeded what they determine as economically efficient and that higher education in Africa is a burden to public finance, (World Bank, 1994, p. 9).

Thus, African countries including Ghana were called upon to adopt policy reforms that would lower public costs of higher education, such as cost sharing. The two policy papers constituted neo-liberal prescriptions for HEIs finance and funding. The papers heralded major changes in the funding of higher education in sub-Saharan Africa. Budgetary allocations to higher education were significantly slashed in favour of basic education (Banya & Elu, 2001; Brock-Utne, 2003; TFHES, 2000); cost sharing and other market-related reforms were also introduced.

In Ghana, the implementation of the World Bank proffered policies of higher education funding was not a matter of choice. These policies were to be implemented as part of structural adjustment programs (SAPs) imposed by the Bank and IMF. The neo-liberal development paradigm advocated by the World Bank was essentially a rejection of the Keynesian approach to education provision that many African countries had pursued since the attainment of political independence.

Keynesian economics was born in February 1936 with the publication of Keynes book; *The General Theory of Employment, Interest and Money.* Keynes recognized that the drastic economic situation confronting the capitalist system in the 1930s threatened its very survival and was symptomatic of a fundamental flaw in the operation of the price mechanism as a coordinating device. To confront this problem Keynes needed to challenge the classical economists from within their citadel. The flaw, as he saw it, lay in the existing classical theory whose teaching Keynes regarded as not only 'misleading' but 'disastrous' if applied to the real-world problems facing the capitalist economies during the interwar period.

For Keynes, capitalism was not terminally ill but unstable. His objective was to modify the rules of the game within the capitalist system in order to preserve and strengthen it. He wanted full employment to be the norm rather than the exception and his would be a conservative revolution. As Galbraith (1977) asserts, Keynes never sought to change the world out of personal dissatisfaction: 'for him the world was excellent'. Although the republic of Keynes's political imagination lay on the 'extreme left of celestial space', he was no socialist. Keynes remained notoriously blind to Marx.

In his opinion, *Das Kapial* contained nothing but 'dreary out of date academic controversialising' which added up to nothing more than complicated *hocus pocus,* Snowdon and Vane (2006, p. 14). At one of Keynes's Political Economy Club meetings, he admitted to having read Marx in the same spirit as reading a detective story. He had hoped to find the some clue to an idea but had never succeed in doing so, Skidelsky (1992, pp.514-23). For Keynes the ultimate political problem was how to combine economic efficiency, social justice and individual freedom.

His solution to economic malaise that was sweeping the capitalist economies in the early 1930s was to accept 'a large extension of the traditional functions of government'. Keynes (1926) argued in *The End of Laissez-Faire*, that if the government is to be effective, it should not concern itself with 'those activities which private individuals are already fulfilling' but have to attend to 'those functions which fall outside the private sphere of the individual, to those decisions which are made by no one if the state does not provide them', Keynes (1972, Vol. IX, p. 291). To Keynes, the state must not shirk its responsibility of funding public higher education or shift the funding on individual private citizens.

According to Aina, Chachage, and Annan-Yao (2004); Aseka (2005); Bundy (2004); Toress and Schugurensky (2002); Aina (1997), neo-liberalism may be described simply as an ideology that favours *Laissez-Faire* or free market economics. It advocates for privatisation, marketisation and performance; and the shift of the cost of public services (e.g. higher education) from the state onto the individual. By privileging privatisation and marketisation, neo-liberalism thus occasions the significant withdrawal of the state in social provisioning through drastic reductions in social expenditure. (Aina, 1997; Aina et al., 2004; Aseka, 2005; Toress & Schugurensky, 2002).

Johnstone (2003, p.3) outlines the tenets that shape strategies proposed by proponents of neo-liberals. They believe that (a) the private rate of returns to higher education to the individual is very high, and that the beneficiary should contribute toward education; (b) regressive free tuition would be used to compensate for individuals who cannot afford the cost of college education as this will create equity as students from middle and upper income families would pay, and there would be a means tested approach to providing grants, loans and

scholarships to individuals from the less advantaged families; (c) paying tuition ensures the efficiency and accountability of institutions to students and parents; and (d) the increased difficulty of taxation in many low income and transitional countries and/or the competition from other compelling public needs such as health care and primary education, make increased tax resources doubtful at best to supporting higher education.

Johnstone (2003, p.351) also advocated for cost sharing. He defines cost sharing in higher education as 'the assumption by parents and students of a portion of the costs of higher education – costs that, in many nations, at least until recently, have been borne predominantly or even exclusively by governments, or taxpayers.

In Ghana, cost sharing accord apportioned the responsibility for HEIs funding between the government and HEIs in the ratio of 70:30. Thus the GOG is responsible for 70 percent of total funding and the HEIs responsible for 30 percent, to be met by increasing internal revenue-generation, private donations and student tuition fees. Student academic and residential facility user fees in Ghana were also introduced in 1998.

Mamdani (2006) argued that the neo-liberal approach of funding HEIs is an assault on the development role of the African HEIs. Although a 2000 study by a task force convened by the World Bank and UNESCO questions the logic of subjecting higher education to resource starvation, the findings of this report have not occasioned any significant policy shifts towards greater public funding of higher education, (TFHES, 2000). Higher education in Ghana still has to grapple with reduced state support that has been advocated for by the neo-liberal Bretton Wood institutions.

## 2.10 Policy Shifts in Funding Ghana's Public Higher Education

There have been three major shifts in funding Ghana Higher educational sector since independence namely; the eras of free education, cost sharing and the present cost sharing cum IGFs or income generation era.

### 2.10.1 The era of free public higher education

Historically, public higher education in Ghana was free, with the public purse covering tuition and students' living allowances, pedagogical and research infrastructure, buildings and staff costs. The rationale for state subsidisation of higher education, especially tuition, was based, *inter alia,* on the country's desire to create highly trained person power that could replace the departing colonial administrators, and also to ensure equity of access. Sawyerr (2001) asserts that, in the welfare-dominated postcolonial period, it was argued that unless the state subsidised the highly expensive higher education system, many students would be unable to benefit from it and that formation of person power would be compromised.

Free provision was therefore seen as the surest way for the state to guarantee equality of opportunity. The university was also seen as the epicentre of social and economic development, which the newly independent state so much desired and aspired to. To achieve its role of spurring social and economic development, it was argued that generous funding be provided. By offering highly subsidised education, free of any direct charges, the government hoped to stimulate enrolments (access) into higher education. This situation continues until

the end of the 1960s, when the Ghanaian higher education budget increased to the extent that GOG could not afford to remain the sole financier of higher education in the country.

### 2.10.2 The era of cost sharing

The World Bank (1988; 1994) policy papers, together with the World Bank and IMF-assisted global re-orientation of economic policies from Keynesian economics to neo-liberalism, triggered major changes in higher education funding, in Ghana. The coercive influence of the World Bank, expressed in structural adjustment programs that favoured drastic reduction of state funding of social services, including higher education, led to a change in the manner in which higher education was funded. The World Bank wanted educational services to be brought into the market place, inter alia, through increased private provision and cost sharing (World Bank, 1988; 1994).

Johnstone (2003, p. 351) defines cost sharing in higher education as 'the assumption by parents and students of a portion of the costs of higher education – costs that, in many nations, at least until recently, have been borne predominantly or even exclusively by governments, or taxpayers. As is characteristic of World Bank loans to poor countries, conditionalities were attached. These included the institution of new financing strategies for higher education, which they actually referred to as cost sharing In effect, the Bank prescribed reduced funding by government to the higher education sub-sector and the introduction of cost sharing.

### 2.10.3 The era of marketisation and internally generated fund

This present era can be linked to the discrediting of the public model of financing higher education, aided by the establishment of neo-liberalism as the dominant economic mode of the century. This is the era of shifting the Ghanaian public HEIs resource dependence from the state to the market, as evidenced by the decline of public expenditure in the total expenditure in higher education. For example, in 2014-2015 calendar year, the PHEIGs were allocated only GH₵ 150, 571, 282 out of a budget request of GH₵325,547,304 leaving a funding gap of 54 percent. With a combined student population of 53,078, the GOG subvention polytechnic student capita per expenditure is GH₵ 2, 836, NCTE Technical Report (2014).

With only 46 percent funding from the GOG, the growing financial problems of PHEIGs have pushed them to operate like private academic institutions in another way, by increasing their reliance on IGFs. In this era, higher education is predominantly viewed as a private commodity and much less as a public good. Consequently, as observed by Altbach (2002), a revolution is taking place in African public higher education; it is becoming a traded commodity to be purchased by a consumer, a product to be bought and sold by academic institutions that have changed themselves into 'businesses'.

In Ghana, this period (i.e. 2000 onwards) may be described as the era of marketisation. Marketisation refers to several income-earning strategies that HEIs have adopted. Various descriptors have been coined to depict these strategies, such as privatisation, commercialisation, commodification, academic capitalism

and entrepreneurialism (Clark, 1998; Johnstone, Arora, & Experton, 1998; Marginson & Considine, 2000; Slaughter & Leslie, 1997).

These descriptors could be said to describe various variants of marketisation. In the Ghanaian Higher education sector, it is referred to as IGFs. Marketisation is also understood as a form of higher education privatization, Johnstone, Arora, and Experton, (1998). As Ghanaian public HEIs now compete for resources in a market context, they are forced to adopt practices that are consistent with private business practice. Hence, Ghanaian public HEIs are forced to act as though they are private entities, with a greater orientation to the student as a consumer (customer) and higher education as a 'product' based on higher pricing' and aggressive marketing Johnstone, Arora, and Experton, (1998).

## 2.11 The GetFund

In the year 2000, the Ghana Education Trust Fund (GETFund) was established, which has been described by Effah (2003) as a "landmark" policy in higher education financing. The GETFund was established by an Act of Parliament 581 on August 25, 2000 to generate additional income to support the nation's educational system at all levels particularly at the higher educational levels.

Specifically the GETFund Act 581 2000 outlines that money generated from the fund is anticipated for the following expenditures:

i. To provide financial resources to support all institutions in developing their infrastructural and academic facilities,

ii. To provide additional sources of funds for needy but gifted students through the Ghana Scholarship secretariat in the form of scholarships and grants,

iii. To generate monies to support the student loan scheme for nationally accredited institutions, and

iv. To offer grants to higher education through the NCTE (GETFund Bill 581).

### 2.11.1 Sources of income for the fund

The major sources of the GETFund are derived from 2.5 percent of the Value Added Tax levied on products and incomes, parliamentary appropriations to education, accruals from the fund's investment returns, grants, donations and gift from organizations, and other donors of the fund. (GETFund Bill 581).

### 2.11.2 Management of the Getfund

To effectively manage the fund, a 17-member Board of Trustees was established as follows:

(a) A chairman; (b) one representative of the Ministry of Finance not below the rank of a Director; (c) one representative of religious bodies; (d) the Executive Secretary of the Revenue Agencies (Governing) Board; (e) the Administrator of the Fund; (f) one representative of the Ministry of Education not below the rank of a Director; (g) one representative of the National Council on Tertiary Education; (h) three representatives of the established financial institutions one of whom shall be a woman; (i) one representative of the Universities and Polytechnics in rotation; (j) one representative of the Ghana National Association of Teachers; (k) one representative of the National Union of Ghana Students and Ghana National Union of Polytechnic Students in rotation; (l) one representative

of the Association of Ghana Industries; (m) one other person who is a woman nominated by the National Council on Women and Development; (n) one representative of the Ghana Employers Association; and (o) one representative of the Ghana Education Service Council. (Ghana Education Trust Fund Bill, p.5)

The board of trustees is charged with the responsibilities including policies concerning the goals and objectives of the fund, overseeing the collection of monies for the fund, maintaining and keeping an accounting system, and raising funds and investing monies into productive ventures considered beneficial to the fund (GETFund Act, 2005). Though the GETFund has hugely supported the education sub-sector since it began operating in 2001, its funding to the PHEIGs have been skewed in favour of the public universities. Between 2001 and 2009 polytechnics received 21.56% of GETFund funding while universities received 73.86% of their GETFund funding during the same period, GET Fund Review and Outlook (2009).

## 2.12 The Student Loan Trust

In furtherance of the GOG.s desire to finance HEIs production cost and sponsor the amount of fees to be paid by students in the form of loans, the GOG set up the student loan trust fund in 2005 to serve the interest of students in HEIs in sourcing for loans to pay fees. The student loan trust fund was established in December 2005 under the Trustee Incorporation Act 1962, Act 820. The objectives of the student loan trust fund are to provide financial resources for the sound management of the Trust for the benefit of students and to help promote and facilitate the national ideals enshrined in Article 28 and 38 of the 1992 Constitution.

For the purpose of achieving the objectives of the student loan trust fund, monies from the student loan trust fund shall be applied to the relevant activities that the Trustees of the Fund may determine, including, in particular:

a. The provision of facilities to enhance the tertiary education to support students.

b. The provision of moneys to support any other activities and programmes for the promotion of relevant courses as determined by the Trustees, in consultation with the Minister of Education. The student loan trust fund is governed by a Board of Trustees that comprises of distinguished individuals of relevant backgrounds relevant to the business of student loan trust fund. The members of the board are appointed by the President of the Republic. The day – to – day administration of the student loan trust fund is headed by CEO, assisted by a team of dedicated professionals.

The student loan trust fund also has Campus offices in major tertiary institutions. The functions of these offices include:

a. Provide first stop for student inquiries.

b. Pickup and drop off points for Loan Application forms.

c. Loan Application verification for completeness of forms.

d. Liaise between the student loan trust fund and the loan applicants.

e. Disseminate information to students in a timely manner.

Yusif and Yussof (2010) established a positive correlation between the students loan and university enrolment.

### 2.12.1 Sources of loanable funds

The sources of loanable funds for SLTF include:

a. Monies paid into the Trust Fund representing up to ten percent of all the inflows into the Ghana Education Trust Fund.

b. Voluntary contributions which will be tax deductible.

c. Mobilization of resources from Ghana's international partners interested in the advancement of tertiary education.

d. Contributions from the corporate sector that shall be tax deductible up to the equivalent of 0.5% of the company's actual profit before tax.

e. Loans from Social Security and National Insurance Trust.

### 2.13 Background of Funding PHEIGs

The World Bank (1994) policy paper, which reinforced the Bank's 1988 policy paper earlier unfavourable inclination towards public investment in higher education in Ghana, had really affected PHEIGs funding. The paper asserts that the extent of government involvement in higher education sub- Saharan Africa has far exceeded what is economically efficient' (World Bank, 1994, p. 9). According to this paper, higher education is a burden to public finance.

Thus, the GOG was called upon to adopt policy reforms that would lower public costs of higher education. Girdwood (1999) assert that PHEIGs have received less adequate funding and stable support compared to the Ghanaian pubilc universities. Nyarko (2011) noted that, PHEIGs in 1998 received about 28% of financial funds requested from government. This percentage however increased to 58% in 2000 hovering around this figure for a long time till it

declined to 46% leaving a funding gap of 54% in the 2014 calendar year, NCTE Technical Report (2014).

The GOG funding policies of the PHEIGs to supply the technical manpower needs of the country have been products of a convergence of the dynamics of cost-sharing, commercialisation and IGFs, symptomatic of a global transition from a development paradigm that was predominantly based on Keynesianism to a neo-liberal paradigm that privileges mean expenditure on social services.

There is a continuously decreasing in funding from the Government of Ghana (GOG) the only shareholder of the PHEIGs. In the 2014-2015 calendar year, the PHEIGs were allocated only GH₵ 150, 571, 282 out of a budget request of GH₵325,547,304 leaving a funding gap of 54 percent. With a combined student population of 53,078, the GOG subvention student capita per expenditure is GH₵ 2,836, NCTE Technical Report (2014). To narrow the funding gap, PHEIGS increasingly have had to generate additional funding sources through their efforts and strategies. These additional funding sources they referred to as IGFs. With only 46 percent funding from the GOG in the 2014-2015 calendar year, the PHEIGs have had to operate by increasing their reliance on IGFs.

But as funding from companies, foundations, organisations and alumni rarely comes with strings and as these private organisations efforts to generate more giving increase, PHEIGs will increasingly have to be careful what they ask for as the growing interrelationship between PHEIGs and private funding constituents is likely to lead to whole sets of issues concerning how the goals of the PHEIGs mesh with the goals of the private funding sources. There is however no empirical studies or literature on what the sources of these increasing PHEIGs IGFs are and whether they are additional costs to students or not.

## 2.14 Allocation of Government of Ghana Funding to PHEIGs in Ghana

The GOG have conventionally used variations of the following two allocation mechanisms to allocate public funds to the PHEIGs in Ghana.

### 2.14.1 Negotiated budgets

Negotiations between GOG and PHEIGs are the most conservative way in which the funds for the operations and investment plans of HEIs are allocated to individual institutions. The levels of funding decided through the negotiations process, usually primarily based on historical trends, are then typically distributed to PHEIGs in one of the two following ways:

i) Line-item budgets: the GOG negotiated budgets very often are implemented through line-item allocations to institutions. These line items typically entail relatively rigid restrictions on how institutions can spend the public funds they receive from the GOG or other statutory bodies. The extent to which institutions can switch or reallocate between budget headings in most instances is centrally controlled by the GOG.

ii) Block grants: The GOG providing a single block grant to each Polytechnic is another way that negotiated budgets is implemented. The GOG Block grants tend to give each HEI a more flexibility and autonomy than line-item arrangements in determining how public funds are to be spent.

### 2.14.2 Categorical funds

Categorical funds are another traditional means the GOG used in allocating public funds to PHEIGs. These usually involve the GOG designating or 'earmarking' a particular institution or group of institutions to receive funds for a specific purpose. The GOG categorical or earmarked funds are established in an attempt to correct or ameliorate real or perceived past under-funding for a group of institutions most often characterized by their geographic location or the types of students they serve. For example, Tamale Polytechnic located in the northern Ghana might be deemed by the government as eligible to receive funds to expand infrastructural opportunities for Bachelor of Technology studies. Or institutions that serve large numbers of scientific students might be eligible for grants to upgrade their facilities or laboratory equipment.

Past analysis suggests that categorical funds are best suited for targeting funds on specific institution or groups of institutions with an identified set of needs, particularly for specific physical resources or services such as libraries or laboratories. The GOG distribution of earmarked funds to participating institutions may be accomplished in one of several ways. The allocation may be specified in legislation, based on an assessment of need for the designated activities or services, or based on enrollment or some other formula basis. As a general rule, the GOG categorical funds seem better suited at funding capital investment projects than operational expenditures.

The GOG Categorical fund is also particularly useful to funding activities in which benefits spill over beyond the institution and its students to the broader community. For example the GOG categorical funding built and refurbished old and new

stadia and sporting complexes in some HEIs when Ghana hosted the CAN 2006 football competition. Unfortunately, categorical funds have the disadvantage of only influencing those institutions eligible for funding. Institutions ineligible for the earmark have little or no incentive to improve or address the expressed government priorities since they are not allowed to compete for funds.

### 2.15 Tracer and Gender Earnings Gap of PHEIGs HND Students

Tracer surveys are designed to find a group of individuals who have shared a specific type of training or educational background. They thus provide a basis to explore the impact of a common training or educational experience on labour market outcomes. If carefully designed, they facilitate the collection of richer and more detailed information than generally provided in conventional household or labour force surveys. Psacharopoulos and Loxley (1985); Narman (1992); Bennell and Ncube, (1993, 1994); Mayanja and Nakayiwa (1997) and Kaijage (2000); and Al-samarrai and Reilly (2008) are the very few tracer studies on graduate earnings to have been conducted in Africa. From the tracer studies, earnings equations are derived which also provide policy-makers with important information to guide education policy. In Ghana, there exist no empirical studies and literature on tertiary education graduates in general and on PHEIGs Higher National Diploma (HND) graduates in particular. The PHEIGs have aggressively embarked on an increased HND Programmes in their quest to increasing the supply of middle level manpower needs of the country. As at 2014-2015 calendar year, 97 perecnt of PHEIGs students were enrolled in 31 HND programmes, 2 percent in BTech programmes and the rest in Technician Certificate courses,

NCTE (2014). The NCTE approved HND programmes being run by the PHEIGs in 2014-2015 calendar year are presented in Table 2.1.

**Table 2.1 NCTE Approved HND Programmes Pursued at the PHEIGS in 2014-2015 Calendar Year**

| HND Programmes |
|---|
| 1. Agricultural Engineering<br>2. Civil Engineering<br>3. Electrical/Electronic Engineering<br>4. Building Technology<br>5. Mechanical Engineering<br>6. Oil & Gas Engineering<br>7. Production Engineering<br>8. Renewable Energy Systems Engineering<br>9. Computer Science<br>10. Computer Network Management<br>11. Statistics<br>12. Science Laboratory Technology<br>13. Dispensing Technology<br>14. General Agriculture<br>15. Purchasing & Supply<br>16. Procurement & Logistics Management<br>17. Entrepreneurship & Finance<br>18. Agro Enterprise Development<br>19. Estate Management<br>20. Secretaryship & Management Studies<br>21. Hotel, Catering & Inst. Management<br>22. Hospitality & Tourism Management<br>23. Fashion Design<br>24. Industrial Arts<br>25. Interior Architecture & Furniture Prod.<br>26. Marketing<br>27. Accountancy<br>28. Banking & Finance<br>29. Accounting with Computing<br>30. Entrepreneurship & Finance<br>31. Purchasing and Supply |

**Source: (NCTE, Technical Report Committee, 2014)**

## 2.16 The Gender Earnings Gap Overview

The incidence of gender pay gap is an age old occurrence with Biblical reference as far back as the Old Testament. The occurrence of gender pay gap is mentioned in the Old Testament, with the worth of females evaluated as three-fifths the worth of males as:

"Set the value of a male between the ages of twenty and sixty at fifty shekels of silver, according to the sanctuary shekel, and if it is a female set her value at thirty shekels" (Leviticus, 27: 2-4, NIV).

Empirical evidence abounds that shows that gender earnings gap exists in in both the developed and developing countries. Grey-Bowen and McFarlane (2010) posit that gender discrimination in earnings is in part, cultural stemming from the belief that men are superior to women in terms of skills, leadership and managerial abilities.

Beginning with Becker (1957) labour discrimination model, discrimination in earnings due to discriminatory tastes of employers, co-workers, or customers have been well documented in the social studies literature (Oaxaca (1973), Blinder (1973) Mincer (1974), Mincer and Polachek (1974), Date-Baah (1986), Wright and Ermish, (1990), Blau and Ferber (1991), Terrell (1992), Anker (1997), Mandel and Shalev (2009), Ashraf and Ashraf (1988), Ermisch Josh and Wright (1990), Terrell, (1992), Weeder, (1998), Gupta (2002), Francois (1996), Harkness (1996), Nor (1998), Glick and Sahn (1997), Machado and Mata (2005), Bren and Garcia-Penalosa. (2002), Barbezeat (1987), Schafgans (1997), Katz (1973), Singh and Bhattarcherjee (1998) Stephen (1998), Weeder (1998), Blau and Kahn (2003), Ashraf and Ashraf (1988), Schafgans, (1997), Bren and Garcia-Penalosa (2002), Liu (2004), Solberg (2005), Newell and Reilly (2001), Pham and

Reilly (2007), Katz (1973), Johnson and Stafford (1974), Gordon, Morton and Braden (1974), Gordon, Morton and Braden (1974), Hoffman (1976), Benjamin (1999), Ward (2001), Benjamin (2004), Okpara, Squillace and Erondu (2005), The European Union (2012), Long, Allison, and McGinnis (1993), McNabb and Wass (1997), Monks and McGoldrick, (2004), Takahashi and Takahashi (2011), Takahashi and Takahashi (2015).

Weichselbaumer and Winter-Ebmer (2005) performed a meta-analysis of more than 260 studies on the international gender earnings gap, finding that in samples consisting of low-wage jobs, the wage gap was higher than that found in samples comprising university graduates.

## 2.17 The Global Gender Gap Report

With renewed interest in the gender earnings gap globally in the 21st century, social researchers began to compile and submit the Global Gender Gap Report. The Global Gender Gap Report was first published in 2006 by the World Economic Forum. The Global Gender Gap Index (2015) ranks 145 economies according to how well they are leveraging their female talent pool, based on economic, educational, health-based and political indicators. With a decade of data, this edition of the Global Gender Gap Report (2015) shows that while the world has made progress overall, stubborn inequalities remain.

An index or score of 1 indicates equality. Out of the 145 countries sampled, Iceland ranked first, with an index of 0.881, followed by Norway, with a score of 0.850 and Finland with a score of 0.850 in the third place. A number of countries in Africa fare relatively well in the 2015 report. This is largely due to

the participation of females in the workforce. Through these economic activities, African women have had greater access to income and economic decision-making. Unfortunately though, they are often presented in low-skilled and low paid sectors of the economy, Addai (2011).

Rwanda is the only African country that falls within the first 10 ranked countries at the sixth position with a score of 0.794. Namibia with an index of 0.760 ranked sixteenth out of the 145 countries followed by South Africa with an index of 0.759 ranking seventeenth out of the 145 countries. Ghana scored 0.704 to place sixty-third out of the 145 countries, The Global Gender Gap Report (2015). Research on gender earnings gap in Ghana is relatively a very new area of social research commencing with the work of Addai (2011), followed by Baah-Boateng (2012).

## 2.18 Meta Regression Analysis

Meta Regression Analysis (MRA) is an approach used in meta-analysis. It is an insightful methodology for literature reviewing, especially in Social Studies (SS) where control and experimental groups requiring comprehensive meta-analysis are often not pursued, Stanley and Jarell (1989). For this reason, this SS thesis study also adopted the MRA methodology for reviewing the literature on the multi-product costs, productivity and efficiency, sources of IGFs and HND graduates gender earnings gap of the PHEIGs. MRA's design allows for the control of biases found in non-experimental SS.

The steps in conducting an MRA involves: a) searching and documenting all relevant studies, b) choosing the summary statistic for the dependent variable,

c) selecting meta-independent variables pertaining to the study design and conduct, d) carrying out the MRA and finally e) conducting specification tests, Stanley (2001).

The study MRA searched for the existing literature and systematic reviews on the subject matters. The keywords chosen are "economies of scale" "scope", "cost structure", "productivity and efficiency", "internally generated funds" "tracer studies" "gender earnings gap". The keywords used in combination with the terms were "polytechnics in Ghana", "polytechnics in Africa", "higher education institutions in Ghana,", "higher education institutions in Africa", "tertiary institutions in Ghana", and "tertiary institutions in Africa". The study then searched for all relevant published empirical articles, books, book chapters during the period 1980 -2016.

The following library stocks, electronic databases and search engines were searched: Accra Polytechnic library stock, Kumasi Polytechnic library stock, Takoradi Polytechnic library stock, Ho Polytechnic library stock, Cape Coast Polytechnic library stock, Tamale Polytechnic library stock, Koforidua Polytechnic library stock, Sunyani Polytechnic library stock, Wa Polytechnic library stock, Bolgatanga Polytechnic library stock, University of Education, Winneba, library stock, Kwame Nkrumah University of Science and Technology library stock, University of Ghana library stock, University of Cape Coast library stock, University of Development Studies library stock, Commonwealth Association of Polytechnics in Africa (CAPA), APA, AJOL, Africa Economic and Research Consortium (AERC), NCTE, Institute of Statistical and Social Research, Ghana (ISSER), ERIC, PsycINFO, Science Direct, SAGE's online database, JSTOR, Social Science Research Network, Center for International

Higher Education Economic Papers, Wiley, Taylor and Francis, Springer, Google Scholar and the Google search engine. The 280 research papers publications and 83 policy briefs publications at the AERC yielded no results on Polytechnic Institutions (PI) in Ghana. All the rest searched also yielded no results on the multi-product costs analysis of PHEIGs, productivity and efficiency of PHEIGs, sources of PHEIGs IGFs and tracer and gender earnings gap of PHEIGs HND graduates.

## 2.19 The Research Gap

In the literature of analysing the multi-output costs, productivity and efficiency of HEIs, enough knowledge as suggested by Cohn, Rhine and Santos (1989) and Färe, and Zhang (1997) respectively are voluminous in the developed countries. On the other hand, empirical knowledge of analysing the multiproduct costs and productivity and efficiency in HEIs, in the context of developing countries is very meager, Hinchliffe (1985). No empirical work however, has been conducted on the multi-product costs structure, productivity and efficiency of PHEIGs in Ghana and this study fills the research gaps and pioneer studies to empirically research on these themes.

A plethora of research has been conducted on dwindling public (Government) funding of higher education in Africa, but very few on the sources of IGFs funding of higher education in Africa and not a single one has been conducted to empirically examine what constitutes the sources of PHEIGs IGFs funding to the best of the authors knowledge in Ghana. The study therefore

bridges this research gap and pioneers an empirical study into what constitutes the sources of PHEIGs IGFs funding.

Beginning with Becker (1957) labour discrimination model, discrimination in earnings due to discriminatory tastes of employers, co-workers, or customers have been well documented in the SS literature. But very few empirical studies of labour market discrimination exist on Ghana. The empirical evidence on labour market outcomes in Ghana is limited. The GOG and individuals invest heavily in education and training, but little is generally known about the extent to which these investments generate rewards in the labour market. This study narrows the research gap by empirically examining and pioneers a research in Ghana using data collected from the 2013 HNDs graduates tracer survey to determine whether or not there exists a gender earnings gap among cohorts who have shared a specific type of training or educational background in the Ghanaian labour market.

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.1 Introduction

This Chapter provides the research design, techniques and procedures and equipment used in both data collection and analysis. It also deals with the description and distribution of instruments of the studies.

## 3.2 Research Design

Research design refers to the overall strategy that is utilised to integrate the different components of the study in a coherent and logical form in order to address the research questions. It constitutes the blue print for collection, measurement and analysis of data.

### 3.2.1 Data sources

The study utilised PHEIGs secondary panel data comprising a sample size of 50 spanning five calendar years (2010-2011 to 2014-2015) obtained from the NCTE for the scale and scope economies and the productivities efficiencies studies. These studies used the total PHEIGs recurrent expenditure comprising:

i) The 2010-2011 to 2014-2015 calendar years total faculty and non-academic staff salaries and fringe benefits otherwise refer to as compensation.

ii) The 2010-2011 to 2014-2015 calendar years annual books and research expenditure.

iii) The 2010-2011 to 2014-2015 calendar years annual Technician programme full-time student enrolments, HND programme full-time-student enrolments and the BTech programme full-time-student enrolments.

Full-time-student (FTE) enrolment has been the most common measure used for teaching output and an essential contributor to institutional costs (Cohn, *et al.* 1989; de Groot, McMahon, & Volkwein, 1991). Again there was not an up-to-date data at the NCTE on some Polytechnics (Wa, Bolgatanga Sunyani) graduating students during the 2014-2015 year that will enable using graduating students as outputs.

A secondary PHEIGs 2014-2015 calendar year cross-section data comprising 24 items obtained from the NCTE and an 8 primary items designed by the researcher are used to explore how the PHEIGs uses IGFs to bridge their funding gap. The PHEIGs sources of IGFs were documented and examined to ascertain how much was generated as IGFs on institutional basis and the amalgamated PHEIGs IGFs generated for the 2014-2015 calendar year. A survey questionnaire administered is analyse to explore the perception of PHEIGs Students, Administrators and Lecturers on whether PHEIGs sources of IGFs generated are additional costs to students or not from a purposive non-probable sample size of 70. A Lecturer for the purpose of the study is defined as a full-time continuing staff who have earned at least a Master's degree, who both teach and research in their relevant field of endeavour, and are of Lecturer to Professorial status' in PHEIGs and a student for the purpose of the study is also defined as a person pursuing any of Technician,

HND, or BTech programmes of study, while an Administrator for the purpose of the study is also defined as a full-time employee in an Administrative capacity comprising those from Administrative Assistant to the Registrar category at the PHEIGs.

Designed survey data was gathered for the PHEIGs 2013 HND graduates tracer gender earnings gap quasi-experimental studies from a purposeful sample of 120 respondents. Bryman (2008) argues that purposive sampling is part of convenience sampling, where the researcher gets into contact with respondents and uses those respondents who are knowledgeable regarding the subject matter under discussion. Purposive sampling as a non-probability sampling has attracted a lot of attention in the current SS research activities. Purposive sampling techniques involve selecting certain units or cases based on a specific purpose rather than randomly doing a selection, (Tashakkori and Teddlie, 2003, p. 713). Creswell (2014) posits that it is always rational for an interviewer to identify the respondents through the application of a purposive sampling technique.

### 3.2.2 Survey instrumentation procedure

Survey questionnaires were considered because of the economy of the design and the rapid turnaround in data collection. Identified 10 HND students from each Polytechnic Institution administered 3 (generated 30) questionnaires to students, 2 to administrators (generated 20) and 2 to Lecturers (generated 20) from January-April 2016 and 10 final year University of Education, Winneba (UEW) Department of Accounting and Management Studies Education internship students each having internship studies in each of the ten regions of Ghana

administered 12 survey questionnaires each (generated 120) on the PHEIGs 2013 HND graduates from September-December 2015.

### 3.2.3 Possible data and designed problems

A number of potential problem areas emerge relative to the data and design of the scale and scope and productivities efficiencies studies. Although the PHEIGs are organized as HEIs with similar objectives and outputs in Ghana, Polytechnics located in the metropolitan cities of Accra, Kumasi, Tamale and Takoradi generally have higher residential Lecturers and students demand. This comes about as a result of a larger population pool, and the attractiveness of social and cultural environments in large cities and the metropolis in Ghana, even if they might not have a higher quality of teaching or research compared with other Polytechnic Institutions in municipalities like Sunyani, Wa, Bogatanga, Ho, Koforidua and Cape Coast and this phenomenon might cause bias in interpreting data. In addition to the teaching and research products of PHEIGs, they also have outcomes in public service and outreach activities. Ideally, the study would have liked to have some index or proxy for the public service produced by the PHEIGs, but data is not available and not captured by the NCTE. As a consequence, the model did not account for public services rendered by the PHEIGs.

### 3.2.4 Ethical consideration

The ethical dimension of a research that uses human subjects or information on them is very crucial. Individuals or institutions whose information

are involved in the study demand respect in terms of values and beliefs and anything else that may be considered unethical to them and the research in general. In view of this, seeking consent was considered very important prior to the start of the study. The University of Education, Winneba (UEW), Research Policy (2011) document was duly studied and its content applied in gathering the data.

### 3.3 PHEIGs Scale and Scope Economies Study Methodology

Examining empirically the PHEIGs scale and scope economies the study addresses three methodological questions in the form of:

(i) What is an appropriate functional form for the cost equation?

(ii) How can economies/diseconomies of scale and of scope be quantified in a multiproduct context?

(iii) And what is the appropriate estimating technique to use?

#### 3.3.1 Functional form

A cost function is an equation that allows costs ($C$) to be evaluated, given information about the level of output being produced by an organisation and information about the price (or quality) of the organisation's inputs. This is written for a Polytechnic institution $k$ as:

$$C_k = f(y_{ik}, w_{lk}) \qquad [3.1]$$

Where $y_{ik}$,= output i of Polytechnic $k$ (i =1,….$n$; $k$=$1$,.....$K$) and $w_{lk}$ is the price of input $l$ ($l$ = 1, …$m$) used in a Polytechnic institution $k$.

A linear cost function is unable to model PHEIGs economies/diseconomies of scope (or synergy) that are due to joint production. Thus more sophisticated PHEIGs cost functions must be hypothesised by the study, and they should be capable of:

(i) Explaining how economies of scope can occur for some output profiles, yet diseconomies of scope can occur for other output profiles.

(ii) Ensuring that estimates of costs are sensible under conditions where a firm produces positive quantities of some output types, but zero amounts of other outputs.

Baumol, Panzar and Willig (1982) pioneered the invention of a comprehensive set of cost analysis methods for multiproduct organizations, pointing out the three most frequently used functions: the flexible quadratic, constant elasticity of substitution and hybrid translog cost functions. These methods have been applied in research works in banking, transportation, public facilities, telecommunication, health care, and many other multiproduct organizations.

Baumol, Panzar and Willig (1982) proposed the three types of multiproduct cost functional forms as:

**3.3.1.1 The constant elasticity of substitution (CES) cost function**

$$C_k = \alpha_0 + \left[\sum_i \beta_i y_{ik}^{\delta i}\right]^{\rho} + v_k \qquad [3.2]$$

Where $y_{ik}$ is as in [3.1], $\alpha_0$, $\delta_i$ and $\rho$ are parameters to be estimated, and $v_k$ is an error term.

### 3.3.1.2 The flexible quadratic cost function (FQCF)

$$C_k = a_0 + \sum_i a_i F_{ik} + \sum_i b_i y_{ik} + (1/2)\sum_i \sum_j c_{ij} y_{ik} y_{jk} + v_k \qquad [3.3]$$

Where $y_{ik}$ is as in [3.1], $a_o, a_i, b_i$ and $c_{ij}$ are coefficients to be estimated, and $F_{ik}$ is a dummy variable such that $F_{ik}$=1 if output *i* in PHEIGs *k* is positive, and zero otherwise.

Cohn, Rhine and Santos (1989) barely 27 years ago paved the way by applying the FQCF set of analysis method to the study of HEIs outputs by investigating the economies of scale and scope of US public and private HEIs.

Since that time, the majority of empirical studies on the economies of scale and scope of HEIs so far have adopted the flexible quadratic cost function (Lewis & Dundar, 1995; Koshal & Koshal, 2001; Laband & Lentz, 2003; Sav, 2004, 2011; Cesar, 2006; Hou, Li, & Min, 2009). Again, Mayo (1984) and Baumol *et al.,* (1988) strongly recommend the use of a quadratic cost function for estimating scale and scope economies for most types of multi-product organizations. They argued that it comply most closely with the required features of a multi-product function, (Baumol *et al.,* 1988, p.453).

### 3.3.1.3 The hybrid translog cost function (HTCF)

$$\ln C_k = \alpha_0 + \sum_l \alpha_l \ln(w_{lk}) + \sum_i \beta_i [(y_{ik}^{\vartheta} - 1)/\vartheta] + \frac{1}{2}\sum_l \sum_m \gamma lm \ln w_l \ln w_m + \frac{1}{2}\sum_l \sum_j \delta_{ij} [(y_{ik}^{\vartheta} - 1)/\vartheta][(y_{jk}^{\vartheta} - 1)/\vartheta] + \sum_l \sum_i \rho li \ln w_l [(y_{ik}^{\vartheta} - 1)/\vartheta] + v_k \qquad [3.4]$$

where $y_{ik}, w_{lk}$ are as above in [3.1] and $v_k$ are as above in [3.3], and the Greek letters are all parameters to be estimated. The HTCF does not contain terms in the logarithm of $y$ variables, and so long as the estimated value of $\vartheta$ is not precisely zero, it is therefore possible to use this functional form to evaluate costs when some $y$ are zero. Undeniably, the HTCF is highly-non-linear just as the CES and are estimated by maximum likelihood. But the the FQCF is estimated rather by the conventional ordinary least squares (OLS) method.

The purpose of this study is to empirically examine the PHEIGs outputs scale and scope economies rather than to compare the advantages and disadvantages of the various functions mentioned above. In the light of this point, the study adopts the FQCF to empirically examine the PHEIGs outputs economies/diseconomies of scale and scope due to its wider application among researchers.

### 3.3.2 Estimation technique

The final methodological issue which is addressed by the PHEIGs scale and scope economies study concerns the technique of estimation**.** In the present case there are observations on PHEIGs over *t* time periods, and so an appropriate technique for panel data estimation is employed. The main focus of modelling panel data is how to model the heterogeneity across observations. The panel data estimation techniques of fixed effects (FE) and random effects (RE) approaches are applied to the panel dataset. The FE approach allows the unobserved individual effects to be correlated with the included explanatory variables.

The study uses the FQCF form in order to estimate a multiproduct cost function for the PHEIGs.

The FQCF of the PHEIGs scale and scope economies study is characterised as follows:

$$\ln TC = \beta + \sum_{p=1}^{4} \alpha_p \ln Q_p + \alpha_5 (\ln Q_1)^2 + \alpha_6 (\ln Q_2)^2 + \alpha_7 (\ln Q_3)^2 + \alpha_8 (\ln Q_4)^2 + \alpha_9 (\ln Q_1)(\ln Q_2) + \alpha_{10} (\ln Q_1)(\ln Q_3) + \alpha_{11} (\ln Q_1)(\ln Q_4) + \alpha_{12} (\ln Q_2)(\ln Q_3) + \alpha_{13} (\ln Q_2)(\ln Q_4) + \alpha_{14} (\ln Q_3)(\ln Q_4) + \varepsilon \quad [3.5]$$

where, ln$TC$ is the total institutional gross recurring cost of all N products for the kth institution in the tth time period, that is cost incurred by PHEIGS authorities for one calendar year and excludes all capital cost, i.e. costs that spill over two or three years or more; $Q_p$ denotes Technician teaching outputs, HND teaching outputs, BTech teaching outputs and research outputs. ln denotes natural logarithm. And β is the intercept, α are coefficients of respective variables to be estimated. and ε denotes random error term. The study uses the log–log form of the cost function by transforming the cost function into natural logarithm format for two reasons. First, the probability distribution of the variables in panel dataset is not normal and in order to have consistent coefficients, the study imposes normality on the data prior to analysis. Again, a log-log function is very interesting for interpretation, as it takes into account very small changes in the model. In addition, it generates a perfect estimate rather than an ordinary form of a function, Wooldridge (2000). In such a functional format, usually zero values of any variables turn out to be a problem under such a circumstance and following Wooldridge (2000) Mamun (2012), the study transform the zero value into one before taking natural logarithm of the values. STATA 12 statistical data analysis software is used to estimate the panel data model and all statistical calculation. STATA 12 takes care of the unbalanced nature of panel data and the study did not provide any special treatment for it. The study collects data for five-calendar-year

period. For the panel data, homogeneity of output is indicated by the similarity of goals in teaching and research as espoused by the NCTE, though there might be perceived differences in output quality. Koshal and Koshal's (1999), Mamun (2012) studies suggests for necessary adjustment for outputs for quality variations among the institutions, a refinement that the study did not pursue for lack of data and defined parameters by the NCTE.

In the empirical work to follow [3.5] is amended as follows for the FE Model:

$$\ln TC_{it} = \beta_i + \sum_{p=1}^{4} \alpha_p \ln Q_{it} + \alpha_5 (\ln Q_1)_{it}^{\ 2} + \alpha_6 (\ln Q_2)_{it}^{\ 2} + \alpha_7 (\ln Q_3)_{it}^{\ 2} + \alpha_8 (\ln Q_4)_{it}^{\ 2} + \alpha_9 (\ln Q_1)(\ln Q_2)_{it} + \alpha_{10} (\ln Q_1)(\ln Q_3)_{it} + \alpha_{11} (\ln Q_1)(\ln Q_4)_{it} + \alpha_{12} (\ln Q_2)(\ln Q_3)_{it} + \alpha_{13} (\ln Q_2)(\ln Q_4)_{it} + \alpha_{14} (\ln Q_3)(\ln Q_4)_{it} + \mu_k + \omega_{kt}$$

[3.6]

The revision of [3.5] under FE splits the error term into $\mu_k$ the part that varies by polytechnic but not over time and $\omega_{kt}$ the usual pure random variation.

And under the RE model, equation [3.5] is amended as follows:

$$\ln TC_{it} = \beta + \sum_{p=1}^{4} \alpha_p \ln Q_{it} + \alpha_5 (\ln Q_1)_{it}^{\ 2} + \alpha_6 (\ln Q_2)_{it}^{\ 2} + \alpha_7 (\ln Q_3)_{it}^{\ 2} + \alpha_8 (\ln Q_4)_{it}^{\ 2} + \alpha_9 (\ln Q_1)(\ln Q_2)_{it} + \alpha_{10} (\ln Q_1)(\ln Q_3)_{it} + \alpha_{11} (\ln Q_1)(\ln Q_4)_{it} + \alpha_{12} (\ln Q_2)(\ln Q_3)_{it} + \alpha_{13} (\ln Q_2)(\ln Q_4)_{it} + \alpha_{14} (\ln Q_3)(\ln Q_4)_{it} + \varepsilon_{it}$$

[3.7]

It is instructive to speculate on the nature of the omitted factors that this study potentially controlled for. There may be Polytechnic level differences in the allocation of GOG subvention resources, internally generated fund, the quality, location and layout of Polytechnic infrastructure, the quality of managerial and administrative skills, making production technology in a particular polytechnic institution highly flexible, the quality of students admitted in terms of good grades

obtained during the senior high school examinations all of which in the context of the within-fixed-effect model, are assumed fixed over time but which rather the study assumes them to be random.

### 3.4 Average Incremental Cost Specification

Following Baumol *et al*., (1988), Hashimoto and Cohn (1990), Sav (2011), Koshal and Koshal, (2001) the average incremental cost (AIC) for the PHEIGs Technician or non-certificated output is specified as:

$$\text{AIC}_{TN} = \frac{C\{S_{TN}, S_{HND}, S_{BT}, S_R\} - C\{0, S_{HND}, S_{BT}, S_R\}}{S_{TN}} \qquad [3.8]$$

Where $C\{S_{TN}, S_{HND}, S_{BT}, S_R\}$ is the total cost of instruction of producing $S_{TN}$ units of Technician students, $S_{HND}$ units of HND and $S_{BT}$ units of BTech students, and $S_R$ of Research outputs. $C\{0, S_{HND}, S_{BT}, S_R\}$ is the total cost of instruction when Technician output is zero.

The average incremental cost (AIC) for PHEIGs HND output is specified as:

$$\text{AIC}_{HND} = \frac{C\{S_{TN}, S_{HND}, S_{BT}, S_R\} - C\{S_{TN}, 0, S_{BT}, S_R\}}{S_{HND}} \qquad [3.9]$$

Where $C\{S_{TN}, S_{HND}, S_{BT}, S_R\}$ is the total cost of instruction of producing $S_{TN}$ units of Technician students, $S_{HND}$ units of HND and $S_{BT}$ units of BTech students, and $S_R$ of Research outputs. $C\{S_{TN}, 0, S_{BT}, S_R\}$ is the total cost of instruction when HND output is zero.

The average incremental cost (AIC) for PHEIGs Bachelor of Technology output or programme is specified as:

$$\text{AIC}_{BT} = \frac{C\{S_{TN}, S_{HND}, S_{BT}, S_R\} - C\{S_{TN}, S_{HND}, 0, S_R\}}{S_{BT}} \quad [3.10]$$

Where $C\{S_{TN}, S_{HND}, S_{BT}, S_R\}$ is the total cost of instruction of producing $S_{TN}$ units of Technician students, $S_{HND}$ units of HND, $SBT$ units of BTech students, and $S_R$ units of Research outputs. $C\{S_{TN}, S_{HND}, 0, S_R\}$ is the total cost of instruction when BTech output is zero.

The average incremental cost (AIC) for PHEIGs Research output is specified as:

$$\text{AIC}_{R} = \frac{C\{S_{TN}, S_{HND}, S_{BT}, S_R\} - C\{S_{TN}, S_{HND}, S_{BT}, 0\}}{S_R} \quad [3.11]$$

Where $C\{S_{TN}, S_{HND}, S_{BT}, S_R\}$ is the total cost of instruction of producing $S_{TN}$ units of Technician students, $S_{HND}$ units of HND, $SBT$ units of BTech students, and $S_R$ units of Research outputs. $C\{S_{TN}, S_{HND}, S_{BT}, 0\}$ is the total cost of instruction when Research output is zero.

Similar to the case of a single product, the economies of scale are measured by the ratio of the average to the marginal costs. Economies of scale are said to exist if this ratio is greater than one. The product-specific economies of scale for PHEIGs product (Technician) $S_{TN}$ is defined as:

$$E_{TN} = \frac{\text{AIC}_{TN}}{\text{MC}_{TN}} \quad [3.12]$$

Where $MC_{TN}$ is the marginal cost of producing product $S_{TN}$ and $MC_{TN} = \partial TC/\partial S_{TN,}$ Hoenack, Weiler, Goodman, and Pierro (1986). If $E_{TN}$ is greater or (less than one), economies or (diseconomies) of scale are said to exist for the product $S_{TN.}$ And the product-specific economies of scale for product (HND) $S_{HND}$ is defined as:

$$E_{HND} = \frac{\text{AIC}_{HND}}{\text{MC}_{HND}} \qquad [3.13]$$

Where $MC_{HND}$ is the marginal cost of producing product $S_{HND}$ and $MC_{HND} = \partial TC/\partial S_{HND.}$

Again, the product-specific economies of scale for the BTech programme $S_{BT}$ is defined as:

$$E_{BT} = \frac{\text{AIC}_{BT}}{\text{MC}_{BT}} \qquad [3.14]$$

And the product-specific economies of scale for Research output $S_R$ is defined as:

$$E_R = \frac{\text{AIC}_R}{\text{MC}_R} \qquad [3.15]$$

### 3.5 Ray Economies of Scale Specification

Ray (overall) economies of scale ($E_{RAY}$) exists when the expansion of all outputs leads to economies of scale and are defined as follows:

$$E_{RAY} = \frac{C\{S_{TN}, S_{HND}, S_{BT}, S_R\}}{S_{TN}MC_{TN} + S_{HND}MC_{HND} + S_{BT}MC_{BT} + S_RMC_R} \quad [3.16]$$

Ray economies (diseconomies) of scale are said to exist when $E_{\text{Ray}}$ is greater (less) than one.

### 3.6 Economies of Scope Specification

In the production process, economies of scope exist when they are cost efficiencies to be gained by joint production of multiple products rather than engaging in separate production. From Baumol, *et al.* (1988), Hashimoto and Cohn (1997), Dundar and Lewis (1995), Koshal and Koshal (1999), Lenton (2008), economies of scope are divided into global and product specific economies of scope.

#### 3.6.1 Global economies of scope specification

The degree of global economies of scope (GES) in the production of all products is defined as:

$$GES = \frac{C\{S_{TN}\,0,0,0\} + C\{0, S_{HND}, 0, 0\} + C\{0,0, S_{BT}, 0\} + C\{0,0,0, S_R\} - C\{S_{TN}, S_{HND}, S_{BT,} S_R\}}{C\{S_{TN}, S_{HND}, S_{BT}, S_R\}} \quad [3.17]$$

or following Worthington and Higgs (2011)

$$GES(y_i) = \frac{\sum_{i=1}^{4} c(y_i) - c(y)}{c(y)} \quad [3.18]$$

Global economies (diseconomies) of scope exists if GES is greater (less) than zero. Thus, economies of scope identify the existence of synergies between outputs.

### 3.6.2 Product-specific economies of scope specification

Cost advantages due to production of each product jointly with the other outputs are referred to as product-specific economies of scope (PSE). The determinations of PSEs for the various programmes or products are specified as follows:

$$PSE_{TN} = \frac{C\{S_{TN},0,0,0\} + C\{0,S_{HND},S_{BT},S_R\} - C\{S_{TN},S_{HND},S_{BT},S_R\}}{C\{S_{TN},S_{HND},S_{BT},S_R\}} \quad [3.19]$$

$$PSE_{HND} = \frac{C\{0,S_{HND},0,0\} + C\{S_{TN},0,S_{BT},S_R\} - C\{S_{TN},S_{HND},S_{BT},S_R\}}{C\{S_{TN},S_{HND},S_{BT},S_R\}} \quad [3.20]$$

$$PSE_{BT} = \frac{C\{0,0,S_{BT},0\} + C\{S_{TN},S_{HND},0,S_R\} - C\{S_{TN},S_{HND},S_{BT},S_R\}}{C\{S_{TN},S_{HND},S_{BT},S_R\}} \quad [3.21]$$

$$PSE_{R} = \frac{C\{0,0,0,S_R\} + C\{S_{TN},S_{HND},S_{BT},0\} - C\{S_{TN},S_{HND},S_{BT},S_R\}}{C\{S_{TN},S_{HND},S_{BT},S_R\}} \quad [3.22]$$

Product-specific economies (diseconomies) of scope associated with programme or products $S_{TN}$, $S_{HND,}$ $S_{BT}$ and $S_R$ is said to exist if the $PSE_{TN}$, $PSE_{HND}$ , $PSE_{BT}$ and $PSE_R$ is greater (less) than zero respectively.

### 3.7 Cost Complementarities

For the total cost (TC) function as already formulated, the estimated mean value of cross marginal cost (CMC) are defined as follows:

$$CMC_{TNHND} = \frac{\partial^2(TC)}{\partial S_{TN}\partial_{HND}} \quad CMC_{TNBT} = \frac{\partial^2(TC)}{\partial S_{TN}\partial_{BT}} \quad CMC_{BTHND} = \frac{\partial^2(TC)}{\partial S_{BT}\partial_{HND}}$$

$$CMC_{BTHND} = \frac{\partial^2(TC)}{\partial S_{BT}\partial_{R}} \qquad [3.23]$$

The values of $CMC_{TNHND}$, $CMC_{TNBT}$, $CMC_{BTHND}$ etc. are the cross-marginal products given by the coefficients of the corresponding interaction terms. If the sign $C_{ij}$ is negative, then cost complementarity is implied; that is there are positive effects of joint production between products i and j.

### 3.8 Description and Definition of PHEIGs Scale and Scope Economies Study Variables

Table 3.1 presents the description and definitions of the variables used in generating the PHEIGs scale and scope economies.

**Table 3.1 Definition of Variables Used for PHEIGs Scale and Scope Economies Study**

| Variables | Definition |
|---|---|
| poly1 | Accra Polytechnic Institution |
| poly2 | Kumasi Institution |
| poly3 | Takoradi Polytechnic Institution |
| poly4 | Ho Polytechnic Institution |
| poly5 | Cape Coast Institution |
| poly6 | Tamale Polytechnic Institution |
| poly7 | Sunyani Polytechnic Institution |
| poly8 | Koforidua Polytechnic Institution |
| poly9 | Wa Polytechnic Institution |
| poly10 | Bolgatanga Institution |
| *lnTC* (Dependent Variable) | Natural log of total cost (Compensation and recurrent expenditure) of PHEIGs for 2010-2011 to 2014-2015 |

| | |
|---|---|
| | calendar years in '000 of Ghana cedis |
| reschlog | Natural log of total book and research expenditure in '000 of Ghana cedis |
| Certlog | Natural log of Technician FTE student numbers |
| hndlog | Natural log of HND FTE student numbers |
| Btechlog | Natural log of BTech FTE student numbers |
| certlog2 | Natural log of certlog squared |
| hndlog2 | Natural log of hndlog squared |
| btechlog2 | Natural log of btech squared |
| reschlog2 | Natural log reschlog squared |
| rescert | certlog x reschlog |
| reshnd | reschlog x hndlog |
| resbtech | reschlog x btechlog |
| certbtech | Certlog x btechlog |
| certhnd | certlog x hndlog |
| hndbtech | hndlog x btechlog |

### 3.9 Data Envelopment Analysis (DEA) Methodology

Examining what the public Polytechnic Higher Education Institutions in Ghana (PHEIGs) Total Factor Productivity Changes and Technical Efficiencies are, the Data Envelopment Analysis (DEA) and the Malmquist Productivity Index (MPI) methodologies are used to examine their (PHEIGs) Total Factor Productivity Changes and Technical Efficiencies. The DEA methodology used as a cross-section data study is first is used to analyse the PHEIGs productive efficiency and inefficiency scores, followed by the use of the MPI to examine the PHEIGs Total Factor Productivity Changes and Technical Efficiencies. The DEA and the MPI methodologies considers the PHEIGs Research expenditure as an input, as espoused by Worthington and Higgs (2011) and is added to their total cost to produce their Technician, HND, BTech multiple outputs.

The Data Envelopment Analysis (DEA), under the assumption of a constant technology is used to analyse the PHEIGs productive efficiency and inefficiency scores. DEA is a non-parametric noise-free linear programming

method for assessing the efficiency and productivity of decision making units (DMUs) such as PHEIGs. DEA is a method for measuring efficiency of DMUs using linear programming techniques to envelop observed input-output vectors as tightly as possible by allowing multiple inputs-outputs to be considered at the same time without any assumption on data distribution. In each case, efficiency is measured in terms of a proportional change in inputs or outputs. The model can be subdivided into input-oriented model which minimizes inputs while satisfying at least the given output levels and output-oriented model which maximizes outputs without requiring more of any of the observed input values.

DEA models can also be subdivided in term of returns to scale by adding weight constraints. Charnes, Cooper, and Rhodes (1978) originally proposed the efficiency measurement of constant returns to scale (CRS) where all DMUs are operating at their optimal scale. Banker, Charnes, and Cooper (1984) later on, introduced the variable returns to scale (VRS) measurement model allowing the breakdown of VRS into technical and scale efficiencies in DEA.

It also makes it possible to identify the most productive scale size (MPSS) at which a DMU could operate. DEA in the present application can yield specific information about targets and benchmarks for each DMU in turn which can be used to examine savings in cost or outputs augmentations for the PHEIGs as a whole or at specific Polytechnic Institutions under alternative paths or priorities for efficiency and productivity gains.

By estimating efficiencies under both CRS and VRS models, it is possible to determine the scale efficiency for a DMU. The scale efficiency score for an individual DMU can be simply calculated as a ratio of its efficiency score under the CRS model to that under the VRS model. The scale efficiency of a DMU

measures the extent to which a DMU can lower its cost by changing its scale size to the most productive scale size.

It is noted that the DEA estimates of efficient levels of costs or outputs are relative rather than absolute. That is to mean that each time it takes the full set of PHEIGs, it identifies a benchmark Polytechnic Institution that offers the lowest total operating cost for their mix and absolute levels of output. Those DMUs that are not on the frontier have scope for efficiency savings relative to the benchmarks. Benchmark DMUs themselves may have a scope for efficiency savings relative to some unknown absolute standards.

The unknown absolute standards is a drawback of the DEA model as there are no suitable comparators for an efficient DMU mix of outputs and/or scale size. But the DEA has the added advantage of identifying a DMU as inefficient and the benchmarks will clearly indicate why that unit is considered inefficient.

Distance functions can be estimated using parametric or non-parametric techniques. The former can create specification errors by virtue of the assumptions the researcher makes regarding particular functional forms for the production function, and because of a specific statistical distribution of the efficiencies.

This study therefore prefers to take a non-parametric approach in investigating PHEIGs productivity. PHEIGs produce many outputs from their resources in which case programming techniques have to be used to identify the piecewise linear frontier joining up all efficient DMUs. If DMUs (PHEIGs) use $m$ inputs to produce $s$ outputs.

Under input-oriented DEA VRS, the following linear programming is specified.

Minimise $\theta_k$ [3.24]

Subject to

$$y_{rk} - \sum_{j=1}^{n} \lambda_j y_{rj} \leq 0 \qquad r = 1,\ldots\ldots,s$$

$$\theta_k x_{jk} - \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0 \qquad i = 1,\ldots\ldots,m$$

$$\sum_{j=1}^{n} \lambda_j = 1, \lambda_j \geq 0, \forall j = 1,\ldots,s$$

Further scale efficiency can be identified by calculating the following ratio for DMU *k*:

$$SCE_k = \frac{E_{k,CRS}}{E_{k,VRS}}, \qquad [3.25]$$

Where the numerator and denominator include efficiency scores calculated under CRS and VRS, respectively.

The CRS efficiency score is simply calculated by deleting the constraint $\sum_{j=1}^{n} \lambda_j = 1$ from [3.24].

Overall input-oriented efficiency of DMU *k* is measured by $E_k = \theta_k$

Lee and Ji (2012) Stata written user command is used to analyse and generate the efficiency scores for [3.24] and [3.25].

### 3.10 Description and Definition of PHEIGs DEA Study Variables

For the PHEIGs DEA empirical study, outputs are specified in terms of FTE of Technician, HND and BTech students as exogenously fixed and the study attempts to estimate the minimum cost at which a Polytechnic Institution could

have handled the output levels that it did have. It is generally expected that PHEIGs as HEIs is expected to produce an output involving the provision of advice and services to business and regional development, the storage and preservation of knowledge and the provision of a source of independent comment on public issues, Verry and Layard (1975), there exist no published data and study could not consider that as an output.

The definition of variables used in the PHEIGs DEA study is presented in Table 3.2.

**Table 3.2 Definition of Variables Used in the PHEIGs DEA Analysis**

| Type of variable | Variable | Description |
|---|---|---|
| **Inputs:** | TopCost | PHEIGs Total 2014-2015 calendar year operating cost (compensation) in millions of Ghana Cedis |
| | BRAL | PHEIGs Total Book and Research Allowances for 2014-2015 calendar year in millions of Ghana Cedis |
| **Outputs:** | TECHn | *FTE Technician Students for 2014-2015 calendar year |
| | HNDs | FTE Higher National Diploma Students for 2015 calendar year |
| | BTECHs | FTE Bachelor of Technology Students for 2014-2015 calendar year |
| **DMUs:** | A | Accra Polytechnic Institution of Higher Education |
| | K | Kumasi Polytechnic Institution of Higher Education |
| | T | Takoradi Polytechnic Institution of Higher Education |
| | H | Ho Polytechnic Institution of Higher Education |
| | C | Cape Coast Polytechnic Institution of Higher Education |
| | Ta | Tamale Polytechnic Institution of Higher Education |
| | S | Sunyani Polytechnic Institution of Higher Education |
| | KD | Koforidua Polytechnic Institution of Higher Education |
| | W | Wa Polytechnic Institution of Higher Education |

| | | |
|---|---|---|
| | B | Bolgatanga Polytechnic Institution of Higher Education |

*FTE = (Full-Time-Equivalence)

### 3.11 The Malmquist Productivity Index (MPI)

The Malmquist productivity index MPI was introduced as a theoretical index by Caves, Christensen and Diewert (1982). The MPI using DEA frontier suggested by Färe, Grosskopf, Norris, and Zhang (1994), and Färe, and Zhang (1997) is the most prevalent MPI method to measure the productivity changes. MPI measures the productivity changes along with time variations and can be decomposed into changes in efficiency and technology with DEA like nonparametric approach.

Productivity decomposition into technical change and efficiency catch-up necessitates the use of a contemporaneous version of the data and the time variants of technology in the study period. The MPI can be expressed in terms of distance function (E) as Equation [3.26] and Equation [3.27] using the observations at time t and t+1.

$$MPI_I^t = E_I^t\left(\frac{x^{t+1}, y^{t+1})}{E_I^t(x^t, y^t)}\right) \qquad [3.26]$$

$$MPI_I^{t+1} = E_I^{t+1}\left(\frac{x^{t+1}, y^{t+1})}{E_I^{t+1}(x^t, y^t)}\right) \qquad [3.27]$$

Where $I$ denotes the orientation of MPI model.

The geometric mean of two MPI in Equation [3.26] and Equation [3.27] gives the Equation

[3.28].

$$MPI_I^G = (MPI_I^t MPI_I^{t+1})^{1/2} = [E_I^{t+1}(\frac{x^{t+1}, y^{t+1})}{E_I^{t+1}(x^t, y^t)} \cdot [E_I^t(\frac{x^t, y^t)}{E_I^{t+1}(x^t, y^t)}) \cdot (E_I^t(\frac{x^{t+1}, y^{t+1})}{E_I^{t+1}(x^t, y^t)})]^{1/2}$$

The input oriented geometric mean of MPI pursued by this study can be decomposed using the concept of input oriented technical change (techch) and input oriented efficiency change (effch) is given in Equation [3.29].

$$MPI_I^G = (effch_I^t) \cdot (techch_I^G) = E_I^{t+1}(\frac{x^{t+1}, y^{t+1})}{E_I^{t+1}(x^t, y^t)}) \cdot [E_I^{t+1}(\frac{x^{t+1}, y^{t+1})}{E_I^{t+1}(x^t, y^t)} \cdot E_I^{t+1}(\frac{x^{t+1}, y^{t+1})}{E_I^{t+1}(x^t, y^t)})]^{1/2}$$

[3.29]

The component (*effch*) measures the change in efficiency, and shows whether the DMUs are getting closer to their production frontiers over time, implying that Polytechnic education providers are using existing resources more efficiently. Examples of how this might occur include increases in managerial or teaching efficiency, such as teaching students in larger groups.

The component (techch) measures change in technology efficiency over the period, and indicates whether the production frontier is shifting outwards over time. Examples may include different ways of teaching, such as e-learning. A value greater than unity will indicate a positive total factor productivity (TFP) growth from period t to t +1.

By utilising VRS DEA frontiers to estimate the distance functions in Equation [3.29], the technical efficiency can be decomposed into scale efficiency and pure technical efficiency components. A scale efficiency change (sech) is given in [3.30].

$$\sec h = [E^{t+1}_{VRS}(\frac{x^{t+1}, y^{t+1}) / E^{t+1}_{CRS}(x^{t+1}, y^{t+1})}{E^{t+1}_{VRS}(x^{t}, y^{t}) / E^{t+1}_{CRS}(x^{t}, y^{t})}) \cdot E^{t+1}_{VRS}(\frac{x^{t+1}, y^{t+1}) / E^{t+1}_{CRS}(x^{t+1}, y^{t+1})}{E^{t}_{VRS}(x^{t}, y^{t}) / E^{t}_{CRS}(x^{t}, y^{t})})]^{1/2}$$

[3.30]

And a pure efficiency change (pech) is given in [3.31].

$$E^{t+1}_{VRS}(\frac{x^{t+1}, y^{t+1})}{E^{t+1}_{CRS}(x^{t}, y^{t})})$$

[3.31].

The MPI input oriented approach assumes that firms aim to minimise costs from a given level of outputs. In the case of PHEIGs, inputs such as compensation and BRA are determined by the GOG from which they target to minimise costs. For that reason an input oriented perspective is pursued for this study.

### 3.12 Definition of Variables Used for the PHEIGs MPI Study

The definition of the variables used for the PHEIGs empirical MPI examination for the 2010-2011 to 2014-2015 calendar years are presented in Table 3.3.

**Table 3.3 Definitions of Variables Used for the PHEIGs MPI Analysis**

| Type of variable | Variable | Description |
|---|---|---|
| **Input** | TOTALCOST | Total 2010-2011 to 2014-2015 calendar years operating cost (Compensation and Book and Research Allowances) in millions of Ghana Cedis |
| **Outputs:** | TECHn | FTE Technician Students for 2010-2011 to 2014-2015 calendar years |
| | HNDs | FTE Higher National Diploma Students for 2011-2015 calendar years |
| | BTECHs | FTE Bachelor of Technology Students for 2010-2011 to 2014-2015 calendar years |
| **DMUs:** | A | Accra Polytechnic Institution of Higher Education |
| | K | Kumasi Polytechnic Institution of |

| | | |
|---|---|---|
| | | Higher Education |
| | T | Takoradi Polytechnic Institution of Higher Education |
| | H | Ho Polytechnic Institution of Higher Education |
| | C | Cape Coast Polytechnic Institution of Higher Education |
| | Ta | Tamale Polytechnic Institution of Higher Education |
| | S | Sunyani Polytechnic Institution of Higher Education |
| | KD | Koforidua Polytechnic Institution of Higher Education |
| | W | Wa Polytechnic Institution of Higher Education |
| | B | Bolgatanga Polytechnic Institution of Higher Education |
| acayear 2010<br>acayear 2011<br>acayear 2012<br>acayear 2013<br>acayear 2014 | | = 2010-2011 calendar Year<br>= 2011-2012 calendar Year<br>= 2012-2013 calendar Year<br>= 2013-2014 calendar Year<br>= 2014-2015 calendar Year |
| tfpch | | total factor productivity change |
| effch | | input oriented efficiency change |
| techch | | input oriented technical change |
| pech | | pure efficiency change |
| sech | | scale efficiency |

### 3.13 The Pragmatic Worldview

The Pragmatic worldview or Pragmatism underpins the studies of the PHEIGs IGF sources and the 2013 PHEIGs HND graduates tracer survey. In SS, worldview refers to a basic set of beliefs that guide action, Guba (1990, p. 17). It could also be referred to as paradigms (Lincoln, Lynham, & Guba, 2011; Mertens, 2010); epistemologies and ontologies (Crotty, 1998), or a broadly conceived research methodologies, (Neuman, 2009). The Pragmatist worldview

derives from the work of Peirce, James, Mead, and Dewey, Cherryholmes (1992). Other pragmatic worldview writers include Murphy (1990), Patton (2002), and Rorty (1990). Instead of focusing on methods, the Pragmatist worldview researchers emphasise the research problem and use all approaches available to understand the problem. As a philosophical underpinning for mixed methods studies, Morgan (2007), Patton (2002), and Tashakkori and Teddlie (2010) convey its importance as focusing attention on the research problem and using pluralistic approaches to derive knowledge about the problem. Pragmatism is not committed to any one system of philosophy and reality and applies mixed methods by liberally relying on both quantitative and qualitative assumptions when a researcher is engage in research. Individual pragmatic researchers have a freedom of choice. In this way, pragmatic researchers are free to choose the methods, techniques, and procedures of research that best meet their needs and purposes. Thus, for the pragmatic mixed methods researcher, it opens the door to multiple methods, different worldviews, and different assumptions, as well as different forms of data collection and analysis, Creswell (2014).

### 3.14 The PHEIGs Sources of IGF Study Document Analysis

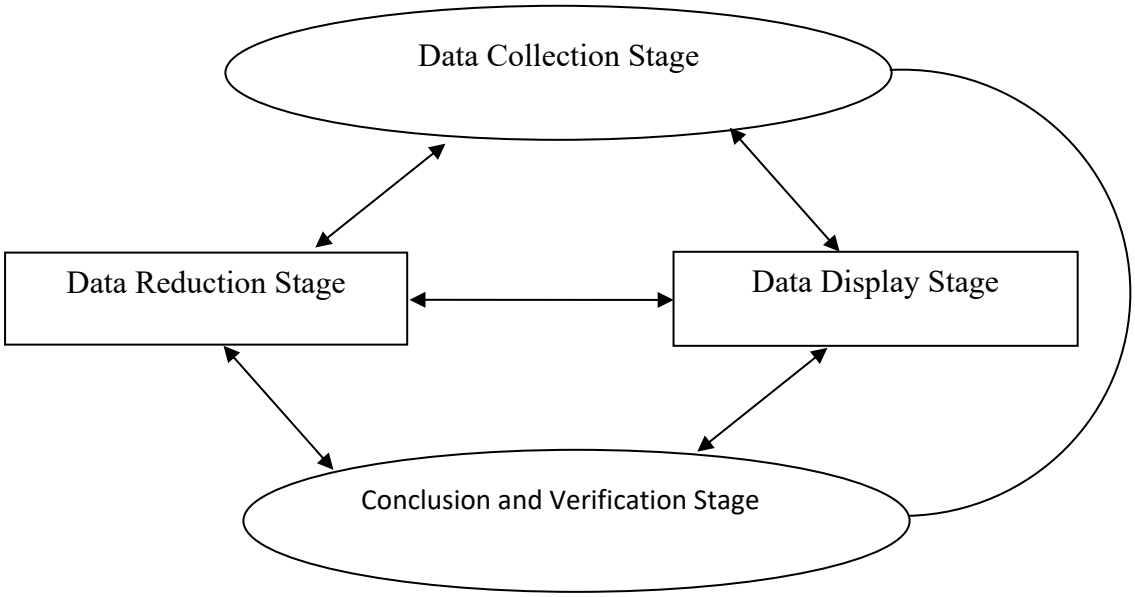
In examining how the public Polytechnic Higher Education Institutions in Ghana (PHEIGs) bridge their funding gap and do the strategies they initiate constitute a burden to students for the 2014-2015 calendar year used document analysis and data analytic framework methodologies.

Document analysis as tools for analysing the sources of PHEIGs IGFs for the 2014-2015 calendar year. In order to evaluate the quality of a document Scott (1990) stressed four outlines. The first is that material being examined must be authentic. Authenticity of the material stressed on the genuine nature of the documents. The credibility of the document is the second outline. Is the document free from error and distortions he queried? The third outline is the representativeness. The document being examined must be representative of the sample. Lastly, the document must be meaningful and fit for the purpose. The data obtained from the NCTE examined meet all this criteria.

### 3.14.1 PHEIGs IGFs data analytic framework

Data analysis is one of the components of pragmatic research. A careful utilisation of the necessary data analysis techniques not only affects the results of the study but also reveals how the researcher is able to blend and weave the tons of information acquired in the entire research process. The methodological approach offered by Miles and Huberman (1994) data analysis framework as adapted by Linacre (1995) is utilised in the data collection stage to data analysis and conclusion drawing stage of this study. This methodological approach is presented in Figure 3.1.

**Figure 3.1 Miles and Huberman Data Analysis Model**




### 3.14.2 The data reduction stage

The volumes of and the quality of information acquired could make data analysis threatening and overwhelming. A complete reduction of information makes the data more manageable and meaningful for interpretation. Data reduction, the first element advocated by Miles and Huberman framework (1994 p.10) refers to the process of selecting, focusing, simplifying, abstracting, and transforming the data that appear in written up field notes or transcriptions.

For the purpose of manageability, I condensed the information through a careful process of deduction and inductions taking into account the research questions and emerging ideas and themes. This process provided me with the opportunity to make meaningful interpretation and focused the data to the research theme. In doing this I also distilled the different views and perspectives expressed by the respondents about what constitute an IGF and whether it

constitutes additional cost to the students or not. By so doing, the litany of pages of interviews gathered are reduced to a short examinable report.

### 3.14.3 The data display stage

The next step is the data display stage. This involves a careful and systematic approach of categorising data, linking data, and connecting categories. After creating and assigning categories, I refine the data with the identified themes and topics relevant to the research. I make a flow chart to map out the critical paths, major points and issues, and supporting institutional documents and evidence that emerge from the various Polytechnic Institutions and cross comparisons. Glaser and Strauss (1967) refer to this process as the 'method of constant comparison, an intellectually disciplined process of comparing and contrasting across instances to establish significant patterns and themes.

### 3.14.4 The conclusion and verification stage

Here I reflect on the analysed data and their implication to the study questions and policies in particular. At the same time I undertake cross comparison which is necessary to establish the truthfulness of the data in connection to answering the research questions and in relations to available documents and reports.

This process of verification helped to establish credibility in the analysed data obtained from the variegated perspectives of respondents. I analysed the variations of views of the different groups. For instance, those of the Polytechnic administrators were compared with the Lecturers and student and vice versa.

Different and conflicting opinions expressed on what constitute an IGF for instance were considered in a comparative manner. In doing so and to establish a corroborative and replication evidence to establish the reliability in analysing the information and data received, the STATA 12 data and statistical analysis programming syntax and estimates obtained are also provided in the Appendix.

### 3.15 Definition of PHEIGs IGFs Study Variables

The description of the variables used in the PHEIGs IGFs study are presented and defined in Table 3.4

**Table 3.4 Definition of Variables Used as Sources of PHEIGs IGFs for the 2014-2015 Calendar Year**

| | |
|---|---|
| afuf | = Academic User Facility Fee Generated |
| tufess | = Tuition Fees Generated |
| rentstaff | = Rent Proceeds From Staff Generated |
| nabtreg | = Nabptex Registration Fees Generated |
| introlet | = Proceeds from issuance of Introductory Letters Generated |
| appforms | = Sale of Admission Application Forms Generated |
| idcards | = Issuance of Students ID Card Fees Generated |
| regfess | = Students and Club Registration Fees Generated |
| admfees | = Admission Fees Generated |
| hostfees | = Students Hostel Fees Generated |
| tracertret | = Students Transcripts, Certificates, and Results Collection Payments |
| attest | = Attestation of Students Fee Generated |
| examsfee | = Examination Fees |
| icts | = ICT Applications Fees Generated |

| | |
|---|---|
| sportfees | = Student Sporting Fees Generated |
| invescom | = Investments Income Generated |
| usepolyfac | = Use of Polytechnic Facilities Payments Generated |
| medfac | = Medical Facility Fees Generated |
| libryfac | = Provision of Library Services Fees Generated |
| indsattch | = Students Industrial Attachment Fees |
| tendoc | = Tender Documents from Contractors/Suppliers Fees Generated |
| matricus | = Matriculation Ceremonies Fees Generated |
| congreg | = Congregation Ceremonies Fees Generated |
| othersors | = Other Incomes Generated |
| markfacresh | = Marketing of Faculty Research works Generated |
| intresfund | = Internal Research Funds through Proposals Writing Generated |
| regfund | = Regional Funding from Municipal/Metropolis/Regional Assemblies Generated |
| liscenpat | = Licensing Income From Patents Generated |
| finorgcorp | = Financial Donations of Organisations. Companies, Corporations Generated |
| alumnfin | = Alumni Financial Donations Generated |
| parklot | = IGFs from tolling and parking of cars at the PHEIGs |
| shortprov | = IGFs from the provision of short courses and competency based skills lasting minimum of two weeks and a maximum of one month duration |
| apttution | = 0 if apart from tuition fees generated, Lecturers do enjoy a share of IGFs =1 otherwise |

### 3.16 PHEIGs 2013 HND Graduates Tracer Earnings Methodology

In exploring what the determinants of the public Polytechnic Higher Education Institutions in Ghana (PHEIGs) 2013 HND graduates gender earnings gap are the Interval Regression Model (IRM) tracer survey

methodology is used to estimate the earnings and the Oaxaca (1973) decomposition model is used to determine the gender earnings gap estimate.

Al-Samarrai and Barry (2008) used the IRM in a tracer earnings study in Tanzania and this section draws heavily on their methodology.

In order to elicit monthly earnings responses that are less prone to measurement error respondents were asked of where their gross monthly earnings were located within a number of mutually exclusive categories. The intervals used for the sampled PHEIGs 2013 HND graduates in the labour market commence at less than 400 Ghana Cedis and rise by amounts of 100 Ghana Cedis for the nine intervals. The penultimate interval is 1,000 to GH₵ 1,100 and the final interval is open-ended and captures those PHEIGs 2013 HND graduates with earnings greater than GH₵ 1,100. There are thus nine coded intervals for the case of PHEIGs 2013 HND graduates.

The interval-coded nature of the responses for the dependent variable requires a maximum likelihood procedure. The appropriate likelihood function is a modification of that used in the estimation of the standard ordered probit model and replaces the unknown threshold values by the set of known values that delineate the intervals Stewart (1983). In illustrating how the IRM is implemented, responses are coded 1,2,…..,9 to capture the eight distinct earnings categories in our application for the 2013 PHEIGs HND graduates. Letting $y_i$ denote the observable ordinal variable coded in this way and letting $y_i^*$ denote an underlying variable that captures the earnings of the $i^{th}$ individual. This can be expressed as a linear function of a vector of explanatory variables ($\mathbf{x}_i$) using the following relationship:

$$y_i^* = \mathbf{x}_i'\boldsymbol{\beta} + u_i \qquad \text{where } u_i \sim N(0, \sigma^2) \qquad [3.32]$$

It is assumed that $y_i^*$ is related to the observable ordinal variable $y_i$ as follows:

$y_i = 1$ if $-\infty < y_i^* < a_1$

$y_i = 2$ if $a_1 \leq y_i^* < a_2$

$y_i = 3$ if $a_2 \leq y_i^* < a_3$

$y_i = 4$ if $a_3 \leq y_i^* < a_4$

$y_i = 5$ if $a_4 \leq y_i^* < a_5$

$y_i = 6$ if $a_5 \leq y_i^* < a_6$

$y_i = 7$ if $a_6 \leq y_i^* < a_7$

$y_i = 8$ if $a_7 \leq y_i^* < a_8$

$y_i = 9$ if $a_8 \leq y_i^* < +\infty$

where the $a_j$ for j=1,…9 denote the interval boundaries. Following Stewart (1983), the first and the last intervals are treated as open-ended in this case so for j=0, $\Phi(a_j) = \Phi(-\infty) = 0$ and for j=9, $\Phi(a_j) = \Phi(+\infty) = 1$, where $\Phi(\cdot)$ denotes the cumulative distribution function (CDF) for the standard normal.

The exact knowledge of the thresholds allows the likelihood function to be specified in a fairly straightforward manner. The variable $y_i^*$ is best interpreted not as a latent measure but one with a quantitative interpretation. In implementing the procedure the standard normal assumption conventionally invoked for the ordered probit model is replaced by the assumption that $y_i^* | \mathbf{x}_i \sim N(\mathbf{x}_i'\boldsymbol{\beta}, \sigma^2)$. This then allows specification of the log likelihood function as follows:

$$L = \sum_{j=0}^{J} \sum_{y_i=j} \log_e[\Phi(\frac{a_j - \mathbf{x}_i'\boldsymbol{\beta}}{\sigma}) - \Phi(\frac{a_{j-1} - \mathbf{x}_i'\boldsymbol{\beta}}{\sigma})] \qquad [3.32.1]$$

where the first summation operator sums across individuals within the given j category and $\log_e(\cdot)$ denotes the natural logarithmic operator. The maximum likelihood procedure involves the estimation of the $\boldsymbol{\beta}$ parameter vector and the ancillary parameter $\sigma$, the standard error of the regression model. Given that the introduction of the known thresholds fixes the scale of the dependent variable, the estimated coefficients are amenable to a direct OLS-type interpretation.

Given an interest in estimating an earnings equation within the established Mincer (1974) tradition, the thresholds used in the log-likelihood function [3.32.1] are based on the natural logarithms of the reported thresholds. Thus, in the context of

the PHEIGs 2013 HND graduates specification, $a_1 = \log_e(400)$ and $a_3 = \log(600)$, and so forth.

### 3.17 Designing PHEIGs 2013 HND Graduates Gender Earnings Gap

Defining the PHEIGs 2013 HND graduates labour market monthly earnings as W the study denote $W_m$ and $W_f$ as male and female labour market monthly earnings respectively. A common measure in SS used to summarise the female position in the labour market is the ratio of average female market monthly earnings to its average male counterpart. This is usually expressed as:

$$\frac{\overline{W}_f}{\overline{W}_m} \qquad [3.33]$$

where the bars denote the average. This gives the fraction of the average male market monthly earnings earned by women and is extensively used as a rough descriptive measure of female labour market disadvantage. The reciprocal of this expression, however, forms the basis for the development of the more conventional 'discrimination' measure used and is defined in SS as:

$$\frac{\overline{W}_m}{\overline{W}_f} \qquad [3.34]$$

The SS literature of labour market discrimination, primarily motivated by the work of Becker (1957) defines the labour market discrimination coefficient (MDC) as:

$$MDC = \frac{W_m - W_f}{W_f} \times 100 \qquad [3.35]$$

This gives the percentage 'mark-up' of male over female earnings. Viewing the male earnings as a 'mark-up' on the female wage is generally the dominant

approach used by social scientists. The use of natural logarithms allows for the computation of an average gender 'mark-up' ($\overline{D}$) as follows:

$$\overline{D} = \overline{\ln(W_m)} - \overline{\ln(W_f)} \qquad [3.36]$$

The difference in the natural logarithms reflects a log point differential, which can be taken to approximate a percentage difference in earnings between the two gender groups. Taking the anti-log of $\overline{D}$, subtracting one and multiply by 100, gives the percentage 'mark-up' of male over female wages.

The fundamental problem in SS with using any of the expressions [3.33], [3.34] is that, although they may provide an estimate of the gender earnings gap, they provide no basis for the isolation of that part of the gap that is not attributable to gender differences in the level of productivity characteristics. This component is the one of most interest to social scientists and policy-makers as it informs on unequal earnings treatment across gender groups.

### 3.17.1 The average *ceteris paribus* gender earnings gap

In order to capture more effectively gender earnings effects, it is useful to control for differences in productivity or other variables that may exist between gender groups. This requirement demands use of statistical analysis that allows for controlling (or holding constant) other factors, while exploring the effect of the relevant characteristic (i.e., gender) on the variable of interest (i.e., the monthly earnings). The other factors held constant are usually measured characteristics like educational level or labour force experience. Following from the seminal work on human capital by Mincer (1974), it has become conventional

for social scientists to specify a relationship between the natural logarithm of earnings and a set of earnings determining characteristics.

Defining w as the natural logarithm of W the monthly earnings equation is specify as:

$$w = X'\beta + \delta G + e \qquad [3.37]$$

Where X is a (n × k) matrix of productivity and other characteristics (e.g., education and labour force experience), and G is a binary control for gender adopting a value of one if the PHEIGs 2013 HND graduate is male and zero otherwise. β is a (k × 1) vector of unknown parameters representing the effects of the various productivity variables on the natural earnings (w) and e is a (n × 1) vector of random error terms.

The framework described in [3.37] can be used to obtain an average estimate for the adjusted gender pay gap. Denoting the OLS estimates for β and δ as $\hat{\boldsymbol{\beta}}$ and $\hat{\delta}$ respectively, equation [3.37] is re-written as:

$$\hat{w} = X'\hat{\boldsymbol{\beta}} + \hat{\delta} G$$

Equation [3.37] is sometimes referred to as a pooled equation (i.e., an equation that pools together data points for both males and females). The *ceteris paribus* gender earnings gap could be written as:

$$D^A = [\hat{w} \mid X, G = 1] - [\hat{w} \mid X, G = 0] = \hat{\delta} \qquad [3.38]$$

In other words, controlling for the variables contained in X, the estimated OLS coefficient on the gender variable (G), provides an average estimate of the

PHEIGs 2013 HND male graduate (relative to female) earnings advantage in the labour market. This is construed by some researchers as informing on the degree of labour market earnings 'discrimination'. The percentage 'mark-up' in male earnings can be obtained by using the following transformation:

$\exp[\hat{\delta}] - 1]\times 100$. This transformation is used when the dependent variable is expressed in natural logarithms and the explanatory variable is a dummy (1/0) measure. where $\exp[\cdot]$ denotes the exponent or anti-logarithm. Any difference between $\overline{D}$ and $\hat{\delta}$ is therefore attributable to the productivity and other measured characteristics contained in X. The $\hat{\delta}$ simply reflects a parallel shifting upwards of the regression line (or plane). In other words, the only part of the estimated relationship allowed to change through the inclusion of a gender variable in this analysis is the estimated intercept term. It may well be the case that the effects of education and labour force experience on earnings also differ across gender group and this restrictive approach, therefore, fails to capture these potentially important differential effects.

### 3.17. 2 The Oaxaca decomposition

The constraint imposed by using a pooled relationship prompted extensive use of separate regression models for male and female. In adopting the separation approach, identical male and female equations of the following form are specified:

$$w_m = X_m'\beta_m + e_m \qquad [3.38]$$

$$w_f = X_f'\beta_f + e_f \qquad [3.39]$$

In this case the subscripts m and f denote PHEIGs 2013 HND male graduates and female graduates respectively. An important property of the OLS procedure is that the regression line (or regression plane) passes through the means of the data making the above expressions to be re-written as:

$$\overline{w}_m = \overline{X}_m'\hat{\beta}_m \qquad [3.38']$$

$$\overline{w}_f = \overline{X}_f'\hat{\beta}_f \qquad [3.39']$$

And re-write [3.36] as:

$$\overline{\ln(W_m)} - \overline{\ln(W_f)} = \overline{w}_m - \overline{w}_f$$
$$= \overline{X}_m'\hat{\beta}_m - \overline{X}_f'\hat{\beta}_f$$

After some algebraic manipulation gives the Oaxaca (1973, 1984) decomposition as:

$$= [\overline{X}_m - \overline{X}_f]'\hat{\beta}_m + \overline{X}_f'[\hat{\beta}_m - \hat{\beta}_f] \qquad [3.40]$$

This allows the overall average differential in earnings between the two gender groups to be decomposed into a part attributable to differences in measured characteristics (as evaluated at the male returns) and a part attributable to differences in the estimated relationship between men and women (i.e., the gender differences in returns) evaluated at the mean set of female characteristics. These two components have been referred to as the 'explained' and 'unexplained' components respectively, with the 'unexplained' component also referred to as the 'residual' component, Addai (2011). They are also classified respectively as the 'endowment' and 'treatment' effects, and these terms are now more in common usage in SS.

The latter part of expression [3.40] provides average estimate of the gender earnings gap adjusted for measured characteristics. It is taken by many

social scientists to capture the effect of discrimination in the labour market. Expressing the last part of expression [3.40] as:

$$\Delta_U = \overline{\mathbf{X}}_f'[\hat{\boldsymbol{\beta}}_m - \hat{\boldsymbol{\beta}}_f] \qquad [3.41]$$

makes the Oaxaca decomposition model to be commonly referred to as the 'index number' model given its similarity to the calculation of index numbers in the field of social statistics. Expanding [3.41] further gives:

$$\Delta_U = \overline{\mathbf{X}}_f'\hat{\boldsymbol{\beta}}_m - \overline{\mathbf{X}}_f'\hat{\boldsymbol{\beta}}_f \qquad [3.42]$$

In this case, the study weighs the 'basket' of average PHEIGs 2013 HND female graduates characteristics ($\overline{\mathbf{X}}_f$) by the PHEIGs 2013 HND male graduates prices for these characteristics as determined in the labour market, and then weighting the same 'basket' or qualification by the PHEIGs 2013 HND female graduates prices for these characteristics as determined in the labour market. The difference between the two provides an indication of the 'mark-up' or earnings advantage secured by PHEIGs 2013 HND male graduates in the labour market relative to females possessing the same 'basket' of characteristics or qualification. The percentage 'mark-up' can then be calculated as:

$$[\exp[\Delta_U] - 1] \times 100. \qquad [3.43]$$

where exp[·] again denotes the exponent or anti-logarithm.

In estimating the PHEIGs 2013 HND graduates gender monthly earnings gap, the male graduates monthly earnings structure is used as the base. PHEIGs 2013 HND graduate, for purpose of this study is defined as an alumnus of PHEIGs who graduated in 2013 with at least a pass or first class in an HND Programme.

### 3.17.3 The PHEIGs 2013 HND graduates tracer study Oaxaca decomposition model OLS regression specification

The Oaxaca Decomposition Model OLS estimation regression model of the following form is specified to estimate the PHEIGs 2013 HND graduates gender monthly earnings gap:

$$lnearns_i = \alpha_0 + \alpha\ gender_i + \alpha_2 sector_i + \alpha_3\ midlevel_i + \alpha_4 age_i + \alpha_5 age2_i + \alpha_5 marired_i + \alpha_6 acchnd_i + \alpha_7 regnat i + \mu_i$$

Where $i = 1, \ldots..96$, and $\mu_i$ is an error term.

### 3.18 Definitions of Variables for PHEIGs 2013 HND Graduates Tracer Survey

Table 3.5 presents the description and definitions of the variables used in the PHEIGs sampled 2013 HND graduates tracer survey.

**Table 3.5 Definition of Variables Used in PHEIGs Sample 2013 HND Graduates Tracer Survey**

| Earnings value | Corresponding Earnings Intervals |
|---|---|
| 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9 | Monthly Earnings < GH₵ 400<br>400 ≤ Monthly Earnings < GH₵ 500<br>500 ≤ Monthly Earnings GH₵ 600<br>600 ≤ Monthly Earnings GH₵ 700<br>700 ≤ Monthly Earnings GH₵ 800<br>800 ≤ Monthly Earnings GH₵ 900<br>900 ≤ Monthly Earnings GH₵ 1,000<br>1,000 ≤ Monthly Earnings GH₵ 1,100<br>Monthly Earnings ≥ GH₵1,100 |
| lnearns | Natural log of monthly earnings |
| gender | = 1 if respondent is male, = 0 if female |
| sector | =1 if respondent works in the informal sector =0 otherwise |
| midlevel | =1 if respondent is in a middle level employment, =0 otherwise |
| age | = Age of respondent |

| | |
|---|---|
| age2 | = Age of respondent squared |
| marired | =1 if respondent is married =0 otherwise |
| acchnd | =1 if respondent holds HND in Accountancy =0 otherwise |
| regnat | =1 if respondent is from the region =0 otherwise |
| newinsti | = 1 if respondent will pursue post-HND studies at PHEIGs, = 0 otherwise |

The STATA 12 and 14 data and statistical analysis softwares are used in generating the statistical estimates.

# CHAPTER FOUR

# RESULTS AND DISCUSSIONS

## 4.1 Introduction

This chapter identifies, interprets and discuss the significant and novel findings of the studies. The discussion highlights the major findings of the study and the inferences made from them in view of findings of related previous studies.

The descriptive statistics of the PHEIGs scale and scope economies of their multiple outputs are presented in Table 4.1.

**Table 4.1 Descriptive Statistics of FQCF Variables**

| Variables | Mean | SD | Min | Max |
|---|---|---|---|---|
| costlog (Dependent Variable) | 15.76273 | .7947613 | 12.93071 | 17.11187 |
| reschlog | 13.15023 | .5664654 | 12.05495 | 14.27549 |
| certlog | 2.262434 | 3.008647 | 0 | 7.780721 |
| hndlog | 8.167444 | .9787961 | 3.258096 | 9.176267 |
| Btechlog | 2.620537 | 2.358975 | 0 | 6.111467 |
| certlog2 | 13.98952 | 21.09103 | 0 | 60.53962 |
| hndlog2 | 67.64602 | 13.6283 | 10.61519 | 84.20387 |
| btechlog2 | 12.32068 | 12.43407 | 0 | 37.35003 |
| reschlog2 | 173.2431 | 14.88647 | 145.3219 | 203.7897 |
| rescert | 30.50071 | 40.56125 | 0 | 106.8675 |
| reshnd | 107.6951 | 15.78278 | 42.70861 | 127.948 |
| resbtech | 35.16 | 32.03634 | 0 | 86.68546 |
| certbtech | 6.716348 | 11.56813 | 0 | 40.8033 |
| certhnd | 18.70285 | 25.13446 | 0 | 68.74012 |
| hndbtech | 22.43641 | 20.51622 | 0 | 54.77337 |

*There are zero output in the data. Before taking logarithm, all zero values were changed to 1. Total number of observations ($n$) =50.

The PHEIGs FQCF FE and RE regression estimates are presented in Table 4.2

**Table 4.2 PHEIGs FQCF FE and RE Regression Estimates**

| **Variable** | **Fixed Effects Model** | | **Random Effects Model** | |
|---|---|---|---|---|
| | Coefficients | (*t*-value) | Coefficients | (*z*-value) |
| certlog | -.681458 | (-0.98) | -1.206116 | (-2.02) |
| hndlog | -4.82051 | (-1.04) | -9.351505 | (-2.62) |
| btechlog | 1.2224 | (1.24) | .4640843 | (0.64) |
| reschlog | 8.758469 | (1.04 ) | 18.04828 | (2.99) |
| certlog2 | .0318796 | (2.13) | .0234635 | (1.94) |
| hndlog2 | -.0089525 | (-0.05) | .023868 | (0.21) |
| btechlog2 | -.0357721 | (-1.13) | -.0015988 | (-0.07) |
| reschlog2 | -.3929465 | (-0.92) | -.8559361 | (-2.88) |
| rescert | .0220247 | (0.29) | .069178 | (1.19) |
| reshnd | .363615 | (0.90) | .681403 | (2.30) |
| resbtech | .0616021 | (0.76) | .0817721 | (1.07) |
| certbtech | -.0067686 | (-0.51) | -.011532 | (-1.30) |
| certhnd | .0190747 | (0.20) | .0149765 | (0.21) |
| hndbtech | -.2050546 | (-1.99) | -.1719884 | (-2.75) |
| $R^2$<br>Overall<br>Within<br>Between | <br>0.8694<br>0.9150<br>0.8694 | | <br>0.9239<br>0.9016<br>0.9734 | |
| Intercept | -30.73575 | (-0.68) | -72.03667 | (-2.20) |
| sigma_u | .2343558 | | 0 | |
| sigma_e | .26028217 | | .26028217 | |
| rho | .44772876 | (fraction of variance due to u_i) | | |

The FE model in Table 4.2 exhibits that the log of Technician output squared variable *certlog2* is statistically significant at 5% level of significance, but the remaining variables are not. The study test the statistical significance of the four output variables with their square terms and their interaction terms altogether. The test results show that:

```
F( 14,     26) =   19.98
          Prob > F =    0.0000
```

It implies that the logs of all the independent variables in the FE are statistically different from zero collectively. The coefficient estimates of BTech (*btechlog*) and research (*reschlog*) reveals that the signs of the coefficient are

positive. It implies that BTech and research outputs are important determinants of PHEIGs recurring costs unlike Technician (*certlog*) and HND (*hndlog*) outputs. The coefficients of the quadratic terms for the log of the outputs are positive for Technician, negative for HND, BTech enrolments and research output. It implies that in spite of the presence of economies of scale while each of the four outputs is expanding, costs per Technician student will eventually increase and costs per HND, BTech students and research outputs will decrease, if other things remain same.

A look at the interaction terms shows that *rescert, reshnd, resbtech, certhnd,* has a positive sign and the coefficients of the variables *hndbtech, certbtech* have negative signs. From statistical point of view, these variables are not different from zero at 5% level of insignificance.

The within $R^2$ value suggests that 91% of the variation in the demeaned data is explained by the included regressors. The fraction of the variance in the dependent variable in this case attributable solely to the fixed effect is 0.45.

In STATA, the regression output for the FE reports a constant term (the value associated with _cons = -30.73575). This is not entirely intuitive given what is known about the formulation of the within FE. The reason is that the results reported by STATA when the within FE command is used have simply been reformulated so that the reported intercept is the average value of all the estimated 10 within FE in this application.

Strictly speaking it should report all 10 intercepts but as a convenience it just reports an average intercept value. This can be a source of confusion and other statistical packages like SAS, EVIEWS, and MATLAB do not report the estimate for such an 'intercept' term for the FE.

*certlog, hndlog, reschlog, reshnd, hndbtech, reschlog2* variables are statistically significant at 5% level of significance so far as the RE model is concerned. The study also test the statistical significance of the four output variables with their square terms and their interaction terms altogether under the RE model. The test results show that:

```
Wald chi2( 14) =  425.20
 Prob > chi2 =    0.0000
```

It implies that the logs of all the independent variables in the RE are statistically different from zero collectively. The between $R^2$ value is 0.97 suggesting that 97% of the variation is explained by the included regressors. The RE command using generalised least squares (GLS), estimate one intercept [-72.03667 ].

The study conducts the Hausman test.

```
Test:  Ho:  difference in coefficients not systematic

                chi2(11) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                         =        7.88
              Prob>chi2 =      0.7240
```

Taking the numerical value at face value, the Hausman test $\chi^2$ value 7.88 indicates a rejection of the proposition that these random effects are independent of the explanatory variables at the 5% level of significance. The FE estimator does not embody this restriction. A difficulty in applying the FE model particularly relevant in the case of the present dataset, is that where the time dimension of the panel is short, most of the variation in the dependent and independent variables is across observations and the application of FE model can

then introduce severe multicollinearity and diminish the precision of the coefficient estimates.

However, in making any judgment regarding the Hausman test, it is desirable to compare the FE and RE models containing reasonably well determined coefficients for the relevant covariates across both estimators. This does not mean that all the estimated effect compared have to be statistically significant but the researcher needs to guard against this case where, all the estimated effects for the covariates for the 'within' estimator were poorly determined because their effects were absorbed by the inclusion of the fixed effects. Thus the study tests whether the RE estimates were different from zero which is decisively rejected, and not whether they are different from well determined FE estimates. Given that the data units used are PHEIGs, which are HEIs the assumption that the omitted factors are not fixed but over time but random appears to the researcher as more reasonable.

The PHEIGS multiple outputs average incremental cost estimates (AIC) obtained are presented in Table 4.3.

**Table 4.3 PHEIGs Average Incremental Costs at Mean Level of Output**

| AIC Technician | AIC HND | AIC BTech | AIC Research |
|---|---|---|---|
| -1.944687 | -.2695491 | -1.879674 | .2144633 |

***All values are indicative rather than definitive.**

The results indicate that the AIC of Research is more than that of Technician, HND and BTech outputs. Implication of such finding is that holding other outputs constant, PHEIGs production of Research outputs increases PHEIGs total cost the most.

The PHEIGs marginal cost (MC) estimates obtained are presented in Table 4.4.

**Table 4.4 PHEIGs Marginal Costs at Mean Level of Output**

| MC Technician | MC HND | MC BTech | MC Research |
|---|---|---|---|
| 11.32378 | 115.5513 | 7.031518 | 23.19514 |

***All values are indicative rather than definitive.**

## 4.2 Ray Economies of Scale

The PHEIGs multiple outputs ray scale economies at mean level of estimates is presented is Table 4.5.

**Table 4.5 PHEIGs Ray Economies of Scale Value at Mean Level**

| |
|---|
| 163.7003 |

**Source: (Estimates computed from STATA 12)**

Ray economies (or diseconomies) of scale are defined in the multi-product case as the cost savings (or dissavings) arising when the size of the aggregate output expands but the composition of output (i.e. output mix) remains constant. The result indicates the existence of PHEIGs multiple outputs ray scale economies suggesting that the PHEIGs costs per unit has decline as the PHEIGs undertake proportional increases in their product mix in the 2010-2011 to 2014-2015 calendar years.

## 4.3 PHEIGs Product-Specific Diseconomies of Scale Estimates at Mean Levels

The PHEIGs multiple outputs product-specific diseconomies of scale at mean level of estimates are presented in Table 4.6.

**Table 4.6 PHEIGs Product-Specific Diseconomies of Scale Estimates at Mean Levels**

| Technician | HND | BTech | Research |
|---|---|---|---|
| -.350794 | 0.0079089 | -.9563028 | 0.1058725 |

**Source: (Estimates computed from STATA 12)**

Product-specific economies (or diseconomies) of scale are the cost savings (or dissavings) which occur when the level of one product increases while the levels of the rest of the outputs remain fixed. If the average incremental cost of output i exceeds its marginal cost then we have product-specific returns to scale for output i. Measures for the PHEIGs product-specific scale economies suggest existence of product-specific scale diseconomies at mean level of outputs.

### 4.4 PHEIGs Product-Specific Scope Economies Estimates at Mean Levels

The PHEIGs multiple outputs product specific scope economies estimates at mean level of outputs are presented in Table 4.7.

**Table 4.7 PHEIGs Product-Specific Economies of Scope Values at Mean Levels**

| Technician | HND | BTech | Research |
|---|---|---|---|
| 53.58325 | 15.41085 | 35.8377 | 14.3393 |

**Source: (Estimates computed from STATA 12)**

The results in Table 4.7 suggest the existence of the PHEIGs scope economies for their multiple outputs at the mean level of outputs. That is it is least costly for the PHEIGs to produce Research output with the other outputs while it is costly to produce Technician output with other outputs. However, the PHEIGs make cost savings in the production of each product jointly with the other outputs.

### 4.5 PHEIGs Global Scope Economies Estimate

The PHEIGs global scope economies of Scope multiple outputs at the mean level estimated is presented in Table 4.8.

**Table 4.8 Global Economies of Scope at Mean Levels**

| |
|---|
| 0.6575071 |

**Source: (Estimates computed from STATA 12)**

There is the existence of PHEIGs global scope economies of their multiple outputs at the mean suggesting there are cost efficiencies gained the PHEIGs joint production of multiple outputs, rather than by being produced. Dundar and Lewis (1995) Hashimoto and Cohn (1997), Worthington and Higgs (2011) also established the existence of global scope economies in their studies.

### 4.6 PHEIGs Economies/Diseconomies of Scale and Scope Study Conclusion

The study empirically examine the scale and scope economies of the PHEIGs multiple outputs. The result indicates the existence of PHEIGs ray scale economies and is quite similar to the findings by Sav (2011) a study conducted in the US, Dundar and Lewis (1995) a study conducted in Turkey, and Hashimoto and Cohn (1997) a study conducted in Japan, Koshal and Koshal, (1999) a study conducted in the US, and Mamun (2012) a study conducted in Bangladesh.

The results imply also the existence of the PHEIGs product-specific scale diseconomies for their multiple outputs and not and not product-specific scale economies the findings. Sav (2011) a study conducted in the US, Cohn, Rhine and Santos (1989) a study conducted in the US, reported no product specific scale economies for any of their outputs in the private universities sector, Dundar and Lewis (1995) a study conducted in Turkey indicates the presence of product-

specific scale diseconomies of undergraduate and graduate education and for all fields except for engineering. Longlong, Fengliang and Weifand (2009) a study conducted in China and Mamun (2012) a study conducted in the Bangladesh all established product-specific scale diseconomies for their studies.

The study results indicate that global scope economies exist for the PHEIGs multiple outputs and imply conclusions similar to those reached in earlier studies by Sav (2011) a study conducted in the US, Dundar and Lewis (1995) a study conducted in Turkey, Longlong, Fengliang and Weifand (2009) a study conducted in China, and Mamun (2012) a study conducted in the Bangladesh and Worthington and Higgs (2008) a study conducted in Australia.

Regarding product-specific scope economies the study findings are in common with the findings of Longlong, Fengliang, and Weifand (2009) a study conducted in China, and Mamun (2012) a study conducted in the Bangladesh., Koshal and Koshal (1999) a study conducted in the US and Lewis and Dundar (1995) ) a study conducted in Turkey, Worthington and Higgs (2008) a study conducted in Australia.

The study marginal cost ratios (MCRs) of 0.2, 2.0, 3.3, also compares with Koshal and Koshal (2000) comprehensive universities study MCRs in the US which varies between 0.90 and 2.64 and Koshal and Koshal (2000) study MCRs which varies between 0.03 and 2.09, 3.0 -5.3 in Nelson and Herverth's (1992) study for the United States, but not 50 in Hashimoto and Cohn's (1997) study for Japanese private universities.

Earlier studies that have estimated HEIs scale and scope economies were very much confined to the developed countries. This study examine the scale and scope economies of PHEIGs using the flexible a quadratic cost function (FQCF)

and provide empirical evidence in the context of a developing country located in the Sub-Sahara African region. Overall, the results suggest that the PHEIGs can reap benefits from both scale and scope economies. Different survey years, samples, model specifications, different survey questionnaires and corresponding variables creates an unmanageable setting for accurate comparisons of studies ,Sav (2011) and for certain prohibits any rejection of contributions of any study to the understanding of Higher Education scale and scope economies. This study has established that it is possible to study the scale and scope economies of HEIs in Ghana, a developing country for that matter and thereby contributes to the study of Economics Education in Ghana. The study opines that country experiences rather than statistical tools can best provide a way to understanding Higher Education scale and scope economies issues.

### 4.7 Descriptive Statistics for PHEIGs DEA Study Variables

The descriptive statistics for the PHEIGs DEA study variables are presented in Table 4.9

**Table 4.9 Descriptive Statistics for PHEIGs DEA Variables in the Data Set for the 2014-2015 Year**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| TopCost | 10 | 1.3807 | 5687665 | 6146644 | 2.3507 |
| BRAL | 10 | 919816.2 | 381152 | 454142.2 | 1584046 |
| TECHn | 10 | 482.2 | 775.9756 | 0 | 2270 |
| HNDs | 10 | 4800.1 | 2847.482 | 26 | 8180 |
| BTECHs | 10 | 115.5 | 157.3166 | 0 | 451 |

***Estimates obtained from Stata 14**

From Table 4.9, out of the 10 observations made for the PHEIGs in the 2014-2015 year, the TopCost variable has a mean value of GH₵ 138,007 a minimum value of GH₵ 614,66. 44 and a maximum value of GH₵ 235,07. The BRAL variable has a mean value of GH₵ 919,816.2 a minimum value of GH₵

454,142 and a maximum value of GH₵ 1,584,046 and a standard deviation value of GH₵ 3,811,52. The mean output of the TECHn variable is 482.2, a minimum output of 0, a maximum output of 2270 and a standard deviation value of 775.9756. The mean output of the HNDs variable is 4800.1 a minimum output of 260, a maximum output of 8180 and a standard deviation value of 2847.482. The mean output of the BTECHs variable is 115.5, a minimum output of 0, a maximum output of 451 and a standard deviation value of 157.3166 for the 2014-2015 calendar year.

Table 4.10 presents the PHEIGs DEA study production efficiencies estimates.

In Table 4.10, the column 1 to the left identifies the DMU being investigated. Column 2 reports the ranking of the DMUs in terms of their technical efficiency. Column 3 reports the technical efficiency computed (theta). Column 4-13 reports the various reference weights (lamdas) that are used to value the inputs. Columns 14-15 reports the input slacks, while Columns 16-18 reports the output slacks. Entries such as "." in the result file mean that the value is virtually zero and less than 10 to minus 12 powers, or too small to mention. However, when sometimes analysing financial data, the distinction between zero and "." value may be required to keep the accuracy, Lee and Ji (2012).

Table 4.10 presents the PHEIGs DEA study production efficiencies estimates

**Table 4.10 about hereYY***************

DMUs (A, K, T, C, KD, W, B, Ta) are ranked 1, DMU H is ranked 9th, and DMU S is ranked 10th. DMUs (A, K, T, C, KD, W, B, Ta) have technical efficiency of 1. DMU H has an efficiency of 0. 839163 and DMU S has an efficiency of 0.736549. DMUs (A, K, T, C, KD, W, B, Ta) are referents. DMU C is strongly efficient because it has no inputs or output slack.

DMU H has a technical efficiency score of 0. 839163. A reduction in all inputs by 16% can be undertaken without worsening any other input and output. Column 14 indicates that DMU H has an input (TopCost) slack of 0. 0059907 Ghana Cedis and, Column 15 indicates that DMU H has an input (BRAL) slack of 54249.1 Ghana Cedis. Thus the performance of DMU H can be improved by subtracting 0.0059907 Ghana Cedis from its input (TopCost) and 54249.1 Ghana Cedis from its input (BRAL). DMUs (A, C, W) are the referents of inefficient DMU H. The sum of the referents of inefficient DMU H is equal to 1 because of $\sum_{j=1}^{n} \lambda_j = 1$ in equation [3.25] (0.227321 + 0.591837 + 0.180842).

Again, DMU S has a technical efficiency score of 0.736549. A reduction in all inputs by 26% can be undertaken without worsening any of its inputs and outputs. Column 14 indicates that DMU S has an input (TopCost) slack of 20221.9 Ghana Cedis and, Column 15 indicates that DMU S also has an input (BRAL) slack of 13862.6 Ghana Cedis and the performance of DMU S can be improved by subtracting 20221.9 Ghana Cedis from its input (TopCost) and 13862.6 Ghana Cedis from its input (BRAL). DMUs (A, C, Ta) are the referents of inefficient DMU S. From Table 4.10, DMUs (A, K, Ta, B) productions exhibit constant returns to scale (RTS = 0), while DMUs (H,C, S, KD, W) productions

exhibit increasing returns to scale (RTS=1), and DMU T production exhibits decreasing returns to scale (RTS = -1) for the 2014-2015 years.

The PHEIGs DEA-VRS frontier results for the 2014-2015 year are also presented in Table 4.11.

**Table 4.11 PHEIGs DEA VRS Frontier Results**

| dmu | CRS-TE | VRS-TE | RTS |
|---|---|---|---|
| dmu:A | 1.000000 | 1.000000 | 0.000000 |
| dmu:K | 1.000000 | 1.000000 | 0.000000 |
| dmu:T | 0.780990 | 1.000000 | -1.000000 |
| dmu:H | 0.665469 | 0.839163 | 1.000000 |
| dmu:C | 0.822935 | 1.000000 | 1.000000 |
| dmu:Ta | 1.000000 | 1.000000 | 0.000000 |
| dmu:S | 0.615941 | 0.736549 | 1.000000 |
| dmu:KD | 0.947072 | 1.000000 | 1.000000 |
| dmu:W | 0.362576 | 1.000000 | 1.000000 |
| dmu:B | 1.000000 | 1.000000 | 0.000000 |

***Estimates obtained from Stata 14**

## 4.8 Descriptive Statistics for PHEIGs MPI Input Oriented Study for the 2010-2011 to 2014-2015 Calendar years

The descriptive statistics for the PHEIGs MPI input oriented variables are presented in Table 4.12.

**Table 4.12 Descriptive Statistics for PHEIGs MPI Study for the 2010-2011 to 2014-2015 Calendar years**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| TOTALCOST | 50 | 9405485 | 6043281 | 600906.3 | 2.82e+07 |
| TECHn | 50 | 340.08 | 715.8946 | 0 | 2394 |
| HNDs | 50 | 4651.92 | 2601.058 | 26 | 9665 |
| BTECHs | 50 | 71.9 | 114.7278 | 0 | 451 |

**Estimates obtained from Stata 14**

From Table 4.12, of the 50 observations made for the PHEIGs from the 2010-2011 to 2014-2015 years, the TOTALCOST variable has a mean value of GH₵ 940,548.5 a minimum value of GH₵ 6,009,06.3 and a maximum value of GH₵ 2.350,7 and a standard deviation value of 6043281. The mean output of the TECHn variable is 340.08, a minimum output of 0, a maximum output of 2394 and a standard deviation value of 715.8946. The mean output of the HNDs variable is 4651.92 a minimum output of 26, a maximum output of 9665 and a standard deviation value of 2601.058. The mean output of the BTECHs variable is 71.9 a minimum output of 0, a maximum output of 451 and a standard deviation value of 114.73 for the five calendar years spanning 2010-2011 to 2014-2015.

## 4.9 PHIEGs MPI Input Oriented DEA Results for the 2010-2011 to 2014-2015 Years

The PHIEGs MPI input oriented DEA results for the 2010-2011 to 2014-2015 Years are presented in Table 4.13.

**Table 4.13 PHIEGs MPI Input Oriented DEA Results for the 2010-2011 to 2014-2015 Calendar Years**

| | acayear | dmu | tfpch | effch | techch | pech | sech |
|---|---|---|---|---|---|---|---|
| 1. | 2010~2011 | A | 2.1695 | 4.2485 | .510651 | 1 | 4.2485 |
| 2. | 2010~2011 | K | 1.73478 | 1 | 1.73478 | 1 | 1 |
| 3. | 2010~2011 | T | 1.82196 | 3.49059 | .521964 | 1 | 3.49059 |
| 4. | 2010~2011 | H | .950695 | .956604 | .993823 | 1.07821 | .887215 |
| 5. | 2010~2011 | C | .214548 | .439391 | .488285 | .605314 | .725891 |
| 6. | 2010~2011 | Ta | .112647 | .608936 | .18499 | .695398 | .875666 |
| 7. | 2010~2011 | S | .931309 | 1.59499 | .583897 | 1.12761 | 1.41448 |
| 8. | 2010~2011 | KD | 4.15728 | 11.6234 | .357664 | 4.34835 | 2.67306 |
| 9. | 2010~2011 | W | 1.19982 | 4.55847 | .263206 | 2.96414 | 1.53787 |
| 10. | 2010~2011 | B | 1.16059 | 4.40942 | .263206 | 2.64432 | 1.66751 |
| 11. | 2011~2012 | A | .599058 | 1 | .599058 | 1 | 1 |
| 12. | 2011~2012 | K | .25142 | .683908 | .367624 | .735322 | .93008 |
| 13. | 2011~2012 | T | 2.63096 | 1.70665 | 1.5416 | 1 | 1.70665 |
| 14. | 2011~2012 | H | .463832 | .781533 | .593489 | .836 | .934849 |
| 15. | 2011~2012 | C | .275416 | .460618 | .597928 | .724273 | .635973 |
| 16. | 2011~2012 | Ta | 2.63642 | 1.64221 | 1.60541 | 1.43802 | 1.14199 |
| 17. | 2011~2012 | S | .971083 | .450192 | 2.15704 | .631948 | .712388 |
| 18. | 2011~2012 | KD | .496613 | .809309 | .613626 | .916988 | .882573 |
| 19. | 2011~2012 | W | .454468 | .746004 | .609204 | 1 | .746004 |
| 20. | 2011~2012 | B | .534343 | .877117 | .609204 | 1.10772 | .791821 |
| 21. | 2012~2013 | A | .688463 | 1 | .688463 | 1 | 1 |
| 22. | 2012~2013 | K | 1.61283 | 1.46219 | 1.10302 | 1.35995 | 1.07518 |
| 23. | 2012~2013 | T | .411925 | .607255 | .67834 | 1 | .607255 |
| 24. | 2012~2013 | H | .776969 | 1.19197 | .651834 | 1.17729 | 1.01247 |
| 25. | 2012~2013 | C | 1.33163 | 1.75508 | .758729 | 1.26026 | 1.39263 |
| 26. | 2012~2013 | Ta | .618857 | 1 | .618857 | 1 | 1 |
| 27. | 2012~2013 | S | 1.18203 | 2.15768 | .547827 | 1.58241 | 1.36354 |
| 28. | 2012~2013 | KD | 1.35928 | 1.71261 | .793692 | 1.38487 | 1.23666 |
| 29. | 2012~2013 | W | .719291 | 1.00576 | .71517 | 1 | 1.00576 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 30. | 2012~2013 | B | .642212 | .897985 | .71517 | .918664 | .97749 |
| 31. | 2013~2014 | A | .806591 | 1 | .806591 | 1 | 1 |
| 32. | 2013~2014 | K | .796294 | 1 | .796294 | 1 | 1 |
| 33. | 2013~2014 | T | 1.05698 | 1.26043 | .838589 | 1 | 1.26043 |
| 34. | 2013~2014 | H | .831552 | 1.03187 | .805871 | 1.01529 | 1.01632 |
| 35. | 2013~2014 | C | 1.66453 | 2.06686 | .805343 | 1.8099 | 1.14197 |
| 36. | 2013~2014 | Ta | 1.0743 | 1 | 1.0743 | 1 | 1 |
| 37. | 2013~2014 | S | .55331 | .613689 | .901612 | .725527 | .845853 |
| 38. | 2013~2014 | KD | 1.1285 | 1.39554 | .80865 | 1.37082 | 1.01803 |
| 39. | 2013~2014 | W | .772872 | .958195 | .806591 | 1 | .958195 |
| 40. | 2013~2014 | B | 3.44104 | 3.45322 | .996471 | 1.30188 | 2.65249 |

**Estimates obtained from STATA 14**

From Table 4.13, the PHEIGs MPI input oriented DEA results indicate that for the 2010-2011 calendar year, six polytechnic institutions namely; Accra, Kumasi, Takoradi, Koforidua, Wa and Bolgatanga productivity exhibited total factor productivity change (tfpch), while four polytechnic institutions namely; while Ho, Cape Coast, Tamale and Sunyani productivity did not exhibited tfpch.

For the 2011-2012 calendar year, two polytechnic institutions namely; Takoradi and Tamale productivity exhibited total factor productivity change (tfpch), while eight polytechnic institutions namely; while Ho, Accra, Kumasi, Cape Coast, Koforidua, Wa, Bolgatanga and Sunyani productivity did not exhibited tfpch.

The MPI input oriented DEA results for the 2012-2013 calendar year inidcate that four polytechnic institutions namely; Kumasi, Cape Coast, Sunyani and Koforidua productivities exhibited total factor productivity change (tfpch), while six polytechnic institutions namely; Accra, Takoradi, Ho, Accra, Wa,

Bolgatanga and various productivity did not exhibited tfpch. For the 2013-2014 calendar year, five polytechnic institutions namely; Takoradi, Cape Coast, Tamale, Koforidua and Bolgatanga productivities exhibited tfpch and Bolgatanga Polytechnic exhibited the highest tfpch during the calendar year under consideration. Five other polytechnic institutions namely; Accra, Ho, Kumasi, Wa, and Sunyani productivity did not exhibited tfpch for the 2013-2014 calendar year. Overall, Takoradi Polytechnic Institution has been the only institution whose productivity has consistently exhibited tfpch for the five years under consideration.

The MPI input oriented DEA results indicate that for the 2010-2011 calendar year, six polytechnic institutions namely; Accra, Takoradi, Koforidua, Wa, Sunyani and Bolgatanga productivity exhibited efficiency change (effch), while four polytechnic institutions namely; while Ho, Cape Coast, Tamale and Kumasi productivity did not exhibited effch.

The MPI input oriented DEA results indicate that for the 2011-2012 calendar year, two polytechnic institutions namely; Takoradi and Tamale, productivity exhibited efficiency change (effch), while eight polytechnic institutions namely Accra, Koforidua, Wa, Sunyani, Bolgatanga; Ho, Cape Coast, and Kumasi productivity did not exhibited effch.

The MPI input oriented DEA results indicate that for the 2012-2013 calendar year, six polytechnic institutions namely; Ho, Cape Coast, Koforidua, Wa, Sunyani and Kumasi productivity exhibited efficiency change (effch), while four polytechnic institutions namely; while Accra, Takoradi, Tamale and Bolgatanga productivity did not exhibited effch.

The MPI input oriented DEA results inidcate that for the 2013-2014 calendar year, five polytechnic institutions namely; Takoradi, Ho, Cape Coast, Koforidua and Bolgatanga productivity exhibited efficiency change (effch), while five polytechnic institutions namely; Accra, Tamale Wa, Sunyani, and Kumasi productivity did not exhibited effch. Overall, Takoradi Polytechnic Institution has been the only institution whose productivity has consistently exhibited effch (moved along its frontier) for the five calendar years under consideration.

The MPI input oriented DEA results indicate that for the 2010-2011 calendar year, only Kumasi polytechnic institution had a technical change efficiency ( shift outside of the production frontier) in productivity, while nine polytechnic institutions namely; Accra, Takoradi, Koforidua, Wa, Sunyani, Bolgatanga, Ho, Cape Coast and Tamale productivity did not have techch (no shift outside of the production frontier) in productivity.

The MPI input oriented DEA results indicate that for the 2011-2012 calendar year, three polytechnic institutions namely; Takoradi, Sunyani, and Tamale have technical change efficiency (techch, shift outside of the production frontier) in productivity, while seven polytechnic institutions namely; Accra, Koforidua, Wa, Bolgatanga, Ho, Cape Coast and Kumasi productivity did not have techch efficiency change (no shift outside of the production frontier) in productivity.

The MPI input oriented DEA results indicate that for the 2012-2013 calendar year, only Kumasi polytechnic institution had a technical change efficiency (techch, shift outside of the production frontier) in productivity, while nine polytechnic institutions namely; Accra, Takoradi, Koforidua, Wa, Sunyani, Bolgatanga, Ho, Cape Coast and Tamale productivity did not have techch (no shift outside of the production frontier) in productivity.

The MPI input oriented DEA results indicate that for the 2013-2014 calendar year, only Tamale polytechnic institution had a technical change efficiency (techch, shift outside of the production frontier) in productivity, while nine polytechnic institutions namely; Accra, Takoradi, Koforidua, Wa, Sunyani, Bolgatanga, Ho, Cape Coast and Kumasi productivity did not have techch (no shift outside of the production frontier) in productivity. Kumasi Polytechnic Institution have for two calendar years 2010-2011, and 2012-2013 been the institution that exhibited technical efficiency change in productivity. The estimates of scale efficiency change (sech) and pure efficiency change are also varied for the PHEIGs.

### 4.10 Conclusion of PHEIGs 2010-2011 to 2014-2015 DEA and MPI Studies

The PHEIGs have been turned into HEIs since 1992 but the present study represents the first attempt to apply recently developed statistical methods as a means of evaluating their total factor productivities and technical efficiencies changes. The MPI results indicate that majority of the PHEIGs productivities have actually decreased over the study period. The results of the total factor productivity change fall between 0.21 and 0.93 values suggesting that majority of the PHEIGs registered losses within the range of 7 percent to 89 percent in productivity over the study period. The PHEIGs technical efficiencies change values reflect whether they have moved closer to or further from most productive scale size for their output mix over the study period. Most values excluding an outlier in Table 4.13 have values ranging from 0.44 up to 1 suggesting the prevalence of technical inefficiencies of 56 percent and little change in distance

from most productive scale size. The value ranges also indicate that the PHEIGs do not operate at a homogeneous level of efficiency.

With total inputs of the PHEIGs which they use to generate their multiple outputs being 100 percent financed by the GOG the sole shareholder, according to the study, there are bound to be productive inefficiencies. This findings is in consonance with Wolszczak-Derlacz (2014) study of 500 US and European Universities conclusion that increased government funding is associated with increased in inefficiencies. Although, to some extent, the PHEIGs establishments are more geographical than economical and are aimed at catering for the needs of students who are unable or unwilling to travel far and across the country for Polytechnic Education.

But the study findings is not in comport with Carlo Salerno, (2003) concerns that one of the most striking findings from reviewing different higher education efficiency studies is that, where judgment is made about the level of system efficiency, most researchers suggest that technical and/or cost efficiency is relatively high. This is puzzling in that it seems to contradict economic theories of non-profit behaviour, especially where Higher Education has been analysed, that suggest inefficiency to be much more prevalent than in for-profit firms. Yet in none of the studies did the author express any concern that inefficiency was pervasive. While some passed no judgment at all, when opinions were presented the most stringent admonishment was that “room for improvement was possible” or should not be ruled out. Most, however characterize productive inefficiencies as “fairly modest.”

Efficiency estimates are sensitive to the type of model one uses, sample size under consideration and assumptions about the production technology. This

study therefore has contributed to development of economics education in Ghana by investigating HEIs efficiencies in Ghana which to the best of the researcher's knowledge is the first of its kind in the country. While the study has demonstrated that there is PHEIGs cost inefficiencies, what remains to be critically evaluated are the sources, nature and structure of the inefficiencies. This requires further study with much more disaggregated data in the future.

### 4.11 Perception on PHEIGs Internally Generated Funds for the 2014-2015 Calendar Year

The perception of respondents on whether a particular PHEIGs IGF generated for the 2014-2015 calendar year is perceived as additional costs to students administered to the PHEIGs Students, Lecturers, and Administrators is presented in Table 4.14.0.

**Table 4.14.0 Distribution for Examining PHEIGs Students Administrators, Lecturers Perception on Whether a Particular IGF Generated is Additional Costs to Students or Not**

| **Polytechnic Institution** | Students Targeted | Students Utilised | Administrators Targeted | Administrators Utilised | Lecturers Targeted | Lectures Utilised |
|---|---|---|---|---|---|---|
| Accra | 3 | 3 | 2 | 2 | 2 | 2 |
| Kumasi | 3 | 3 | 2 | 2 | 2 | 2 |
| Takoradi | 3 | 2 | 2 | 2 | 2 | 2 |
| Ho | 3 | 2 | 2 | 2 | 2 | 2 |
| Cape Coast | 3 | 3 | 2 | 2 | 2 | 2 |
| Tamale | 3 | 3 | 2 | 2 | 2 | 2 |
| Sunyani | 3 | 3 | 2 | 2 | 2 | 2 |
| Koforidua | 3 | 3 | 2 | 2 | 2 | 2 |
| Wa | 3 | 2 | 2 | 2 | 2 | 2 |
| Bolgatanga | 3 | 3 | 2 | 2 | 2 | 2 |
| **Total** | 30 | **27** | 20 | **20** | 20 | **20** |

3 of the students provided no meaningful response. In the ensuing analysis of the responses as to whether a particular IGF constitute a cost to students or not, the study used the 67 respondents as the population. If over fifty percent of all respondents perceived an IGF item generated as being an additional cost to students, the study report it as yes and less than fifty percent of all respondents is reported as no at the cost column in Table 4.14. 1. The summary statistics of the sources of the PHEIGs IGFs generated in 2014-15 calendar year and the responses of respondents are presented in Table 4.14. 1.

**Table 4.14.1 Summary Statistics of the Sources of Amalgamated PHEIGs IGFs Generated for the 2014-2015 Calendar Year and Respondents Response to Whether a Particular IGF is a Cost to Students**

| Variable | Mean | Std. Dev. | Min | Max | cost | Total GH₵ | % of Total IGFs |
|---|---|---|---|---|---|---|---|
| afuf | 428417.6 | 1100931 | 0 | 3526844 | Yes | 4,284,176.07 | 8.39 |
| tufess | 2810982 | 4352281 | 0 | 12349476 | Yes | 28,109,818.54 | 55.06 |
| rentstaff | 15168.88 | 31041.37 | 0 | 94508.78 | No | 151,688.78 | 0.29 |
| nabtreg | 20427.45 | 37774.83 | 0 | 118294.1 | Yes | 204,274.52 | 0.4 |
| introlet | 850.527 | 1543.943 | 0 | 4917.27 | Yes | 8,505.27 | 0.01 |
| appforms | 266929 | 272532.4 | 0 | 757500.8 | Yes | 2,669,289.64 | 5.22 |
| idcards | 3293.862 | 5591.531 | 0 | 18005 | Yes | 18005 | 0.03 |
| regfess | 10668.4 | 17650.03 | 0 | 45994.46 | Yes | 106,683.96 | 0.20 |
| admfees | 5985.731 | 8525.235 | 0 | 22450 | Yes | 59,857.31 | 11.7 |
| hostfees | 284544.2 | 333536.1 | 0 | 1046580 | Yes | 2,846,342.25 | 5.5 |
| tracertret | 60115.71 | 53124.51 | 0 | 189933.4 | Yes | 601,157.06 | 1.1 |
| attest | 4321.6 | 5764.909 | 0 | 18461 | Yes | 43,216.00 | 0.08 |
| examsfee | 124690.4 | 138790.5 | 0 | 332914 | Yes | 1,246,903.83 | 2.44 |
| icts | 12609.53 | 26459.06 | 0 | 63953.27 | Yes | 126,095.27 | 0.24 |
| sportfees | 15559.23 | 32909.49 | 0 | 83441 | Yes | 155,592.29 | 0.30 |
| invescom | 82950.41 | 151319.1 | 0 | 447845.3 | No | 829,504.14 | 1.62 |
| usepolyfac | 35376.65 | 27570.1 | 2400 | 81263 | No | 318,389.88 | 0.62 |
| medfac | 5870.475 | 13424.73 | 0 | 40663.75 | Yes | 58,704.75 | 0.11 |
| libryfac | 5145.563 | 11169.37 | 0 | 31628 | Yes | 51,455.63 | 0.10 |
| indsattch | 2053.2 | 6284.799 | 0 | 19932 | Yes | 43,172.38 | 0.08 |
| tendoc | 7364.5 | 10252.09 | 0 | 30000 | No | 73,645.00 | 0.14 |
| matricus | 1721.431 | 894.766 | 0 | 11606.31 | Yes | 17,214.31 | 0.03 |
| congreg | 108830.4 | 130425.6 | 0 | 390081.9 | No | 1,309,304.45 | 2.56 |
| othersors | 769695.1 | 1661522 | 4934 | 5468615 | Yes | 7,696,950.76 | 15.07 |
| markresh | 0 | 0 | 0 | 0 | No | 0 | 0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| intrsfund | 0 | 0 | 0 | 0 | No | 0 | 0 |
| regfund | 0 | 0 | 0 | 0 | No | 0 | 0 |
| liscenpat | 0 | 0 | 0 | 0 | No | 0 | 0 |
| finorgcor | 0 | 0 | 0 | 0 | No | 0 | 0 |
| alumnfin | 0 | 0 | 0 | 0 | No | 0 | 0 |
| parklot | 0 | 0 | 0 | 0 | No | 0 | 0 |
| shortprov | 0 | 0 | 0 | 0 | No | 0 | 0 |
| **Totale** | | | | | | 51,044,880.71 | 100% |

**Source: (From survey, NCTE Polytechnics 2015 IGF Document Analysis January-April, 2016)**

From Table 4.14.1 the study identifies thirty-two items as comprising the PHEIGs sources of IGFs. The academic user facility user fee (*afuf*) is charged to students for using the PHEIGs academic facilities, notably the class rooms, chairs and tables. It generated an amount of GH₵ 4,284,176.07 representing 8.39 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Koforidua Polytechnic Institution generated the highest amount of GH₵ 3,526,844.03 representing 82 percent of the total *afuf* IGF generated for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'Yes' yielding 100 percent response to *afuf* as involving an additional cost to PHEIGs students.

The tuition fee (*tufess*) is charged to students as a fee-paying component of the free-tuition offered by the GOG. It generated an amount of GH₵ 28,109,818.54 representing 55.06 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Kumasi Polytechnic Institution generated the highest amount of GH₵ 12,349,476.32 representing 44 percent of the total *tufess* IGF generated for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'Yes' yielding 100 percent response to *tufess* as involving an additional cost to PHEIGs students.

The PHEIGs bungalows and apartments are rented (*rentstaff*) as a source of IGFs to staffs who occupied them. It generated an amount of GH₵ 151,688.78 representing 0.29 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Kumasi Polytechnic Institution generated the highest amount of GH₵ 94,508.78 representing 62 percent of the total *rentstaff* IGF generated for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'No' yielding 100 percent response to *rentstaff* as not involving an additional cost to PHEIGs students.

The National Board for professional and Technician Examinations (Nabptex) is one of three bodies with the mandate to regulate the tertiary education sector, Nabtex, (2015). Nabptex set the standards of quality assurance for non-university tertiary educational institutions to consolidate their role in national development. At the heart of this initiative lies the conviction that non-university tertiary institutions can provide appropriate and effective solutions to the unique manpower development challenges that Ghana faces if quality is infused in the development and assessment of skills competencies. PHEIGs students as a requirement are also to register with Nabptex. Nabptex registration (*nabtreg*) is a source of PHEIGs IGFs. It generated an amount of GH₵ 204,274.52 representing 0.4 percent of the total PHEIGs IGFs for the 2014-2015 calendar Wa Polytechnic Institution generated the highest amount of GH₵ 118,294.06 representing 58 percent of the total nabtreg IGF generated for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'Yes' yielding

100 percent response to *nabtreg* as involving an additional cost to PHEIGs students.

The issuance of introductory letters (*introlet*) is charged to students who apply for such introductory and other letters to diplomatic missions for visas and other identifiable organisations. As a source of PHEIGs IGFs, it generated an amount of GH₵ 8,505.27 representing 0.01 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Accra Polytechnic Institution generated the highest amount of GH₵ 4,917.27 representing 58 percent of the total *introlet* IGF generated for the 2014-2015 calendar year. All the 20 administrators respondents and 6 of the Lecturers, representing 39 percent of the respondents population responded 'NO' to *introlet* as not involving an additional cost to PHEIGs students, whilst 41 responded 'Yes' representing 61 percent response to *introlet* as involving an additional cost to PHEIGs students.

Prospective applicants applying for the various PHEIGs programmes are sold application forms (*appforms*) for further processing. As a source of PHEIGs IGFs, *appforms* generated an amount of GH₵ 2,669,289.64 representing 5.22 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Accra Polytechnic Institution generated the highest amount of GH₵ 757,500.77 representing 28 percent of the total *appforms* IGF generated for the 2014-2015 calendar year. 20 respondents comprising 20 administrators representing 30 percent of the respondents population responded 'No' to *appforms* as not involving an additional cost to PHEIGs students, whilst all the 27 students and the and 20 Lecturers responded 'Yes' representing 70 percent response to *appforms* as involving an additional cost to PHEIGs students.

Identification cards (*idcards*) are issued to PHEIGS students for a fee. As a source of PHEIGs IGFs, *idcards* generated an amount of GH₵ 32,938.62 representing 0.03 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Kumasi Polytechnic Institution generated the highest amount of GH₵ 18,005.00 representing 55 percent of the total *idcards* IGF generated by PHEIGs for the 2014-2015 calendar year. 20 respondents comprising 20 administrators representing 30 percent of the respondents population responded 'NO' to *idcards* as not involving an additional cost to PHEIGs students, whilst all the 27 students and the and 20 Lecturers responded 'Yes' representing 70 percent response to *idcards* as involving an additional cost to PHEIGs students.

There are various student associations, social and religious clubs formed within the PHEIGs campuses. For such clubs and associations to be operational, they have to be registered and given the necessary permits, known as 'registration fees (*regfess*). As a source of PHEIGs IGFs, *regfess* generated an amount of GH₵ 106,683.96 representing 0.20 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Tamale Polytechnic Institution generated the highest amount of GH₵ 45,994.46 representing 43 percent of the total *regfess* IGF generated by PHEIGs for the 2014-2015 calendar year. 20 respondents comprising 20 administrators representing 30 percent of the respondents population responded 'No' to *regfess* as not involving an additional cost to PHEIGs students, whilst all the 27 students and the and 20 Lecturers responded 'Yes' representing 70 percent response to *regfess* as involving an additional cost to PHEIGs students.

Successful applicants who secure admission to pursue further studies at PHEIGs are charged admission fees. It generated an amount of GH₵ 59,857.31 representing 11.7 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Cape Coast Polytechnic Institution generated the highest amount of GH₵17,420.00 representing 29 percent of the total *admfees* IGF generated for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'Yes' yielding 100 percent response to *admfees* as involving an additional cost to PHEIGs students.

The PHEIGs provide Halls of residence for students *in situ*. The students pay for these services which is a source PHEIGs IGFs referred to as hostel fees (*hostfees*). *hostfees* generated an amount of GH₵ 2,846,342.25 representing 5.5 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Accra Polytechnic Institution generated the highest amount of GH₵ 1,046,579.50 representing 38 percent of the total *hostfees* IGF generated for the 2014-2015 calendar year. Sixty-five respondents comprising 18 administrators, 20 Lecturers, 27 students of PHEIGs responded 'Yes' yielding 97 percent response to *hostfees* as involving an additional cost to PHEIGs students.

Issuance of transcripts of programme offered, programme certificates and results (*tracertret*) all constitute a source of PHEIGs IGFs. *tracertret* generated an amount of GH₵ 601,157.06 representing 1.1 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Kumasi Polytechnic Institution generated the highest amount of GH₵ 81,921.00 representing 13.62 percent of the total *tracertret* IGFs generated for the 2014-2015 calendar year. 20 respondents

comprising 20 administrators and 8 Lecturers representing 42 percent of the respondents population responded 'No' to *tracertret* as not involving an additional cost to PHEIGs students, whilst 39 responded 'Yes' representing 58 percent response to *tracertret* as involving an additional cost to PHEIGs students.

Some cost involve in conducting examinations are passed on to PHEIGs students as examination fees (*examsfee*) and treated as a source of an IGFs. *examsfee* generated an amount of GH₵ 1,246,903.83 representing 2.44 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Kumasi Polytechnic Institution generated the highest amount of GH₵ 312,884.00 representing 25 percent of the total *examsfee* IGF generated for the 2014-2015 calendar year. 20 respondents comprising 20 administrators representing 30 percent of the respondents population responded 'No' to *examsfee* as not involving an additional cost to PHEIGs students, whilst all the 27 students and the and 20 Lecturers responded 'Yes' representing 70 percent response to *examsfee* as involving an additional cost to PHEIGs students.

Provision of information communication technology (*icts*) services is treated as a source of PHEIGs IGFs. *icts* generated an amount of GH₵ 126,095.27 representing 0.24 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Tamale Polytechnic Institution generated the highest amount of GH₵ 63,953.27 representing 51 percent of the total *icts* IGFs generated for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'Yes' yielding 100 percent response to *icts* as involving an additional cost to PHEIGs students.

Athletics and sporting activities engaged in by the PHEIGs and the use of its sporting facilities are paid for and are treated as a source of IGFs (*sportfees*). s*portfees* generated an amount of GH₵ 155,592.29 representing 0.3 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Tamale Polytechnic Institution generated the highest amount of GH₵ 72,151.29 representing 46 percent of the total *sportfees* IGFs generated for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'Yes' yielding 100 percent response to *sportfees* as involving an additional cost to PHEIGs students.

The PHEIGs also engaged in investment ventures proceeds from which are treated as a source of IGFs. Investment incomes (*invescom*) generated an amount of GH₵ 829,504.14 representing 1.62 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Kumasi Polytechnic Institution generated the highest amount of GH₵ 447,845.27 representing 54 percent of the total *invescom* IGFs generated for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'NO' yielding 100 percent response to *invescom* as not involving an additional cost to PHEIGs students.

The renting out of PHEIGs facilities like conference rooms and auditoria (*usepolyfac*) constitute a source of PHEIGs IGFs. *usepolyfac* generated an amount of GH₵ 318,389.88 representing 0.62 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Kumasi Polytechnic Institution generated the highest amount of GH₵ 81,263.00 representing 26 percent of the total *usepolyfac* IGFs generated for the 2014-2015 calendar year. All the sixty-seven respondents

comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'No' yielding 100 percent response to *usepolyfac* as not involving an additional cost to PHEIGs students.

PHEIGs provide medical services; the payment for these services (*medfac*) is treated as a source of IGFs. *medfac* generated an amount of GH₵ 58,704.75 representing 0.11 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Tamale Polytechnic Institution generated the highest amount of GH₵ 40,663.75 representing 69 percent of the total *medfac* IGFs generated for the 2014-2015 calendar year. 29 respondents comprising 20 administrators and 9 Lecturers, comprising responded 'NO' giving 43 percent response to *medfac* as not involving an additional cost to PHEIGs students, whilst 38 yielding 57 percent responded to *medfac* as involving an additional cost to PHEIGs students.

The provision of library services (*libryfac*) are also treated as a source of PHEIGs IGFs. *libryfac* generated an amount of GH₵ 51,455.63 representing 0.11 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Tamale Polytechnic Institution generated the highest amount of GH₵ 19,677.63 representing 38 percent of the total *libryfac* IGFs generated for the 2014-2015 calendar year. 20 respondents comprising 20 administrators representing 30 percent of the respondents population responded 'NO' to *libryfac* as not involving an additional cost to PHEIGs students, whilst all the 27 students and the and 20 Lecturers responded 'Yes' representing 70 percent response to *libryfac* as involving an additional cost to PHEIGs students.

PHEIGs students are supposed to acquire an industrial practical knowledge refer to as 'industrial attachment' (*indsattch*). Application for approval

for an industrial attachment attracts fees which are treated as a source of PHEIGs IGFs. *indsattch* generated an amount of GH₵ 43,172.38 representing 0.08 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. WA Polytechnic Institution generated the highest amount of GH₵ 19,932.00 representing 46 percent of the total *indsattch* IGF generated for the 2014-2015 calendar year. 20 respondents comprising 20 administrators representing 30 percent of the respondents population responded 'NO' to *indsattch* as not involving an additional cost to PHEIGs students, whilst all the 27 students and the and 20 Lecturers responded 'Yes' representing 70 percent response to *indsattch* as involving an additional cost to PHEIGs students.

From time to time, the PHEIGs advertised for the supply of equipment, vehicles and architectural designs for some infrastructure development from suppliers and contractors. The tendering for the supply of these goods attracts bids (*tendoc*) which are considered as a source of PHEIGs IGFs. *tendoc* generated an amount of GH₵ 73,645.00 representing 0.14 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Bolgatanga Polytechnic Institution generated the highest amount of GH₵ 30,000.00 representing 41 percent of the total *tendoc* IGFs generated for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'NO' yielding 100 percent response to *tendoc* as not involving an additional cost to PHEIGs students.

PHEIGs organize matriculation services (*matricus*) to officially admit their fresh students to the privileges and responsibilities as junior faculty members. *matricus* attract fee payments which are treated as a source of IGFs.

*matricus* generated an amount of GH₵ 17,214.31 representing 0.03 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Tamale Polytechnic Institution generated the highest amount of GH₵ 11,606.31 representing 67 percent of the total *matricus* IGFs generated for the 2014-2015 calendar year. 20 respondents comprising 20 administrators representing 30 percent of the respondents population responded 'NO' to *matricus* as not involving an additional cost to PHEIGs students, whilst all the 27 students and the and 20 Lecturers responded 'Yes' representing 70 percent response to *matricus* as involving an additional cost to PHEIGs students.

PHEIGs as well organize congregation services (*congreg*) to officially graduate their students and award certificates to deserving students and personalities. *congreg* attract fee payments to many of the participants which are treated as a source of IGFs. *congreg* generated an amount of GH₵ 1,309,304.45 representing 2.56 percent of the total PHEIGs IGFs for the 2014-2015 calendar year. Accra Polytechnic Institution generated the highest amount of GH₵ 390,081.90 representing 30 percent of the total *congreg* IGFs generated for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'No' yielding 100 percent response to usepolyfac as not involving an additional cost to PHEIGs students.

Renting the PHEIGs hostels to outsiders during vacation sessions, utility charges, environmental degradation charges are classified as other sources of income (*othersors*) and treated as PHEIGs IGFs. *othersors* generated an amount of GH₵ 7,696,950.76 representing 15.07 percent of the total PHEIGs IGFs for the

2014-2015 calendar year. Accra Polytechnic Institution generated the highest amount of GH₵ 5,468,614.80 representing 71 percent of the total *othersors* IGFs generated for the 2014-2015 calendar year. 40 respondents comprising 20 administrators, 20 Lecturers responded 'No' yielding 60 percent response to *othersors* as not involving an additional cost to PHEIGs students. Whilst 27 respondents comprising 40 percent responded to *othersors* as being an additional cost to PHEIGs students.

PHEIGs as HEIs conduct researches which are meant to solve social and scientific problems. Marketisation of these research findings (*markresh*) is innovative and could be a major source of PHEIGs IGFs. Telephone inquiries to the various PHEIGs indicated that *markresh* did not generate any income to the PHEIGs IGFs for the 2014-2015 calendar year. Although the PHEIGs have industrial liaison offices they do not have marketing of research findings offices or commercial offices for the sale of any break-through findings. It is established that institutional marketing of research findings, help to generate more external research funding, Ehrenberg, Rizzo and Jakubson (2002). Ehrenberg, Rizzo and Jakubson (2002) assert that increased marketisation of research findings are associated with lower student/faculty ratios, higher rates of faculty salary growth, higher rates of tuition growth, holding constant all other sources of revenue coming into the HEI. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'No' yielding 100 percent response to *markresh* as not involving an additional cost to PHEIGs students.

PHEIGs faculties generating funding (*intresfund*) through winning huge financial projects and programmes through competitive proposal writings

constitute innovative sources of PHEIGs IGFs. Telephone inquiries to the various PHEIGs turned out that *intresfund* did not generate any income to the PHEIGs IGFs for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'No' yielding 100 percent response to *markresh* as not involving an additional cost to PHEIGs students.

PHEIGs as HEIs could contribute to the economic growth of the territories in which they operate, Huggins, Johnston and Stride (2012). As a result, PHEIGs must present academic and competitive proposals to the metropolitan, municipal and regional coordinating councils for funding (*regfund*) to help conduct researches to spur metropolitan, municipal and regional economic growth. The correspondences between the PHEIGs and the various metropolitan, municipal and regional coordinating councils unfortunately, do not include innovative comprehensive proposals for metropolitan, municipal and regional coordinating councils funding being it negotiated budget or categorical funding. Telephone inquiries to the various PHEIGs turned out that *regfund* as a source of PHEIGs IGFs did not generate any income for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'No' yielding 100 percent response to *regfund* as not involving an additional cost to PHEIGs students.

PHEIGs as HEIs by means of innovation may generate revenues from commercialisation of their faculty members' research, licensing income and other forms of royalties relating to patents (*liscenpat*) as a source of IGFs. The Association of University Technology Managers (AUTM) reported in their fiscal year 2000 survey of their members that USA colleges and universities received

more than $1 billion dollars in licensing income and other forms of royalties relating to patents that year, Ehrenberg. (2003). Telephone inquiries to the various PHEIGs turned out that *liscenpat* as a source of PHEIGs IGFs did not generate any income for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'No' yielding 100 percent response to *liscenpat* as not involving an additional cost to PHEIGs students.

PHEIGs as HEIs may have links through their innovative strategies with corporate organisations which will be involved in annual givings, endowment incomes, sponsorships and start-up capitals (*finorgcor*) which will serve greatly as a source of IGFs. However, telephone inquiries to the various PHEIGs turned out that *finorgcor* as a source of PHEIGs IGFs did not generate any income for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'No' yielding 100 percent response to *finorgcor* as not involving an additional cost to PHEIGs students.

PHEIGs as HEIs and partners in development must innovatively designed strategies to receive endowment incomes, annual giving, corporate sponsorships and start-up capitals from alumni relations (*alumnfin*). Telephone inquiries to the various PHEIGs however, turned out that *alumnfin* as a source of PHEIGs IGFs did not generate any income for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'No' yielding 100 percent response to *alumnfin* as not involving an additional cost to PHEIGs students.

PHEIGs as HEIs do have various interactions with all manners of people, from students to the general public. The telephone inquiries placed to the various PHEIGs campuses estimated that the PHEIGs have 805 cars parking or arriving (*parklot*) at the various campuses each day in the 2014-2015 calendar year. It comprised Accra Polytechnic Institution (150 cars per day), Kumasi Polytechnic Institution (120 cars per day), Takoradi Polytechnic Institution (100 cars per day), Cape Coast Polytechnic Institution (75 cars per day), Tamale Polytechnic Institution (65 cars per day), Koforidua Polytechnic Institution (65 cars per day), Bolgatanga Polytechnic Institution (35 cars per day), Wa Polytechnic Institution (25 cars per day), Sunyani Polytechnic Institution (80 cars per day) Ho Polytechnic Institution (90 cars per day). Innovatively, tolling parking cars at the various campuses *(parklot)* will serve as a source of PHEIGs IGFs. However, telephone inquiries to the various PHEIGs turned out that it did not generate any income as source of IGFs for the PHEIGs in the 2014-2015 calendar year. Although, the PHEIGs have security-manned gates but do not toll or charge on using a car on their roads. If each car is toll GH₵ 1, GH₵ 805 is generated daily, GH₵ 24,150 is generated monthly, and GH₵ 289,800 generated the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'No' yielding 100 percent response to *parklot* as not involving an additional cost to PHEIGs students.

With over thirty different tertiary programmes at its arsenals, PHEIGs can innovate and mount short courses and competency-based workshops (*shortprov)* for the public with a minimum of two weeks duration and a maximum of one month duration with certificates of participating awarded to participants and the incomes generated from such innovative short activities could serve as a source of

IGFs. However, telephone inquiries to the various PHEIGs turned out that *shortprov* did not generate any income to the PHEIGs IGFs for the 2014-2015 calendar year. All the sixty-seven respondents comprising 20 administrators, 20 Lecturers, 27 students of PHEIGs responded 'No' yielding 100 percent response to *shortprov* as not involving an additional cost to PHEIGs students.

On the question of whether apart from paying for tuition (*apttution*) departments or Lecturers do have a share in the other sources of IGFs generated posed to the administrators and Lecturers only, 18 representing 90 percent of the administrators responded 'No' while the remaining 2 representing 10 percent of the administrators responded 'Yes'. For the Lecturers, 20 respondents representing 100 percent responded 'No'.

### 4.11.1 Specific polytechnic institution generated IGFs for 2014-2015 year

The summary statistics of Polytechnic Institutional specific generation of IGFs for the 2014-2015 calendar year are presented Table 4.15.

**Table 4.15 Summary Statistics of Individual Polytechnic Institution IGF Generated in 2014-2015 Calendar Year**

| INSTITUTION | IGF | % | Cumulative % | FTE Student Enrolment | IGF Per student Capita |
|---|---|---|---|---|---|
| ACCRA POLYTECHNIC | 11,166,547.94 | 21.87 | 21.87 | 8180 | 1,365.10 |
| KUMASI POLYTECHNIC | 15,114,692.66 | 29.61 | 51.48 | 8338 | 1,812.74 |
| TAKORADI POLYTECHNIC | 10,192,396.15 | 19.96 | 71.44 | 8452 | 1205.91 |
| HO POLYTECHNIC | 1,552,220.61 | 3.04 | 74.48 | 3850 | 403.17 |
| CAPE COAST POLYTECHNIC | 872,107.39 | 1.70 | 76.18 | 2996 | 291.09 |
| TAMALE POLYTECHNIC | 1,181,466.88 | 2.31 | 78.49 | 8548 | 138.21 |

| | | | | | |
|---|---|---|---|---|---|
| SUNYANI POLYTECHNIC | 3,917,314.23 | 7.67 | 86.16 | 4383 | 893.75 |
| KOFORIDUA POLYTECHNIC | 5,419,514.72 | 10.61 | 96.77 | 6079 | 891.51 |
| WA POLYTECHNIC | 1,157,288.16 | 2.26 | 99.03 | 1202 | 962.80 |
| BOLGATANGA POLYTECHNIC | 471,331.97 | 0.97 | 100 | 1509 | 312.34 |
| TOTAL | 51,044,880.71 | - | - | 53537 | |

**Source: (NCTE Polytechnics 2015 IGF Document Analysis: January-April, 2016)**

Reference to Table 4.15, the consolidated PHEIGs IGFs generated for the 2014-2015 calendar year is GH₵ 51,044,880.71 as against 53537 FTE students giving an estimate of GH₵ 953 PHEIGs IGFs student per capita. Kumasi Polytechnic Institution contribute largest share of the PHEIGs IGFs for the 2014-2015 calendar year, generating an IGF amount of GH₵ 15,114,692.66 representing 29.61 percent of PHEIGs IGFs for the 2014-2015 calendar year. With a FTE student population of 8338 its students IGF per capita is GH₵ 1,812.74, GH ₵ 859.74 more than the national average.

Accra Polytechnic Institution contributed the second largest share of the PHEIGs IGFs for the 2014-2015 calendar year, generating an IGF amount of GH₵ 11,166,547.94 representing 21.87 percent of PHEIGs IGFs for the 2014-2015 calendar year. With a FTE student population of 8,180 its students IGF per capita is GH₵ 1,365.10, GH ₵ 412.1 more than the national average.

Takoradi Polytechnic Institution contributed the third largest share of the PHEIGs IGFs for the 2014-2015 calendar year, generating an IGF amount of GH₵ 10,192,396.15 representing 19.96 percent of PHEIGs IGFs for the 2014-

2015 calendar year. With a FTE student population of 8452 its students IGF per capita is GH₵ 1205.91, GH ₵ 252.91 more than the national average.

Koforidua Polytechnic Institution contributed the fourth largest share of the PHEIGs IGFs for the 2014-2015 calendar year, generating an IGF amount of GH₵ 5,419,514.72 representing 10.61 percent of PHEIGs IGFs for the 2014-2015 calendar year. With a FTE student population of 6079 its students IGF per capita is GH₵ 891.51, GH ₵ 61.49 less than the national average.

Sunyani Polytechnic Institution contributed the fifth largest share of the PHEIGs IGFs for the 2014-2015 calendar year, generating an IGF amount of GH₵ 3,917,314.23 representing 7.67 percent of PHEIGs IGFs for the 2014-2015 calendar year. With a FTE student population of 4383 its students IGF per capita is GH₵ 893.75, GH ₵ 59.25 less than the national average of GH₵ 953.

Ho Polytechnic Institution contributed the sixth largest share of the PHEIGs IGFs for the 2014-2015 calendar year, generating an IGF amount of GH₵ 1,552,220.61 representing 3.04 percent of PHEIGs IGFs for the 2014-2015 calendar year. With a FTE student population of 3850 its students IGF per capita is GH₵ 403.17, GH ₵ 549.83 less than the national average of GH₵ 953 for the 2014-2015 calendar year.

Tamale Polytechnic Institution contributed the seventh largest share of the PHEIGs IGFs for the 2014-2015 calendar year, generating an IGF amount of GH₵ 1,181,466.88 representing 2.31 percent of PHEIGs IGFs for the 2014-2015 calendar year. With a FTE student population of 8548 its students IGF per capita is GH₵ 138.21, GH ₵ 814.79 less than the national average of GH₵ 953 for the 2014-2015 calendar year.

Wa Polytechnic Institution contributed the eighth largest share of the PHEIGs IGFs for the 2014-2015 calendar year, generating an IGF amount of GH₵ 1,157,288.16 representing 2.26 percent of PHEIGs IGFs for the 2014-2015 calendar year. With a FTE student population of 1202 its students IGF per capita is GH₵ 962.80 GH ₵ 9.80 more than the national average of GH₵ 953 for the 2014-2015 calendar year.

Cape Coast Polytechnic Institution contributed the ninth largest share of the PHEIGs IGFs for the 2014-2015 calendar year, generating an IGF amount of GH₵ 872,107.39 representing 1.70 percent of PHEIGs IGFs of GH₵ 51,044,880.71 for the 2014-2015 calendar year. With a FTE student population of 2996 its students IGF per capita is GH₵ 291.09, GH ₵ 661.91 less than the national average of GH₵ 953 for the 2014-2015 calendar year.

Bolgatanga Polytechnic Institution contributed the tenth largest share of the PHEIGs IGFs for the 2014-2015 calendar year, generating an IGF amount of GH₵ 471,331.97 representing 0.97 percent of PHEIGs IGFs of GH₵ 51,044,880.71 for the 2014-2015 calendar year. With a FTE student population of 1509 its students IGF per capita is GH₵ 312.34, GH ₵ 640.66 less than the national average of GH₵ 953 for the 2014-2015 calendar year.

Institutional-wise, the Kumasi Polytechnic Institution generated 29.61 percent being the largest chunk of the total PHEIGs IGFs in 2014-205 calendar year. It also had the largest IGF per student capita value of GH₵ 1,812.74 as compared to Bolgatanga Polytechnic Institution which contributed 0.97 percent, the smallest of the total PHEIGs IGFs in 2014-205 calendar year. It also had the smallest IGF per student capita value of GH₵ 312.34. It implies that on average

and *ceteris paribus* a student at Bolgatanga Polytechnic Institution paid GH₵ 1500.4 less as IGFs than their counterparts at the Kumasi Polytechnic Institution during the 2014-2015 calendar year.

The three Polytechnic Institutions (Kumasi, Accra and Takoradi) cumulatively contributed 71.44 percent of the consolidated PHEIGs IGFs generated for the 2014-2015 calendar year, implying that Polytechnic Education in the Southern Ghana regions are more costly than in the Northern regions in terms of payments of IGFs by PHEIGs students. Bolgatanga Polytechnic Institution, Tamale Polytechnic Institution and Wa Polytechnic Institution contributed 5.54 percent of the total PHEIGs IGFs for the 2014-2015 calendar year.

### 4.12 PHEIGS IGFs Study Conclusion

The PHEIGs are confronted with decreasing funding from the central government which requires of them to be innovative in bridging their funding gaps. The analysis so far indicated that to a very large extent, the PHEIGs are not being innovative in generating incomes outside of the 'realm of their students'. Innovative strategies such marketisation of research findings, faculties generating funding through winning huge financial projects and programmes through competitive proposal writings, presenting academic and competitive proposals to the metropolitan, municipal and regional coordinating councils for funding, generating royalties relating to patents, generating annual givings, endowment incomes, sponsorships, and start-up capitals from companies and corporations, alumni relations, tolling of cars and charging parking fees, and provision of short

courses and competency-based workshops, all did not generate any income as sources of IGFs. PHEIGs bungalows and apartments rented to staffs who occupied them which generated a total of GH₵ 151,688.78, investment incomes which generated an amount of GH₵ 829,504.14 facilities like conference rooms rented to clients which generated an amount of GH₵ 318,389.88, tender bids from potential contractors which generated an amount of GH₵ 73,645.00, congregation services fees which generated an amount of GH₵ 1,309,304.45 are the IGFs perceived by respondents as not being additional costs to students for the 2014-2015 calendar year. These IGFs sources amounted to GH₵ 2,364,142.37 representing 4.6 percent of the total PHEIGs IGFs generated for the 2014-2015 calendar year indicating GH₵ 48,680,738.34 (51,044,880.71- 2364142.37) generated as IGFs are additional costs to students for the 2014-2015 calendar year. Adding GH₵ 48,680,738.34 to their 2014-2015 calendar year allocated funds of GH₵150,571,282 gives GH₵199,252,020.34 which increased their funding to (199252020.34/325,547,304*100) = 61 percent thereby decreasing their funding gap from 54 percent to 39 percent. The total IGFs generated of GH₵ 51,044,880.71 out of the potential funding GH₵ 325,547,304 is 16 percent requiring the PHEIGs to be innovative in generating more incomes and revenues to augment their funding shortfalls.

For the PHEIGs to be innovative requires competition and marketization of research findings among other things. Goodall (2009) argued that top research universities making academic and financial gains from maketisation of research findings which are the way HEIs in the 21st century should go must be led by top researchers. And her data showed that the heads of major research universities which generate huge sum of monies from research marketisation internationally

tend to have previously highly successful careers as academic researchers. In the case of the PHEIGs, Rectors (Heads of Polytechnic Administration) like in many African countries are appointed by the central government and they might not be top researchers by international standards but politically loyal to the establishment from within the ranks of academic staff, Sifuna (1998). Confronting the challenges of dwindling central government funding, new funding arrangements, increasing focus on accountability and performance, globalization and international competition requires the amendment of PHEIGs Institutional Mission Statements for the generation of more incomes to augment the dwindling GOG subvention outside the 'realms of their student body as the study had shown that 95.4 percent of what the PHEIGs termed as IGFs are financial burdens and disguised additional cost to their students populace in the 2014-2015 calendar year.

With the caveat that this is an exploratory study with so many factors not yet accounted for, it has been the first study however to examine the sources of PHEIGs IGFs in particular and have now paved the way for a broader analysis in the Higher Education sector in Ghana partcular and the Sub Saharan Africa in general. Thus while the GOG has to scale up funding of the PHEIGs, they must be innovative in their strategies to generate IGFs which does not revolve round their students only. This study is to further develop economics education in Ghana concerning the financing of HEIs. The current financial regulation requiring PHEIGs to submit all the yearly IGFs inflows to the GOG pool supervised on their behalf by the NCTE before applying for the release of some amount needed for specific institutional use is a disincentive. This kills initiative in diversifying and increasing the PHEIGs IGFs. Using duration analysis to estimate how long it

takes for PHEIGs application for the utilisation of their IGFs is given clearance by the Ministry of Finance and the Ministry of Education was not pursued in this current study and remains a high agenda for future research.

## 4.13 PHEIGs 2013 HND Graduates Gender Earnings Gap Tracer Survey Findings

24 out of the 120 sample reported not being employed and thereby earning no monthly income giving a usable sample size of 96.

The data is presented in Table 4.16.

**Table 4.16 PHEIGs 2013 HND Graduates Tracer Survey Data Distribution**

| Region | Respondents Identified | Respondents in Employment |
|---|---|---|
| ASHANTI | 12 | 11 |
| BRONG AHAFO | 12 | 10 |
| CENTRAL | 12 | 10 |
| EASTERN | 12 | 10 |
| GREATER ACCRA | 12 | 11 |
| NORTHERN | 12 | 10 |
| UPPER EAST | 12 | 8 |
| UPPER WEST | 12 | 6 |
| VOLTA | 12 | 10 |
| WESTERN | 12 | 10 |
| **TOTALE** | **120** | **96** |

**Source: (From survey, Sept-December, 2015)**

The gender summary statistics of the PHEIGs sampled HND 2013 graduates for the tracer study is presented in Table 4.16.1

**Table 4.16.1 Sampled 2013 HND Graduates 2015 Labour Market Gender Statistics**

| gender \| | Freq. | Percent | Cumulative. |
|---|---|---|---|
| 0 \| | 29 | 30.21 | 30.21 |
| 1 \| | 67 | 69.79 | 100.00 |
| Total \| | 96 | 100.00 | |

**Source: (From survey, Sept-December, 2015)**

Using a tracer survey sample representing 80 percent of respondents is extremely high. By the NCTE regulation, Polytechnic graduates after their National Service (NS) must have a two-year working experience before they could pursue any Post-HND studies. By 2015, no PHEIGs HND 2013 graduate would have completed any post HND studies and be in Post-HND employment. The tracer survey response rate of 80 percent compares favourably with the few tracer surveys conducted in Africa by Psacharopoulos and Loxley (1985), Narman (1992), Bennell and Ncube (1993; 1994); Mayanja and Nakayiwa (1997) Kaijage (2000) and The Psacharopoulos, and Loxley (1985), and Al-Samarrai and Reilly (2008).

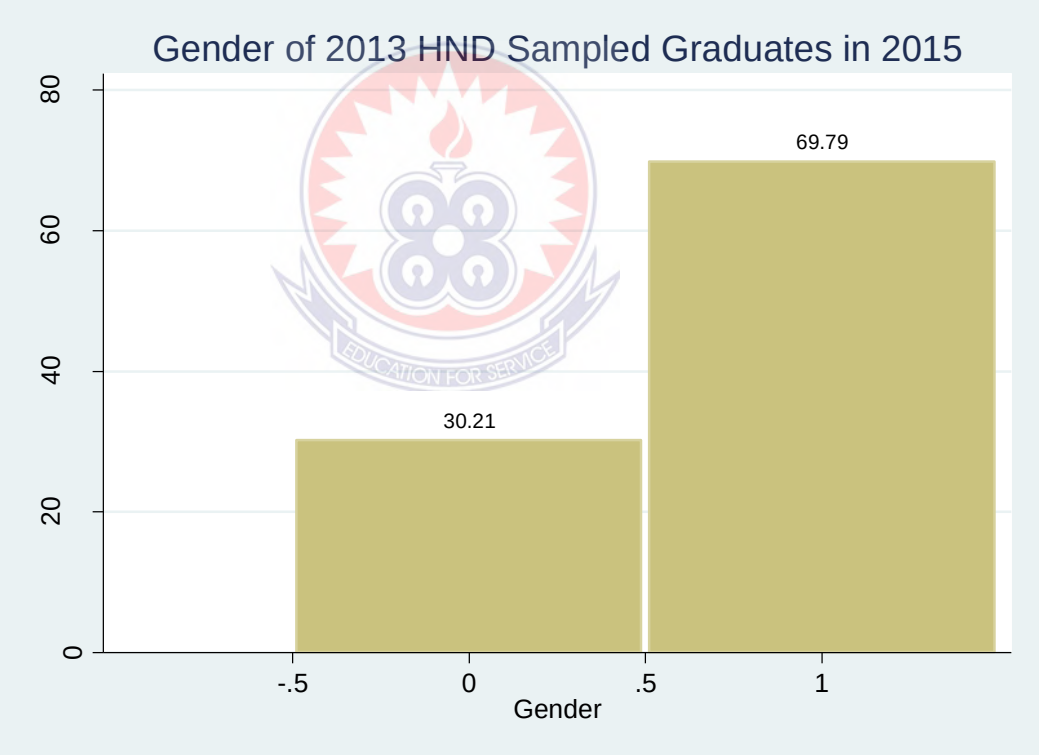
29 respondents representing 30.21 percent of the respondents were females while 67 respondents representing 69.79 percent were males as is presented in Table 4.16. The data in Table 4.16.1 is presented as a bar chart in Figure 4.1. The respondents employment by sector is also presented in Figure 4.2. It shows that 28 respondents representing 29.17 percent of the respondents work in the formal sector while 68 respondents representing 70.83 percent work in the informal sector. The private sector continues to be the major source of employment for Polytechnic HND graduates. This is in consonance with McKay

and Aryeetey (2007) findings that the informal sector continues to be the largest sector for employment for the HEI graduates in Ghana.

It is also in consonance with Glick and Sahn, (1997) findings that the informal sector increasingly is the dominant sector of employment for tertiary graduates in the Sub-Saharan Africa.

90 respondents representing 93.75 percent do not prefer post-HND studies at PHEIGs while 6 responded that they will prefer post-HND studies at the PHEIGs.

**Figure 4.1 Sampled 2013 HND Graduates Market Gender Statistics in 2015**

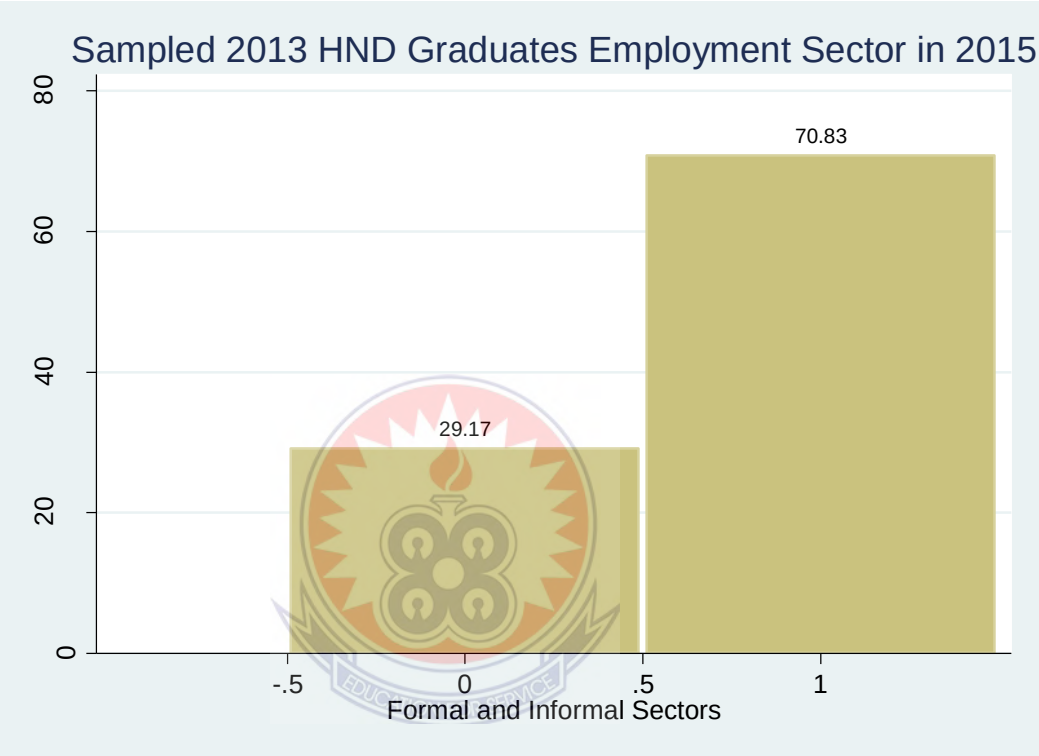



From Figure 4.1, 29 respondents representing 30.21 percent of the 2013 HND graduates respondents were females while 67 respondents representing 69.79 percent were males.

### 4.14 PHEIGs Sampled HND 2013 Graduates Employment by Sector in 2015

The summary statistics of the PHEIGs sampled 2013 HND graduates post-National Service by sector of employment for the tracer study is presented as a bar chart in Figure 4.2.

**Figure 4.2 PHEIGs Sampled 2013 HND Graduates Employment by Sector**




From Figure 4.2, 28 respondents representing 29.17 percent of the respondents are employed in the formal sector while 68 respondents representing 70.83 percent are employed in the informal sector.

### 4.15 Sampled PHEIGs 2013 HND Graduates in Mid-Level Employment

PHEIGs HND programmes are mandated to supply the middle-level manpower needs of the country. As a result, the HND graduates are expected to

be manning mid-level career positions. The summary statistics of the PHEIGs 2013 sampled HND graduates mid-level career for the tracer study is presented in Table 4.17

**Table 4.17 PHEIGs Sampled 2013HND Graduates in Mid-Level Employment in 2014-2015 Calendar Year**

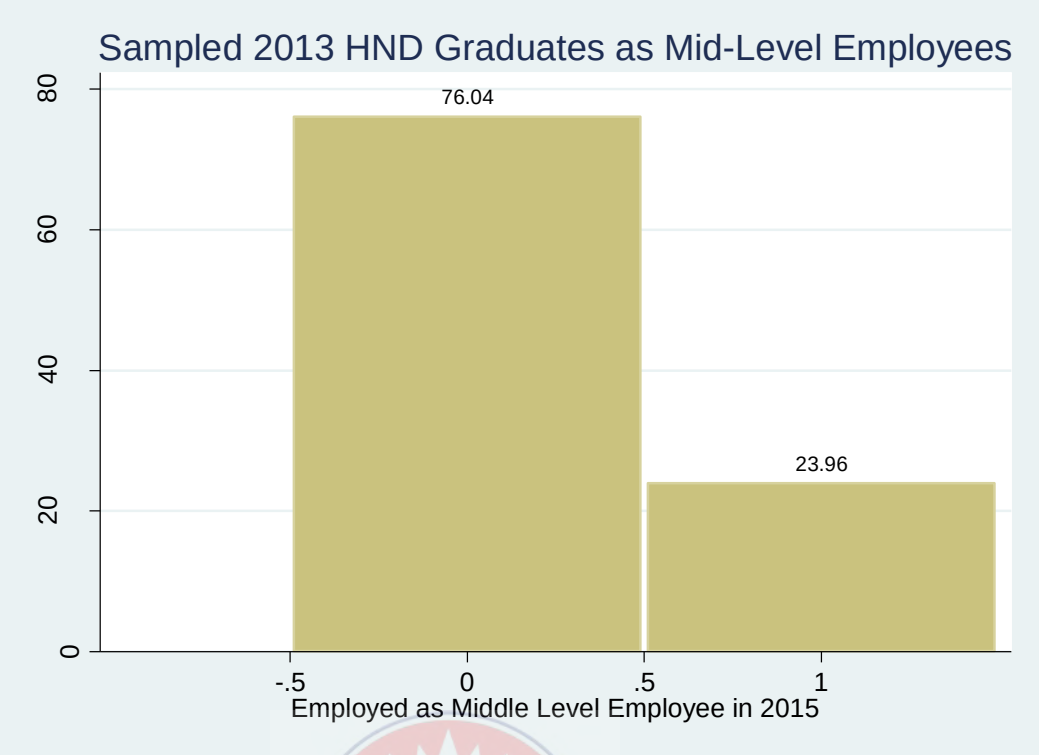
| midlevel l | Freq. | Percent | Cumulative. |
|---|---|---|---|
| 0\| | 73 | 76.04 | 76.04 |
| 1\| | 23 | 23.96 | 100.00 |
| Total \| | 96 | | |

**Source: (From survey, Sept-December, 2015)**

From Table 4.17, 23 respondents representing 23.96 percent are in the middle level category of employment, whilst 73 representing 76.04 percent are not in the middle level category of employment.

This data is presented as a bar chart in Figure 4.3.

**Figure 4.3 PHEIGs Sampled 2013 HND Graduates Mid-Level Employment**




### 4.16` PHEIGs Sampled 2013 HND Graduates Earnings Categories

The summary statistics of the PHEIGs cohort2013 sampled HND graduates market earnings categories in year 2015 are presented in Table 4.18.

**Table 4.18 Summary Statistics of Sampled PHEIGs 2013 HND Graduates Earnings Categories in 2014-2015 Calendar Year**

| earnscat \| | Frequency | Percent | Cumulative Frequency |
|---|---|---|---|
| 1 \| | 10 | 10.42 | 10.42 |
| 2 \| | 25 | 26.04 | 36.46 |
| 3 \| | 12 | 12.50 | 48.96 |
| 6 \| | 28 | 29.17 | 78.13 |
| 7 \| | 16 | 16.67 | 94.79 |
| 9 \| | 5 | 5.21 | 100.00 |
| **Total \|** | 96 | 100.00 | |

**Source: (From survey, Sept-December, 2015)**

From Table 4.18 10 respondents are in the category 1 earnings representing 10.42 percent, 25 respondents are in the category 2 earnings representing 36.46 percent, 12 respondents are in the category 3 earnings representing 12.50 percent, 28 respondents are in the category 6 earnings representing 29.17 percent, 16 respondents are in the category 7 earnings representing 16.67 percent and 5 respondents are in the category 9 earnings representing 5.21 percent.

### 4.17 The Interval Regression Model Estimates

The Interval Regression Model (IRM) PHEIGs sampled 2013 HND graduates earnings in 2015 estimates are presented in Table 4.19.

**Table 4.19 PHEIGs IRM Sampled 2013HND Graduates Earnings Estimates**

| Item | Coefficient | Standard Error | z statistic |
|---|---|---|---|
| gender | .0978811 | .0655393 | 1.49 |
| sector | .1758679 | .0597543 | 2.94 |
| midlevel | .4234922 | .0639155 | 6.63 |
| age | .989771 | 2.581819 | 0.38 |
| age2 | -.0225982 | .0923774 | -0.40 |
| marired | -.0258493 | .0923774 | -0.28 |
| acchnd | .2593381 | .0678876 | 3.82 |
| regnat | .0768069 | .0907492 | 0.85 |

Interval regression — Number of observation = 96

LR $chi^2(8)$ = 65.37

Log likelihood = -179.125 — Prob > chi2 = 0.0000

Observation summary:
- 10 left-censored observations
- 0 uncensored observations
- 5 right-censored observations
- 81 interval observations

**Estimates obtained from STATA 12**

There are no censored observations, 10 left-censored (i.e., those in the lowest earnings category), 5 right-censored observations (i.e., those in the highest earnings category), and 81 observations in the remaining intervals. The reported estimates relate to a Mincer (1974) earnings function. The sector variable suggests that those who are employed in the informal sector earn $[e^{0.097} - 1]\times100$ = 40% more than those who are employed in the formal sector, on average and *ceteris paribus*. The estimate is significant at the 5% confidence level and the *apriori* sign of expectation of negative was also not signed.

The midlevel variable suggests that 2013 PHEIGs HND graduates who are employed as middle level employees earn $[e^{0.423} - 1]\times100$ = 56% more than those who are employed not as middle level employees on average and *ceteris paribus*. The estimate is statistically significant at the 5% confidence level with the expected the *apriori* sign.

The acchnd variable suggests that 2013 PHEIGs HND graduate in Accountancy earn $[e^{0.259} - 1]\times100$ = 48% more than those employed with other HND certificates. The estimate is statistically significant at the 5% confidence level with the expected a *priori* sign.

## 4.18 Statistics of the OLS Variables in the 2013 HND Graduates Tracer Survey Earnings Equation

The mean estimated statistics of the variables involved and the tracer survey OLS regression earnings estimates of the pooled, male and female sub-samples are presented in Table 4.20.

**Table 4.20 Summary Statistics of the PHEIGs 2013 HND Graduates Tracer Earnings Variables**

| Variable | Pooled Mean Statistics | Male Mean Statistics | Female Mean Statistics |
|---|---|---|---|
| lnearns | 6.630154 | 6.659593 | 6.562138 |
| gender | .6979167 | 1 | 0 |
| sector | .7083333 | .7164179 | .6896552 |
| midlevel | .2395833 | .2537313 | .2068966 |
| age | 23.21875 | 23.22388 | 23.2069 |
| age2 | 539.5313 | 539.8209 | 538.8621 |
| married | .1041667 | .0597015 | .2068966 |
| acchnd | .2395833 | .2089552 | .3103448 |
| regnat | .8645833 | .9701493 | .6206897 |
| Observation | 96 | 67 | 29 |

**Estimates obtained from STATA 12**

### 4.18.1 2013 HND graduates tracer survey OLS regression estimates

The OLS earnings equation estimates of the pooled, male and female sub-samples of the 2013 HND Graduates tracer survey are presented in Table 4.21.

**Table 4.21 PHEIGs Sampled 2013 HND Graduates Earnings Equation OLS Regression Estimates**

| Variable | Pooled | Male | Female |
|---|---|---|---|
| constant | 1.182363<br>(27.15605) | -6.751885 | -22.81995 |
| gender | .0640797<br>(.0597342) | Not Applicable | Not Applicable |
| sector | .1829448*<br>(.0538824)<br>t: 3.40 | .3469337 | .005216 |
| midlevel | .370199*<br>(.0584749) | .4500963 | .349205 |
| age | .4876903<br>(2.349828) | 1.195579 | 2.570787 |
| age2 | -.0116179<br>(.0508298) | -.0268651 | -.0567462 |

| | | | |
|---|---|---|---|
| married | -.0317884<br>(.0840875) | -.0736764 | -.0346497 |
| acchnd | .2237471*<br>(.0615468) | .197086 | .3169432 |
| regnat | .0915822<br>(.0807509) | -.25941 | .2150185 |
| R-Squared | 49% | 53% | 67% |
| Observation | 96 | 67 | 29 |

***denote statistical significance at the 0.05 level respectively using two-tailed tests.**

**White (1980) Standard errors in parentheses, Estimates obtained from STATA 12**

The pooled regression model is as an augmented Mincer (1974) earnings equation. It is noteworthy that forty-nine percent of the variation in log monthly earnings is explained by variation in the log monthly earnings determining characteristics, which is good by the standards of transitional economies, Reilly (2007). The use of age here is designed to capture the role of labour force experience and the quadratic captures the effects of human capital depreciation, Reilly (2007). The estimated linear effect is positive and the quadratic term is negative suggesting an inverted U-shaped relationship between log monthly earnings and age. Both estimated coefficients are not individually well determined and statistically significant at a 5 percent conventional level but all do have the *a priori* signs. Using the estimates, the age at which the 2013 HND graduates log monthly earnings are maximized is 21 years obtained by setting the first order partial derivative to zero as follows:

$$\frac{\partial \text{lnearns}}{\partial \text{age}} = 0.4876903 - 2\ \text{x}.0116179\ \text{x age} = 0$$

$$\frac{\partial \text{lnearns}}{\partial \text{age}} = age = \frac{0.4876903}{0.0232358} = 21$$

The 2013 HND male graduates in the informal sector earns on average and ceteris paribus [e.1829448 – 1] × 100 = 44 percent more than the female cohorts, and the 2013 HND male graduates employed in the mid-level positions earns on average and ceteris paribus [e. .370199 – 1] × 100 = 53 percent more monthly than their female cohorts. These are indications of the existence of discrimination in monthly earnings suggesting 'glass-ceiling' effects and are in resonance with Glick and Sahn (1997), Date-Baah (1986), Vijverberg (1993) Hart (1973) findings that the informal sector exhibits much higher levels of average gender earnings differential than in the formal sector. The 2013 HND Accountancy graduates earn on average and ceteris paribus [e.2237471 – 1] × 100 = 46 percent more in earnings than 2013 non Accountancy HND holders. These established demand-side factors prevalent in the 2013 HND graduates labour market in 2015 results in 'discrimination in hiring.'

### 4.19 PHEIGs Sampled 2013 HND Graduates Monthly Earnings Gap due to Endowment Effect

The estimates of the Oaxaca decomposition for difference in PHEIGs 2013 HND graduates monthly earnings due to endowment is presented in Table 4.22.

**Table 4.22 Oaxaca Decomposition PHEIGs Sampled 2013 HND Graduates Monthly Earnings Gap due to Endowment Effect**

| Variable | Male Earnings Coefficient estimates $\beta_m$ | Mean Gender Differences $(\bar{Z}_m - \bar{Z}_f) = \Delta\bar{Z}$ | Earnings Differential Due to Skill $\beta_m \times (\Delta\bar{Z})$ |
|---|---|---|---|
| constant | -6.751885 | 0 | 0 |
| sector | .3469337 | 0.0267627 | 0.00928488253299 |

| | | | |
|---|---|---|---|
| midlevel | .4500963 | 0.0468347 | 0.02108012518161 |
| age | 1.195579 | 0.01698 | 0.02030093142 |
| age2 | -.0268651 | 0.9588 | -0.02575825788 |
| married | -.0736764 | -0.1471951 | 0.01084480506564 |
| acchnd | .197086 | -0.1013896 | -0.0199824707056 |
| regnat | -.25941 | 0.3494596 | -0.090653314836 |
| Total | | | -0.05490082851576 |

**Source: (Computed by using STATA 12)**

### 4.20 The Oaxaca Decomposition for PHEIGs Sampled 2013 HND Graduates Monthly Earnings Gap due to Treatment Effect

The estimates of the Oaxaca Decomposition for difference in PHEIGs 2013 HND graduates monthly earnings due to treatment or discrimination effect is presented in Table 4.23

**Table 4.23 PHEIGs Sampled 2013 HND Graduates Monthly Earnings Gap due to Treatment Effect**

| Variables | Gender Coefficients estimates difference $(\beta_m - \beta_f) = \Delta\beta$ | Mean Female Characteristics $\bar{Z}_f$ | Wage Differential due to Discrimination $\bar{Z}_f \times(\Delta\beta) + \Delta$ in Constant |
|---|---|---|---|
| Change in constant | 16.068065 | 1 | 16.068065 |
| sector | 0.3417177 | .6896552 | 0.23566738873704 |
| midlevel | 0.1008913 | .2068966 | 0.02087406693958 |
| age | -1.375208 | 23.2069 | -31.9143145352 |
| age2 | 0.0298811 | 538.8621 | 16.10179229631 |
| married | -0.0390267 | .2068966 | -0.00807449153922 |
| acchnd | -0.1198572 | .3103448 | -0.03719705876256 |

| | | | |
|---|---|---|---|
| regnat | -0.4744285 | .6206897 | -0.29447288333645 |
| Total | | | 0.17233978314839 |

**Source: (Computed Using STATA 12)**

The Oaxaca Decomposition model of gender earnings gap comprising the treatment and endowment effects respectively based on the monthly earnings of PHEIGs 2013 HND graduates is presented in Table 4.24.

**Table 4.24 Oaxaca Decomposition Model for the Monthly Earnings of the PHEIGs 2013 HND Graduates**

| Monthly Gender Earnings Gap | Endowment Effect | Treatment Effect |
|---|---|---|
| 0.11743895463263 | -0.05490082851576 | 0.17233978314839 |

**Source: (Computed Using STATA 12)**

## 4.21 Discussion of PHEIGs 2013 HND Oaxaca Decomposition Model in Earnings

A gender earnings gap estimate of -0.05490082851576, under the earnings assumption of an 0.11743895463263 is estimated in Table 4.24 comprising a treatment effect of estimated value of 0.17233978314839 and an endowment or skills effect estimate value of -0.05490082851576.

The treatment estimate of 0.17233978314839 is interpretable as the PHEIGs female 2013 HND graduates sample average *ceteris paribus* unequal treatment effect and suggests that male 2013 HND graduates with sample average female 2013 HND graduates characteristics earn $[e^{0.172} -1]$ x 100% = 44 percent more in monthly earnings than female 2013 HND graduates in 2015. This point to

the phenomenon of an intra-class inequality, explained by Mandel and Shalev (2009) as differences between male and female earnings located within the same class. It also confirms the earlier study asserting the existence of gender earnings gap, in the Ghanaian labour market, Addai (2011). The remaining component suggests that the endowment differential enjoyed by male PHEIGs 2013 HND graduates over their female counterparts gives $[e^{-0.054} - 1] \times 100\% = 35$ percent earnings advantage in terms of monthly earnings, on average and *ceteris paribus* in the Ghanaian labour market in 2015.

### 4.22 PHEIGs 2013 HND Graduates Gender Earnings Gap Study Conclusion

The study has overcome the SSSDA criticism of taking no account of the employment sector as the study establishes that the PHEIGs HND graduates continue to be gainfully employed suggesting that the PHEIGs must continue to supply them into the Ghanaian labour market. There is the empirical evidence of the existence of intra-gender earnings gap. As many of the 2013 HND cohorts find employment in the formal sector of the labour market, the gender earnings gap is expected to attenuate. This pioneering study had further contributed to the study of economics education in Ghana.

The standard Oaxaca decomposition OLS model provides estimates for the conditional mean effect of explanatory variables (e.g., education or gender) on a response variable (e.g., the log salary) holding other factors constant. This is why OLS is generally described as a mean (or average) regression procedure. The resultant estimate for the variable is just one numerical value that captures the relationship between the independent variable (e.g., gender) and the dependent variable (e.g., the log salary). Specifically, the approach assumes that the

conditional distribution of the dependent variable is homogeneous. In other words, regardless of where you are on the conditional log salary distribution (i.e., bottom, middle or top) the effect of gender, for example, on the log salary is assumed the same.

The quantile regression (QR) approach provides the framework within which the assumption of homogeneity across the conditional distribution of the dependent variable can be relaxed. The contribution of Koenker and Basset (1978) was to extend these ideas and situate them within a regression framework whereby conditional quantile functions were estimable. We could use quartiles, quintiles, deciles to delineate the position on the distribution but the term 'quantile' is taken to refer to the general case. The quantile regression may be estimated conditional on a given specification and then calculated at various percentile, quartiles, quintiles, deciles and quantile (e.g., the 10th, the 20$^{th}$, the 25th, the 75th or the 90th). Thus, one can estimate QR estimates for any given level of between 0 and 1, Hao and Naiman (2007). Unfortunately, quantile regression analysis was not pursued in this study. Tracing the earnings and using the QR model to estimate the gender earnings gap, if it exist among the Higher Education graduates in the Ghanaian labour market, remains a fruitful line of inquiry for future research.

# CHAPTER FIVE

# SUMMARY OF FINDINGS, RECOMMENDATIONS, CONTRIBUTIONS TO ECONOMICS EDUCATION AND RELEVANCE OF STUDY

## 5.1 Summary of Findings

This SS thesis empirically examine and provide an updated understanding of the PHEIGs scale and scope economies/diseconomies, productivity and efficiency, sources of IGFs and the 2013 HND graduates gender earnings gap in the Ghanaian labour market. The first study empirically examines the PHEIGs multiple output cost to estimate the economies/diseconomies of scale and scope for five calendar years spanning the 2010-2011 to 2014-2015. Up until the conduct of this study nothing was known in the PHEIGs multi-output regarding the existence of economies/diseconomies of scale and scope for instruction and research outputs. The study finds the existence of ray economies of scale and global economies of scope for the PHEIGs multi-production.

The second study empirically examines PHEIGs productivity and technical efficiency. The DEA analysis of the production of PHEIGs indicate that 80% of them were technically efficient in their production with 20% (Ho and Sunyani Polytechnics) not being technically efficient in their production for the 2014-2015 year. The PHEIGs MPI results indicate a decrease in efficiency change for the five years spanning 2010-2011 to 2014-2015.

The third study provides an empirical examination of the sources of the PHEIGs IGFs. The results suggest that 94 percent of what the PHEIGs classify as IGFs are indeed additional cost to the students indicating a continuation of the era

of cost-sharing disguise as IGFs and that the polytechnic institutions situated in the southern part of Ghana generates more IGFs than their northern counterparts making polytechnic education in the southern part of Ghana more expensive than in the northern part of Ghana.

The fourth tracer study find that the PHEIGs 2013 HND graduates continued to gain employment in the labour market and the PHEIGs must continue to supply them into the Ghanaian labour market. Majority of them are employed in the informal sector and there exist a 2013 HND graduates gender earnings gap in the labour market suggesting that male 2013 HND graduates with sample average female 2013 HND graduates characteristics earn 44 percent more in monthly earnings than female 2013 HND graduates *ceteris paribus* in the Ghanaian labour market in 2015.

## 5.2 Recommendations

(i) From the study, it has been found that the PHEIGs have very low enrolment for Technician and BTech programmes to have meaningful economies of scale for optimal production or programmes efficiencies. If the pursuit of cost efficiencies has any system propriety, then the PHEIGs should focus more on expanding and increasing the enrollments of current Technician, BTech HND programmes and research outputs.

(ii) It is recommended that PHEIGs can reap benefits from scale and scope economies and therefore have to be pursued to the fullest by maximising all potential outputs.

(iii) Since the MPI results indicate a decrease in efficiency change for PHEIGs for the five calendar years spanning 2010-2011 to 2014-2015, it is recommended that the GOG's intention to convert the PHEIGs into Technical Universities must be put on hold and all the bottlenecks leading to the decrease in efficiency change addressed else the status of Technical Universities would be very difficult to operate during the post 2016-2017 calendar years.

(iv) The study recommends changing the PHEIGs IGFs name to Alternate Funding Sources (AFS) and diversifying the sources of generation which must not be additional costs to students. And to ensure a maximum sustainable funding contribution from AFS, PHEIGs managements should employ professional staffs who will seek more efficient ways of developing their AFS drives. The PHEIGs should establish AFS co-ordination offices on institutional basis manned by personnel independent of the respective central administrations to ensuring that creative revenue generating initiatives are not stifled by long bureaucratic bottlenecks. These AFS managers must be paid on commission basis devoid of minimal central administrative interferences. PHEIGs managements should make the academic departments and faculties stakeholders in the AFS generation to demystify it as a central administration or management initiatives. Very attractive profit sharing formula between the central administration and the faculties where AFS are generated is to be encouraged.

The study recommends a 50:50 win-win sharing formula between them. PHEIGs must also ensure that adding to the generation of AFS is made a condition for promotion from the Senior Lecturer rank, to the Associate Professor and the Professorial ranks to really make the academia (Lecturers) major partners in generating PHEIGs AFS. The current financial regulation requiring PHEIGs to

submit all the yearly IGFs inflows to the GOG pool supervised and managed on their behalf by the NCTE before applying for the release of some amount needed for specific institutional use is a disincentive. This kills initiative in diversifying and increasing the PHEIGs AFS.

(v) There appears to be empirical evidence from the PHEIGs 2013 HND graduates tracer survey that the BTech and post HND programmes run by the PHEIGs are little attracted to their own former students or HND graduates. To this end, it is recommended that PHEIGs Academic Boards and the Quality Assurance Units 'sit up' to ensure and promote efficiency to attract and increase students enrolments for the BTech and post HND programmes. By doing these, matters of efficiency and product-specific economies of scale can be accomplished.

(vi) Although the gender earnings gap do exist in the labour market, efforts will have to be made through expanding the formal sector labour market to get many of the 2013 HND graduates gain employment in the formal sector as that will minimise the prevalence of the gender earnings gap.

(vii) There is persistent weakness in the quality of institutional data available at the NCTE office on the PHEIGs. The PHEIGs must be mandated by the NCTE to provide costs specific to respective programmes, rather than the current NCTE request which lump all costs together under the caption of 'compensation' and 'Book and Research Allowance' for any particular calendar year to ease future research analysis.

### 5.3 Contribution of Study to Knowledge

The study examines what are the ray and product-specific scale and scope economies of the PHEIGs multiple outputs. The result indicates the existence of PHEIGs ray scale economies, product-specific scale diseconomies, global and product-specific scope economies and further established that is it is least costly to produce research outputs with other outputs. The study further indicates that the PHEIGs total factor productivities changes fall between 0.21 and 0.93 values suggesting that majority of the PHEIGs registered losses within the range of 7 percent to 89 percent in productivity, and the prevalence of technical inefficiencies in the range of 0 - 56 percent and little changes in distance from most productive scale size over the study period. The value ranges also indicate that the PHEIGs do not operate at a homogeneous level of efficiency.

The study also established that the PHEIGs bridge their funding gap using the strategy of IGFs and that 95.4 percent of what the PHEIGs termed as IGFs sources are additional cost to their students populace and the funding gap in the 2014-2015 calendar year is 39 percent and not 54 percent. The fourth study established the prevalence of gender earnings gap among the 2013 HND graduates and that working in the informal sector, possessing an HND Accountancy certificate, being employed as mid-level employee which are demand- side prevalent factors drive the 'discrimination in hiring' among the 2013 HND graduates in the Ghanaian labour market

These study findings are unique in that all the earlier studies were conducted on traditional universities and not any on Polytechnic Institutions.

### 5.4 Relevance of the Study

Dramatic changes are underway in the structure of Ghanaian economy by trying to move away from the current agricultural, extractive and basic industries sectors towards activities which rely heavily on human capital. Moreover, globalisation has transformed the economic and social conditions in which Ghanaians live. The essential tools for international competitiveness in the new global economy are innovation, ideas, skills and knowledge, which all are characterised by the intensive use of human capital. Ghana can grow and sustain its knowledge base only if its workforce is extremely highly educated and well trained and this critical role places a responsibility on PHEIGs to build and improve upon existing links between academia and industry both in terms of the supply of graduates and knowledge transfer. This SS thesis study has contributed immensely to knowledge by making the PHEIGs as HEIs a focus of SS research in the Ghanaian higher education market.

The study also contributes to knowledge as it can be relied on by the NCTE and NAB and higher-education policy makers in Ghana in evaluating PHEIGs productivity and efficiency, AFS, and HND graduates tracer earnings for the post 2014-2015 calendar years.

And the study also contributes to knowledge immensely in furthering the growth and development of SS as a programme of study at higher levels in Ghana to the level of counterpart social sciences disciplines as economics, sociology, political science among others.

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## Appendix A: STATA Programming Syntax and Statistical Estimates of the Study

Generated Panel Data Summary Statistics

```
. sum costlog

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
     costlog |         50    15.76273    .7947613   12.93071   17.11187

. sum reschlog

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
    reschlog |         50    13.15023    .5664654   12.05495   14.27549

. sum certlog

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
     certlog |         50    2.262434    3.008647          0   7.780721

. sum hndlog

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
      hndlog |         50    8.167444    .9787961   3.258096   9.176267

. sum btechlog

    Variable |        Obs        Mean    Std. Dev.       Min        Max
```

```
-------------+---------------------------------------------------------
    btechlog |         50    2.620537    2.358975          0   6.111467

. sum certlog2

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
    certlog2 |         50    13.98952    21.09103          0   60.53962

. sum hndlog2

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
     hndlog2 |         50    67.64602     13.6283   10.61519   84.20387

. sum btechlog2

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
   btechlog2 |         50    12.32068    12.43407          0   37.35003

. sum reschlog2

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
   reschlog2 |         50    173.2431    14.88647   145.3219   203.7897

. sum rescert

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
     rescert |         50    30.50071    40.56125          0   106.8675

. sum reshnd
```

```
    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
      reshnd |         50    107.6951    15.78278   42.70861    127.948

. sum resbtech

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
    resbtech |         50       35.16    32.03634          0   86.68546

. sum certbtech

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
   certbtech |         50    6.716348    11.56813          0    40.8033

. sum certhnd

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
     certhnd |         50    18.70285    25.13446          0   68.74012

. sum hndbtech

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
    hndbtech |         50    22.43641    20.51622          0   54.77337
```

Generated Regression Coefficients of the Flexible Quadratic Cost Function Using the Fixed Effect Random Models and Hausman Test

```
xtreg costlog certlog hndlog btechlog reschlog certlog2 hndlog2 btechlog2
reschlog2 rescert reshnd resbtech certbtech certhnd hndbtech, fe i (poly)

Fixed-effects (within) regression               Number of obs     =        50

Group variable: poly                            Number of groups  =        10
```

```
R-sq:                                                 Obs per group:
     within  = 0.9150                                               min =          5
     between = 0.8054                                               avg =        5.0
     overall = 0.8694                                               max =          5
                                                      F(14,26)          =      19.98
corr(u_i, Xb)  = -0.2788                              Prob > F          =     0.0000

------------------------------------------------------------------------------
     costlog |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     certlog |   -.681458   .6935649    -0.98   0.335    -2.107101     .744185
      hndlog |   -4.82051   4.642235    -1.04   0.309    -14.36276    4.721741
    btechlog |     1.2224    .982415     1.24   0.224    -.7969834    3.241782
    reschlog |   8.758469   8.456437     1.04   0.310    -8.623986    26.14092
    certlog2 |   .0318796   .0149895     2.13   0.043     .0010681     .062691
     hndlog2 |  -.0089525   .1672835    -0.05   0.958    -.3528087    .3349037
   btechlog2 |  -.0357721   .0317093    -1.13   0.270    -.1009516    .0294073
   reschlog2 |  -.3929465   .4248886    -0.92   0.364    -1.266317    .4804245
     rescert |   .0220247   .0761538     0.29   0.775    -.1345118    .1785611
      reshnd |    .363615   .4050869     0.90   0.378    -.4690529    1.196283
    resbtech |   .0616021   .0815858     0.76   0.457       -.1061    .2293041
   certbtech |  -.0067686   .0134016    -0.51   0.618     -.034316    .0207789
     certhnd |   .0190747   .0977745     0.20   0.847    -.1819036    .2200529
    hndbtech |  -.2050546   .1030509    -1.99   0.057    -.4168786    .0067695
       _cons |  -30.73575   45.26691    -0.68   0.503    -123.7832    62.31172
-------------+----------------------------------------------------------------
     sigma_u |   .2343558
     sigma_e |  .26028217
         rho |  .44772876   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(9, 26) = 0.97                     Prob > F = 0.4849

. test certlog hndlog btechlog reschlog certlog2 hndlog2 btechlog2 reschlog2
rescert reshnd resbtech certbtech certhnd hndbtech

 ( 1)  certlog = 0

 ( 2)  hndlog = 0

 ( 3)  btechlog = 0

 ( 4)  reschlog = 0

 ( 5)  certlog2 = 0
```

```
 ( 6)  hndlog2 = 0

 ( 7)  btechlog2 = 0

 ( 8)  reschlog2 = 0

 ( 9)  rescert = 0

 (10)  reshnd = 0

 (11)  resbtech = 0

 (12)  certbtech = 0

 (13)  certhnd = 0

 (14)  hndbtech = 0

       F( 14,    26) =   19.98

            Prob > F =    0.0000
```

```
 xtreg costlog certlog hndlog btechlog reschlog certlog2 hndlog2
btechlog2 reschlog2 rescert reshnd resbtech certbtech certhnd hndbtech,
re i (poly)

Random-effects GLS regression                   Number of obs     =         50

Group variable: poly                            Number of groups  =         10


R-sq:                                           Obs per group:

     within  = 0.9016                                         min =          5

     between = 0.9734                                         avg =        5.0

     overall = 0.9239                                         max =          5

                                                Wald chi2(14)     =     425.20

corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000

------------------------------------------------------------------------------

     costlog |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]

-------------+----------------------------------------------------------------

     certlog |  -1.206116   .5981569    -2.02   0.044    -2.378482   -.0337498

      hndlog |  -9.351505    3.57552    -2.62   0.009     -16.3594   -2.343614

    btechlog |   .4640843   .7301308     0.64   0.525    -.9669458    1.895114

    reschlog |   18.04828   6.041284     2.99   0.003     6.207582    29.88898

    certlog2 |   .0234635   .0121156     1.94   0.053    -.0002827    .0472096

     hndlog2 |    .023868   .1159609     0.21   0.837    -.2034112    .2511473

   btechlog2 |  -.0015988   .0222129    -0.07   0.943    -.0451353    .0419377

   reschlog2 |  -.8559361   .2968832    -2.88   0.004    -1.437816   -.2740558

     rescert |    .069178   .0581666     1.19   0.234    -.0448264    .1831823

      reshnd |    .681403   .2965811     2.30   0.022     .1001146    1.262691

    resbtech |   .0817721   .0762182     1.07   0.283    -.0676128     .231157

   certbtech |   -.011532   .0088731    -1.30   0.194     -.028923    .0058589
```

```
    certhnd |   .0149765    .069846     0.21   0.830    -.1219191    .1518722
   hndbtech |  -.1719884   .0626365    -2.75   0.006    -.2947537   -.0492231
      _cons |  -72.03667     32.755    -2.20   0.028    -136.2353   -7.838045
-------------+----------------------------------------------------------------
    sigma_u |          0
    sigma_e |  .26028217
        rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------


test certlog hndlog btechlog reschlog certlog2 hndlog2 btechlog2
reschlog2 rescert reshnd resbtech certbtech certhnd hndbtech


 ( 1)  certlog = 0
 ( 2)  hndlog = 0
 ( 3)  btechlog = 0
 ( 4)  reschlog = 0
 ( 5)  certlog2 = 0
 ( 6)  hndlog2 = 0
 ( 7)  btechlog2 = 0
 ( 8)  reschlog2 = 0
 ( 9)  rescert = 0
 (10)  reshnd = 0
 (11)  resbtech = 0
 (12)  certbtech = 0
 (13)  certhnd = 0
 (14)  hndbtech = 0
           chi2( 14) =  425.20
         Prob > chi2 =    0.0000
. est store fix


. hausman fix
                ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |      fix            .          Difference          S.E.
-------------+----------------------------------------------------------------
     certlog |    -.681458    -1.206116        .5246578        .3510563
      hndlog |    -4.82051    -9.351505        4.530995        2.960743
```

```
    btechlog |      1.2224     .4640843        .7583152        .6573037
    reschlog |    8.758469     18.04828       -9.289812        5.917281
    certlog2 |    .0318796     .0234635        .0084161         .008826
     hndlog2 |   -.0089525      .023868       -.0328206        .1205688
   btechlog2 |   -.0357721    -.0015988       -.0341734        .0226289
   reschlog2 |   -.3929465    -.8559361        .4629896        .3039583
     rescert |    .0220247      .069178       -.0471533        .0491534
      reshnd |     .363615      .681403        -.317788        .2759257
    resbtech |    .0616021     .0817721         -.02017        .0291039
   certbtech |   -.0067686     -.011532        .0047635        .0100435
     certhnd |    .0190747     .0149765        .0040981        .0684206
    hndbtech |   -.2050546    -.1719884       -.0330662          .08183
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                 chi2(11) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =         7.88
               Prob>chi2 =       0.7240
```

Generating the Scale and Scope Estimates

```
. tabstat AICtech, statistics(mean)

    variable |      mean
-------------+----------
     AICtech | -1.944687
-------------------------

. tabstat AIChnd, statistics(mean)

    variable |      mean
-------------+----------
      AIChnd | -.2695491
-------------------------
```

```
. tabstat AICbtech, statistics(mean)

    variable |      mean
-------------+----------
    AICbtech | -1.879674
------------------------

. tabstat AICbresch, statistics(mean)

    variable |      mean
-------------+----------
   AICbresch |  .2144633
------------------------

. tabstat AICtech, statistics(mean)

    variable |      mean
-------------+----------
     AICtech | -1.944687
------------------------

. tabstat MCcert, statistics(mean)

    variable |      mean
-------------+----------
      MCcert |  11.32378
------------------------

. tabstat MCbtech, statistics(mean)

    variable |      mean
-------------+----------
     MCbtech |  7.031518
------------------------
```

```
. tabstat MChnd, statistics(mean)

    variable |      mean
-------------+----------
       MChnd |  115.5513
------------------------

. tabstat MCresch, statistics(mean)

    variable |      mean
-------------+----------
     MCresch |  23.19514
------------------------

. tabstat TECHPSEco, statistics(mean)

    variable |      mean
-------------+----------
   TECHPSEco |  -.350794
------------------------

. tabstat HNDPSEco, statistics(mean)

    variable |      mean
-------------+----------
    HNDPSEco |  .0079089
------------------------

. tabstat BTECHPSEco, statistics(mean)

    variable |      mean
-------------+----------
  BTECHPSEco | -.9563028
------------------------
```

```
. tabstat RESCHPSEco, statistics(mean)

    variable |      mean
-------------+----------
  RESCHPSEco |  .1058725
------------------------

. tabstat RAYEcos, statistics(mean)

    variable |      mean
-------------+----------
     RAYEcos |  163.7003
------------------------

. gen GLOScope= (Allcost- costlog)/ costlog

. tabstat GLOScope, statistics(mean)

    variable |      mean
-------------+----------
    GLOScope |  .6575071
------------------------


------------------------
```

Generating Product Specific Estimates

```
gen PScophnd= hndcost+( certcost* btechcost*resechcost)- costlog/ costlog

. tabstat PScophnd

    variable |      mean
-------------+----------
    PScophnd |  15.41085
```

```
------------------------


. gen PScophnd= hndcost+( certcost* btechcost*resechcost)- costlog/
costlog


. gen PScopcert= certcost+(hndcost* btechcost*resechcost)- costlog/
costlog


. tabstat PScopcert


    variable |      mean
-------------+----------
   PScopcert |  53.58325
------------------------


. gen PScopbtech=btechcost+(hndcost* certcost*resechcost)- costlog/
costlog


. tabstat PScopbtech


    variable |      mean
-------------+----------
  PScopbtech |   35.8377
------------------------


. gen PScopresch = resechcost+(hndcost* certcost* btechcost)-
costlog/costlog


. tabstat PScopresch


    variable |      mean
-------------+----------
  PScopresch |   14.3393
------------------
```

**Generate DEA Results**

```
dea  TopCost  BRAL =  TECHn HNDs BTECHs,  rts(vrs) ort(in) stage(2)
```

```
options: RTS(VRS) ORT(IN) STAGE(2)
VRS-INPUT Oriented DEA Efficiency Results:
                                  ref:      ref:      ref:      ref:      ref:      ref:      ref:      ref:      ref:
             rank     theta         A         K         T        Ho         C        Ta         S        KD         W
 dmu:A          1         1         1         .         .         .         .         0         .         .         .
 dmu:K          1         1         .         .         .         .         .         0         .         .         .
 dmu:T          1         1         0         0         1         .         .         0         .         .         .
dmu:Ho          9   .839163   .227321         .         .         .   .591837         0         .         .   .180842
 dmu:C          1         1         .         .         .         .         1         .         .         .         0
dmu:Ta          8         1         .         .         .         .         .         1         .         .         .
 dmu:S         10   .736549   .248956         .         .         .   .255102   .194273         .         .         .
dmu:KD          1         1         0         .         .         .         .         0         .         1         .
 dmu:W          1         1         0         .         .         .         0         .         .         .         1
 dmu:B          1         1         .         .         .         .         .         0         .         .         0

             ref:   islack:   islack:   oslack:   oslack:   oslack:
               B   TopCost      BRAL     TECHn      HNDs     BTECHs
 dmu:A         .         .         0         .         .         .
 dmu:K         0         .         0         .         .         .
 dmu:T         .         0         0         .         .         .
dmu:Ho         .   .0059907   54249.1         .         .         .
 dmu:C         0         0         .         .         0         .
dmu:Ta         0         .  2.91e-11         .         .         .
 dmu:S         .   20221.9   13862.6         .         .         .
dmu:KD         .         .         0         .         .         .
 dmu:W         .         .         0         0         .         .
 dmu:B         1         0         .         .         .         0
```

**DEA VRS FRONTIER**

| VRS Frontier(-1:drs, 0:crs, 1:irs) | | |
|---|---|---|
| CRS_TE VRS_TE NIRS_TE | SCALE | RTS |
| dmu:A 1.000000 1.000000 1.000000 | 1.000000 | 0.000000 |
| dmu:K 1.000000 1.000000 1.000000 | 1.000000 | 0.000000 |
| dmu:T 0.780990 1.000000 1.000000 | 0.780990 | -1.000000 |
| dmu:Ho 0.665469 0.839163 1.000000 | 0.793015 | 1.000000 |
| dmu:C 0.822935 1.000000 1.000000 | 0.822935 | 1.000000 |
| dmu:Ta 1.000000 1.000000 1.000000 | 1.000000 | 0.000000 |
| dmu:S 0.615941 0.736549 0.680375 | 0.836253 | 1.000000 |
| dmu:KD 0.947072 1.000000 1.000000 | 0.947072 | 1.000000 |
| dmu:W 0.362576 1.000000 1.000000 | 0.362576 | 1.000000 |
| dmu:B 1.000000 1.000000 1.000000 | 1.000000 | 0.000000 |

## Generated Malmquist productivity Index Results

```
malmq TOTALCOST = TECHn HNDs BTECHs,period(acayear)
```

```
     +-------------------------------------------------------------------+
     |   acayear    dmu      tfpch      effch     techch       pech      sech |
     |-------------------------------------------------------------------|
  1. | 2010~2011     A     2.1695     4.2485    .510651          1     4.2485 |
  2. | 2010~2011     K    1.73478          1    1.73478          1          1 |
  3. | 2010~2011     T    1.82196    3.49059    .521964          1    3.49059 |
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4. | 2010~2011 | H | .950695 | .956604 | .993823 | 1.07821 | .887215 |
| 5. | 2010~2011 | C | .214548 | .439391 | .488285 | .605314 | .725891 |
| 6. | 2010~2011 | Ta | .112647 | .608936 | .18499 | .695398 | .875666 |
| 7. | 2010~2011 | S | .931309 | 1.59499 | .583897 | 1.12761 | 1.41448 |
| 8. | 2010~2011 | KD | 4.15728 | 11.6234 | .357664 | 4.34835 | 2.67306 |
| 9. | 2010~2011 | W | 1.19982 | 4.55847 | .263206 | 2.96414 | 1.53787 |
| 10. | 2010~2011 | B | 1.16059 | 4.40942 | .263206 | 2.64432 | 1.66751 |
| 11. | 2011~2012 | A | .599058 | 1 | .599058 | 1 | 1 |
| 12. | 2011~2012 | K | .25142 | .683908 | .367624 | .735322 | .93008 |
| 13. | 2011~2012 | T | 2.63096 | 1.70665 | 1.5416 | 1 | 1.70665 |
| 14. | 2011~2012 | H | .463832 | .781533 | .593489 | .836 | .934849 |
| 15. | 2011~2012 | C | .275416 | .460618 | .597928 | .724273 | .635973 |
| 16. | 2011~2012 | Ta | 2.63642 | 1.64221 | 1.60541 | 1.43802 | 1.14199 |
| 17. | 2011~2012 | S | .971083 | .450192 | 2.15704 | .631948 | .712388 |
| 18. | 2011~2012 | KD | .496613 | .809309 | .613626 | .916988 | .882573 |
| 19. | 2011~2012 | W | .454468 | .746004 | .609204 | 1 | .746004 |
| 20. | 2011~2012 | B | .534343 | .877117 | .609204 | 1.10772 | .791821 |
| 21. | 2012~2013 | A | .688463 | 1 | .688463 | 1 | 1 |
| 22. | 2012~2013 | K | 1.61283 | 1.46219 | 1.10302 | 1.35995 | 1.07518 |
| 23. | 2012~2013 | T | .411925 | .607255 | .67834 | 1 | .607255 |
| 24. | 2012~2013 | H | .776969 | 1.19197 | .651834 | 1.17729 | 1.01247 |
| 25. | 2012~2013 | C | 1.33163 | 1.75508 | .758729 | 1.26026 | 1.39263 |
| 26. | 2012~2013 | Ta | .618857 | 1 | .618857 | 1 | 1 |
| 27. | 2012~2013 | S | 1.18203 | 2.15768 | .547827 | 1.58241 | 1.36354 |
| 28. | 2012~2013 | KD | 1.35928 | 1.71261 | .793692 | 1.38487 | 1.23666 |
| 29. | 2012~2013 | W | .719291 | 1.00576 | .71517 | 1 | 1.00576 |
| 30. | 2012~2013 | B | .642212 | .897985 | .71517 | .918664 | .97749 |
| 31. | 2013~2014 | A | .806591 | 1 | .806591 | 1 | 1 |
| 32. | 2013~2014 | K | .796294 | 1 | .796294 | 1 | 1 |
| 33. | 2013~2014 | T | 1.05698 | 1.26043 | .838589 | 1 | 1.26043 |
| 34. | 2013~2014 | H | .831552 | 1.03187 | .805871 | 1.01529 | 1.01632 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 35. | 2013~2014 | C | 1.66453 | 2.06686 | .805343 | 1.8099 | 1.14197 |
| 36. | 2013~2014 | Ta | 1.0743 | 1 | 1.0743 | 1 | 1 |
| 37. | 2013~2014 | S | .55331 | .613689 | .901612 | .725527 | .845853 |
| 38. | 2013~2014 | KD | 1.1285 | 1.39554 | .80865 | 1.37082 | 1.01803 |
| 39. | 2013~2014 | W | .772872 | .958195 | .806591 | 1 | .958195 |
| 40. | 2013~2014 | B | 3.44104 | 3.45322 | .996471 | 1.30188 | 2.65249 |

## Generated Summary Statistics of Sources of IGFs

```
. sum  afuf

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
        afuf |        10    428417.6     1100931          0    3526844

. sum tufess

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
      tufess |        10     2810982     4352281          0   1.23e+07

. sum rentstaff

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
   rentstaff |        10    15168.88    31041.37          0   94508.78

. sum nabtreg

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
     nabtreg |        10    20427.45    37774.83          0   118294.1
```

```
. sum introlet

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
    introlet |        10     850.527    1543.943          0    4917.27

. sum appforms

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
    appforms |        10      266929    272532.4          0   757500.8

. sum idcards

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
     idcards |        10    3293.862    5591.531          0      18005

. sum regfess

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
     regfess |        10     10668.4    17650.03          0   45994.46

. sum admfees

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
     admfees |        10    5985.731    8525.235          0      22450

. sum hostfees

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
    hostfees |        10    284544.2    333536.1          0    1046580
```

```
. sum tracertret

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
  tracertret |        10    60115.71    53124.51          0   189933.4

. sum attest

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
      attest |        10      4321.6    5764.909          0      18461

. sum icts

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
        icts |        10    12609.53    26459.06          0   63953.27

. sum sportfees

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
   sportfees |        10    15559.23    32909.49          0      83441

. sum invescom

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
    invescom |        10    82950.41    151319.1          0   447845.3

. sum usepolyfac

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
  usepolyfac |         9    35376.65     27570.1       2400      81263
```

```
. sum medfac

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
      medfac |        10    5870.475    13424.73          0   40663.75

. sum libryfac

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
    libryfac |        10    5145.563    11169.37          0      31628

. sum indsattch

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
   indsattch |        10      2053.2    6284.799          0      19932

. sum tendoc

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
      tendoc |        10      7364.5    10252.09          0      30000

. sum matricus

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
    matricus |        10    1721.431    3894.766          0   11606.31

. sum  congreg

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
```

```
    congreg |        10    108830.4    130425.6          0    390081.9
```

```
. sum  othersors
```

```
    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
   othersors |        10    769695.1     1661522       4934    5468615
```

```
. sum markfacresh
```

```
    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
 markfacresh |        10           0           0          0          0
```

```
. sum examsfee
```

```
    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
    examsfee |        10    124690.4    138790.5          0     332914
```

Generated Summary Statistics of Tracer Study

```
. tab gender
```

```
     gender |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |         29       30.21       30.21
          1 |         67       69.79      100.00
------------+-----------------------------------
      Total |         96      100.00
```

```
. tab sector
```

| sector | Freq. | Percent | Cum. |
|---|---|---|---|
| 0 | 19 | 19.79 | 19.79 |
| 1 | 77 | 80.21 | 100.00 |
| Total | 96 | 100.00 | |

tab wage

| wage | Freq. | Percent | Cum. |
|---|---|---|---|
| 400 | 10 | 10.42 | 10.42 |
| 600 | 25 | 26.04 | 36.46 |
| 800 | 12 | 12.50 | 48.96 |
| 900 | 28 | 29.17 | 78.13 |
| 1000 | 16 | 16.67 | 94.79 |
| 1200 | 5 | 5.21 | 100.00 |
| Total | 96 | 100.00 | |

. tab wage if gender==1

| wage | Freq. | Percent | Cum. |
|---|---|---|---|
| 400 | 7 | 10.45 | 10.45 |
| 600 | 14 | 20.90 | 31.34 |
| 800 | 6 | 8.96 | 40.30 |
| 900 | 25 | 37.31 | 77.61 |
| 1000 | 10 | 14.93 | 92.54 |
| 1200 | 5 | 7.46 | 100.00 |
| Total | 67 | 100.00 | |

. tab wage if gender==0

| wage | Freq. | Percent | Cum. |
|---|---|---|---|

```
------------+-----------------------------------
        400 |          3       10.34       10.34
        600 |         11       37.93       48.28
        800 |          6       20.69       68.97
        900 |          3       10.34       79.31
       1000 |          6       20.69      100.00
------------+-----------------------------------
      Total |         29      100.00

. tab wage if acchnd ==0

       wage |      Freq.     Percent        Cum.
------------+-----------------------------------
        400 |         10       13.70       13.70
        600 |         25       34.25       47.95
        800 |          6        8.22       56.16
        900 |         22       30.14       86.30
       1000 |          9       12.33       98.63
       1200 |          1        1.37      100.00
------------+-----------------------------------
      Total |         73      100.00

. tab midlevel

 midlevel=1 |
  if midlle |
 level, = 0 |
  otherwise |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |         73       76.04       76.04
          1 |         23       23.96      100.00
------------+-----------------------------------
      Total |         96      100.00
```

Generated Interval Regression Model Estimates

```
gen wage_low=.
gen wage_high=.
replace wage_low=. if wagecat==1
replace wage_high=log(400) if wagecat==1
replace wage_low=log(400) if wagecat==2
replace wage_high=log(500) if wagecat==2
replace wage_low=log(500) if wagecat==3
replace wage_high=log(600) if wagecat==3
replace wage_low=log(600) if wagecat==4
replace wage_high=log(700) if wagecat==4
replace wage_low=log(700) if wagecat==5
replace wage_high=log(800) if wagecat==5
replace wage_low=log(800) if wagecat==6
replace wage_high=log(900) if wagecat==6
replace wage_low=log(900) if wagecat==7
replace wage_high=log(1000) if wagecat==7
replace wage_low=log(1000) if wagecat==8
replace wage_high=log(1100) if wagecat==8
replace wage_low=log(1100) if wagecat==9
replace wage_high=log(1200) if wagecat==9
replace wage_low=log(1200) if wagecat==9
replace wage_high=. if wagecat==9

. intreg wage_low wage_high gender sector midlevel age age2 marired acchnd regnat

Fitting constant-only model:

Iteration 0:   log likelihood = -213.56723
Iteration 1:   log likelihood = -211.82349
Iteration 2:   log likelihood = -211.81193
Iteration 3:   log likelihood = -211.81193

Fitting full model:

Iteration 0:   log likelihood = -180.37858
```

```
Iteration 1:   log likelihood =   -179.127
Iteration 2:   log likelihood =   -179.125
Iteration 3:   log likelihood =   -179.125

Interval regression                             Number of obs     =         96
                                                LR chi2(8)        =      65.37
Log likelihood =   -179.125                     Prob > chi2       =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gender |   .0978811   .0655393     1.49   0.135    -.0305736    .2263358
      sector |   .1758679   .0597543     2.94   0.003     .0587517    .2929841
    midlevel |   .4234922   .0639155     6.63   0.000     .2982201    .5487644
         age |    .989771   2.581819     0.38   0.701    -4.070501    6.050043
        age2 |  -.0225982   .0558494    -0.40   0.686     -.132061    .0868645
     marired |  -.0258493   .0923774    -0.28   0.780    -.2069057    .1552071
      acchnd |   .2593381   .0678876     3.82   0.000     .1262809    .3923952
      regnat |   .0768069   .0907492     0.85   0.397    -.1010583    .2546721
       _cons |  -4.640253   29.83781    -0.16   0.876    -63.12129    53.84079
-------------+----------------------------------------------------------------
    /lnsigma |  -1.431743   .0834456   -17.16   0.000    -1.595293   -1.268193
-------------+----------------------------------------------------------------
       sigma |   .2388921   .0199345                      .202849    .2813396
------------------------------------------------------------------------------
            10  left-censored observations
             0     uncensored observations
             5 right-censored observations
            81       interval observations
```

| Item | Coefficient | Standard Error | z statistic |
|---|---|---|---|
| gender | .0978811 | .0655393 | 1.49 |
| sector | .1758679 | .0597543 | 2.94 |
| midlevel | .4234922 | .0639155 | 6.63 |
| age | .989771 | 2.581819 | 0.38 |
| age2 | -.0225982 | .0923774 | -0.40 |
| marired | -.0258493 | .0923774 | -0.28 |
| acchnd | .2593381 | .0678876 | 3.82 |
| regnat | .0768069 | .0907492 | 0.85 |

| | | |
|---|---|---|
| Interval regression | | Number of observation = 96 |
| | | LR chi$^2$(8) = 65.37 |
| Log likelihood = --179.125 | | Prob > chi2 = 0.0000 |
| Observation summary: | 10 | left-censored observations |
| | 0 | uncensored observations |
| | 5 | right-censored observations |
| | 81 | interval observations |

**Generated Summary Tracer Earnings Statistics**

```
sum lnearns gender sector midlevel age age2 married acchnd regnat
```

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| lnearns | 96 | 6.630154 | .3008057 | 5.991465 | 7.090077 |
| gender | 96 | .6979167 | .4615715 | 0 | 1 |
| sector | 96 | .7083333 | .4569157 | 0 | 1 |
| midlevel | 96 | .2395833 | .4290698 | 0 | 1 |
| age | 96 | 23.21875 | .6521725 | 22 | 24 |
| age2 | 96 | 539.5313 | 30.18363 | 484 | 576 |
| married | 96 | .1041667 | .3070802 | 0 | 1 |
| acchnd | 96 | .2395833 | .4290698 | 0 | 1 |
| regnat | 96 | .8645833 | .3439642 | 0 | 1 |

```
. sum lnearns  sector midlevel age age2 married acchnd regnat if gender==1
```

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| lnearns | 67 | 6.659593 | .3051738 | 5.991465 | 7.090077 |
| sector | 67 | .7164179 | .4541382 | 0 | 1 |
| midlevel | 67 | .2537313 | .4384298 | 0 | 1 |
| age | 67 | 23.22388 | .6924024 | 22 | 24 |
| age2 | 67 | 539.8209 | 32.01085 | 484 | 576 |

```
     marired |         67    .0597015    .2387212          0          1
      acchnd |         67    .2089552    .4096308          0          1
      regnat |         67    .9701493    .1714598          0          1

. sum lnearns  sector midlevel age age2 marired acchnd regnat if gender==0

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
     lnearns |         29    6.562138    .2839211   5.991465   6.907755
      sector |         29    .6896552    .4708236          0          1
    midlevel |         29    .2068966    .4122508          0          1
         age |         29     23.2069    .5592923         22         24
        age2 |         29    538.8621    25.98176        484        576
-------------+---------------------------------------------------------
     marired |         29    .2068966    .4122508          0          1
      acchnd |         29    .3103448    .4708236          0          1
      regnat |         29    .6206897     .493804          0          1

. reg lnearns gender sector midlevel age age2 marired acchnd regnat

      Source |       SS       df       MS      Number of obs   =        96
-------------+------------------------------   F(8, 87)        =     10.61
       Model |  4.24522684         8  .530653354   Prob > F        =    0.0000
    Residual |  4.35076067        87  .050008743   R-squared       =    0.4939
-------------+------------------------------   Adj R-squared   =    0.4473
       Total |  8.59598751        95  .090484079   Root MSE        =    .22363

------------------------------------------------------------------------------
     lnearns |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gender |   .0640797   .0597342     1.07   0.286    -.0546486    .1828079
      sector |   .1829448   .0538824     3.40   0.001     .0758477    .2900419
    midlevel |    .370199   .0584749     6.33   0.000     .2539737    .4864242
         age |   .4876903   2.349828     0.21   0.836    -4.182847    5.158228
        age2 |  -.0116179   .0508298    -0.23   0.820    -.1126477    .0894118
     marired |  -.0317884   .0840875    -0.38   0.706    -.1989213    .1353446
      acchnd |   .2237471   .0615468     3.64   0.000     .1014162    .3460779
      regnat |   .0915822   .0807509     1.13   0.260     -.068919    .2520834
```

```
       _cons |   1.182363   27.15605     0.04   0.965    -52.79322    55.15794
------------------------------------------------------------------------------

. reg lnearns  sector midlevel age age2 marired acchnd regnat if gender==1

      Source |       SS           df       MS      Number of obs   =        67
-------------+----------------------------------   F(7, 59)        =      9.46
       Model |  3.25049035         7  .464355765   Prob > F        =    0.0000
    Residual |   2.8961589        59  .049087439   R-squared       =    0.5288
-------------+----------------------------------   Adj R-squared   =    0.4729
       Total |  6.14664926        66  .093131049   Root MSE        =    .22156

------------------------------------------------------------------------------
     lnearns |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      sector |   .3469337   .0754917     4.60   0.000     .1958751    .4979924
    midlevel |   .4500963   .0791523     5.69   0.000     .2917129    .6084797
         age |   1.195579   2.729053     0.44   0.663    -4.265243      6.6564
        age2 |  -.0268651   .0590652    -0.45   0.651    -.1450543     .091324
     marired |  -.0736764   .1177651    -0.63   0.534    -.3093238    .1619709
      acchnd |    .197086     .07315     2.69   0.009     .0507131    .3434589
      regnat |    -.25941   .1701286    -1.52   0.133    -.5998367    .0810166
       _cons |  -6.751885   31.49899    -0.21   0.831    -69.78122    56.27745
------------------------------------------------------------------------------

. reg lnearns  sector midlevel age age2 marired acchnd regnat if gender==0

      Source |       SS           df       MS      Number of obs   =        29
-------------+----------------------------------   F(7, 21)        =      6.26
       Model |  1.52614216         7  .218020308   Prob > F        =    0.0005
    Residual |  .730970931        21   .03480814   R-squared       =    0.6761
-------------+----------------------------------   Adj R-squared   =    0.5682
       Total |  2.25711309        28  .080611182   Root MSE        =    .18657

------------------------------------------------------------------------------
     lnearns |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

| | | | | | | |
|---|---|---|---|---|---|---|
| sector | .005216 | .0850794 | 0.06 | 0.952 | -.1717163 | .1821483 |
| midlevel | .349205 | .1009724 | 3.46 | 0.002 | .1392214 | .5591886 |
| age | 2.570787 | 4.239219 | 0.61 | 0.551 | -6.245151 | 11.38672 |
| age2 | -.0567462 | .0916601 | -0.62 | 0.543 | -.2473638 | .1338713 |
| marired | -.0346497 | .1151388 | -0.30 | 0.766 | -.2740939 | .2047945 |
| acchnd | .3169432 | .1077871 | 2.94 | 0.008 | .0927877 | .5410988 |
| regnat | .2150185 | .0905582 | 2.37 | 0.027 | .0266923 | .4033446 |
| _cons | -22.81995 | 48.99587 | -0.47 | 0.646 | -124.7124 | 79.07254 |

**APPENDIX B: Students, Lecturers, Administrators Perception of Polytechnics Internally Generated Funds Questionnaire**

Hello, I am a PhD researcher from the University of Education, Winneba. This questionnaire is used to gather data to examine whether in your perception, a Polytechnic Institution Internally Generated Funds (IGFs) item in 2015 is an additional cost to students or not. IGFs refer to incomes generated by the Polytechnic Institutions which do not form part of the Government of Ghana subventions granted. Please, you have been selected as a respondent to respond to this questionnaire and may you spare some time to fill out this questionnaire. It is strictly for an academic purpose and all responses provided shall be treated with maximum caution and confidentiality. All personal data shall be treated collectively and not on personal terms.

Thank you.

**Section A: Employment Demographics of Respondents**

Please, tick (√) as appropriate.

- A Polytechnic Administrator ( )
- A Polytechnic Lecturer ( )
- A Polytechnic Student ( )

**Section B: Response of Perception on whether a source of an IGF item is a Cost to Students or Not.**

Please, tick (√) the response that suits your perception.

1. Do you perceive the *Polytechnics IGFs item Academic Facility User Fee* generated in 2015 as an additional cost to students? Yes ( ) No ( )

2. Do you perceive *Polytechnics IGFs item Tuition Fees* generated in 2015 as an additional cost to students? Yes ( ) No ( )

3. Do you perceive *Polytechnics IGFs item Rent from Staff* generated in 2015 as an additional cost to students? Yes ( ) No ( )

4. Do you perceive *Polytechnics IGFs item NABPTEX Registration Fees* generated in 2015 as an additional cost to students? Yes ( ) No ( )

5. Do you perceive *Polytechnics IGFs item Introductory Letter Charge* generated in 2015 as an additional cost to students? Yes ( ) No ( )

6. Do you perceive *Polytechnics IGFs item Application Forms Charges* generated in 2015 as an additional cost to students? Yes ( ) No ( )

7. Do you perceive *Polytechnics IGFs item ID Card Fees* generated in 2015 as an additional cost to students? Yes ( ) No ( )

8. Do you perceive *Polytechnics IGFs item Registrations Fees* generated in 2015 as an additional cost to students? Yes ( ) No ( )

9. Do you perceive *Polytechnics IGFs item Admission Fees* generated in 2015 as an additional cost to students? Yes ( ) No ( )

10. Do you perceive *Polytechnics IGFs item Hostel Fees* generated in 2015 as an additional cost to students? Yes ( ) No ( )

11. Do you perceive *Polytechnics IGFs item Transcript/Results Charges* generated in 2015 as an additional cost to students? Yes ( ) No ( )

12. Do you perceive *Polytechnics IGFs item Attestation Charges* generated in 2015 as an additional cost to students? Yes ( ) No ( )

13. Do you perceive *Polytechnics IGFs item Examination Fees* generated in 2015 as an additional cost to students? Yes ( ) No ( )

14. Do you perceive *Polytechnics IGFs item ICT Fees* generated in 2015 as an additional cost to students? Yes ( ) No ( )

15. Do you perceive *Polytechnics IGFs item Sports Fees* generated in 2015 as an additional cost to students? Yes ( ) No ( )

16. Do you perceive *Polytechnics IGFs item Investment Income* generated in 2015 as an additional cost to students? Yes ( ) No ( )

17. Do you perceive *Polytechnics IGFs item Polytechnic Facilities Charges* generated in 2015 as an additional cost to students? Yes ( ) No ( )

18. Do you perceive *Polytechnics IGFs item Medical Fees* generated in 2015 as an additional cost to students? Yes ( ) No ( )

19. Do you perceive *Polytechnics IGFs item Library Services Fees* generated in 2015 as an additional cost to students? Yes ( ) No ( )

20. Do you perceive *Polytechnics IGFs item Industrial Attachment Fees* generated in 2015 as an additional cost to students? Yes ( ) No ( )

21. Do you perceive *Polytechnics IGFs item Tender Documents Fees* generated in 2015 as an additional cost to students? Yes ( ) No ( )

22. Do you perceive *Polytechnics IGFs item Matriculation ceremony charges* generated in 2015 as an additional cost to students? Yes ( ) No ( )

23. Do you perceive *Polytechnics IGFs item Congregation Charges* generated in 2015 as an additional cost to students? Yes ( ) No ( )

24. Do you perceive *Polytechnics IGFs item Other Income* generated in 2015 as an additional cost to students? Yes ( ) No ( )

25. Do you perceive *Polytechnics IGFs item Marketing of Faculty Research Works* generated in 2015 as an additional cost to students? Yes ( ) No ( )

26. Do you perceive *Polytechnics IGFs item Marketing of Faculty Research Works* generated in 2015 as an additional cost to students? Yes ( ) No ( )

27. Do you perceive *Polytechnics IGFs item Regional Funding from Municipal/Metropolis/Regional Assemblies* generated in 2015 as an additional cost to students? Yes ( ) No ( )

28. Do you perceive *Polytechnics IGFs item Licensing Income from Patents* generated in 2015 as an additional cost to students? Yes ( ) No ( )

29. Do you perceive *Polytechnics IGFs item Financial Donations of Organisations, Companies, Corporations* generated in 2015 as an additional cost to students? Yes ( ) No ( )

30. Do you perceive *Polytechnics IGFs item Alumni Financial Donations* generated in 2015 as an additional cost to students? Yes ( ) No ( )

31. Do you perceive *Polytechnics IGFs item Tolling and Parking of Cars Charges* generated in 2015 as an additional cost to students? Yes ( ) No ( )

32. Do you perceive *Polytechnics IGFs item Provision of Short Courses and Competency Based Skills* generated in 2015 as an additional cost to students? Yes ( ) No ( )

**Section C: Relevant to only Lecturers and Administrators**

33. Do you agree that apart from tuition fees generated, Lecturers do not enjoy in all the other IGFs generated? Yes ( ) No ( )

**APPENDIX C: Polytechnics 2013 HND Graduates Tracer and Gender Earnings Gap Study Questionnaire**

Hello, I am a researcher from the University of Education, Winneba. This questionnaire is used to gather data to explore the monthly market earnings and gender earnings gap of the public Polytechnic Institutions 2013 HND graduates in the Ghanaian labour market in 2015. Please, you have been purposefully selected as 2013 HND graduate and may you spare some time to fill out this questionnaire. It is strictly designed for an academic purpose and thus all responses you provide shall be treated with maximum caution and confidentiality. All personal data shall be treated collectively and not on personal terms.

Thank you.

**Section A: Gender Demographics of Respondents**

Please, **tick (√)** as is appropriate.

Gender: Male ( ) Female ( )

**Section B: Employment Demographics of Respondents**

1. Please are you employed? Yes ( ) No ( )

If yes:

2. Are you employed in the informal sector? Yes ( ) No ( )
3. Are you a native of the region where you are now employed? Yes ( )

   No ( )
4. Are you a 2013 Accountancy HND certificate holder? Yes ( ) No ( )
5. Are you married? Yes ( ) No ( )
6. Please respectfully write down your age ……..
7. Do you consider yourself as a mid-level employee? Yes ( ) No ( )
8. Please, respectfully where do your monthly earnings in the labour market in 2015 falls within these earnings categories? Please tick (√) as is applied to you.

Monthly Earnings < GH₵ 400 ( )

400 ≤ Monthly Earnings < GH₵ 500 ( )

500 ≤ Monthly Earnings GH₵ 600 ( )

600 ≤ Monthly Earnings GH₵ 700 ( )

700 ≤ Monthly Earnings GH₵ 800 ( )

800 ≤ Monthly Earnings GH₵ 900 ( )

900 ≤ Monthly Earnings GH₵ 1,000 ( )

1,000 ≤ Monthly Earnings GH₵ 1,100 ( )

Monthly Earnings ≥ GH₵1,100 ( )

**Section C: Response on Whether to Pursue Post-HND at the Polytechnic Institutions or at the Traditional Universities**

Please, tick (√) as is appropriate to you.

9. Would you want to pursue a post-HND study at the Polytechnic Institutions or at the Traditional Universities? Yes ( ) No ( )