UNIVERSITY OF CAPE COAST

BUSINESS ENVIRONMENT, INNOVATION AND FIRM PERFORMANCE IN AFRICA

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BY

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A Thesis submitted to the Department of Economic Studies of the School of Economics, College of Humanities and Legal Studies, University of Cape Coast, in partial fulfillment of the requirements for the award of Doctor of Philosophy degree in Economics

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DECLARATION

Candidates Declaration

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

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

Name: Emmanuel Atta Anaman

Supervisors' Declaration

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

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

Name: Prof. Emmanuel Ekow Asmah

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

Name: Dr. Francis Kwaw Andoh

ABSTRACT

This thesis examined the effect of different aspects of business environment and innovation on firm performance in Africa. It employed micro-level data set (World Enterprise Survey, 2013) from a sample of 9,019 firms and used eight econometric regression techniques in the empirical estimations: Stochastic Meta-frontier, OLS, standard IV, Lewbel 2SLS, ESR, probit, PSM and dominance analysis. Using the stochastic meta-frontier efficiency estimation approach, evidence is adduced to show that firms in Sub-Saharan Africa on the average are more efficient than their counterparts in the Maghreb Africa area and also operate closer to the best technological frontier than the Maghreb firms though the efficiency levels in all the sub regions are found to be very low. However, firms in all the two regions operate under increasing returns to scale suggesting that they are functioning within the first stage of production and not utilizing the most optimal combinations of inputs available to them. There is, therefore, room for firms in the two regions to improve their efficiency by reducing their long-run average costs. The empirical estimation of the relationship between the business environment and innovation on firm efficiency conditioned on firm characteristics showed that business environment and innovation independently and positively enhance firm efficiency but their combined effect is greatest. Empirical results also suggest that efficiency significantly influence capacity utilization, sales, and exports, though in varying degrees. From a policy standpoint, governments in Africa are encouraged to strive to create the facilitating business environmental conditions which motivate firms to innovate, and also adopt more modern production technologies to be able to scale up their efficiencies. Firms must also be encouraged to employ appropriate innovation strategies to achieve specific performance objectives.

KEYWORDS

Africa
Business environment

Efficiency

Firm performance

Innovation

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DEDICATION

To my Daddy, the loving memory of my late Mother and all my siblings.

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CHAPTER ONE

INTRODUCTION

Background to the study

The firm is the basic unit of production in every economy and is thus the driving force which advances economic growth and development across the world. The performance of firms therefore, represents the one of the most observed aspects of economies which is taken very seriously in all countries because firms are the bedrock of wealth generation, a source of employment for the mass of the people and a veritable avenue for raising tax revenues for development. According to the ILO (2012), by the year 2020, more than 600 million jobs are required to be created in the developing countries alone and this can only be realized through more efficient and better functioning firms. The importance of firms is put in greater context by Stein, Goland and Schiff (2010) when they intimate that in developing countries, the operations of SMEs alone account for more than 45% of employment and more than 35% of GDP.

Similarly, the OECD report (2004) underlines the role of the firm in their region by stating that about 70% of all jobs are created through the activities of MSMEs and their operations produce more than 55% of the GDP in the region. Thus, firm-level activities are the fulcrum around which the growth and expansion of the economies of various countries revolve and hence without consistent growth of firms, countries and for that matter the regions that they belong to may experience economic stagnation, increasing unemployment and ultimately causing declining standards of living. Aside of the income and wealth that they create, firms also build up the human capital of societies in which they are found and also serve as the bedrock for nurturing entrepreneurs and captains of industry in countries. Thus, in the world over, a lot is expected of firms and they can only prove equal to these expectations when they are able to rapidly expand their operations.

Even though the crucial role of the firm is significantly understood and recognized in every part of the world, most firms, especially in Africa, find themselves in harsh and debilitating business environments which make it difficult for them to operate the way they want. Businesses and for that matter firms all over the world encounter very torrid situations and face both internal and external adversities which negatively impinge on their performance. Many firms in different parts of the world have had to contend with a wide diversity of problems from finance to even registration procedures. Even as there challenges confronting firms across the world, they are usually not exposed to the same types of problems but may experience peculiar environments depending on the country, industry or an area of a country within which they find themselves.

The reason why business environment is seen as a very critical factor which affects firm performance is that it acknowledged as that which defines the conditions within which firms operate, creates the incentive structure and for that matter significantly contributes to shaping and defining the competitiveness of firms.

Blagova and Tokhtarova (2014) opined that business environment has a number of components including business regulation; labour; taxation; institutions and property rights; infrastructure; finance as well as the general macroeconomic environment. They further indicate that these factors affect firms individually and separately as well as collectively.

It has also been advanced that the transition of firms from a predominantly controlled environment to a more libertarian, market propelled production and business environment, especially in developing economies, has underscored the need for taking the prevailing business environment into account in firm-level performance analysis (Commander & Svejnar, 2011). Accounting for the influence of the business environment on the efficiency and performance of firms in Africa is more critical than anywhere else in the world. This is particularly so because of the fact that of the various regions in the world, the performance of firms in Africa over the years have been the least impressive and as a result, economic growth rates have generally not been as satisfactory as people expect. This is amply demonstrated by Abderrahim and Aggad (2018), who calculate that between 2000 and 2010, the average growth in Africa hovered around 5.4% but between 2010 and 2015, the overall average growth had slumped to 3.3% and these do not compare favourably with firm performance in other regions of the world such as China whose performance averaged 10% growth rate between 2000 and 2013 as well as other Asian countries whose economic growth rates have consistently been maintained above 5%.

Moyo and Taiwo (2011) underline the precarious nature of the business environment in Africa when they assert that the domestic trade sector of African countries is plagued by serious dysfunctional ailments and these seriously hamper the operations and ultimately the performance of firms. The nature of the business environment in Africa is aptly reflected in the African

Development Report (2011). According to the report, the 2010 and 2011 *Doing business* reports show that of the twenty-five countries categorized as the worst in terms of the index of doing business, twenty of them were found in Africa and more specifically in sub-Saharan Africa and even more damning, the average ranking of African countries on the league of 183 countries was 137 as opposed to the average ranking of 72 for the East European and Central Asia regions and 96 and 87 respectively for the Latin American and East Asia regions. Indeed over the last ten years there has been very little improvement in the business environment in Africa and this continues to hamper the production environment on the continent. Apart from these, the institutional environment is classified as the weakest compared with that of the other regions of the World and this is underlined by the fact that 13 out of the twenty countries with the weakest institutions were said to be in Africa.

Generally, the business environment in Africa is characterized as the least friendly across the World and these are fuelled by deep, widespread perceptions of the unpredictable nature of regulations and frequently chaotic, confused interpretation of rules which increase the propensity for corruption, adverse tax policies, increasing levels of internal and external competition as well as poor infrastructural overheads (Doing business report,)

. With these in perspective, it is not surprising that across the continent, the private sector continues to identify the prevailing business environment as the biggest obstacle to the performance and growth of firms and businesses.

Against the background of unfriendly, hostile and sometimes excruciating business environmental conditions which businesses encounter in Africa, it is argued that firms can continue to survive even in such a milieu by being innovative. Innovation is thus seen as the vehicle by which firms can surmount the harsh realities that they usually are confronted with. This view is well articulated by Olugbhor (2015) who argues that innovation allows firms to be competitive even in a torrid business environment. Gunday, Ulusoy, Kilic, & Alpkan, (2011) reiterate a similar view by asserting that the use of innovation is important for firms to be able to escape the realities of global competition against the background of challenging business environments and indeed it is strongly argued that through innovation firms may be able to set themselves apart from others.

This view is highlighted and amplified by Cantwell and Mudambi (2005) who reaffirm the importance of innovation and argue that innovation not only distinguishes firms in terms of their products and technological applications but also ensures their continued sustenance and competitiveness in both the domestic and international markets. Reçica (2016) also emphasizes the centrality of innovation in contemporary development policy. He maintains further that innovation is the key driver of firm performance and economic growth. This perspective is put in greater context by Oluwatobi, Efobi, Olurinola and Alege. (2014) who demonstrate using the Solow growth model that innovation accounts for 85% of economic growth. In the words of Pavit (1984) therefore, the adoption of innovation has dramatically influenced production in certain parts of the world and this has contributed significantly to social evolution and development; bringing about the rapid transformation of the face of such societies.

Despite the fact the extant literature has amply demonstrated the potential advantages and the consequent impacts of innovation on firm performance in

Africa, the adoption of innovative approaches in firm operations has generally not been very encouraging compared with other regions of the world and therefore innovation-driven and enhanced growth and performance of firms have not been as is expected. Examining the literature, it is obvious that in most innovation surveys which are available, Africa appears to be always lagging behind other regions of the world (See Global innovation index 2019, 2020 and 2021). It is widely believed and demonstrated in the innovation surveys that in Africa, there are a lot of practical barriers and challenges to firm innovation mainly on account of the conditions which exist in most African countries. Most African firms are confronted with a wide array of bottlenecks within the business environments that they operate and these make it difficult for them to embark on innovations which could ultimately enhance their competitiveness within the market spaces that find themselves. Some of the most common problems which usually hinder firm innovativeness are access to adequate financing, bureaucratic tendencies within patenting and regulatory institutions, the lack of consistency of power supplies, frequent power outages, the tax structures and the way their administration affects firms as well as customs payments at entry/exit points for goods.

To the extent that firms are in business to make the best out of their operations, they would always endeavour to maximize outputs from their respective input sets. Thus, firms in Africa just as firms everywhere else in the world are always working towards deriving output levels which are as close as possible to the optimum set of output achievable. However, as already elucidated, firms in Africa come up against a host of factors which militate against their strides to achieve efficiency and key among them are the prevailing business environment and the ability to innovate.

Statement of the Problem

The slow growth of the economies of most African countries has particularly been very detrimental to the aspirations of their people and the developmental trajectory of most of the countries on the continent. As a result, the rate of creation of jobs, the growth in the incomes of the people and above all the ability of the countries to transform their economies and reduce poverty have not been the most desired.

Against the background of slow growth, Commander and Svejnar (2011) suggest that increasing the efficiencies and performances of firms is a *sine qua non* to achieving rapid growth. This is particularly an imperative in Africa where growth is weakest across the world.

In contemporary firm level studies, the business environment has been highlighted as a key factor which affects firm performance and this is well in articulated by North (1990) and reinforced by Alby, Dethier and Straub (2010) .According to them, the business environment can create the right conditions for production or undermine it by affecting the incentive structure in the economy.

In the literature there is an overwhelmingly accepted view that the performance of African economies have generally been disappointing especially over the last decade (Sundaram, Schwank and Von Armin , 2011) and for that reason this has triggered a number of the studies which have sought to understand this situation largely from a macroeconomic perspective. However the microeconomic aspects have not received the same attention as the macroeconomic. It is instructive to note that the microeconomic dimensions directly affect firms and how they operate and these ultimately have implications for overall economic growth. Indeed even as firm performance is accepted as the bedrock of economic growth, in the literature, firm level analysis especially relating to Africa has been limited. And of the few available ones, most of them are country oriented and hence endeavoured to assess performance of firms in specific countries. Edjigu (2016) in Ethiopia; Aggrey, Eliab and Shitundu (2010) centred around East Africa; Ndemezo and Kayitana (2020) which focused on Rwanda and Nguimkeu (2013) undertaken in Cameroon, for example have yielded some knowledge and hence provided the impetus for firm level performance oriented studies in Africa. Even though these studies have provided some insights on firm level performance in Africa, to date there is no evidence of any study which examines business environment and firm performance in Africa. Apart from the fact this is to best of my knowledge the first cross Africa study, it is also one of the early empirical researches to use the meta-frontier analysis to examine and compare the efficiencies of firms in Sub-Saharan Africa and those in the Maghreb Africa. This method makes it possible to examine the technological gaps which exist between the firms in these two sub regions in Africa, especially having regard to the differences between these two sub regions in respect of the key factors which influence production and technological choices.

Another advantage that the employment of the meta-frontier analysis in this study brings over previous studies is that it allows the measurement of the extent to which firms in the sub regions are closer or far away from the technological frontier and therefore test the assertion of Goedhuys and Sleuwaegen (2010) that firms in developing countries mostly operate below the technological frontier.

With the emergence of the African Continental Free trade Area (ACFTA), the issue of firm efficiency across Africa has become very imperative. This is because it is only when firms on the continent are sufficiently efficient that the benefits of the initiative would be enjoyed by the African countries and the people for that matter. It is in this light that the study seeks to determine whether there are able to operate at the potential output levels.

Thus another contribution which this study seeks to make is the application of efficiency as an overall performance indicator instead of the conventional productivity employed in most analysis .This is in line with De Loecker (2011) and Sadaf and Ishaq (2018) who have argued that when the objective of a study is to compare firm performance, efficiency is a better indicator.

Again from the extant literature, it is observed that examining the connection between business environment and firm performance is not only fairly new but also that most of the studies available suffer from issues of endogeneity (see, for example, Beck, Demirguc, & Maksimovic, 2005; Dollar, Hallward-Driemeier, & Mengistae, 2005; Johnson, McMillan & Woodruff, 2002a, 2002b). Apart from this obvious problem, another issue which has not been appropriately tackled in the literature and which the current study takes up is examining how an overall aggregate business environment influences firm performance.

Another important area which has been a focal point of empirical firm level analysis is how innovation effectively influences firm performance especially as innovation has been argued to provide a strong impetus for firm performance. Even though innovation has been applied to a great effect in other areas of the world, in Africa it has not been leveraged very well and therefore has had little impact .Also the existing literature relates to the advanced areas of the world and thus the analytical framework which has preponderantly been employed in this line of studies is the Crépon Duguet Mairesse (CDM) approach encompassing a four stage process described by Aghion and Tirole (1994) as the 'black box' phenomenon. However its applicability to developing countries' contexts especially Africa is questioned by AfDB (2014) and Goedhuys and Vengelers (2012) on account of the fact that it was developed to suit developed economic environment with little relevance to developing countries. According to them, in reality, technological and innovative advancement of production in developing countries especially Africa occurs through absorption and adoption of existing technologies.

Secondly the CDM model is designed in a way that it is not able to account for and deal with endogeneity and selection bias comprehensively (Ndemezo & Kayitana, 2020). This study therefore resolves the problem of the applicability of the CDM model by employing the endogenous switching regression model.

Gleaning the literature, another area which has not been explored in empirical analysis is the joint effect of business environment and innovation on firm performance .within the African region and across the entire .world Thus beyond investigating the influences of business environment and innovation separately on firm performance, this study seeks to understand how the interaction between the two factors affect the performance of firms in Africa. This is important especially for policy purposes because the business environment can influence the innovation behaviours of firms and also combine with innovation to produce different effects on firm performance.

Another aspect of firm level analysis which has not received the needed attention in empirical literature but this study seeks to tackle is how efficiency of the firm drives specific aspects of performance which are usually outcome variables for firms. In this study therefore, efficiency is regarded as a latent performance concept which must ultimately reflect in the objective, observable outcome/performance variables like exports, revenues and capacity utilization. In the literature however, no substantial studies have been conducted to provide an understanding of the extent to which efficiency affects these objective outcome variables in Africa and the sub regions for that matter. For example it is known that one of the ultimate objectives of firms is to eventually be in a position to penetrate foreign markets and therefore firms strive hard to enter external markets usually by continuously improving upon their operations and being competitive. In the literature there appears to be an overwhelming gravitation towards a view that firms become more efficient when they export. This so called learning –by –doing effect is highlighted in a plethora of studies. The underlining argument in this is that firms enjoy technological spillover effects, learn new ideas and acquire new skills in the external markets within which they operate and these enhance the efficiencies of firms.

There is however the other view which suggests that firms are able to enter and access external markets only when they have become efficient and can therefore compete within that market sphere, a phenomenon referred to as the self-selection effect. In the view of the researcher, the latter position is more plausible for developing areas of the world such as Africa but there is only one known study (Granér and Isaksson, 2009) in Africa which is built on the premises of the self-selection theory and this study was restricted to the manufacturing sector in Kenya. The current study therefore argues that the self-selection theory is the most appropriate theoretical position to support empirical studies in the field of efficiency-exports relationship in Africa. It is in this vein that this study undertakes to ascertain the effect of efficiency of African firms on their ability to export. Another contention of the present study is the fact that one of the key factors which influence the ability of firms to ramp up their revenues and capacity utilization is obviously efficiency and these areas are largely unexplored and therefore warrant to be researched into. This study therefore hopes to contribute to knowledge in this area as well.

Objectives of the study

The main aim of this study is to investigate the effects of business environment and innovation on firm performance in Africa.

More specifically we seek to

1. Examine the levels of efficiency of firms in Africa and determine whether firms in SSA and Maghreb operate under different technological environments
2. Measure the extent to which firms in SSA and Maghreb are able to achieve potential output and identify the firm specific factors which influence efficiencies of these firms.
3. Investigate the relationship between business environment, innovation and efficiency of firms in Africa.
4. Assess the effect of efficiency on financial and non-financial performance indicators of firms in Africa.

Hypotheses of the study

Flowing from the objectives above, the following hypotheses are defined to be tested.

1. H_0: Firms in Sub-Saharan and Maghreb Africa do not produce from different sectors of the technological set available.

   Ha: Firms in Sub-Saharan and Maghreb Africa do produce from different sectors of the technological set.

2. H_0: There is no significant difference between the efficiencies of firms in SSA and Maghreb Africa.

   Ha: The efficiency of firms in SSA is significantly different from that of firms in Maghreb Africa.

3. H_0: Firms in both SSA and Maghreb Africa do not experience any inefficiencies in their respective productive environments.

   Ha; Firms in SSA and Maghreb Africa experience inefficiency effects in their lines activity.

4. H_0: Firm specific factors do not significantly influence their efficiencies.

   Ha: The efficiencies of firms in Africa are conditioned by firm specific factors.

5. H_0: Innovation by firms in Africa is not significantly influenced by the prevailing business environment.

   Ha: Innovation by firms in Africa is significantly influenced by the prevailing business environment.

6. H_0: Innovation does not have a significant impact on the efficiency of firms in Africa

Ha: Innovation has a significant effect on the efficiency of firms in Africa.

7. H_0: The joint effect of the business environment and firm innovation does not significantly affect the efficiency of firms in Africa.

   Ha: The joint effect of business environment and innovation significantly influences the efficiency of firms.

8. H_0: Efficiency does not significantly affect the utilization of the full capacity of firms in Africa

   Ha: Efficiency significantly affects the utilization of the full capacity of firms in Africa.

9. H_0: Exports by firms in Africa are not significantly affected by the firm efficiency.

   Ha: The efficiency of firms in Africa significantly influences exports .

10. H_0: The efficiency of firms in Africa does not significantly influence their sales revenues.

   Ha: The efficiency of firms in Africa significantly influences their revenues.

In the above, hypotheses 1, 2 and 3 relate to the objective one, hypothesis 4 is associated with objective 2, hypotheses 5, 6 and 7 are linked to objective 3 and finally hypotheses 8, 9 and 10 are connected with objective 4.

Significance of the study

This research work makes significant contributions to the literature on the factors which influence firm performance in many respects. First, gleaning majority of the existing studies on the effects of business environment on firm performance, it is obvious that they have approached their investigation by basically considering the individual effects of the elements of the business environment on the performance of firms. However, in this thesis, beyond examining the individual effects of the constituents of the business environment on the performance of firms, the aggregate effect of the business environment on firm performance is also considered by deriving business environmental index from these individual elements, which makes it possible to appropriately assess the general impact of the business environment on the performance of firms. This is very important for policy purposes because aside of implementing policies to respond to specific situations of the impact of the business environment on firm performance, countries would also normally want to look at how to design policies to be able to tackle how the aggregate business environment affects the performance of the firms.

Again, another novelty of this study is its added approach in relating the business environment that confronts the firm to the ability and the propensity of the firm to engage in innovation. Till date, this has not been very well articulated in the literature and therefore this study brings that important perspective to bear in moving forward the frontiers of knowledge in this domain.

Again the study proceeds to determine the how business environment and innovation jointly influence the efficiency of the firms in Africa. This is also another aspect which has not been taken up in the literature and has definitely been missing from the literature and therefore this approach seeks to bring that new dimension to the discussion and by that enrich the literature and knowledge available. Based on the evidence adduced, policymakers would get a better understanding and sense of what elements of the business environment are the most formidable obstacles to firm efficiency and in what way the business environment combines with innovation to influence overall firm performance.

Indeed, gleaning the literature perhaps one of the most striking things that comes across is that in dealing with the innovation-firm performance relationship/nexus, all the analyses available have been calibrated within the Crépon-Duguet–Mairesse (CDM) framework, a framework which has been argued to be empirically inappropriate for the Africa environment for peculiar reasons. The current study therefore introduces for the first time, endogenous switching regression as the most appropriate analytical framework for determining the effects of innovation on firm efficiency and by it is expected that something new to would be added to what knowledge exists in this field. Besides adding to the literature, this approach is better able to inform policymakers as to how to design the right supporting mechanisms to provide the enabling environment for firms to perform better.

The use of the stochastic meta-frontier analysis for firms in Africa also allows policymakers to determine whether firms are functioning with the best technology possible. This would effectively provide analysts and policymakers with the requisite evidence to address firm inefficiencies across the regions.

To conclude, it has to be emphasized that this study has the potential of adding to the repository of knowledge that already exists in the domain of determinants of firm performance and even more importantly provide policy-oriented evidence to improve the performance of the firms in Africa.

Motivation for the Study

In the contemporary world of production, business environment and innovation have become the most important planks of the strategy for attaining competitive advantage in all domains of activity. Whilst the business environment may nominally affect firms' cost of production, the innovativeness of firms usually allows firms to be able to create certain crucial advantages for themselves within the market space and thus set themselves apart from their competitors.

In Africa, one of the problems associated with poor economic performance is the lack of relative competitiveness of the firms that operate here as compared with others which are in other areas of the world. Firms in Africa mostly operate in very strangulating circumstances and this makes it difficult for them to cope within their various market spheres and this compromises their ability to grow and expand as they are very susceptible to shocks and pressure both from within or outside.

Apart from the challenging business environments as is reflected in most of the *Doing business* surveys, there is at least anecdotal evidence corroborated by innovation researches across the world which underlines the status of Africa generally as a laggard when it comes to innovation activities. This exacerbates the competitive disadvantage of firms on the continent and creates an existential threat to its economic growth and development potentials.

Particularly with the creation of the African Continental Free Trade Area, African firms can derive the maximum benefits only when they are propped up to optimize their efficiencies. Firms would be in good stead to do this when the issue of the business environment is dealt with. Furthermore, a doubled-up approach is needed to create the conditions for firm innovation in Africa.

Put together, the ability of Africa countries to decisively deal with the issues of the business environment and firm innovation has the potential of drastically improving upon the fortunes of the firms across the continent and through that firms would take the rightful place in opening up the African economy, creating employment and prosperity on the African continent and enable Africans to derive the best out of the free trade area arrangement.

With the barriers of the business environment and the conditions for innovation well addressed in Africa, many more prospective entrepreneurs would be motivated to invest in businesses which development would dramatically improve on the circumstances of Africa and its people.

Organization of the Study

This thesis is written and presented in eight chapters. In the first chapter, an attempt is made to provide a broad introduction to the topic with a background to the study followed by the identification and the elucidation of the problem of the study. From the problem statement, the researcher proceeds to identify the broad and specific objectives of the study after which the hypotheses of the study are outlined. The concluding parts of the chapter encompass the significance, the motivation and the scope of the thesis in that order.

The Chapter Two is devoted to a thorough and diligent review of the relevant literature and undertakes a systematic synthesis of all the relevant issues to be able to put all of them into the context of the topic at stake. It also discusses the concepts of the business environment, innovation as well as performance within the firm context and endeavours to establish the relationship between them.

Chapter Three considers all the theories which underpin firm innovation, performance and provides the empirical basis for the study by considering and examining previous studies in areas related or similar to the topic under study

In Chapter Four, the methodological approach in the study is broadly highlighted and elucidated. It discusses the alternative research paradigms and teases out the philosophy underpinning the current study. It then considers the approaches of the stochastic frontier and meta frontier efficiency models and follows this up with technical outlines of the probit model, the endogenous switching regression model (ESR) as well as the description of the dominance and propensity score matching analyses..

Chapter Five concentrates on the derivation of the production functions from the estimations, measurement of the efficiencies of firms and as well, the key determinants of firm-level efficiency in Africa. It also reports on the outputs of the sub-regions relative to the potential output as well as the technological gaps which exist among African firms taking into consideration two sub main regions in Africa-Sub Saharan and Maghreb Africa and then explores the returns to scale of the firms in the sub regions as well as the entire African continent.

Chapter Six delves into the nexus between the business environment, innovation and efficiency of firms in Africa from the empirical standpoint by systematically considering impacts of business environment and innovation on how firms perform in Africa. It begins by assessing the separate effects of business environment and innovation respectively on the efficiency of firms in

Africa and then presents the results from the estimation of the joint effect of the business environment and innovation on efficiency. The last section of the chapter deals with the discussion of the outcomes of the endogenous switching regression (ESR) to help ascertain how business environmental and firm specific factors moderate the empirical connection between innovation and efficiency.

Chapter Seven takes up the investigation of the effect of firm efficiency on various specific aspects of their performance-capacity utilization, revenue and exports. These are followed by the dominance analysis and propensity score matching to verify the influence of efficiency on the performance indicators above. .

Chapter Eight, the concluding chapter provides a synopsis and summary of the study and then draws the relevant conclusions from the results of the empirical estimations. The closing sections of the chapter highlight the key policy implications and vital recommendations which are required to enhance the performance of firms on the African continent. Lastly it underlines and points to areas of challenge to the research from which possible future research areas are identified and defined.

CHAPTER TWO

THE CONCEPTS OF FIRM PERFORMANCE, INNOVATION AND BUSINESS ENVIRONMENT

Introduction

The objective of the chapter is to isolate, review and properly position the relevant conceptual issues in the study. It delves into the performance concepts – efficiency, capacity utilization, sales revenues and exports and also discusses the nature of the business environment which is usually encountered by production units and how it influences the operations of the firm. It also highlights the significance of innovation by firms in the pursuit of higher performance, dissects how firm innovation is inhibited or promoted by the prevailing business environment and discusses the theories of innovation and how these affect firms' operations especially within the study area -Africa. The concluding part of the chapter considers developments in the business environment in Africa and provides an overview of innovation activities in Africa.

Concepts of Performance

Every firm is in business to maximize its objectives and most of these objectives are in the form of performance indices which define the progress of that entity. In the economic domain, there are different ways of measuring the performance of firms; Whereas in the literature, efficiency and variants of productivity-total factor productivity and labour productivity are considered general, broad measurements of performance, firm level variables like revenues, capacity utilization, exports and employment are regarded as outcome oriented indices which are used by firms to determine the extent to which they are achieving their objectives. . To be more precise, measurements of performance in Economics can broadly be categorized under financial and non-financial indices. However, in this thesis, the focus will be on one broad measure of performance-efficiency and three specific performance indices-capacity utilization, sales revenue, and exports.

Efficiency

This is one of the important approaches adopted by economists in determining the performance of firm units in an economy. It is fundamentally a relative concept which determines/measures the level to which a production unit is able to convert its inputs into outputs compared to a certain optimum which could be achieved by the firm given its inputs. Put in another way, the efficiency of a firm relates a firm's observed output to the potential output the firm can achieve employing a given set of inputs. The works of Farell, Koopmans and others have provided a strong basis for both the theoretical and empirical development of the concept of efficiency and have largely led to the current body of knowledge in the field of efficiency.

According to Farrell (1957) which is regarded as one of the trail blazers in efficiency studies, efficiency can be characterized as the advantage that one production unit has over another or its competitors in terms of their ability to maximize the output of a good or service within the constraints of a given set of inputs. Koopmans (1951) however defines efficiency from another perspective. In his words, efficiency is a description of a situation in which for a given society it is not possible to expand its output of a good any further without producing less of the other goods or having to use more of some inputs. This definition is reinforced by Coelli and Battese (1998) who opine that efficiency is an expression of the extent to which a given firm can extract maximum output from a given set of inputs and following that Rogers (1998) therefore argues that a firm would be described as efficient if it is able to derive the highest attainable output from a given set of inputs. Because this maximum serves as the highest output threshold it implies that for any given number of firms, the firm which is able to attain an output closest to the maximum given that they all have available to them the same set of inputs can be described as the most efficient of them whereas the firm with an output level the most distant away from the measured potential output level is said to be least efficient.

When one delves into modern efficiency research literature, the concept of productive efficiency has mainly been distinguished into technical and allocative efficiency (Rao, Coelli and Battase, 1998; Lovell, 1993). Technical efficiency is basically argued to reflect the ability of the productive unit to as much as possible minimize the wastage of the firm's resources by extracting the highest output that it possibly could from the bundle of resources /inputs available to the firm. However, allocative efficiency is said to occur according to Coelli and Battase (1998) when a firm opts for a certain optimal mix of inputs to attain a given desired output taking into consideration the prevailing input prices and the production technology available. Huang and Wang (2002) reinforce this when they intimate that a firm is allocatively efficient when it deploys factors of production in such a way that the marginal rate of technical substitution between any two of its inputs equals the ratio of corresponding input prices. In a sense, a firm may be deemed technically efficient as long as it attains the highest output relative to its inputs but allocatively inefficient when that firm is not able to select the most optimal input combination at given prices. Jayamaha and Mula (2011) therefore conclude that a firm can be touted as having attained productive efficiency when the firm is able to derive the highest achievable output from a given fixed amount of inputs, such that the firm incurs the least cost .of production.

Gleaning the literature, the most common measurement of efficiency employed is technical efficiency and two conceptual ways of measuring technical efficiency are highlighted. These are the output and input-oriented approaches. In the former approach, the firm aims to achieve the highest possible output from a given set of inputs whilst in the input-oriented approach, the firm aims to minimize its input use to achieve a certain desired amount of output (Debreu, 1951, Farrell, 1957, Huang and Wang, 2002). This input-oriented view is reinforced by Timmer (1980) when he argues that the concept of technical efficiency has to do with how productive unit utilizes the best practice in that productive setting in a way that not more than the required quantity of the given input mix is used to produce the best level of output. Following this, technical efficiency is mathematically defined simply as the relationship between observed output attained by a firm and the corresponding potential/maximum output that the firm can achieve with the same given set of inputs. With this background, in empirical analysis, when the measured ratio above is one, the implication is that firm is perfectly efficient. In essence, therefore, the closer the measured value is to one the higher the efficiency of the firm and the more distant the calculated ratio is away from one, the lower the efficiency of the productive unit and finally when in very rare situations the measured value for a productive unit is zero, then that unit is described as being fully or absolutely inefficient.

In classical research, the performances of firms are measured in relation to a certain boundary set of potential output usually referred to as the frontier. Jayamaha and Mula (2011) have described the efficiency frontier as the boundary which defines the best inputs mixes which can be employed to obtain the most optimal output level. Thus the outputs of fully efficient firms they argue would be located exactly on the defined frontier or boundary. The implication is that firms whose outputs fall below the frontier can be said to be contending with some levels of inefficiency with the level of inefficiency of the firm increasing as the distance between the boundary and the output level of a given firm widens.

Approaches to Measuring Firm Level Frontier Efficiency

When one gleans the literature, it is evident that there exist a variety of methods which can be employed to measure the efficiency of production units. However, the most well-known and widely used methods as identified so far are the parametric (based on production functions) and non-parametric frontier (based on mathematical programming) approaches. These techniques are so-called because of the approach employed in determining or creating the efficiency frontier. Whereas in the parametric case, the efficiency frontier is obtained by using the output of the best performers, in the case of non-parametric approach, the frontier is obtained by mathematically deriving the output levels of the best virtual producers.

The typical parametric frontier technique employs an econometric approach to estimate the efficiency frontier from which the efficiency scores of the decision-making units are generated. According to Asmare and Begashaw (2018), there are three main parametric methods which can be employed in empirical researches. They are the Stochastic Frontier Approach (SFA), the Thick Frontier Approach (TFA) and the Distribution Free Approach (DFA) of which the SFA is by far the most frequently applied. At the other end of the spectrum is the non-parametric approach, which essentially employs deterministic, linear programming methods to generate the efficiency scores for the decision-making units. The main types of non-parametric estimation techniques found in the literature are Data Envelopment Analysis (DEA), the most popular in this category and the Free Disposal Hull (FDH) approach.

Generally, in a typical parametric efficiency estimation process, a functional form is traditionally imposed on a normally distributed data and the production function generated allows the efficiency scores of the decision making units (DMUs) to be obtained. Under such circumstances, the form of the production function could either be Cobb-Douglas or Translog, a determination which is executed employing the statistic called the log-likelihood ratio.

When one considers the actual field of analysis, the two broad approaches of estimating efficiency have their positive aspects as well as their weaknesses/pitfalls The literature identifies the strongest point of the parametric methods as their ability to capture and take into consideration exogenous but random shocks which affect the firm unit and hence its ability to distinguish and separate these exogenous shocks from the so-called inefficiency effects of the firm. Apart from this, the approach is fully able to take care of measurement errors which would otherwise jeopardize the integrity of the estimation process. The major limitation of the parametric approach, however, is that it is susceptible to specification errors on account of the fact that the functional form imposed on the data may only be an approximation to the actual functional form defined by the data (Huang and Wang, 2002).

On the part of the non-parametric methods, their main advantage is that they do not need any functional specification as is required in the parametric estimation methods. Their nemesis, however, is their inability to accommodate statistical noise arising out of measurement and other errors as well as exogenous but random shocks affecting firm units and as a consequence, treat all the deviations from the defined efficiency frontier as being due to the inefficiency of the firm or production unit.

To the extent that each of them has its positive and negative points, according to Huang and Wang (2002) and Coelli *et al* (1999), the determination as to which one is employed in any given empirical situation should be based on a number of considerations. For instance, it is argued that in research contexts where it is believed that the data may be challenged and suffering from measurement errors, random situations and also when the researcher is encountering problems of drawing a clear distinction between inputs and outputs, the most appropriate method to use is the parametric approach. However, the non-parametric technique is best suited for scenarios in which the researcher is dealing with data having very minimal random disturbances and no price information whatsoever.

Even though it is clear that the literature categorizes the two broad methods of estimating firm level efficiencies, it is also obvious that that the frontier defining approaches have been dominant compared with the non-frontier methods in empirical studies .This is because it is held that whilst the frontier methods are very objective quantitative estimates which are not affected by exogenous factors like market prices, the non-frontier measures usually defined in the form of performance ratios are heavily affected by prices of both inputs and outputs as well as other external factors which make it difficult to assess them in relation to some desired standards and hence not appropriate for comparisons.

The Stochastic Frontier Function

The stochastic frontier function has by far been the most predominant approach in the measurement of production efficiency in empirical studies and its framework is such that it depends generally on a functional representation which may have a stochastic character or a deterministic one. The key difference between the stochastic and deterministic frontier functions is in the nature of the way the error terms are presented. Whilst the stochastic specification is structured in a way that it accommodates both random and non-random errors (see Meeusen and van den Broeck,1977 and Aigner, Lovell and Schmidt ,1977), the deterministic model is rigid in outlook in the sense that it is designed to only take care of non-random errors. Put in another way, the stochastic specification allows for both technical inefficiency effects of the producer as well as random shocks like sudden changes in weather among other things to be accommodated for whereas the deterministic one caters only for the inefficiency effects of the producer (Mohammed and Alorvor, 2004).

To this extent, the deterministic specification is not suited to handling scenarios where we have statistical noise as much as the stochastic specification can. It is therefore generally argued that the ability of a given specification to provide accurate estimates of efficiency is fundamental and this reflects the form in which the specification has been structured.

Though the stochastic frontier specification has been very useful in empirical research in the area of efficiency measurements, one of the key criticisms which are strongly advanced against it is the kind of the assumptions which are made about the technical inefficiency term. According to Green (1980), Stevenson (1980) and Croppenstedt and Mueller (2000), the truncated normal, the half-normal and the exponential distributions are not chosen *a priori* on any grounds. Each researcher seems to have his/her preference. Thus, while for instance Aigner, Lovell and Schmidt (1977) leaned toward the half-normal distribution, Stevenson (1980) made a case for the truncated normal distribution, Greene (1980) and Beckers and Hammond (1987) respectively opted for the two gamma and the exponential distributions respectively.

Looking at the differing viewpoints in relation to the assumptions imposed on the inefficiency component of the error term, Erkoc (2012) surmises that making a determination as to which distribution should be upheld is a very daunting task. In end, however, Coelli, Rao and Battase (2005) argue that the rule of the thumb in making a choice should be which one is the least cumbersome and easy to operationalize.

To conclude, it is obvious that there is a recognition however, that in the stochastic frontier framework, researchers have employed one of two types of representation of the production technology at any point in time; the so-called primal and dual forms. While the primal is more appropriate for production and distance functions, the dual representation is better suited for cost and profit functions.

Methods for Identifying determinants of technical efficiency/inefficiency

At the end of the typical efficiency estimation process, after having estimated the appropriate production function and derived the efficiency scores for the production units, the next step that researchers usually proceed to is to isolate the key environmental determinants of efficiencies or inefficiencies of the decision-making units, particularly for policy purposes.

According to Dasmani (2015), two approaches can be identified. These are the two-step method and the one-step maximum likelihood method. In the two-step model, the first step is the derivation of the efficiency boundary and specific efficiency scores for the all various DMUs in the sample after which these efficiency values are regressed against a set of firm unique as well as exogenous/environmental factors in order to determine and identify the factors which most significantly influence the efficiency or inefficiency of the DMU. The other approach which is more modern is the one-step maximum likelihood estimation technique which has been championed by Battase and Coelli (1995). In this technique, external factors which are responsible for the technical inefficiency effects which are assumed not to be identically distributed are included in the estimation process from the start.

The application of the Stochastic Meta frontier Efficiency function

The literature on the measurement of efficiency has evolved further to encompass areas of research which cannot easily be addressed with the traditional stochastic frontier analysis. Under this approach, it is assumed that all firms operate within the same environment and using the same technology. In the real world, however, researchers are sometimes confronted with a situation where DMUs operate within completely different environments and as well utilizing varying technologies. Under such circumstances, the use of the traditional SFA is impossible because the assumptions have fundamentally changed. To deal with such methodological problems, Hayami (1969) and later Hayami and Ruttan (1970) conceived and pioneered the idea of the meta-frontier production function in their seminal work on efficiency. The hypothesis underlying this concept is that we may in the real world have DMUs in an industry belonging to different groups with all groups having potential access to the best technology for production. However, each group of DMUs may decide to operate in different sectors of a common production function (called the meta production function) which encapsulates all the various groups of producers who are so defined by reason of the peculiar circumstances such as natural endowments, relative input prices and even the prevailing business environment that confront them as alluded to by (Lau and Yotopoulos, 1989). Therefore each group may be defined by a unique input-output relationship and underlain by a technology distinctly different from that in the other groups. .

The overall philosophy behind meta frontier production and concept of the stochastic meta frontier production functions from the literature, have been advanced through the work of Battese and Rao (2002), O'Donnell, Rao and Battese (2008) and further extended by Amsler, O'Donnell and Schmidt(2017) and these researchers have argued and reemphasized that firms in different industries, regions and/or countries face different production opportunities and because of these differing conditions, they may usually make technical choices from different sets of feasible input-output combinations. These so-called technology sets differ because of differences in available stocks of physical, human and financial capital like the type of machinery, size and quality of labour force, economic infrastructure and resource endowments, therefore, creating an imperative for efficiency researchers to estimate separate production frontiers for the different groups of firms (O'Donnell *et al*, 2008).

The technique, therefore, enables researchers to define the best efficiency points given the best technology for the DMUs in the various groups and hence provides them the opportunity of relating the technical efficiencies of the firms in the different groups to each other. In empirical applications therefore, researchers are able to relate the performance of each DMU to the performance of the group (group frontier) and then that of the group with the overall best efficiency points (Meta frontier).Following the main types of frontier efficiency analysis, there are two types of meta-frontier approaches; one which is based on the generation of production functions ,called the stochastic meta-frontier and the other derived through mathematical programming, known as the DEA meta frontier. In this particular instance, the use of the stochastic meta frontier would allow a cross group comparison of efficiency of firms across the Arab Maghreb Africa and Sub-Saharan Africa to be done and also determine whether there exist technological gaps between the firms in these zones in Africa and may inform the acquisition of the needed technology by the firms to be able reach the most optimum output as defined by the meta- frontier.

Capacity Utilization as a performance measure

This is basically a measure of an observed output to how much output would be produced if all units of capital in a production setting are employed at their full capacity. Morrison (1985) defines capacity utilization in more traditional sense to mean relating prevailing output to the highest potential output that the firm can achieve given the plant and equipment the firm possesses. In the view of Morrison (1985), this description of capacity utilization is regarded as more of an engineering than an economic concept and therefore suggested that a more appropriate definition from an economic perspective is the long-run equilibrium output at which the short-run average cost of the firm equates its long-run average cost. In most empirical papers, capacity utilization is conceptualized as the deviation of the current output from the capacity output where the capacity output is seen as the long-run optimal output or the steady-state output.

Gajanan and Malhotra (2007) stress the importance of capacity utilization of the firm and argue that it is one of most critical performance indicators in economics in the sense it can be directly linked with the short-run outcome variables like investment, output as well as the employment of the firm. Gajanan and Malhotra (2007) subscribe to the traditional view of capacity utilization as espoused by Morrison (1985) and other earlier researchers but also emphasize that there are a number of ways by which the traditional definition could be operationalized. According to them, the capacity or the potential output of the firm can be obtained by extracting its production data over business cycles or by using survey methods ascertain it.

Exports and Firm Growth

Generally, when firms get the opportunity to access foreign market it creates an advantage for them ahead of their counterparts who are confined to operating within the local markets in a number of ways and for the reason that the ability of firms to enter foreign markets is usually considered in the literature as a performance index. The potentials of exports are strongly espoused by Park, Yang. Shin and Jiang (2010) who assert that participation in exports markets is seen as an important prerequisite for economic growth. They back their position with the World Bank reports especially on Asia which highlights the pivotal part that exports have played in transforming the economies of the countries in East Asia. Cebeci (2014) amplifies this point when he intimates that it is generally agreed that firms which are able to access foreign markets are on the average able to perform better than their counterparts who are limited to local markets.

Several reasons have been advanced to explain the advantages of export-oriented firms over domestic market-oriented firms. According to Bernard and Jensen (1999), firms which engage in exports are able to provide more employment, higher wages for its workers and employ a much more capital intensive approach to production than their counterparts.

Another important thing to note is that the ability of a firm to access exports markets signals the growth of the firm in terms of its competitiveness. It demonstrates that the maturation of the firm and the gradual development of its competitive position that allows it to be able to rub shoulders with companies outside the markets within which it is situated and operate. By that, the firm is always conscious of being abreast with international standards to stay relevant in those external markets. Indeed, as they export, they continue to acquire higher competencies in both technological and non-technological aspects of their operations and these lead to a further widening of the gap between them and their counterparts who are have not been able to break into the external markets. Thus, for a given export-oriented firm, there are several pathways through which it could be more productive than its contemporaries

According to Evenson and Westphal (1995), the first avenue in this direction is through the provision of technical assistance by the external buyers and beneficiaries of the firm's products .Another, it is argued, is the participation of firms in international trade which empowers and enables them to readily access knowledge on current technological approaches to production which would improve the firm's productivity. Verhoogen (2008) provides another advantage that export-oriented firms enjoy over non-exporting firms. According to him, the fact that a firm is into exports gives the firm an incentive to upgrade its production technologies to remain competitive. Besides these reasons, Fafchamps, el Hamine, & Zeufack (2008) also suggest that while a firm is engaged in exports, it may be in a position to learn more about the external markets, identify opportunities and through that create new products which may fit the demands in those markets. The last rationale for engaging in exports is offered by the World Bank (1993).In their view, the opportunity to export enables the firm to increase its capacity utilization through rapid sales which then reduces the susceptibility of the firm to undesirable situations on the domestic markets.

Innovation

The word innovation has widely been given different connotations and therefore misconstrued or misunderstood. It is a lot of the time confused with the concept of the invention. In the semantic sense, invention primarily deals with the origination of an idea, product or a system when the said idea, product or system has never existed. However, OECD (1981) characterizes innovation as ″ all those scientific, technical, commercial and financial steps necessary for the successful development and marketing of new or improved manufactured products, the commercial use of the new or improved processes or equipment or the introduction of a new approach to social service delivery″. Based on the various conceptions of innovation, Neely and Hii (1998) assert that in all the differing views, the common strand that runs through all of them is that innovation essentially embodies change.

The types of Firm-level Innovation

Gleaning the literature, a number of different types of innovations can be identified. The main types which are encountered are product, process and marketing innovations and each of these uniquely influences performance of the firm in a particular way. Rostami (2015) underlines the importance of the various aspects of innovation in the growth of the firm. In his view innovation broadly leads to the renewal of the core processes of the firm and this includes managers always identifying ways of improving what products they have to offer as well as how those products are delivered. This is reinforced by Damanpour and Gopalakrishnan, (2001) who emphasize that whereas product innovation critically looks at putting new products or service on the market to meet the needs of external users, process innovation is seen as any approach which introduces more dynamism into the production operations or functions of the firm.

Thus, within the context of the firm, process innovation manifests sequentially before product innovation and process innovation improves or enhances the entire or at least some aspects of the production process putting the firm in a position to deliver better products or services whilst product innovation delivers relatively novel or improved products and services to the external user. Marketing innovations however are employed by firms to be able to improve the likeability of their products/services to the external users and thereby increasing their patronage of the goods or services in question. In conclusion, it could be said that whilst product innovations are essentially market-oriented, usually add value to products and are aimed at the winning the heart of the customer, process innovations concentrate on how to scale up the internal functioning of firms and thus aspire to increase efficiency within the firm as intimated by Utterback and Abernathy (1975) whilst marketing innovation involves the branding of products to increase their likeability. Cirera and Cusolito (2019) sum up the importance of the various types of innovation and in their view, each of these offers some advantages to the firm. In the case of process innovation, they believe that it contributes to higher firm efficiency and productivity by mitigating the cost of production of the firm and enabling the firm to operate at a certain cost threshold which makes exports beneficial while product innovation creates learning-by-doing experiences for the firm and enable firms to put fresh or upgraded brands onto the market. Finally, in their view, marketing innovations allow firms to distinguish what they produce and offer from what their competitors put on the market within which all of them operate and thus create the opportunity for better level of acceptance of their products and by that increase their market share in global value chains.

Apart from these, in the literature, there are writers who choose to do categorization of innovation based on degree into incremental and radical innovations. According to Naqshbandi and Kaur (2015), incremental innovation as the name suggests describes the development of products upon the creation of knowledge which is itself built on existing knowledge that firms have developed. Incremental innovation therefore does not involve drastic technological developments and usually leads to the enhancement of the competencies that exist within firms and which enable them to offer products which are still competitive on the market. This way, the established firms are able to maintain a firm grip on the markets within which they operate relying on the resources that they accumulated through the knowledge they created.

Radical innovation, however, involves a drastic shift from an existing knowledge/technology and culminates in the creation of new knowledge/technology which is usually very new and can generally be seen as competence destroying. With the level of the transformation that comes in the wake of radical innovation, new products emerge on the market and by that, all existing products become out of date and therefore very uncompetitive compared with the new ones.

Determinants of Firm Innovation

In trying to be efficient and much more productive, firms in most environments would always adopt strategies and methods which may not necessarily be in line with their routine approach to production. Firms, therefore, go out of the way to adopt innovative mechanisms to stay competitive. However, firms' approach to innovation is not necessarily monolithic. Indeed, the ability of the firm to carry through its quest to innovate is always circumscribed by a number of factors.

The emergence of the endogenous growth theories has expanded the narrow traditional view of firm productivity and expansion into a more open broad perspective which conceptualizes innovation as one of the most important factors which influence efficiency and expansion of firms and businesses and indeed of economies. It may be said, therefore, that any factor which influences firm innovation may be deemed as indirectly affecting the efficiency and growth of firms.

Scanning the literature, several factors can be identified and isolated as important when one wants to understand the process of innovation. To start with, the size of the firm has been one of the factors which are seen as having substantial influence over the ability of the firm to engage in innovation and there are two perspectives when it comes to explaining how the size of the firm influences firm innovation. The first view attributed to Schumpeter (1942) posits that larger firms have a higher propensity to innovate than smaller productive entities. By that, he argued that monopolists are much more empowered to innovate because they are able to cream a lot of profits from their operations and these financial resources allow them to innovate to consolidate their positions and maintain their stranglehold on the market. This is buttressed by Williamson (1970) when he alludes to the fact that large firms may benefit from efficient human specializations as well as scale economies.

The second view espoused by Arrow (1962) actually coincides with the earlier Schumpeterian position which argued that smaller firms which are operating in a competitive environment are much more incentivized to innovate to be able to remain competitive in the market space.

Thus, based on these theoretical positions, two conflicting hypotheses can be formulated- The larger the firm the more innovative the firm is likely to be and the smaller a firm is the more innovative it is. Cohen *et al* (1987) however submit that the kind of relationship that exists between the size of the firm and its propensity to innovate cannot always be that straight forward and that in many instances, it is influenced by such factors as the industry-specific characteristics which exist and which eventually determines the kind of nexus between firm size and firm innovation.

Accessibility to lines of credit by firms is also largely considered as an important factor which determines the extent to which firms are able to innovate. This is because most of the things or activities that firms are engaged in and which are regarded as innovation-oriented require financial outlay. This means that if firms can leverage funds from any source that they could, then it would make it easier for the firms to embark on innovation-oriented production. There are some writers who have however underlined finance as an obstacle to firm innovation and as aptly intimated by Kerr and Nanda (2014) as well as Hall and Lerner (2009), innovation turns out an intangible asset and usually the returns to the investments made cannot readily be predicted and in cases where the investments can be recouped, it takes a long time to happen. Aside of this, there is also a strong belief that most of the times there is a substantial discrepancy between the rate of return on privately engineered innovation and the actual cost of capital arising out of information asymmetries. In respect of this, it asserted that the predicament of the smaller firms is even direr and this exacerbates the challenges that such firms normally endure and which seriously undermines the quest to innovate.

Another factor which has been found to substantially affect firm innovation is corruption and thus in the literature, a theoretical link is established between corruption and innovation. Indeed, there are two main perspectives in respect of how corruption affects firm-level innovation which can be gleaned from the literature. One view is that corruption undermines firm innovation by imposing an extra cost on firms through demands made by public bureaucrats especially when the said entrepreneurs are supposed to obtain some license or permit from state institutions. This position is held by Gaspar & Hagan (2016), Paunov (2016) and Ugur (2014) among others. However, Dreher & Gassebner (2013) and Williams & Kedir (2016) offer a contrary opinion. They contend that rather than being an impediment to firm innovation and reducing their propensity to innovate, corruption actually oils and lubricates the ability of firms to innovate especially in the typical developing country environment where institutions of state which regularly interface with these businesses have very poor and systemic weak structures and for this reason, their operations are fraught with pervasive bureaucratic challenges. In the view of these writers, therefore, private sector players employ corruption as a lubricant through which firms can get things done timeously for them within the public services and by that avoid costs resulting from unnecessary time-wasting in accessing the services that they require from the public institutions.

Competition has also been identified as one of the factors which affect the propensity of the firm to innovate. It is a recognized fact that competition among firms within a market drives and engenders innovation. This is because, in markets where firms are in stiff competition to take a good share of the market, firms may well be able to distinguish themselves from the others by creating some kind of uniqueness especially in what they have to offer by introducing innovations in a manner that would set them apart. The case for competition as an important determinant of firm innovation is acknowledged and reaffirmed by Blagova and Tokhtarova (2014) and in the considered opinion of Bastos and Nasir (2004), it can be argued strongly that competition is perhaps a much weightier determinant of innovation than can be said of other factors like infrastructure, labour laws and tax administration.

Other writers highlight the importance of infrastructure -power, roads telecommunications, etc. on the ability of the firm to innovate. This is because these provide the right and needed platform for businesses to even to think about innovations. For example, the reliable supply of power to firms would encourage technologically-driven innovations like the adoption of online and web-based marketing channels as well as the deployment of plant and equipment which are much more advanced. Good and robust telecommunication infrastructure also guarantees the adoption of the online and web-based firm operations.

Roper *et al* (2019) suggest that the type of firm ownership also influences the propensity of the firm to innovate. They argue that firms which have foreign involvement in their ownership especially those which belong to international groups or conglomerates are advantaged in the sense that they are a lot of the time able to leverage on this to be able to access finance, physical and human capital, technological know-how, modern and better management approaches as well as replicate world-class branding, marketing and distribution practices that they employ in their mother organizations.

Another factor which is adduced as one of the drivers of firm-level innovation is the nature of the stock of human capital which is possessed by the firm. According to RECICA (2019) firms which have high numbers of their employees have been exposed to higher educational training and acquired higher-level skills usually have a higher capacity for the adoption and implementation of innovative strategies. This is because innovation activities are knowledge-oriented and therefore require a crop of skill and well-trained people to get to them consummated.

In the literature, other factors have been identified as influencing firm-level innovation activities. For instance, the age of the firm is also argued to affect firm innovation in the sense that firms are reckoned to acquire more experience as they stay in a given line of activity for a long time and the experience that comes with the knowledge which eventually empowers the firms to be innovative.

Barriers to Innovation

As has been said by various writers, there are so many requisites needed to ensure that people and indeed firms feel motivated to engage in innovation. According to Buddelmeyer, Jensen, and Webster (2010), one of the key ingredients for encouraging firm innovation is a robust legal and institutional environment for the simple reason that innovation by firms is a high risk activity which may end up in one of two outcomes; success thus promoting firm performance or failure in which case the firm is plunged into financial distress. Therefore in developing countries where there is higher risk in engaging in innovation than exists in the developed countries usually as a result of aberrative behaviours like stealing and unlawful copying of people's intellectual and creative works, irrational, unfair market practices and unjustifiable cancellation of contracts coupled with the unavailability of special purpose funding mechanisms, corruption ,low demand for goods and weak institutional support and protection (Wang and Lin 2008), the incentive to innovate is very much reduced.

Thus, in developing countries especially Africa, there is an imperative to create, build, fortify and capacitate all various institutions and mechanisms of state whose activities are supposed to provide the enabling environment for firms to engage in innovations. Creating and building solid state institutions like the judicial system and other regulatory bodies in the context of developing countries are very crucial in ensuring that they can bear the risks which confront them as they undertake innovation in their operations.

Measurement of Innovation

One of the daunting challenges which are encountered by researchers in innovation studies is how to measure innovation and this is because innovation involves a chain of events ;first is the decision to innovate, then the production of knowledge from innovation inputs and then, the transformation of the knowledge into tangible and intangible items such as skills training, intellectual property, technology ,plant, equipment and machinery which consequently leads to the development and the adoption of new processes, new products, enhanced quality products and improved organizational ,branding and marketing strategies.

Thus the process of innovation encompasses a wide plethora of activities and in words of Cirera and Cusolito(2019), firms which make investments in order to scale up their capabilities to be able to produce innovation outcomes, also require tangible things such as machinery as well as a crop of skilled personnel and a stock of scientific ,creative and organizational capability and therefore like suggested by Nelson & Romer (1996), they in the process of innovation create software, wetware and hardware as component parts of the entire process.

With all of these being part or components of the innovative process, measuring or quantifying what constitutes innovation is a nightmare and according to Neely and Hii (1998) fraught with statistical and conceptual problems. In the light of this, there is a real challenge as to what to include and what not to and especially against the background that studies into the measurement of innovation activities are rare. Neely and Hii (1998) acknowledge that because of the practical difficulties with measuring innovation, many of the attempts at measuring the concept have generally been technically biased and for this reason a lot of the studies have approached it from the research and development perspective.

Neely and Hii (1998) identify the most commonly employed measurements as expenditures on R&D as well as documentation of the number of patents and innovations. To some, R&D expenditures represent an essential component of the process of innovation but as explained by Geroski (1994), there are others too to whom the R&D does not mean much because in the world of business it could be demonstrated that a good number of firms had embarked on innovations without necessarily undertaking R&D.

Another approach that is sometimes used to measure innovation is what is referred to as patent count. The patents simply refer to the protection of some ideas which usually may have been developed and therefore by their nature can be regarded as intermediate outputs in the innovation chain. Patents are in the literature characterized as propensity to innovate though not the actual innovations and are usually positively correlated with the innovative inputs because they are derived from such inputs. It must however be noted according to Griliches (1990) that patents may not necessarily lead to innovation outputs even though they can easily be transformed into the latter.

The innovation counts capture all the outputs which are the outcomes of innovation processes and the difficulty involved in using this approach of measurement is that all outputs are given the same weight even though some innovations may be much more significant than others.

Overall, characterizing and measuring innovation is such a daunting challenge and this is mainly on account that it is basically a multi-dimensional concept and also very difficult to compare on the basis that it is usually context specific.

The Business Environment

In the world of production, firms operate within certain environments, systems, frameworks or even events which usually directly or indirectly influence their activities. All these when put together is described as the business environment and as aptly put by Soppelsa, Lozano-Garcia and Xu (2019), the business environment provides the framework for firms to interact, trade and compete. According to Litavniece & Znotiņa (2015), the business environment of firms is largely made up of elements which are external to the firm and therefore point to factors like socio-economic, geographical location, legal regulation and demographic conditions as constituting a significant proportion of the business environment. Though in the definition of Litavniece and Znotiņa (2015), they tend to highlight external elements of the business environment, Orginni & Adesanya, (2013) in their characterization of the business environment underline the fact that the business environment that confronts businesses has both internal and external dimensions. They therefore define the business environment as the totality of the external and internal conditions which affect the creation, nurturing and development as well as the progress of businesses.

Orginni and Adesanya ((2013) describe the internal business environment as that part of the firm's environment over which the firm can exercise control and identify business policy, recruitment of manpower, the stock of capital to deploy, etc. as some important examples of the constituents of the internal business environment. To them however, the external environment is always out of the purview of the firm and dominated by factors like the political situation, government legislations and policies and unfolding technological developments etc. Estay (2004) reinforces this view of the external environment and contends that the external environment also encompasses the social context within which the firm operates, the framework of incentives provided by the government, the inclinations and the shared culture of consumers as well as the competitive milieu that confronts the firm.

Johnson, Scholes and Whittingham (2008) have developed a scheme which broadly shows the environment that firms have to contend with. In the scheme they depict that the firm is characteristically influenced by factors which are within its own domain and beyond this by the markets within which are found the competitors of the firm, all together which constitutes the first layer of the external environment and secondly industry (sector) specific issues which may influence firm behaviour and performance and lastly, the overarching economy-wide factors/situations which exert influence on firms. This perspective is shared by Estay (2004) who opines that the trajectory of a firm depends very much on the personal characteristics of the businessman /men at the forefront as well as what is going on within the environment that s/he operates.

With regards to the business environment that confronts firms, Laouiti, Gharbi and Liquane (2014) also identify three main dimensions; these are the socio-cultural, institutional and technological environments. The socio-cultural environment according to them, defines the social network, beliefs, attitudes ,behaviours and values of the society within which the firm operates and argue that it is that which allows firms to build up their social capital and provides them with the skills set required ,funding and even contacts necessary for the sustenance of the business and in the words of Minniti(2005) the socio-cultural environment broadly defines the boundaries within which the firm is able to carefully design its entrepreneurial objectives and tasks.

The second element, the institutional environment usually encompasses all the institutional frameworks available, the various policy interventions undertaken by government or its agents as well as the legal system which are very critical in shaping up how firms behave and operate whilst the last embodies the deployment of technology, innovations and cutting edge scientific applications to be able to push forward the performance of firms to levels not experienced before. In a sense, the last two components of the business environment can be placed within the broader system of regulation usually employed by governments to ensure that the decisions and actions of economic agents are well within the societal objectives in order that information asymmetries, incomplete and defective markets as well externalities which may occur in the absence of regulations may not distort market outcomes (Loayza, Oviedo and Servén, 2010).

The concept of economic regulation is rationalized by Schleifer (2005) on the basis of three theories- the public interest, contracting and capture theories and argues that the public interest theory as espoused by Pigou in 1938 demonstrates how responsible and benign governments would always endeavour to preempt the occurrence of market failures and correct them when they occur, the contracting theory illustrates how the arbitration arm of the state, the courts are able to deal with issues of the enforcements of contracts and the disputes which may arise out of business contracts whilst the capture theory which is rooted in Stiglitz's(1971) research which emphasizes the ability of big business entities to take advantage of the state regulation mechanisms and benefit far more from same at the expense of the other not so fortunate smaller businesses. Even though these theories generally attempt to explain the behaviour of the state in relation to businesses, they are sometimes criticized on the grounds that the regulatory activities of governments may be severely undermined by the incompetence and corrupt nature of public officials and institutions. So, in a sense as intimated, the business environment encapsulates all the factors which affect the risks and returns of firms as they operate wherever they find themselves (Xu, 2010).

In the literature there is evidence that each of these aspects of the business environment has its own influence/effect on firm performance and growth. For instance, it can be argued that the effect of the regulatory systems on the firm may reflect the quality of the institutions, the kind of mechanisms/policies they implement or enforce as well as the calibre of the people who oversee and run these institutions of state. To the extent that this is the case, Schleifer (2005) asserts that regulation especially in developing countries usually result in very poor outcomes mainly on account of excessive nature of the regulation which makes it easier for public bureaucrats to exploit the system , engage in wanton abuse of power and corruption and effectively undermine the regulatory systems and institutions thereby rendering the business environment inhibitive rather than supportive and creating impediments for business growth.

Xu (2010) describes how the macroeconomic aspects of the business environment such as the government's tax and revenue, monetary and exchange rate policies influence the performance of the firm. He argues that taxes usually reduce the returns enjoyed by firms whilst inflation serves to escalate the variability of the profits of firms. In respect of the institutional environment , Xu (2010) asserts that one of its key planks is the nature and quality of the judicial and legal system which define the level of the rule of law and points out that this usually influences the confidence and decisions of investors on how much to invest, what kind of contracts/transactional relationships and the form of the organization to enter into because this according to him would normally define and underline the trust and confidence that entrepreneurs have in the institutions and the environment within which they operate. In addition, the institutions also influence the firm behaviours particularly when they create the social capital as well as the required social networks which support the operations of firms and thus facilitate their growth and expansion. Apart from these layers of the business environment, another important aspect of the business environment which is considered as very critical is the provision of infrastructure like power, transportation systems as well as telecommunications overheads which make the operations of firms very smooth.

To properly put in context the kind of relationship that exists between government and businesses, Schleifer (2005) has compartmentalized this relationship especially with respect to the business environment in order that society can derive optimal outcomes into aspects which deal with ensuring market discipline, providing for litigation and guaranteeing public enforcement of regulations.

According to Xu (2010), relying on market discipline simply implies creating the conditions for firms to engage in competition within the market space without any degeneration, rampant litigations and enforcement of government regulations.

However, as Xu asserts any time firms are unable conduct themselves in a manner consistent with market discipline, then the other two aspects of private litigation and /or public regulation may kick in to make sure entrepreneurs/firms do not misbehave within the market space. It is argued that the use of the court system is especially beneficial because it is assumed that judges are apolitical and impartial and would dispense justice, the way it ought to be. The disadvantage inherent in this in the words of Xu is that the justice system can be subverted, perverted and compromised through the influence of judges via appointments by governments and bribes offered to them by interested litigating parties and also the rich and powerful in society who control by far a huge proportion of the resources of a given country.

In respect of the employment of public regulation, theorists believe that may be an avenue through which governments can introduce a system of rules and reinforcements within which firms are expected to operate and function to be able to achieve much more socially favourable outcomes though at certain times too it is accepted that public regulation leads to the capture and the corruption of public officials whose job it is to enforce and police the regulations designed and put in place to be followed by firms and businesses.

One of the major elements which define the business environment in a given country is the infrastructure and in the language of development experts, the provision of infrastructure -road, railways, electricity, telecommunication overheads and even custom systems are indispensable ingredients in the facilitation of growth and development within a given economy. The development of infrastructure therefore serves to reduce the complexity and the difficulty of transactions as well as firms' costs of production and by that enhances their competitiveness in the markets within which they operate.

Again, at the firm level, access to credit is also a very important determinant of firm performance. This is because a flow of credit to firms allows them to pursue their business objectives much more vigorously than before. Firms tend to benefit much more when rates of interest are low in the sense that cost of credit represent a key component of the cost of production of firms and hence a lower the rate of interest, reflects in a lower the cost of production of firms and lower costs of production enhance firms' competitiveness , performance and growth

The business environment also encompasses the nature and level of competition that exists within the market space and most economists agree that one of the key factors which provide momentum to business activities and the market is competition .This which is especially true of the market system that forces firms who want to continue in their chosen lines of activity to always be up and doing in order to remain relevant in the space they operate

Overview of the Business Environment in Africa

When one considers the world of production, one of the most critical things which facilitate or hinders firm activities is the business environment. This is because it is the business environment which largely defines the returns of firms and the extent to which they are able to achieve all their objectives. The African Development Report (2011) acknowledges the importance of the business environment when it intimates that to successfully develop the private sector, it is imperative to provide a sound legal and regulatory environment with strong institutions which have very effective monitoring and enforcement powers and mechanisms.

According to the African Development Report(2011), in such a sound environment, businesses are able to systematically expand and create more employment avenues , registration and licensing processes are simplified and streamlined, the property rights of individuals and corporate organizations are respected and protected, creditors develop confidence in these properties as collaterals and are much more inclined to advance greater amounts of credit to firms ,innovative activities are given momentum through appropriate patency and inventions laws and protection, bureaucratic red tapes are reduced within supporting public institutions and as a result corruption is minimized .

With these myriad of issues defining the nature of the prevailing economic environment, it is argued that the latter in Africa is still reckoned as one of the least attractive across all regions of the world even though over the past decades, African countries have embarked on numerous and radical reforms meant to improve the legal and regulatory framework and create the atmosphere for greater competition and free trade (African Development Report, 2011).

Even in the face of the reforms which are being pursued in different parts of the continent the business environment is generally a far cry from what it has to be to be able to engender confidence in firms and the private sector for that matter. This state of affairs is consistently reflected in the Doing Business reports. For example in both 2010 and 2011 reports , most of the countries in the bottom twenty five are in Africa and the average ranking of African countries is measured to be the worse compared with the averages for the other regions in the world .Again, the cost of registering businesses in Africa is said to be many times higher than can be found in other regions in the world implying that from their inception, African firms are disadvantaged and far less competitive than their peers in other continents.

The World Bank Enterprise Surveys also provide some understanding of the nature of the business environments which exist in various African countries and in the 2010 wave, the three top (most severe) constraints to firms in Africa were identified as regulation, infrastructure and access to finance and land and these were rated approximately by 65%, 63% and 48% respectively of the total number of firms as their major concern.

Indeed the African business environment is largely characterized by excessive business regulations, complex and time-wasting procedures for obtaining permits and other business authorizations, corruption-riddled and opaque tax administration mechanisms as well as weak judicial and enforcement mechanisms.

Indeed one critical aspect of the environment , the arbitration arm of the state which is the judiciary is generally seen in a negative light by the public across Africa and this perception is reflected and echoed in the African Development Report (2011) which categorically states that of all firms which were surveyed in the period, less than a third of them were of the conviction that the judicial system was absolutely impartial in their functions and operations and that perception they observed is not improving but to the contrary worsening .

Again the state of the institutional environment is also measured to be fragile and precarious to encourage strong private sector activities. Indeed according to the Capital Access Index measurements, Africa has the worst institutional environment score when the continent's performance is compared with that of other continents. To be more precise, Africa scores four points out of ten with the Americas and Caribbean, Asia, Europe and the Middle East all ahead on that scale.

In the field of business registration and start-ups, the story is not any different. The World Bank (2009) calculates that both in terms of the minimum start-up and the cost of registration of businesses, it is way much more difficult and far more expensive starting a business and successfully registering it in Africa than other regions of the World. Africa Development Report (2011) illustrates and buttresses this point by providing some country specific details. According to the report, minimum start—up capital requirement may be as high as 614% and 780% of the GNI of Niger and Guinea Bissau respectively. Apart from this, the length of time that it takes to get a business registered in Africa is also a big issue and of the 24 countries which use two months to consummate a business registration, more than half of them are in Africa (Africa Development Report, 2011). Another classic illustration is given in the Doing Business report (2019) in which it is said that in Uganda, it takes about a month for a typical entrepreneur to register a nascent business after having navigated 13 different procedures and a further 18 procedures in four months to finally obtain a building permit to start off and to get connected to an electricity line, then needs to cough up an amount equivalent to about 7514% of the per capita income.

One other thing highlighted in the Doing Business report(2019) is the problem of the provision and supply of consistent ,reliable and relatively cheap electricity .In the words of the Doing Business(2019),even though electricity constitutes a major part of the competitiveness of firms , in Africa ,high costs of energy and frequent power outages represent a serious challenge and some firms usually attempt to deal with these issues by resorting to less electricity-intensive production leading to reduced productivity whilst a lot more others use generation sets to power their machines and equipment ultimately increasing the costs of operations.

Another veritable source of instability in the environment for businesses in Africa is the problem of corruption which imposes extra transaction costs on them especially when they have to satisfy some requirements to be able to continue to operate. Corruption is a significant impediment to growth of firms in Africa in the sense that the African region is considered one of the most corruption endemic regions of the world and with this unenviable situation, important facets of the business environment like tax administration, regulations and even the legal environment present and create considerable obstacles for private sector activities.

Though the business environment in Africa has largely been encumbered and undermined with the attendant deleterious obstacles, in recent times the situation in Africa is gradually improving and this is demonstrated by some of the emerging statistics in the both the Doing Business reports and the World Bank surveys.

The African Development Report (2011) notes some progressive developments on the reforms front in the last decade or so with very significant initiatives which have continued to improve the business environment in several areas of the continent. A lot of the countries are reported to have initiated monumental changes and reforms in several aspects of their business environments. Some of the well-known reforms which have been embarked upon are simplification of tax administration procedures, lowering of tax burdens of businesses, reduction in the bureaucracy associated with the acquisition of permits and licenses, making contract enforcement regimes more transparent and trustworthy, streamlining registration and start-up processes and removing trade barriers. Indeed, the African Development

Report (2011) asserts that it is a lot simpler and less expensive to set up and run a business in Africa currently than a decade ago. The report provides evidence which can be used to buttress the improvements in the business environment in Africa. In Ghana, for instance the report says that in 2005, for an entrepreneur to register and start up a new, he/she on the average had to go through twelve different procedures across about 81 days and spend approximately 78% of the per capita income. But as a result of ongoing reforms, the procedures had reduced to 8, the number of days cut down to 33 and the cost involved sliced to only about 26% of the per capita national income. In addition, when measured on the Doing Business scale, Ghana leapfrogged from 145th in 2006 to 99th in 2010, out of 183 countries.

Just as the Ghanaian situation, Rwanda also epitomizes the case of improvement of the business environment in Africa. According to the Africa Development Report (2011), for an entrepreneur to complete registration of a business and start its operations in 2004 required nine procedures over a 43-day period and costing as much as 232% of the then per capita income. However, by 2011, the entire process involved only two procedures and could be consummated in not more than three days and required 9% of the prevailing per capita income to pay for it and the overall ranking of Rwanda improved from 58th in 2007 to 9th in 2011 on the ease of doing business list. A lot of other countries in Africa have also chalked successes in the area of improving the business environment. A significant example of a remarkable performance on the Doing Business report is that of Mauritius which was ranked 10th and 17th in 2010 and 2011 respectively and as result of its consistent performance, Mauritius has become the best performing country on the Doing Business list. Indeed, Mauritius was adjudged the best performing Sub-Saharan Africa for four consecutive years from 2008-2011. Apart from these achievements, there have been significant successes in the area of reforms in other countries in Africa. In the 2019 Doing Business rankings, four African countries - Côte d'Ivoire, Kenya, Rwanda and Togo were listed among the ten top improvers across the world having introduced radical innovations into their regulatory spaces.

To conclude, it fair to say that the business environment in Africa has come a long way from its restrictive and inhibitive outlook which for years had undermined and discouraged private sector firm led growth. Over the last decade especially, tremendous strides have been achieved and significant progress has been made across the continent in respect of reforming the business environment. Despite these refreshing developments, Africa still lags behind on several Doing Business indicators and firms on the continent are generally less competitive than their counterparts from other continents meaning that African governments would need to redouble their efforts in embarking on very radical reforms which would enable them to catch up with the countries with the best practices in terms of the overall business environment.

Innovation and the Growth of the Private Sector in Africa

Innovation, in contemporary times has become the major outlet which provides momentum for growth and development of the private enterprise in the world .In particular, Verspagen (2004) and Aghion and Howitt (1998) have underlined the fact that the it is through the diffusion of innovation that lagging countries are able to shift production towards areas of increasing returns and catch up with countries with rapid growth. Indeed, according to

Oluwatobi, Efobi, Olurinola and Alege (2015) innovation is the engine that drives economic development .This is because it leads to the creation and an increase in the stock of knowledge that fuels economies and therefore defines the growth potentials of firms and hence nations. Egbetokun, Atta-Ankomah and Jegede (2016) characterize firm level innovation as involving all processes of adoption and possible modification of products and technologies which have been developed elsewhere. It however also encompasses processes which may not necessarily be technical but involving organizational and marketing aspects of the operations of firms (UNU-INTECH, 2005).

With respect to Africa, the development and the adoption of innovation within the broad context of pushing forward the frontiers of economic growth and development has not caught on as well as can be found on other continents. This situation has generally been responsible for the slow expansion of firms and an overall snail pace progress that economies in Africa are experiencing. The slow pace of the growth and development of Africa is underscored by UNCTAD (2017), when they intimate that assessing the implementation of the Millennium Development Goals (MDGs), Africa is the only continent which failed to achieve the MDG target of halving poverty by 2015. Indeed the role of innovation particularly technological innovation it is argued is very critical in that it is an efficient vehicle for promoting inclusive growth in various economies especially developing ones. This position is canvassed by Naude and Nagler (2015) who emphasize that the application of innovation in production usually aids in minimizing environmental pollution but maximize the efficient use of resources .Aside of these , it is intimated that it can also actually engender an egalitarian distribution of the dividends of development across economies.

It can be illustrated that the pace of development in Africa is generally not in tune with the statistics on innovation across the continent .This is because the rate of innovation in Africa can be said to be quite high ranging from about 40% in Egypt to an estimated 77% in Uganda in the period 2008-2010 (Egbetokun *et al.*, 2016) but the level of innovation seems not to translate into a rapid transformation of the production landscape of Africa.

Though the level of innovation in certain areas of Africa is measured to generally at an appreciably good level, the level of innovativeness is still far lower on the average than in relatively wealthier countries and this is underlined by the 2019 African Innovation Outlook III, which suggests that none of the African countries so far has been able to reach the target threshold of 1% spending of GDP on R&D which drives scientific and technological endeavours as enunciated in the African Union agreements on Science, Technology and Innovation Strategy (STISA) (AUDA-NEPAD, 2019). Indeed from Africa Innovation Outlook III, the highest expenditure of 0.7% recorded by South Africa was a whopping 0.3% off the target mark with Uganda recording as low as 0.18%. In fact in the survey only three countries are identified to have expended more than 0.5% of GDP on research. On per capita basis too, South Africa expended the highest, $86.88 in (PPP terms) whilst Eswatini recorded $2.20 (PPP value).Oluwatobi et al.(2014) further highlight the state of innovation in Africa by referring to figures in the World Development Indicators (WDI),2009 which show that Africa accounted for less than 1%(0.64%) of the total world innovations published and circulated in scientific journals in 2009 against 36.84%,24.17% ,2.72% and 3.04% by Europe, East Asia, South Asia Latin America respectively. This state of affairs underscores the fact that most African firms hardly expend money on creating their own knowledge which enhances the ability to create new ideas or concepts Aside of these problems, Egbetokun *et al* (2016) flags another important situation which affects firm level innovation. According to them there seems to be virtually no linkages between firms and research institutions across the continent. Indeed it is argued that apart from Kenya, firms in Africa hardly access and make use of research outputs from Universities and other public or private institutions and this constitutes a major drawback in Africa when it comes to promoting firm level innovation and by that ensure rapid growth of firms on the continent.

Africa's position in relation to innovation is underlined by the statistics in the Global Innovation Index of WIPO (2021); which showed that the top three performing countries on the continent –South Africa, Kenya and Tanzania had rankings of 61st ,85th and 90th in the world compared with the top three Latin America & Caribbean countries who were ranked 53rd,55th and 56th respectively and as opposed to South East Asia, East Asia, and Oceania region whose top three countries – South Korea, Singapore and China were 5th, 8th and 12th respectively.

When the environment for innovation to occur is considered, one critical thing which has been a hindrance is the quality of the institutions which interface with firms and provide them with critical services necessary for creating the momentum for innovative activities to be set in motion. The institutions which provide the support and define the rules of engagement especially when it comes to innovation activities in Africa are generally very weak by virtue of the fragmentation of roles and sometimes overlaps in terms of mandates of these institutions and in the words of Esubiyi (1996), these make it difficult for the relevant institutions to exercise effective external regulation and control.

According to Oluwatobi *et al* (2016), Africa generally has serious issues with three of the most important institutional quality variables- corruption, effectiveness of government and regulatory quality measures and the performance of the continent when related to that of other regions of the world exposes the weakness in providing the critical support for innovation. In the words of Oluwatobi *et al* (2016), the failings of these variables which have continued to manifest inhibit the implementation of innovative activities and thus undermine the development of the private sector on the continent. Indeed, in terms of these indicators, the World Bank computations show that the countries which appear to be performing are Botswana, Mauritius, South Africa and Cape Verde. The vast majority of the countries however are not doing well.

The non-performance of the majority of the African countries on the list of innovation pushers across the world is highlighted by Egbetokun *et al* (2016) when they suggest that most African countries hardly utilize information/findings from their Universities or government institutions or even private laboratories and for that reason, there are very weak linkages between firms/private sector and the research institutions on the continent.

Many reasons have been cited as being responsible for the slow advancement of innovation on the continent and key among them are the lack or the inadequacy of relevant infrastructure as well as the appropriate institutional mechanisms and support, low domestic capacity and poor policy frameworks and environment.

The importance of infrastructure to the promotion of innovation has been underscored by various authors and it is contended that in Africa, there is a huge yawning gap between what is needed and what really exists. Indeed, according to Egbetokun *et al* (2016), Africa has an estimated infrastructural deficit amounting to about 31 billion dollars per year which situation means that the continent by far lags behind other regions of the world. Compared with China and other regions, the average expenditure on infrastructure is the lowest both in per capita or percentage GDP terms; It is estimated China's expenditure on infrastructure averaged about 8.6% of GDP between 1992 and 2013 enabling China to catch up with the developed areas of the world whilst in Africa, expenditure is measured at around 3% of GDP.

In terms of which aspect of infrastructure is most problematic, Foster and Bricefio-Garmendia (2010) intimate

that the generation and provision of power is the greatest infrastructural impediment to private sector activities and firm level innovation and solidify their argument with an allusion that on the average the cost of infrastructural services in Africa is about 100% more expensive than what pertains in other regions of the world and as a result, firms are negatively impacted by this thereby driving them to divert resources away from innovation activities and hence undermining the prospects for rapid expansion of firms. Thus the inadequacy of infrastructure in Africa largely accounts for the low innovation and productivity of firms.

Aside of the problem of infrastructure, the other key issues which affect innovation are the lack of easy access to credit lines by firms, weak governance structures , defective policy lay outs and policy incoherence and inconsistencies within the support systems. All of these make it difficult for firms to embark on innovations and eventually expand as they wish to.

In sum even though one would concede that over the last few decades, there have some appreciable strides in innovation and technological advancement on the African continent, the innovation and technological gap between the other regions of the world and Africa is still very wide. For Africa to be able to catch up there is a need for focused attention by African governments to create or drastically improve the conditions which allow innovations to occur.

Chapter Summary

It is very clear that firm performance is very critical and central to economic growth. Especially in Africa where incomes are very low and poverty is very rife, putting in place conscious and systematic strategies for whipping up strong firm performances is an imperative. Against this background, discussions which relate to evaluating the key factors which influence firm growth and performance - especially the business environment and innovation have become most significant among academics and policy analysts. In this chapter of the study, the various performance constructs were described and analyzed and an overview of the business environment and innovation in Africa was provided. One thing which is clear though is that Africa has a lot to do in terms of providing the right business environment and creating the conditions for firms to innovate and grow as desired.

CHAPTER THREE

LITERATURE REVIEW

Introduction

This chapter reviews all the relevant literature for the study. The literature survey is situated within the contexts of theoretical approaches, methodological developments and empirical evidence on innovation, business environment and firm growth. It is organized into four sections. The early sections cover all the theoretical issues on firm performance from all the different perspectives whilst the second section capture and discusses theories of innovation. The third section synthesises the theoretical strands regarding the connections between innovation and firm performance and also considers the methodological approaches for understanding firm innovation and performance.

Concluding sections of the chapter are dedicated to the systematic and critical review of similar studies around the world from which the study can draw useful but relevant lessons.

Theoretical Review of Literature

This section deals with the review of the related theoretical literature for the study and encompasses the main theoretical perspectives: the stochastic and deterministic theories of firm growth (García-Manjón & Romero-Merino, 2012),

Theories of Firm performance

The issue of firm performance is something which is very prominent especially in the firm level literature. This is because firm performance is the most important ingredient underlying the growth and development that occurs in an economy.

Looking into the literature, two broad perspectives which seek to explain the performance of firms can be isolated. They are the stochastic and deterministic theories of firm growth (Garcia-Manjón & Romero-Merino, 2012). In their view, those who subscribe to the stochastic perspective believe that the performance of firm units is mainly driven by factors which largely emanate from the external environment of these units. Proponents of this theory therefore point to the non-industry or non-firm specific factors which sporadically influence the growth and performance of firms.

The deterministic view is diametrically opposite to the view point expressed by the proponents of the stochastic approach. It views firm growth path and performance as following a linear, sequential, deterministic and invariant course and is championed by Churchill and Lewis (1983) and Hank, Watson, Jansen and Chandler (1993) among others. According to them, the growth or the performance of the firm is largely attributable to the firm or industry specific factors. Inherent in this argument here is that the growth or the performance of the firm does not happen by chance but rather there are certain factors which occur in both the internal and external environments of the firm which define the parameters for the performance or growth of the firm.

Under the deterministic theory, a number of positions have been espoused and can be identified in the literature. Among the most widely encountered is the so-called resource-based view which is largely credited to Penrose (1959) whose main argument is that the differential performances of firms can be explained from the standpoint of what resources they have and how these resources are utilized. The theory in other words asserts that a productive unit is essentially a bundle of resources and therefore it is the nature of the accumulation and assimilation of these resources which ultimately defines the performance trajectory of the firm. According to the Penrosian theory, firm growth or performance is driven by internal momentums that firms are able to generate within and which occasion learning by doing and which allow managers and all other important participants along the production chain to perform better and better time after time. The resources of the firm through this process, it is argued overtime builds up knowledge for the firm which necessarily continues to define the growth path of the firm.

Embedded in Penrose's theory are two main drivers of firm performance- unused resources and increase in knowledge which provide the impetus for firm expansion and it has formed the basis for the emergence of other theories. The most common ones which readily come to mind are the resource based theory of the firm attributable to Wernefelt (1984) and Peteraf (1993), the knowledge based view of the firm proffered by Loasby (1998) and Nonaka *et al.* (2000) and the competence-based theory as espoused by Dosi and Marengo (1994), Foss and Knudsen (1996) and Teece, Pisano and Shuen (1997). The common strand running through all these theories is that firms are essentially generally heterogeneous entities which go through cycles of evolution which allow them to cumulatively create competitive advantage through a systematic generation of the requisite knowledge and resources (Lehtoranta, 2010).

For the proponents of the knowledge-based theory, the firm’s employees, its organizational culture, systems and policies create a certain unique sense of doing things and enable them to produce products in a way that provides it with competitive advantage over the long term because no other firm may be able to imitate them.

The knowledge based theory of the firm as can be gleaned from the literature is considered as an extension of the resource based theory of the firm (Huizing and Bouman, 2002; Balogun and Jenkins, 2003) in that it argues that knowledge is the single most important resource of a firm and that it is knowledge which creates and defines the stock of information, experiences and capabilities that firm has acquired and continues to acquire. Knowledge is therefore responsible for the heterogeneous productivities at the firm level and underlines why one firm may be more efficient and productive than another.

The competence-based theory goes beyond the main tenets of the resource based theoretical precepts. The proponents of this view argue that it is not merely the collection of resources which is makes the firm tick but beyond this, the firm must be able to utilize these resources in a strategic but market-oriented way and this can only occur when the firm possesses action-oriented competencies (Freiling, 2004).It is strongly asserted from the standpoint of the proponents of this theory therefore that it is these competencies of firms which enable them to unfold and unlock the potential of the resources that they possess and enable them to adapt to the demands in the target markets instantly in a systematic but non-random manner. At the end of the day , however, it can be said without equivocation that the three theories are very much related or even somehow propagate the same line of thought though from slightly differing perspectives in that whilst the resource based theory flaunts superior resources as the reason behind better performances by certain firms , the competence based theory underlines the fact that resources by themselves may not create differences in performance *per se* but differential performances may be observed among firms by reason of the competencies that the firms may have generated within the period that they have been in existence whereas the knowledge-based theory of the firm positions the accumulation of capabilities and knowledge as the veritable source of the firm's competitive advantage which differentiates it from other firms. It must be said that since the knowledge and competence-based theories emphasize the centrality of such intangible resources as capabilities and stock of experience and knowledge in shaping the unique advantages a firm may possess, these intangible resources form the basis upon which firms can embark on innovations which further strengthen their competitive edge in the markets that they find themselves.

One of the key shortcomings of the above deterministic theories is that they unduly focus on the internal factors which influence the firm without due consideration to the factors which lie outside the firm. To address this, firm theorists have evolved environmental deterministic theories which seek to explain how external factors can have an influence on firm behaviour and performance .Notable among these are the institutional theory, the open system theory and the contingency theories. The institutional theory as discussed by Fan *et al.* (2017) and Connell (2016) posits that firm behaviour is basically a reflection of the quality of institutions which exist in the environments within which they operate implying that proper institutional mechanisms are fundamental in getting firms to perform optimally. According Bukari and Anaman (2020), the main thesis of the theory is that firm behaviours are largely determined by the nature of the institutions and regulatory mechanisms existing in a given economic environment well as the legal and the political structures which government the given society. The open systems theorists also argue that the environment of an organization can be seen as a system that is outside of that entity but influences every dimension of the firm/organization. Firms thus change or modify the strategies, processes or procedures to respond to changes in their external environments. The theoretical premise of this theory is very similar to that first laid out in the contingency theory by Lawrence and Lorsch (1967) in the sense that the contingency theory argues that the typical firm grows by adapting to the environment within which it operates.

An important phase however in the evolution of the theories of firm performance is the emergence of the dynamic capabilities view which not only emphasizes the ability of the firm to strategically make use of its internal resources but also underlines the relevance of the integration of externally generated resources into what the firm has uniquely created to gain an edge and attain a level that provides them with competitive advantage over their peers. It is argued however that there are some critical elements in the external environment of the firm which crucially influence how the firm can mobilize and organize the necessary resources to maximize its performance.

Theories of Innovation: A structural approach

The main aim of structural theories of innovation is to identify, specify and characterize organizational design characteristics that which provide the framework for innovation to occur within productive units. In the extant literature two sets of structural theories of innovation can be recognized. In one set, usually referred to as uni-dimensional theories of organizational innovation, its proponents seek to establish the relationships between structural variables within firms and innovation and in particular how these structural variables impinge on firm innovation. For example, one fundamental position of the uni-dimensional theory is that professionalism and innovation are positively related for the reason that professionalism increases boundary-spanning activity within firms, bolsters self-confidence of employees within firms and enhances their commitment to move beyond the established *status quo* (Pierce & Delbecq, 1977).On the other hand, Hull and Hage(1982) stress that vertical differentiation, according to the theory, inversely influences innovation because it is said to increase the bureaucracy in communication channels, slow down communication or make communication between levels more difficult and thus inhibit the flow of innovative ideas within the firm

From the point of view of the literature, structural variables are often classified under two constructs—organizational complexity and bureaucratic control and according to Damanpour (1991), each construct can be associated with three variables which are commonly considered as fundamental elements of that construct. Within organizational complexity are embodied specialization, functional differentiation and professionalism whilst formalization, centralization and vertical differentiation are encompassed in the concept of bureaucratic control.

Even though the structural theories endeavour to explain some of the nuances and the complexities of the process of innovation, it has been criticized on the grounds that its precepts have yielded inconsistent results in empirical studies. This is particularly canvassed by Downs and Mohr (1976).

To deal with the problems with the theory as highlighted by Downs and Mohr (1976). a new set of structural theories of innovation, usually known as the middle-range theories of organizational innovation have been evolved by scholars in the field of innovation.. These so-called middle-range theories have been categorized on the basis of *types of innovation* as elucidated by Daft,(1978) Kimberly and Evanisko(1981) and Zmud,(1982), *radicalness of innovation* as suggested by Dewar and Dutton (1986) and Ord and Tucker(1987) and finally *stages of innovation process as* espoused by Duncan (1976) Marino (1982) as well as Zmud(1982). Even though these theories attempt to draw the line between the types and stages of innovation .they generally are unable to account holistically for the conditions as well as the broad contexts which allow innovations to occur.

In the following sections an attempt is made to isolate from the literature some improvements on the theories discussed above and understand the conditions or environments within productive units which create the grounds for them to be valid

The dual-core theory of innovation

The dual-core theory of innovation popularized by Daft (1978) essentially distinguishes between innovations which are of administrative and technical character. According to Damanpour and Evan (1984), this distinction between administrative and technical innovations is important because it can be tied to systems and aspects of organizational set ups which are social and technical in nature.

Technical innovations involve and encompass such areas as product development, internal services as well as production processes and technologies which are directly related to the primary work activity of the organization and in the words of Damanpour and Evan, (1984) can be either associated with product or process innovations. .

On the other hand, administrative innovations as pointed out by Daft, (1978), Damanpour and Evan (1984) and Kimberly and Evanisko (1981) are primarily embedded in organizational structures and administrative processes of firms. In other words they are the systems which are indirectly associated with and connected to the primary work operations of the organization but much more directly linked to the supervisory layers of firms and for that matter emanate from the decisions and actions of managements of organizations.

The adherents of the dual-core theory therefore believe that there exists in every organization a technical core which is clearly distinguishable from its administrative core. The technical core in the opinion of Daft (1978) is primarily preoccupied with the core function of the firm- the transformation of raw materials into organizational products and services, whilst the administrative core's oversight relate to the organizational structure of the firm as well as control and coordination systems/mechanisms designed for the easy execution of the firm's mandate. Hence innovation can occur within each core though in different ways.

Daft (1978) has outlined the process and sequence in which each of these innovations occur. In the opinion of Daft ″technical innovations typically originate in the technical core and follow a bottom-up process, while administrative innovations originate in the administrative core and follow a top-down process″. However Daft(1982) intimates that the relative balance between these two types of innovation depends upon a number of factors like the prevailing environmental conditions, organizational goals and whether or not the dominant innovation issue faced by a firm can be traced to the administrative or technical domain of the organization.

As already earlier indicated the dual-core theory also suggests that the structures that facilitate innovation in each core in the organization are different. In the view of Daft (1982), the strategies for developing an organizational innovation cannot be monolithic but depends on a host of factors. For example he argues that when it is expedient for firms and organizations to respond and adapt to changes in goals, policies, strategies, structure, control systems and personnel then a mechanistic structure is needed. Under these circumstances therefore, low employee professionalism, high centralization in decision making and high formalization of behavior facilitate the top-down process of administrative innovations. On the other hand, with changes in organizational products, services and technology an organic structure is required in which case high professionalism, low centralization and low formalization are needed to encourage and promote the bottom-up process of technical innovation.

The Theory of Innovation Radicalness

This theory generally looks at the process of innovation largely from the lenses of the degree to which it occurs and in doing so it develops a system of paired terms which define the nature of innovation.

From the literature, a number of variations of these paired terms for innovation radicalness can be found and these vary from one author to another. Normann (1971) in drawing the line between one type of innovation and the other uses the terms 'variation' and 'reorientation;' Norman uses variation to refer to refinements and modifications in existing products while he characterized fundamental changes as re-orientation. On the part of Knight (1967) and Nord and Tucker (1987), innovations are classified as 'routine' or 'non-routine' depending on the nature of the changes which are introduced in products ; that is whether the innovation brings about minor or major changes in products, services, or production process in the organization.

Just as the other researchers have introduced paired words to draw a dichotomy between two types of innovation, by the same token Grossman and Helpman (1994) also create their conception of two levels of innovation; ultimate innovations—those that are complete and ends in themselves—and instrumental innovations those which promote or facilitate the creation and adoption of other innovations subsequently. In empirical research, these categories are often collapsed into the more familiar but routinely used terms-radical and incremental innovations. While radical innovations produce fundamental but drastic changes in the activities of the organization and represent a clear departure as well as a clean break from existing practices/product, incremental innovations come with much less degrees of changes in practices, processes or products .

Though it is difficult to identify the most preponderant view, researchers have argued that ultimately the view that suffices in a particular situation usually depends on a myriad of factors. Dewar and Dutton (1986) for instance have suggested that when there exists a favourable managerial attitude toward change, concentration of technical specialists and the rich stock of knowledge resources available to the firm, then there is greater propensity for radical innovation to occur. Hage (1980) also argued that firms which have developed deeper democratic values and largely devolved power from the centre and properly evolved their organic structures would innovate incrementally whereas as intimated by Nord and Tucker (1987) organizations whose structures are mechanistic may have the right conditions and environment for radical change. Lastly From the perspective of Ettlie *et al*. (1984) whenever organizations build centralized and informal structures, radical innovations are more likely to occur, however in organizations which have developed more complex and decentralized structures, there is a higher propensity for incremental than radical innovations to occur.

The Ambidextrous Theory of Innovation

The ambidextrous theory basically highlights and explains the process of adoption of innovation and posits that the process of the adoption of innovation includes the pre-adoption activities which result in the decision to adopt, the activities that pave way for its implementation and then processes which guarantee the continued use of the innovations which have been created. The ambidextrous theory, according to Duncan (1976), has two stages in a sequence-the initiation and implementation of innovation and in the view of Rogers (1983) the initiation stage can be defined to encompass all the activities which relate to conception of the problem, gathering and evaluation of information and as well as the resource development which culminate in the decision to adopt The implementation stage also comprise the events and actions which relate to changes in the organizational make-up, the initial use of the innovation and the continued use of the innovation until it becomes a routine feature of the organization..

Other Theories of Innovation

In every productive landscape, the most overriding objective of every firm is to make increased profit year-in-year-out. As established firms continue to reap good profits from their operations, these profits that they are earning become the cynosure of other risk takers who by reason of the prevailing lucrative environment become empowered to enter the productive activity in order to cream off some of the huge profits and the market share being enjoyed by the established players in the activity (Kline and Rosenborg 1986). Reçica (2016) however intimates that with the influx of many more firms to enjoy the benefits in the market, all firms now begin to earn normal profits in line with classical microeconomic theory and this situation creates the momentum for firms to begin to innovate in order to catapult themselves into positions where they would have competitive advantage. In the words of Reçica (2016) as this process goes on, it creates dynamic movements within the industry as firms seek to outdo each other in order to command and control the greater share of the market.

Examining firm level analysis literature, one can find a number of models of innovation which attempt to explain how innovation at the firm level affects firm performance. Right from the time of the early classical economists, the concept of innovation has been part of the economic thinking albeit at lower profile level. Indeed, it worth noting that in the writings of the early classical economists like Adam Smith, Alfred Marshall and Karl Marx, the idea of innovation implicitly featured though at the time, they did not specifically use the word innovation. For instance, in his early treatise, "The Wealth of Nations", Adam Smith indicated the importance of inventions as a way of enhancing productivity through improvement in the nature of machinery employed within the production setting whilst Karl Marx in his seminal work on capitalism makes reference to technical change as a major driver of firm performance. Finally, Alfred Marshall underlined the role of knowledge in the entire chain of production (Reçica, 2016) in his book "Principles of Economics". Though these ideas could be said to be indicative of the concept of innovation, they were not prominently thrust unto the main stream economic analysis during their time.

Schumpeter (1934) therefore marked a watershed in economic theory as for the first time there was a conscious effort at researching into the concept of innovation and putting it at the forefront of economic discussions. Schumpeter's contributions were detailed in two main write-ups; “The Theory of Economic Development”, the first in 1934 and followed by “Capitalism, Socialism and Democracy” released in 1942 usually referred to as Mark I and Mark II respectively in the literature. According Carlsson (2003), the first exposition by Schumpeter sought to clearly establish the critical and basic function of the entrepreneur as well as the role of new firms in undertaking innovation. Schumpeter saw innovation and knowledge as concepts which lead to persistent and recurring disequilibrium by constantly bringing into being new technologies and products.

Schumpeter therefore strongly asserts that innovation becomes an avenue through which firms continue to breach prevailing technological *status* *quo* and produce goods and services which are much more advanced and better than those which already exist. According to Lazonick (2005), the process of innovation by a firm can be seen as a way by which the firm can utilize its newly acquired skills to challenge the *status quo* and by that threaten the market position of existing optimizing firms and thereby shift the production cycle. It must be noted that Schumpeter's Mark I was generally developed around the hypothesis that the firm is small in size and operates in a competitive market framework and implicitly inherent in its arguments was that the entrepreneur was the fulcrum around which the accumulation of knowledge and the consequent innovation revolve.

Schumpeter (1942) refined his theory of innovation into what is now called Mark II but reiterated the role of innovation as the one important thing which is responsible for pushing forward the frontiers of economic change in all societies. Indeed, he argued that embedded in innovation was a certain force which could cause what he called creative destruction from within by constantly breaching the old established economic order and creating new ones in their place. Instead of small firms being at the forefront of innovative activities as he originally opined, Schumpeter (1942) this time hypothesized that by virtue of their size, larger firms are have a higher capability and much more empowered to innovate than smaller ones.

Reçica (2016) views this shift in position as being premised on the assumption that larger firms have an edge over smaller firms on the grounds of both technological and financial capacities to be able to absorb huge costs incurred in the process of innovation because they are assumed to be able to commit more financial resources and also in a better position to engage more skilled staff to undertake research and development (R&D). The theoretical basis of Schumpeter (1942) was challenged by Arrow (1962) when he suggested that the propensity for firms operating within a competitive environment is much higher than in a dominated market in the sense that competitive firms operate to be able to upstage and outdo their competitors whereas in the case of the monopolist, innovation only serves to improve upon his/her own established *status quo*.

Following Schumpeter, other theories of innovation emerged to influence economic discourse. Of these theories the one which has had the greatest effect on economic theory is the Solow theory of growth. Even though the theory did not expressly and explicitly use the word innovation, Solow identified technological change as the variable which has far reaching impact on the productivity of labour and capital. According to the Solow proposition, technological change is regarded as an exogenous factor which has the same innovative effect on labour and capital and in the words of Egging (2013) for neoclassical economists, even though routine internal adjustments of labour and capital are usually responsible for stable economic growth in the short run, economic growth in the long run would be determined by technological changes which are exogenously engineered. One of the main highlights of the Solow theory is that it assumes that an economy always heads to equilibrium unlike the Schumpeterian view which posits that the economy is ushered into a continuous state of disequilibrium by the process of innovation. Though the Solow model is considered as a theory of innovation, there are a number of writers who have criticized it for a number of reasons. From the precepts of the Solow theory, technological change which is used as an implicit representation of innovation is considered as an exogenous factor and because innovation is regarded as largely endogenously determined, it ceases to be a true theory of innovation (Lazonick, 2013) .In addition to this it is seen as commoditizing knowledge and not clearly able to distinguish the variants of knowledge especially the types which drive and give momentum to innovation within the firm setting.

According to Romer (1990) for a long time the Solow theory had become the orthodoxy for explaining how innovation affects performance/growth though the theory treated innovation as exogenous and it was only in the 1990s that the neoclassical economists parted ways with the Solow perspective of knowledge and introduced knowledge as an endogenously determined factor which drives growth. Thus, emerged what is usually known as the endogenous growth theory which asserts that innovation and technology are the main determinants of economic growth. The theory has been applied theoretically and empirically both at the small unit levels as well as the aggregate level to explain the innovation / firm performance and innovation /economic growth nexuses (Wong *et al*, 2005).

Another theory of innovation which can be found in the literature though not as popular as the previously discussed theories is the evolutionary theory of innovation put forward by Nelson and Winter (1982).The theory which is essentially a micro driven theory argues that innovation is internally generated by a myriad of factors which unique to the firm-the level of knowledge generated within the firm, the type of organizational culture within the firm functions as well as how much financial outlay is channeled into research and development by the firm. This theory is thus very similar to the endogenous theory as discussed earlier even though it is not given the prominence as enjoyed by the other theories. One of the weaknesses it is identified with is that it tends to overlook the importance of market environments as well as the role of institutions in driving innovation at the firm level. This position is canvassed particularly by Edquist (1997) and Lundvall *et al* (2002) and their criticism appear to provide the rationale and fillip for the institutional/systems theory which seeks to position institutions as the key facilitating mechanism for firm innovation and growth.

Apart from all the theories discussed , there is also the human capital theory which basically but strongly argues that the first step in creating the drive for innovation is by investing in the development of the critical mass of people who are highly knowledgeable and acquired better skills. Hong (2016) stress that human capital development guarantees a systematic enhancement of the skills set of the human resource base of organisations and therefore provides them with a critical mass of quality labour force endowed and learned enough to be able to create new things , processes and products for institutions that they work for .

To conclude, it is fair to assert that when one examines the theories of the innovation, it is obvious that for a firm to be in the position to engage in innovation, there are certain requisites which must be in place. Key among these is that the firm must have resources – both in terms of finances and other types of soft resources which help instill and enhance the creativity of employees.

Innovation / Firm performance Relationship: Some Theoretical Arguments

Following the pioneering work of Crépon, Duguet and Mairesse (1998) dissecting and examining the innovation firm /performance relationship has assumed greater prominence in the sense that it has triggered even closer look at the relevance of innovation in the promotion of better firm performance. In the literature, one can surmise that there are various perspectives which can be identified. Mai *et al* (2019) strongly underline this fact when they assert that the innovation/firm performance nexus has different perspectives.

One of the views proffered can be ascribed to writers like Fernandes and Paunov (2015) and Shields and Young (1994). According Fernandes and Paunov (2015), the introduction of innovative strategies in a firm's operations can make the firm more susceptible to risks because once a firm introduces new products unto the market , then it has to find ways of resolving technical challenges that it may possibly encounter, deal with the market competition that it confronts and ultimately counter the sales strategies of its competitors by investing more money into marketing research and strategies, and acquiring higher grade technologies .

These decisions and actions according to Mai *et al* (2019) ultimately lead to a significant and unexpected escalation of their budgets plans which development may force their hands to increase the prices of their products and in the end harming their profits. This position is reinforced by Shields and Young (1994) who argue that when firms invest huge monetary outlay in research and development and in adopting innovative products, they suffer financially especially if consumers are not utilizing or have not utilized their products. A different perspective is offered by Freeman (1994) who in what is referred to as the signaling argument posits that because innovation projects come with a high risks which may be offset by the potential higher returns, firms which have consistently shown higher performance have a higher likelihood of engaging in innovative activities than lower performing ones.

Another dimension to the innovation-performance debate is articulated by Narver and Slater (1990). They believe that with the adoption of innovation, firms are able to whip up the satisfaction and loyalty of their customers who in turn would recommend the products to their friends and contemporaries and this it is argued has the potential for increasing the profitability of firms. . Aside of this, it is also argued that when firms engage in innovative activities, they are motivated to implement new effective strategies to be able to deal with market situations and breach the technological and competitive barriers in a way that influences their financial performance as well as taking greater control of the market (Bisbe and Otley,2004).

To sum up, Greve and Taylor (2000) point out that positive impact of innovation in propelling higher firm performance and profitability cannot be underestimated for the reason that it enables and empowers productive entities to produce new brands, gain competitive advantage in their spheres of operation and ultimately ensure that firms become more efficient and productive..

Relationship between Business Environmental conditions and innovation adoption

The open systems theory generally attempt to relate the environment that exists outside of a firm or organization to how it can position itself to be able to maximize its outcomes.

According to the open systems theorists, the environment of an organization can be seen as a system that is outside of that entity but influences every dimension of the firm/organization. .

The main thesis of this theory is that firms/organizations operating as open systems continuously work towards attaining a certain state of equilibrium with their environments. To be able to achieve that they constantly appraise their strategies, structures and processes to be able to cope with the rapidly changing external environments. Thus it is argued by the open system theorists that the manner in which any given entity is able to cope and appropriately respond to the changing external environment defines its organizational effectiveness.

The open system theorists regard the environment of an organization as a cumbersome, complex and convoluted system with many dimensions and within which a plethora of complex process occur and that of the many dimensions, the most important is the task environment which embodies and defines the competitive milieu according to Dess and Beard,(1984)

In the literature, three main dimensions of the environment—munificence, dynamism and complexity are identified and examined by Keats and Hitts (2002). To them dynamism in this regard refers to the rapidity and unpredictability with which changes occur in the environment that the firm operates, munificence deals with the potentials and opportunities for growth that the firm has within the industry it operates while complexity defines the competitive environment of the firm.

Scott (1992) argues that of the three aspects of the environment, it is the dynamism dimension, which defines the kinds of changes which occur in the environment of the firm and therefore the factor which most closely affects the ability of the firm to innovate. Dess and Beard (1984) have provided further insights into the concept of dynamism and asserted that dynamism can be compartmentalized into the extent of stability and extent of turbulence or predictability. Environmental stability has been characterized as the frequency with which events occur in the environment and reflects the regularity of change in the environment whereas environmental predictability defines the extent to which events can be anticipated and occur in the nature and rhythm that it was anticipated and for which a pattern could have been discerned in advance (Scott, 1992). Generally for each environmental dimension, two sets of values can associated with it. Thus for example from extent of stability we derive two constructs- stable vs. unstable whilst predictable vs. unpredictable also emanate from the concept of environmental predictability. From the identified constructs therefore four environmental possibilities emerge - stable and predictable EC1; stable and unpredictable EC2; unstable and predictable EC3; and unstable and unpredictable EC4 as illustrated in Figure 1.

In figure 1 below, Quinn (1988) considers the innovation characteristics of organizations and how they influence their ability to innovate. Specifically, important elements like the rate, speed, types and sources of the innovations are then examined under each of the four sets of environmental conditions identified earlier. These enable us to understand the relationship between structure of firm and the nature of innovation that it is able undertake in the next section.

In the following sections, the discussion focusses on the various scenarios of the interplay between structure of firm and its external environment.

Business Environmental Condition 1: Stable, Predictable

Under such prevailing environmental conditions, change occurs but it relatively slow and predictable and with the general stability of the environment the organization is not put under any kind of pressure to adopt innovations frequently, hence the rate of adoption of innovation is low. Also, because the environment is quite predictable, productive entities could take their time to carefully plan and adopt innovations in a way that is structured.

The stability and the predictability in this environment therefore create the conditions for firms to tweak and modify existing technological applications as well as their overall production strategies hence innovations which are embarked upon are largely incremental in character and in the words of Henderson and Clark(1990),innovations in these entities seek to reinforce their capabilities and practices without moving too far away from its existing knowledge base. Examples of organizations in the real world which are in this category are Universities and Colleges, hospitals, container manufacturers, gas and electric utilities and food packaging companies.

In these organizational set ups, the main pre occupation is enhancing their internal operations to foster efficiency rather than concentrating on innovation and therefore more attention is paid to technical innovations more than administrative ones.

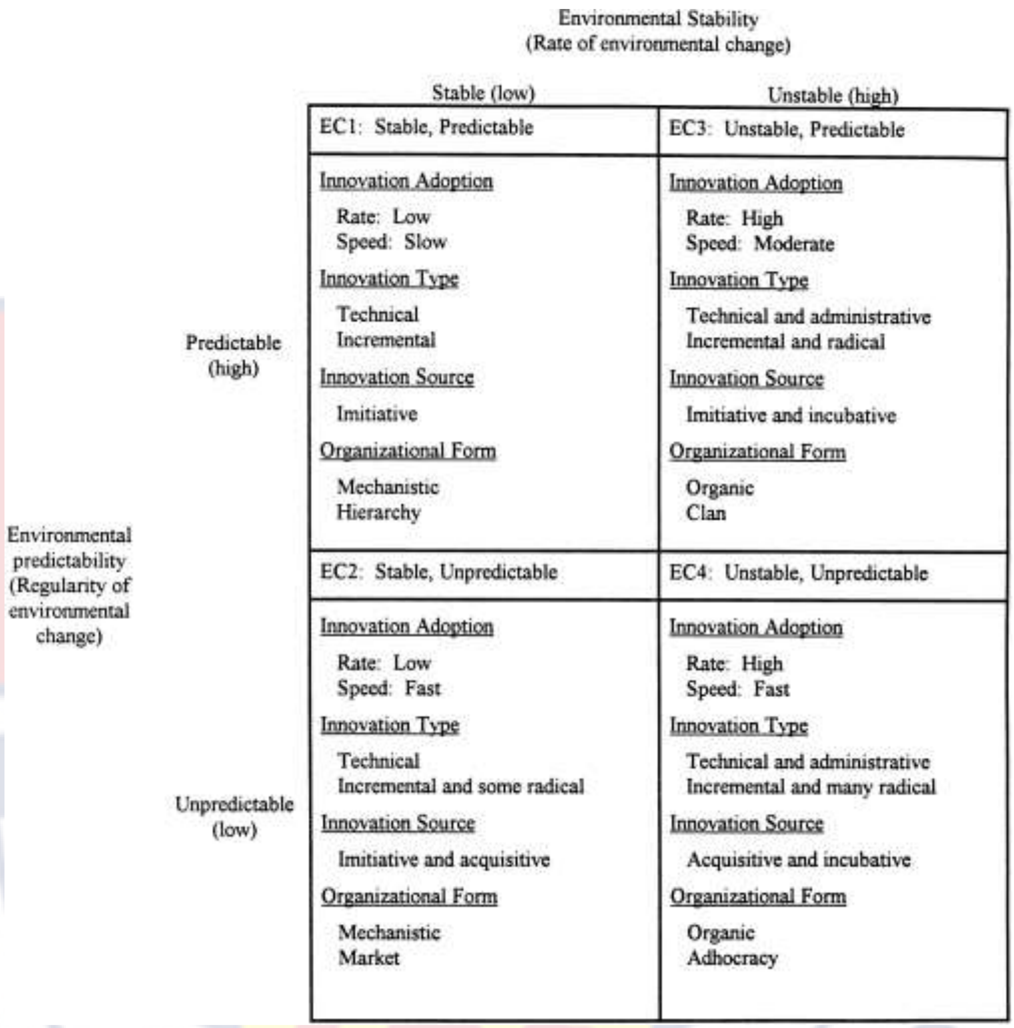

Figure 1: Effects of nature of business environment on type of innovation adopted

Source: Quinn, R.E.(1988)

Again as managerial attention to and investment for innovation is limited, the organization usually does not aim at developing its own capabilities for creating original innovations internally. Instead, it tends to look elsewhere to copy and adopt innovations developed by others.

Business Environmental condition 2: stable, unpredictable

Within this environment, a prevailing stable condition implies that the rate at which changes occur in the environment is low and cannot be easily predicted. The regularity and frequency with which organizations embark on innovations reduces markedly. Because the organization operates in an unpredictable environment, it is not able to fully prepare and pre-plan to innovate. However, as the firm/organization may have to contend with unexpected patterns of environmental change, there is a certain sense obligation placed on the organization to have the requisite developed capabilities to be able to adopt innovations when it encounters unforeseen changes in its external environment in order to keep its competitiveness. Thus, where necessary, an EC2 organization is able to respond to the changing environment, innovate quickly and adopt the innovation as fast as possible. Faced with stable environment, EC2 institutions would normally embark on technical and incremental innovations, though under an unpredictable environment where change can occur suddenly but irregularly underlining the fact that organizations trigger processes to significantly alter existing practices or completely replace them .This implies that EC2 organizations sometimes engage in radical innovations when conditions require that they do so .

Firms which are found in this category are fashion &clothing, advertising companies, personal computer manufacturers, mail-order retailing and music industry.

Thus depending on the circumstance that confronts it, an EC2 organization employs the imitative or acquisitive innovation approach but overall the EC2 organization may not be that keen on making investments in incubative sources of innovation like R&D which are not regarded as cost effective and economical, judging by the frequency of adoption of innovations due to the low rate of environmental change.

Again the environmental unpredictability that the organization faces makes it quite externally oriented because they tend to be on their guard to respond to external situations thereby putting them in a stead to keep their competitive mettle within the market and as put by Quinn and Hall (1983) ,the organizational form employed by the firm looks like what they called the market form .

In sum, this type of firm organization is described by Mintzberg, (1979) and Zammuto and Krakower (1991) as control-oriented and mechanistic and doused with a good level of centralization reasonable enough to be able to remain competitive.

Environmental Condition 3: Unstable, Predictable

This environment is characterized by a high rate of change but with a predictable pattern. The predictability of the prevailing environment thus makes it possible for the firm to plan properly for innovation though such plans must be more elaborate and also flexible than pertains in firm in EC1 to enable the organization to react to regular environmental changes timeously. Under this structure, the organization puts itself in a position that guarantees its capacity to continuously introduce and adopt innovations and in the words of Jurkovich (1974), managers of this category of firms are on regular basis confronted with decisions which have to do with tinkering with their processes and practices as well as services. These conditions thus impose on them the obligation to be swift in terms of decision making thereby speeding up the rate of adoption of innovation. Broadly, the rate of decision making is much faster in this in organizational form than that of a firm in EC1 though not driven by urgency. Examples of organizations in this group are electronic firms, airlines, film industry, hospitals, oil and chemical companies and many financial services firms.

Leveraging on the peculiar environmental conditions which they face, EC3 organizations would normally adopt a balanced approach to the adoption of both incremental and radical innovations in their operations. According to Henderson and Clark (1990) in responding to environmental changes, the organizations in this category do not radically depart from existing innovative concepts but simply improve or refine them in order to meet the prevailing environmental conditions. With EC3 organizations having to contend with continuous changes in their environment, they usually engage in radical innovations and they are able to maintain their competitive positions by continuously searching for new opportunities, fashion out changes as well as identifying more economical ways of producing their goods and services (Zahra and Covin, 1994). Unlike EC2 organizations which depend on the acquisitive source for radical innovations, EC3 firms rely on sources of innovation which are largely incubative.

To achieve the objectives of the organization, entities in this category do not pay attention only to issues which relate to productive activities but also take the development of their manpower and workers in general very seriously and for these reasons they are interested in promoting both technical and administrative innovations. Whereas technical innovations are embarked upon to ultimately scale up the efficiency of the firm or maintain the organization's technical *status quo*, administrative innovations are engaged in with the aim of improving the organizational structures of the entity to engender and reinforce the collective commitment to the ideals of the organization. This view is well articulated by Ford and Gioia (1995) and reechoed by Hooijberg & Petrock, (1993) who assert that the organizational structures in EC3 firms are hinged on respect for every view and role, teamwork , enhanced collective efforts , greater participation , consensus building in the production ecosystem. Above all, the administrative structures are designed to respond to the concerns of their customers and clients so as to provide utmost satisfaction to them.

Business Environmental Condition 4: Unstable, Unpredictable

According to D'Aveni, (1994), organizations operating in this environment are confronted with rapidly changing and hypercompetitive circumstances defined by frequent but irregular changes. These conditions within which they operate therefore provide the impetus for the high rate and fast adoption of innovations both incrementally and radically which make it possible for the organization to be in the competitive frontier and even step ahead of its competitors , though radical innovations are much more employed by firms in this category because of the obvious more difficult environment that they face-high unpredictability of environment coupled with continuously changing environment.

Thus the nature of the environment that they operate in makes it imperative for them to combine environmental elements in EC2 and EC3 firms to appropriately deal with the size of the change and then how sudden an experienced change is. Examples of organizations in this group are telecommunication companies, biogenetic engineering companies, software design companies, specialty chemical companies, supercomputer manufacturers and research-oriented pharmaceutical firms which are primarily high technology firms that must innovate consistently to compete effectively, and ensure their survival (Jelinek & Schoonhoven, 1993).

In these category of organizations therefore, radical innovations are prioritized and derived from both acquisitive and incubative sources and according to Zahra and Covin, (1994) the acquisitive source empowers the organization to respond rapidly to changes in the environment . On the other hand, the incubative source enables firms to internally develop innovations from which new products and technologies are developed in a way that allows them to keep or even improve their competitive position.

Empirical Literature Review

Business Environment and Innovation

Blagova and Tokhtarova (2014) executed ″the impact of Business Environment on Innovation: Evidence from Eastern Europe and Central Asia″. Using an instrumental variable approach to correct for endogeneity, the authors discovered that competitive environment is the most important business environmental factor driving innovation, meaning that by far competition had the largest impact compared to other factors followed by the legal environment. More conclusively, competition was proved to have the strongest relative impact on innovation and that a decrease in the market power of the firm significantly increases the probability of innovation undertaken by it.

Similarly, Fabová, and Janáková (2015) authored the paper "Impact of the Business Environment on Development of Innovation in Slovak Republic". Their study based on the evolution of Summary Innovation Index EU 28 from 2008 to 2014 revealed that, there was an increase in innovation of EU countries and Slovak Republic .The implication of the results is that Slovakia was steadily catching up with more advanced European countries in terms of innovations. The study again, finds that based on the 2010 – 2012 wave of data, the Slovak Republic was still lagging in the business innovation behind the European average. Again in broad terms. , while innovating businesses in Slovakia were measured at 34% of all businesses, the average innovation level in the European Union was at 48.9%. Another interesting finding from the survey based on a comparison of eight dimensions of innovation performance of the EU28 countries and Slovak Republic was that the Slovak Republic has achieved above average results (almost 113% of the average European level) only in the dimension of human resources (carriers of innovation). With respect to the issues of barriers of innovation in Slovak companies the study identified costs, market and knowledge factors as the key obstacles with costs being seen as the greatest barrier to the adoption of innovation by Slovak companies

Kariuki, *et al.* (2011) also examined how firm level factors, firm strategy, and business environment impact on the performance of firms. Empirical analysis showed that the strategy choice of an organization is influenced by the business environment. More succinctly, the study discovered that the firm strategy links the organization to its environment and that also in turn exerts impact on its performance. However, their analysis also demonstrated depending on the measure of performance used that the performance of the firm change as and when strategy employed changes.

Akrofi (2016) studied the extent to which external business environmental factors have effects on the performance of small & medium sized enterprises in the Pharmaceutical industry in Kumasi metropolis. Results from the study indicated that competitive environmental factors in a form of strategic groups, market segments and strategic customers directly affect players as they have to employ different strategies to achieve increased performance. Industry level factors such as threat of entry, power of buyers, power of suppliers, threat of substitutes and competitive rivalry are other critical factors identified by firms in the pharmaceutical businesses as their obstacles to increasing their shares of the market as well as their profitability. In assessing the effect of macro business environmental factors (political, economic, technological and legal) on firm performance, Akrofi (2016) found these macro factors to exert a positive impact on firm performance with the legal factors registering the strongest positive impact on performance implying that legal environment most significantly explains performance of pharmaceutical businesses in Ghana.

Ting Chi (2015), examined how business contingency and strategy formation influence firm level performance from a Chinese standpoint and found out that among the four influencing environmental dimensions (Dynamism, Hostility, Diversity and Complexity) which affect firm level performance, dynamism and hostility showed greater impacts on the formation of firm strategies by high performing firms. This means that of the factors under study, dynamic and hostile environment were measured to have positive but statistically significant effects on firm strategy responses in relation to quality, delivery performance, and flexibility, but negative, insignificant impact on low cost. In the case of low performing firms however, of the key factors , only environmental diversity and complexity were found to significantly influence low cost strategy. Further results also showed that the more diverse and complex the environment was, the more low performers are motivated to place emphasis on cost reduction. Again, results indicate that environmental dynamism significantly but positively affects both low cost and quality strategies.

Simon Commander and Jan Svejnar (2011), set out to investigate how business environment, exports, ownership, and firm performance relate. After resolving the problems of self-selection and endogeneity suffered by previous papers, they discovered in the analysis that, type of firm ownership and competition significantly influence the performance of firms. While foreign ownership of firms was found to have significant positive effect on performance, no evidence of the significant impact of domestic private ownership was adduced. Again, the export orientation of the firm is found to have a positive effect on performance and foreign owned firms were particularly found to be more efficient. Regarding the impact of perceived business environment constraints on the performance of firms, it is found that there is no demonstrable empirical link between constraints and performance. However, different aspects of the regression showed that, tertiary school enrolment and health care expenditure per GDP have stronger (positive) effects on firm performance compared with the Doing Business or Heritage Foundation indicators of business environment. The overall GDP per capita is assessed to also have significant but positive impact on firm performance.

The African Development Report (2011) which assessed the legal and regulatory environment in Africa found that over two-thirds of businesses in Africa listed and rated at least one or a combination of regulatory issues as major or severe business constraints. ADR(2011) generally found the African legal and regulatory environment to be very inhibitive and that among the major constraints , perceived corruption; customs and trade regulations; tax administration and rates; labour regulations, ease of getting operating permits and licensing and the judicial system were identified as the ones which were of greater concern to firm level actors.

Xu (2010) considered and examined how business environments impact on development and the findings revealed suggest that favourable business environment and better economic performance are positively related. The results in the study show that of many elements of the business environment their measured positive impacts are dependent on type of industry, existing complementary institutions, as well as the initial business environment. Using cross-country firm data, the regression results show that labour regulations result in reduced job turnover especially in industries that are more dynamic and technologically advanced and therefore suggest that governments in developing countries, especially those with problematic labour regulations, should examine how their labor regulations compare with other countries and whether their labor regulations can be relaxed to facilitate growth. Analysis also shows infrastructural development appears to be a necessity for poor developing countries because it enhances performance of firms.

Commander, Svejnar and Tinn (2016), worked on the study "Explaining the performance of firms and countries: what role does the business environment play?" Using a regression analysis that took account of cross-country heterogeneity, they showed that country effects rather than business environment constraints were significant factors to consider when it comes to firm performance. No evidence was however adduced to suggest that the business environmental indicators strongly impact on economic growth, although it is shown in the regression estimates that there is a positive correlation between business environmental indicator variables and intermediate outcomes at the aggregate level.

Nguimkeu (2013) concerned himself with “Business environment and firm performance: the case of retailing firms in Cameroon” and found that several business level factors constrain firm performance in Cameroon. The major barriers identified in the analysis are taxation, corruption, illicit trade, credit constraints, lack of relevant supporting infrastructure, inefficient regulatory structures, and lack of competence of the workforce. These barriers are shown to have significant negative impacts on the performance of businesses and hence have important implications for firms in terms of gross margins shortfalls.

Apart from the political instability that was measured in the analysis to have a rather insignificant effect on the performance of the firms, all other business environment related factors were found to have significant negative effects on the profits of firms. In terms of productivity parameters related to the entrepreneur, the estimated results show that the level of education and experience of the entrepreneur positively correlate with the firm gross profitability, though foreign owned companies are estimated to perform better in their margins than their locally owned counterparts. The results again, demonstrate that trade margins are positively associated with such firm characteristics as age, type, membership to a business group, high rate of unionization of employees and computerized management processes.

Farole, *et al* (2017), authored "Business environment and firm performance in European lagging regions. Do firms perform worse in lagging regions?" From the results of the study, a number of things came to the fore; First, they found differences in performances between the 'low growth' (Italy and Spain) and the 'low income' (Poland and Romania) regions. In Spain and Italy, firms in lagging regions are discovered to achieve performance which are lower than that of firms in other regions across all performance variables, while in Poland and Romania; firms in lagging regions rather perform better than those in non-lagging regions across in terms of many variables. The study highlights evidence of the underperformance of lagging regions in the sample countries in the rate of investment of firms: 9.3 percentage points lower in Spain; 11.6 percentage points in Poland; 12.0 in Romania; and 18 percentage points lower in Italy.

Again, the regression results strongly substantiate the descriptive observations of underperformance in lagging regions in the sample countries, showing the significant differences between 'low growth' and 'low income' of the lagging regions. The regression estimates again indicate that in 'low growth' Spain and Italy, firms in the lagging regions achieved negative performance compared with their counterparts across all variables. By contrast, in 'low income' lagging regions, the relationships are mixed and the direction difficult to decipher. The only significant, negative relationship is generated by the investment rate, while all other variables exert positive effects. Another important finding from the study is that the business environmental factors are somewhat more important for lagging regions, because the impact of the business environment on firm performance is stronger in these areas.

Xue, Ray and Sambamurthy (2012) in their study "Efficiency or Innovation: How Do Industry Environments Moderate the Effects of Firms' IT Asset Portfolios?", obtained results which indicate that firms achieve enhanced efficiency of operations in less dynamic, munificent, but complex industry environments when they possess a reasonable level of IT asset portfolio . Another result emerging from the study is that firms with strong IT asset portfolio tend to be able to embark on greater increase in new product and process innovations as well as breaking down of barriers and the creation of growth opportunities even in more complex environments. Again, the findings show that firms have a greater chance of improving their efficiency of inventory management, supplier relationship management, and customer relationship management in less dynamic environments than in more dynamic environment when they substantially invest in their IT asset portfolios.

Kaya (2009) dealt with "Unfavorable Business Environment and Foreign Direct Investment Activities of Turkish Manufacturing Firms (TMFs)" and found that in the order of importance; high utility costs, unstable exchange rates, high inflation rate and political instability are identified to be the top push motives of TMFs that clearly affect firms' outward internationalization. For the purposes of creating clear understanding, the 12 different factors of TMFs internationalization were grouped into three as: "market pushers" (Low profitability of firm, increased competition and slow growth of the firm), "efficiency pushers"(High employment costs, High cost of raw materials and High utility costs) and "unfavorable business environment pushers" (Unfavorable legal climate, Political instability, Unstable exchange rates, High inflation rate, escalating cost of finance and High corporate tax rate). In analyzing the relationship between the push factors and ages of Firms, the study finds that whereas older firms (30 years or above) find the push factors of home country less significant for their internationalization, the other firms regard these as more important. Again, while the relative importance of these push motives does not vary with the firms' amount of capital, they rather moderately vary with the firms' amount of total assets. On the other hand, relative importance of push motives are found to be less important with the increased parent firms' employee number and the amount of total sales. More specifically, small firms (i.e., firms whose employees number less than 500 and have total sales of less than or equal to $2 million) consider home country business environment more unfavorable than the large firms.

Luliya Teeratansirikool, Siengthai, Badir and Charoenngam (2012), focused attention on "Competitive strategies and firm performance: the mediating role of performance measurement". Their study involved a qualitative survey-based enumeration of Thai listed firms with respect to how the performance measurement in the firms mediated between firms' corporate strategy and their performance. Using factor and path analysis, results from the data analysis indicate, that there is a significant positive relationship between each of competitive strategy and performance measurement on one hand, and firm performance on the other, though it is established that cost leadership does not significantly influence firm performance,. It is also evident from the estimated results that the total effects of cost leadership and differentiation on firm performance mediated by performance measurements are greater than the direct effect of cost leadership and differentiation on firm performance meaning both financial, and non-financial measures operate as intermediary variables between the competitive strategies and firm performance.

Assessing the determinants of innovation activities in small and open economies within the Lebanese business sector was the main focus of the study by Hadri, Arvanitis and M'Henni (2016).Predicating their arguments on the two main theoretical positions espoused by Schumpeter (1939, 1942) and Arrow (1962), they embarked on surgical analysis of the literature from which they developed dichotomous probabilistic regression model which formed the basis of their empirical analysis. Hadri *et al.* (2016) also performed an instrumental variable regression to deal with the issue of endogeneity and confirmed from their analysis that the firm's likelihood of innovating increased with increasing size. The other main determinants of innovation from their data analysis were export orientation of firm, the R&D activities, partnerships as well as technological transfer activities engaged in by firms.

Gunday, Ulusoy, Kilic and Alpkan (2011) assessed the main factors which influence the innovation capacity of manufacturing firms in Marmara region of Turkey using a sample of 184 .They employed factor analysis, structural equation modelling and the multiple linear regression approaches to establish that the intellectual capital of the firm and firm organizational culture in that order are the most significant factors which influence the firm propensity to innovate. Further empirical analysis showed that factors such as intellectual capital, firm organizational culture, and manufacturing strategy of the firm and joint efforts of firms all positively impact on the ability of the firm to innovate and as expected, the barriers to innovation were demonstrated to negatively affect the propensity of the firm to innovate.

Bhattacharya and Bloch (2014), investigated the determinants of innovation and using binary probit and Tobit estimation techniques found that firm size exerts significant positive effect on innovation by the firm. Specifically, from the estimated regression model, innovative activity is shown to increase significantly as firm increases in size, but this occurs at a decreasing rate. The other key findings from the data analysis are that R&D intensity, industry concentration as well as exports and imports intensity positively affect innovation with the effects of intensity of R&D, market concentration as well as intensity of export applying more in high-tech firms but that of profitability being relevant in the case of low-tech firms.

EBRD (2014), Transition Report on innovation and firm productivity identifies that firm productivity is impacted significantly but positively by all types of innovation – product, process, marketing and organizational innovation. With the product innovation, the results are particularly striking and very significant because it is estimated to lead to about 43 per cent increase in labour productivity with a high degree of statistical significance. Similarly the implementation of process innovations are also found to increase labour productivity albeit with a smaller effect though also statistically significant. The report again shows that improving the average firm's management practices from the median to the top leads to an increase in labour productivity.

Abdu and Jibir (2018) sought to isolate and investigate the factors which drive innovation in Nigeria. Utilizing a wave of the World Bank Enterprise Survey (WBES) they constructed probit and tobit regression models to fit their analysis and their estimated regression equations showed that the main positive drivers of firm innovation in Nigeria are R&D activities, structured training of employees, size of firm, exporting status, the nature and level of competition, location of firm as well as the activity firm engages in. However, firm age and employee education were found to negatively influence innovation by firms. The regressions specifically show that all the factors which affect innovation broadly also drive marketing, product, process as well as organizational innovations and in order of importance the study finds that marketing innovations are the most employed by Nigerian firms followed by product, process and organizational innovations respectively.

Zemplinerová and Hromádková (2012), also researched into the determinants of firm innovation. They applied a classical CDM model to a Czech innovation survey which was integrated with the financial statements of firms. The empirical analysis showed that firms that are foreign markets oriented (larger market) commit more investments into innovation and therefore embark on higher levels of innovation. Further, foreign markets orientation is also found to strongly influence firm innovation decisions. Again, the study finds that the factors which inhibit knowledge acquisition and also undermine markets have a negative and statistically significant effect on innovation but subsidies which are given to firms surprisingly impact negatively on their ability to innovate; however, no evidence of a statistically significant effect of marketing or organizational innovation on firm productivity is adduced in the analysis.

Gundaya, *et al.* (2011), examined the impacts of the various types of innovation on firm performance. The study essentially employed a qualitative survey method to isolate the innovative factors which influence firm performance and key findings from the analysis reveal that, innovations significantly and positively impact on firm performance in the manufacturing industries. More precisely in the study all factors of innovations are found to practically exert significant impact on firm performance regarding the sample size employed. The study further shows firms have develop higher innovation capabilities in all its dimensions are associated with increased innovative production, and market performances but the relationship between organizational, product and process innovations, taken individually on one hand and innovative performance is not found to be significant, although the analysis shows that there is statistically significant positive correlation between organizational, product and process innovations.

The Oslo Manual (2018) of OECD/European Union, which assessed external factors' effect on firm innovation determined that the firm’s market environment; public policies including regulations; and the social environment are main categories of the external factors that drive innovation. The report indicates that the various environmental elements relate to each other and influence firm activities as well. For instance the report details that, public policy generally influences the nature of a firm’s business environment via the markets by creating structures for regulating monopolistic firms or by using market mechanisms to reduce the negative environmental impacts resulting from the activities of firms. The report suggests that strong and effective markets, governmental and social institutions and also well-defined norms are important factors which ensure the availability of useful knowledge that firms draw upon to create their innovation potentials, shape their knowledge flows, networks and repositories, out of which they are ultimately able to innovate.

Gurhan Gunday *et al* (2012), studied ″ the determinants of innovation in manufacturing Firms″ and identified organizational culture, barriers of innovation, firm manufacturing strategy, intellectual capital as the main constructs which influence firm innovation and among these determinants, intellectual capital is found to be the most important innovation determinant. Using SEM, the researchers demonstrated that indigenous factors such as internal deficiency and internal limitations are the most significant factors which impede firm innovation but the results show that the other identified determinants of innovation all have significant, positive effects on the innovative capability of a firm.

Krammer (2015), concerned himself with the study “Coping with political instability: firm innovation in Sub-Saharan Africa”. He employed a binary probit model to examine how political instability impacts on the ability of firms in the Sub-Saharan African (SSA) region to innovate. In the analysis, the dependent variable was disaggregated into product and process innovation to be able to determine which of them is most affected by political instability.

The estimated results suggest that better performance of firms in SSA is closely and significantly linked with increased likelihood of firm innovation. Regression results indicate that political instability negatively impacts on firms' likelihood of innovating, irrespective of how they are measured. Overall, the effect of political instability on radical innovation (new processes), appears more pronounced than on incremental one (new products) and also that the development of quality human capital supports and promotes greater innovation by firms. The study further finds that product innovation is promoted by increased competition in the market and indeed it is shown in the regression results that more vigorous competition positively affects firms' propensity to introduce new products, most likely in response to new competitors but the same cannot be said of process innovations, which are usually more radical and dependent on the availability of increased resources and capabilities. Finally estimated results indicate that large firm have a higher propensity to innovate than smaller ones whilst exporting firms are less likely to be affected by political instability than firms who serve only their domestic markets.

Al-Zyadaat *et. al* (2012), examined how innovation influences marketing performance in business organizations focusing on industrial organizations in the Persian Gulf region. The researchers adopted the qualitative oriented descriptive analysis and discover that, product innovation together with its impact on marketing performance are responsible for a little under a third of the overall change in the marketing performance of business organizations (companies). Again the analysis indicate increasing marketing performance leads to increased market share, the rate of investment, or sales and profits magnitude whilst a positive association between product innovation and marketing performance is adduced. Further, the empirical results point to a significant positive effect of pricing innovation on marketing performance indicators in business organizations.

Another study of interest, Isogawa, Nishikawa and Ohashi (2015) was on the relationship between innovation height and firm performance using the Community Innovation Survey (CIS). Employing a simultaneous equation regression model, the study endeavours to account for technological spillovers from innovation. The estimated results show that, product innovations drive higher sales outcomes and are less likely to suffer from reductions in existing sales potentials. Surprisingly, R&D expenditures are estimated not to significantly impact on new-to-market product innovation. On the other hand, new-to-market product innovation is measured to trigger significantly increased performance of firms and also create technological spillovers for firms. The estimated equation also shows that firms with many employees, increased R&D workers, as well as much more tangible fixed assets are able to achieve greater sales when they embark on product innovation.

Masso, and Vahter (2014), embarked on studying the effect of innovation on firm performance in a Catching-up economy. They adopted the popular Crepon-Duguet-Mairesse (CDM) structural framework of analysis using the Community Innovation Surveys (CIS) waves 3&4 firm level survey relating to Central and Eastern Europe and results from the data analysis indicate that process innovations significantly and positively impact on productivity but product innovations are found not to significantly influence firm productivity. The implication of these results is that in promoting increased productivity in the CEEC catching up economies especially, attention should be focused on enhancing process innovations rather than product innovations. The results also show that country level funding are much more impactful on innovation by firms in the region than funding received from the EU. The findings again, indicate that there is a positive relationship between firm size and the likelihood of firm engaging in innovations However, with respect to obstacles to innovation, only the one which shows up significant is the lack of appropriate sources of finances. Finally from the study, the estimated regression indicates that firm size has no significant effect on product innovation but positively influences the probability of the firm undertaking process innovations.

Rostami (2015), undertook the study "Examining the Relationship between Marketing Capability and Innovation". The research essentially involved an instrument-driven qualitative data collection applied to test hypotheses. The result establishes that increased marketing capability acquired by firm significantly affects firm innovation ability implying that innovation is enhanced by improved marketing capability. Other findings show that marketing capabilities are particularly related to firm innovation. The main conclusion from the study is that firm innovation propelled by marketing capability is relevant for achieving competitive advantage.

Mai, Vu, Bui and Tran (2019), examined the how innovation influences firm profitability using panel data set from a transitional economy. The key finding from the study is that innovative activities significantly leads to increased firm profitability funding; in other words, the study demonstrates that innovating firms achieve higher profits than their non-innovating counterparts; the findings also show that innovation has a positive impact on firm performance both in the short and long term. Again, evidence is adduced from the regression analysis that once firms innovate, they are able to gain higher firm profitability through such channels as productivity improvement, higher participation in exporting and also obtaining governmental support. Finally results show that innovating firms not only have higher profits but are also able to achieve value addition to their products compared with firms which do not innovate. Regression estimates also reinforce the view that increased firm formalization leads to higher firm profits and that larger firms get more profits compared with their peers which are less formalized.

Reçica (2016), set out to investigate how innovation influences firm performance in transition economies, with particular focus on Kosovo. The study focused on two core areas-first, the impact of innovation on firm performance and second, assessing how innovation affects firms' exports performances. The main methodological framework employed was the CDM model supplemented with probit and Tobit estimations using data drawn from the European Community Innovation Surveys. The data analysis yielded some interesting key results; both process and product innovation significantly influence firms' sales growth but an increased production of novel items by firms is found to trigger the biggest impact on the export performance of the firm compared with other types of innovation whilst uncertain domestic environment is estimated to drive firms towards exports markets.

Etienne Ndemezo and Charles Kayitana (2020) also sought to understand how the performance of firms in Rwanda is influenced by innovation of the firms in the paper "Innovation and Firms' Performance in the Rwandese Manufacturing Industry. A firm Level Empirical Analysis". The study applies the CDM methodology to the World Bank Enterprise Survey

(WBES) 2006 wave and finds that financial performance of a firm does not determine the innovation decisions of firms. The generated regression results point to the fact that innovative activities by firms rather improve their financial outcomes. From the estimated results, the main factor which propels increased financial efficiency of manufacturing firms is the acquisition of international quality certification but the second factor, use of web site in relating with clients or suppliers is estimated to negatively affect firm performance From the estimated equations the effect of competition proxied by capacity utilization and export sales share of the firm on financial performance of firms is positive and significant. Another finding from the empirical analysis is that small firms are most able to compete in Rwanda relative to bigger counterparts, but the medium firms are also less competitive when compared with large firms

Goya, Vaya and Surinach (2012), authored “Do intra- and inter-industry spillovers matter? CDM model estimates for Spain”. Relying on the Technological Innovation Panel (PITEC) 2004-2010 survey, they find that, firm size positively and significantly impacts on the manufacturing sector and has no impact whatsoever in the service sector generally but specifically has a negative impact in the non-knowledge-intensive services sectors. Their estimates further show that, public funding for innovation activities is strongly leads to high levels of technological development and that receipt of funding from the public increases the propensity to innovate in the low-tech sector. The study underlines the fact that firms which engage in international competition experience significant positive impact on their performance, and motivates them to engage in R&D activities, especially in low-tech industries.

Another important finding from the estimated regressions is that intra- and inter-industry spillovers create positive impact on the productivity of the firm, though this changes as the level of firm technology also changes. Further examination of the results indicates that larger firms are the more likely to be able to engage in R&D activities compared with smaller ones. In the case of productivity, the results show that it is positively influenced by both product and process innovation though process innovation is estimated to have a greater impact on productivity than product innovation. Besides, in high-tech sectors increased process innovation pushes firm to perform better.

Lehtoranta (2010), embarked on the study “Innovation, Collaboration in Innovation and the Growth Performance of Finnish Firms” with the key objective of identifying how the performance of firms in Finland is impacted by the dynamic impacts of innovation. The study drew its data from two waves of Finnish Community Innovation Surveys; CIS2 and which was merged with growth performance data sourced from the Finnish Business Register. With the aid of the CDM structural model augmented by two step Heckman selection model, estimations provide evidence that process innovations positively affect total sales growth among innovative firms.

Among all firms in the study’s full sample, process innovations are found to have no more significant influence on the long-term sales growth prospects of firms. In respect of product innovation, the study finds that it significantly affects total sales growth but only in the CIS2 sample. Again, results show that firms which engage in product innovation achieve higher sales growth rate compared with other innovative firms in the five-year period after innovation. Also, in the regression results it is demonstrated that among all firms in the full sample including innovative and non-innovative firms, product innovation exerts a positive significant impact on total sales growth in both the CIS2 and CIS3 samples while firms which cooperate and collaborate with foreign competitors tend to derive higher total sales growth, but only in the CIS2 sample. Among firms, collaboration with other firms create a positive employment effect. Finally, in the CIS3 sample, the findings indicate as firms collaborate more and more with research institutes, their demand for labour increases..

In “Innovation and firm-level productivity: econometric evidence from Bangladesh and Pakistan”, Waheed (2017), developed a three equation simultaneous system based on Cobb-Douglas innovation augmented production function designed to be able to take care of problems of selectivity bias and endogeneity and found that, firm size (sales) significantly influences both R&D and the likelihood of firms engaging in process innovation. However, the estimated equation fails to show that product innovation significantly affects sales of Pakistani firms. The results further indicate that education significantly affects product innovation positively but it does not have any impact on process innovation for Bangladesh’s firms but impacts positively on both process and product innovation in the case of Pakistani firms. Again, the results adduce evidence that in Pakistani, imports and exports by firms significantly induce both product and process innovation but no such evidence is found from the regression estimates for Bangladeshi firms. Another important finding is that in Bangladesh, exports are measured to have a negative response from product innovations but the latter rather has positive effect on imports

However, the results from analysis of Pakistani firms are mixed: in that, product innovation is significantly driven by labor productivity in basic and extended net book value of firm assets. On the other hand, process innovation shows its significant importance as a factor that affects the productivity output of all firms in both Pakistan and Bangladesh from the estimated results. In the case of all firms together, product innovation appears to more impactful on productivity output even though it is estimated not have a substantial impact on Bangladeshi firms' productivity. The main conclusion from the study is that in the two countries studied, process innovation has a bigger effect on productivity compared to product innovation.

Martin and Nguyen-Thi (2015), embarked on the study "The Relationship between Innovation and Productivity based on R&D and ICT use. An Empirical Analysis of Firms in Luxembourg". Staying with the orthodoxy in this field of analysis, they employed a three stage CDM framework and revealed from the analysis, collaborations are important when it comes to R&D, but not relevant for achieving in-house (internal) R&D. The analysis of R&D intensity shows it is impacted positively when firms cooperate with public research organizations like Universities, higher educational institutions, and government or public research institutes when it comes to in-house R&D intensity (internal R&D), but does not apply to external R&D. Another important regression result is that external R&D intensities positively motivate the introduction of all types of innovation but internal R&D intensities positively affects only product innovation out of the types.

In relation to the use of ICT, the study finds that it positively influences the innovation capacity of firm to be able to improve their output, production processes and also their organizational management. The results indicate that labour productivity levels are positively impacted by technological innovation, given that R&D expenditure and ICT use are guaranteed. The study again, proves that higher investments in R&D increases the probability of firms embarking on product innovation while results do not show any such evidence for process and organizational innovation. It is also observed from the regressions that external R&D expenditures significantly affect innovation outputs and also that external communication ICT positively impacts on only process innovation, while e-management positively and significantly affects product and organizational innovations. However, no evidence that the development of internal communication ICT impacts on firm innovativeness is adduced from the regression results.

Howell (2018) undertook the study "Innovation and firm performance in the People's Republic of China: a structural approach with spillovers". Employing a CDM structural innovation framework, Howell shows from his estimations that firms that engage in indigenous research and development are able to increase their performance through the availability of enhanced innovative outputs, Moreover, firms develop and enhance their innovation potentials as a result of learning by doing effects and theses spillovers provide firms especially those with high absorptive capacity, increased innovation outputs.

The regression estimates also suggest that while the likelihood of both old and young firms engaging in innovation is high, young firms are more likely to adopt more intensive innovation strategies. Further it is proven from the results that, the larger the market share a firm has, the more likely it would innovate. The estimated result do not however show that access to foreign knowledge significantly influences the decision of the firm to innovate, though it is found that lack of access to foreign knowledge tends to dampen the R&D intensity of the firm. Another finding which is interesting from the estimates is that the firms which have higher export intensities, have a higher likelihood of innovate though via lower intensity of R&D. Finally, it is demonstrated that firms which receive direct government subsidies have an increased propensity to innovate and also increasing the intensity of their R&D.

Sakala and Kolster (2014), also examined how innovation influences productivity within the North African context and found that, the size of firm motivates and enhances the innovation process within them but R&D intensity does not significantly affect innovation in these countries. However, the effect of vocational training on innovation is significant, which shows the importance of skills upgrading within firms to be able to adopt and assimilate new know-how and knowledge which are crucial for creating the potential for innovation. The regression results show that in Egypt and Morocco, innovation was measured to be significantly but positively related to productivity while in Algeria, there is no evidence that innovation significantly impacts on productivity. In respect of the technological ownership indicators the results indicate they significantly and positively impact on the ability of the firm to innovate. With regard to the export effect on the incentive to innovate, the results affirm that in Egypt increased exports lead to increased innovation whilst in Morocco, exports by firms do not impact on innovation. Meanwhile, these countries are found to have common barriers as well as potentials.

Audretsch, Hafenstein, Kritikos and Shiersch (2018) investigated how and the extent to which firm size affects innovation within the service industry. Like many studies in this field, their analysis was based on the CDM model and modified by Ackerberg et al (2015) with data taken from IAB Establishment Panel. The regression results reveal that increasing firm size positively influences the decisions of firms to embark on R&D though it is discovered in the regression analysis that the probabilities of young and mature firms engaging in R&D activities are almost the same in the manufacturing sector. Again, the estimated equations indicate that younger firms in knowledge intensive sector (KIS) industries are generally more likely to adopt R&D compared with firms which are older in the market. In terms of knowledge production, it is discovered that firms in both manufacturing and knowledge-intensive services which are in R&D activities generally show a greater propensity to innovate though larger ones while micro sized firms in KIS also exhibit a high likelihood of innovating Also, labour is estimated is estimated to have a more significant impact on firm productivity in the service oriented than in manufacturing firms.

However, investment in physical capital does not significantly impact on innovation by micro firms in the KIS sector. Regarding the nexus between innovation and productivity, the study finds that innovations in firm trigger increases in their labour productivity. Again, from the estimation we observe that a one percent increase in the probability to innovate scales up labour productivity by 1.1 percent for all firms in KIS sector. The regression results also show that for firms which engage in R&D their probability of being innovative for both types of innovation increases. Again the results indicate that effect of product innovation on firm productivity is higher in both KIS and manufacturing than for process innovation. Also while young firms are more likely to create a new product than mature firms, KIS firms benefit more from investments in R&D in the sense that their innovation outcomes causally increase their labor productivity.

Spescha and Woeter (2016) assessed the impact of innovation on firm growth within business cycles particularly investigating how the business cycle influences the effect of between innovation on the growth in firm sales Drawing on a panel data and utilizing the OLS fixed and random effects regression estimations, they showed that in periods of economic boom, there is no difference in sales growth between innovating and non-innovating firms. However, during the periods of recession and economic downturn, innovating firms are estimated to perform better in terms of sales growth. The estimated regression also shows that small innovative firms outperform their peers.

Mansour (2017) explored the relationship between innovation expenditure, innovation outputs and firm productivity among German manufacturing firms. Based on an unbalanced panel data set, he utilized a three stage CDM structural equation model to demonstrate that the decision to innovate impacts positively on productivity of labour in the previous period. Regression estimates also shows that as innovation expenditure rises, it leads to an increased development of new products by firms. In addition, the estimated equations suggest that marketing innovations, process innovations as well as organizational innovations all promote enhanced labour productivity in the firms. The main factor promoting marketing innovation is found to be the quality of personnel in the firms. However, the regression estimates do not isolate clear cut factors which significantly drive process and organizational innovations.

ERBD (2014) is a study which examined how firm productivity is impacted by innovation. Using the orthodox CDM model, it was demonstrated that labour productivity is positively influenced by both product and process innovation though it is observed that product innovation has greater impact compared with process innovation .Again improved management practices are found to lead to increased labour productivity as well. Another finding from the regression analysis is that effects of innovation are relatively higher in less technology-oriented manufacturing subsector within which traditionally the adoption of innovative strategies by firms is very rare.

Castellacci (2009) employed a modified CDM estimation technique on three waves of Norwegian innovation surveys to assess how competition influences the innovation/productivity nexus. Estimated regression results indicate that oligopolistic firms are motivated to invest more in R&D activities and that increases their likelihood of undertaking innovative activities. However, firms in the competitive sector are found to experience stronger impacts of innovation on both their technological and economic performance.

An investigation of the nexus between innovation and productivity of Dutch firms was the main the preoccupation of Vancauteren, Melenberg, Plasmans and Borgard (2017). The study implemented an extended version of the CDM model using a panel data set of Dutch firms (2000-2006) separating the effects of R&D expenditures on patent licensing from the effects of these patents on firm productivity. Results from the estimations indicate that innovation outputs strongly impact positively on firm productivity. Also, the random effects for individual firm heterogeneity are also found to be important in explaining the R&D-patents relationship and ultimately their effect on firm innovation.

Iavorska (2014) sought to investigate the innovation /firm performance relationship within the Ukrainian context. Using panel fixed effects regression method with data spanning 2004-2010, estimated results show that lagged innovation activities negatively impacts on financial performance measured by returns on assets (ROA) but does not significantly influence total factor productivity. Further, the performance variables are estimated to positively influence the ability to innovate and launch new products with results showing that larger firms are associated with increased propensity to innovate..

Barasa, Vermeulen, Knoben, Kinyanjui and Kimuyu (2019) also ventured into assessing how innovation inputs affect firm efficiency with a focus on manufacturing entities in the Sub-Saharan region of Africa. Barassa *et al.*(2019) adopted the half-normal stochastic frontier to investigate the impact of innovation inputs on the technical efficiency of firms in the chosen study area. Key findings from regression output indicate that the adoption of foreign technology by firms when combined with internal R&D tend to promote technical efficiencies of the firms under study. Their results also underline the complementarity between technology from outside and in-house R&D and indicates that foreign technology would positively affect technical efficiency of firms when firms have developed the required absorptive capacity with respect to the technology. In addition to the above, the estimation results also provide evidence of the Schumpeterian theory that bigger firms tend to be much more inefficient whilst it is also expectedly observed that access to foreign markets increases the efficiency of firms. Other important variables which from the estimations are measured to impact positively on technical efficiency are access to credit, the level of competition that firms face as well as capacity utilization of the firm.

Firms and exports performance

In the literature, one of the key research issues relating to firm performance has centered on the nexus between firm innovation and exports and gleaning the literature, not that many studies have attempted to investigate this relationship.

Reçica, Harshi, Jackson and Krasniqi (2019) embarked on the study "Innovation and export performance of firms in transition economies: the relevance of the business environment and the stage of transition". The study employs the Tobit model as the analytical framework with data extracted from 2002, 2005 and 2008 waves of the Business Environment and Enterprise Surveys involving 29 transition countries in Europe and commissioned by European Bank for Reconstruction and Development (EBRD). Key results generated from the data analysis show that newly formulated products as well as improved products significantly impact on firm export performance. More precisely, the regression estimates reveal that the stage of transition of firm moderates and the impact of innovation on export performance increases as countries into higher stage of transition. In addition, it is observed from the the estimates that in countries where the rule of law is weak, it generally negatively affects the export performance of medium sized firms as well as that of fast reforming countries whilst macroeconomic instability is measured to enhance export performances of countries which have attained higher development levels. Again, while access to finance is observed to have significantly impact on export performance in some countries, infrastructure surprisingly seems not to have any significant effect on export performance.

The study of Angelo(2012) assessed innovation/export performance relationship among the Italian high-tech SMEs and using a Tobit regression approach, showed that though there is a positive and significant influence of R&D on export performance, expenditures on R&D surprisingly do not have any significant impact on exports. Again, the work of Universities and others external R&D partners also has a significant but positive effect on the export performance of these firms. The estimated equations showed that product innovations by the SMEs as well as the turnover that they generate from their innovation activities both have high and positive impact on the export performance of these firms.

Sterlacchini (2001) set to isolate and identify the determinants of export performance of Italian manufacturing firms using data collected at the firm level. Making use of Probit and Tobit estimation techniques, the results show that the firm size has a positive impact on the export performance of small firms though it is observed that the relationship is U-shaped for bigger firms. Big firms from the results are also shown to be able to leverage their affiliation to international conglomerates to achieve a better export performance. Another illuminating result from the regression is that small firms are shown to be able to achieve better performance in the exports markets. They are estimated to be able to achieve better outcomes when they undertake product as opposed to process innovation. Lastly, with regards to R&D intensity, medium and large sized firms are found to derive better export performance.

Kirbach and Schmiedeberg (2008) undertook a study titled "Innovation and export performance: An adjustment and remaining differences in East and West German manufacturing". The study adopts the Probit and Tobit regression analysis in relation to the likelihood of the firm exporting and then firm's intensity of export respectively. Regression results established that a strong positive effect of innovation on export performance of the firms and further results showed fundamental and structural differences between the export performances of East and West German firms. The results also showed that exports behaviour of West German medium technology firms was similar to their high tech firms whilst the firms in East German are found to behave like the low-tech firms. Again, the estimated equations establish that in respect of East German firms, labour productivity of firms is taken more seriously compared with that of the West German firms which impliedly confirms that the West German firms operate more in a technologically driven high-tech segments of the exports markets.

Conceptual Framework

In this study, the key objective is investigate how business environment and innovation which according to the literature are critical in defining and creating the competitiveness of the firm, influence firm performance.

In the study therefore, the researcher seeks to primarily determine the extent to which business environment and firm innovation shape the performance of the firm.

In the diagram below, an attempt is made to illustrate in a snapshot how the key variables in the study are related and linked. The policy variables are business environment and innovation and they when acting on firm inputs determine the level of efficiency of the firm. To condition firm efficiency, the policy variables act in two ways – separately and independently and then interactively to produce a certain level of efficiency.

However, while efficiency broadly measures the performance of the firm, it does act like a latent variable which eventually determine the ultimate performance objectives-the extent of capacity utilization, exports and sales revenues.

In the diagram, exports, capacity utilization and sales revenues are the defined as the ultimate performance/objective variable because they represent the indices that the firms ultimately use to measure their performances

It must be noted that in this study, the level of efficiency attained by the firm is to a great extent determined by the nature of the business environment –that is how favourable (unfavourable) it is and then the extent of innovation, that is the level of innovation that firms have been able to pursue and achieve .

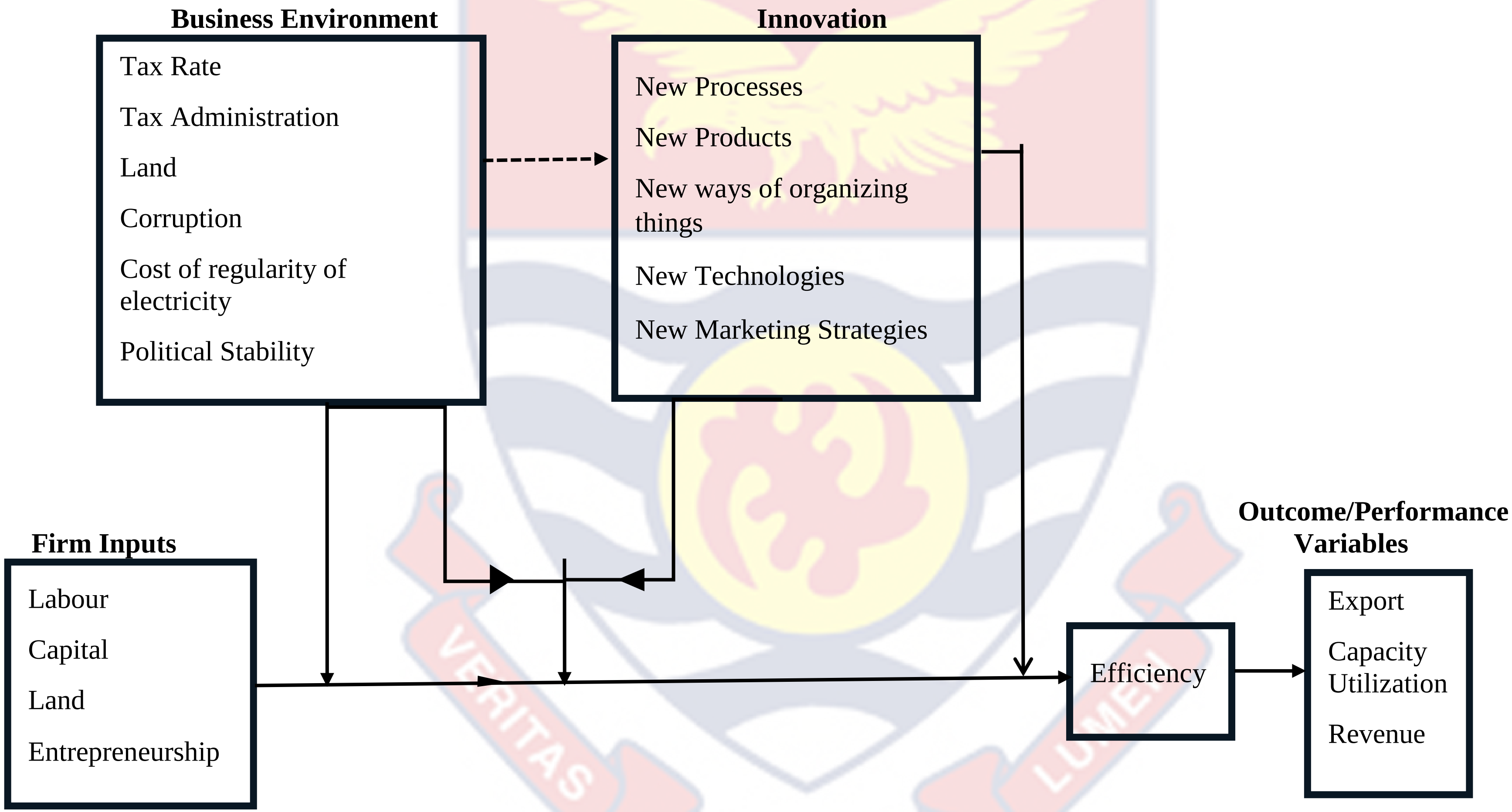

Figure 2: Conceptual Framework
Source: Author's creation.

Chapter Summary

In the past when production was discussed it was seen largely in the lenses of tangible ,material factors which influenced it .In contemporary times however, there is an important shift in the arguments and the business environment and innovation have now become key inputs in influencing firm performance. Business environment and innovation have become important in especially defining competitive advantage for firms. In this chapter, we have underlined the importance of the business environment and innovation from both the theoretical and empirical stand points and critically examined all the relevant theories which situate them properly within the context of firm growth and performance.

CHAPTER FOUR

RESEARCH METHODS

Introduction

The methodology of a study is the heartbeat of the research because it is that which provides the scientific basis for the study and therefore lays out the technical structures upon which the empirical analysis can be conducted. This chapter therefore delves into the overall methodological framework employed in the study and presents the technical details of the methods, processes and procedures used in the analyses in this thesis. The chapter is begun with a discussion on the range of research paradigms which are employed in contemporary researches so as to provide the rationale and basis for the choice of the positivist research paradigm as the philosophical anchor for this study. In the next section, the research design which has been adopted for the thesis is briefly examined and followed with a detailed explanation of the analytical methods to be employed for the estimations and making inferences. In the concluding section of the study, the .relevant data set relied on for the empirical analysis is described.

Research Philosophy

According to Sekaran, (1992) ″ research is a systematic and methodical process that investigates a phenomenon, addresses an issue, answers a particular question and solves problems, with the view to increasing existing knowledge″. Every research therefore aims at unravelling that which is not yet known and thus pushes forward the frontiers of knowledge through a systematized approach which is usually replicable and verifiable. To be able to do this effectively, every research needs to be guided, directed and shaped within a particular theoretical framework or body of constructs. This theoretical framework or body of constructs is what is referred to as the research paradigm or philosophy (Babbie, 2005).

In social science research in particular, the use of research paradigm is very important because it underlines and defines the theoretical and empirical confines of the study and thus provides people with the perspective from the which researcher has conceived and operationalized his/her study.

A paradigm or philosophy has been characterized in different ways in the arena of social science research. According to Silverman (2005), a paradigm or philosophy is the ontological or the epistemological assumptions which provide the basis for the purpose of the study, its methodological outlook as well as the level of abstraction and deductions which can be drawn from the results that it generates. Chalmers (1982) reinforces Silverman when he says that a paradigm is generally made up of a body of assumptions which are theoretical, laws, precepts and techniques which are adhered to and usually adopted by the scientific community and which are applied in the studies that they embark on and argues there are five important ingredients which can be found in every research paradigm or philosophy. These are that

1) Its laws and theoretical assumptions are clear and unambiguous.
2) There is a standard approach to applying its laws and assumptions to different situations.
3) It has a unique system of instrumentation and techniques for operationalizing its laws.
4) Embodies a set of metaphysical principles which provides direction to studies within the confines of the paradigm.

5) Defines a particular methodological approach to studies within the paradigm.

In the philosophy of Social Science literature, there is a plethora of paradigms that one comes across. The most common ones are the Positivistic, interpretive and Critical paradigms.

According to Shah and Al-Bargi (2013), positivism which is built on the tradition and philosophy of empiricism and rationalism established by Comte, Kant and Locke is regarded as the scientific approach in the sense that it strongly believes that effects and outcomes are essentially determined by their causes and therefore to positivists, real knowledge emanates from sensory experience and can be ascertained and verified through experimentation and observation. The positivist approach to discovering knowledge is predicated on the existence of an absolutely objective reality which is truly not dependent on the human perceptions, interpretations and above all the world view of people. This is underlined by Cohen, Levin and Mowery (2007) who argue that researchers from the positivist standpoint believe that the world is viewed as a separate, external but objective reality from which the observers are independent and detached. Ultimately positivism from an epistemological standpoint always seeks to objectively measure and establish causal relationships and through that be able to forecast or predict events within the social world. To the adherents of positivism therefore, social science approach to obtaining knowledge is very close and similar to the natural science methods. By virtue of the fact that positivism relies on the demonstration and the verification of the objective reality through establishing relationships, it uses the quantitative and experimental methods, though usually under controlled conditions.

Even though positivism is considered to have a substantial influence in the development and advancement of social sciences particularly the field of economic science, it has attracted some criticisms of its precepts .In particular critical issues have been raised in terms of its ontological and epistemological approaches and how they can be applied to social researches. One of the most notable critiques is by Popper (1959) and in his words, positivism is too mechanistic and is driven strongly by verification and less by the principle of falsification which in his view is able to provide more value in terms of sound research questions as well as practices.

Another criticism of the positivist approach is that it practically treats human beings and natural occurring things the same way and by extension does not make a distinction between social and natural sciences ((Bryman, 2008) which is problematic. Again, even though Perri6 and Bellamy (2012) acknowledge the ability of positivist approach to synthesize and derive patterns and observations from data sets, they however contend that it is largely unable to provide sufficient explanations of the 'hows' and the 'whys' of the patterns that it discovers. Above all, one major characteristic of positivist approach to research is that it seeks to generalize its outcomes in social sciences. However, in the view of Shah and Al-Bargi (2013), that assumption that outcomes can be generalized is difficult to accept and indeed inapplicable in a lot of situations because of differences in culture, beliefs and human experiences. This argument is reinforced by Della Porta and Keating (2008) who believe that the assumption of the positivists that the outcomes from social research can used for predictions may also be pervious because it is a well-known fact that human beings change and their behaviours change very fast over time.

One of the strong arguments of the proponents of the positivist approach to research is that its methods are value free and very robust and thus its precepts are a notch above metaphysics. This claim is however challenged by Kuhn (1962) on the grounds that there is hardly a dichotomy between dogmas yielded by metaphysics and reasoned beliefs as espoused by social science.

The interpretative philosophy is considered as an anti-positivist method of deriving knowledge from the social world and in the words of Crotty (2003), it views knowledge essentially as culturally derived and historically situated interpretations of the social world. Inherent in the interpretative paradigmatic conviction is that people obtain knowledge by interpreting things through their own perceptive framework and therefore interpretivists believe that as a result, social phenomena can only be explained subjectively. People, according interpretivists may view and describe the same reality from different angles and indeed as Creswell (2009) affirms, ″the interpretive methodology seeks an understanding of phenomena from individual's perspective, investigating interaction among individuals as well as the historical and cultural environment and contexts which people inhabit″. Interpretivism is thus a sort of method which depends on the construction of knowledge through the individual perceptive appreciation of the reality that exists outside of the individual and it is upon this that its analysis is largely hermeneutical and dialectical. These two concepts therefore combine to provide the consensual view of the phenomenon.

Shah & Al-Bargi (2013) infer that by the methods they employ, adherents of the interpretivist philosophy do not subscribe to the use of quantitative research methods as the basis for understanding social phenomena but rather advocate qualitative means as the most appropriate method of studying social issues since it allows for diverse presentations.

Even though interpretivism is regarded as a more flexible approach to social research than the positivist paradigm, there are a number of criticisms which have been advanced against it. One of the foremost critiques is that its approach is usually very subjective and also contextual in character and for reason, its outcomes are hugely challenged in terms of the ability to generalize to different organizational settings (Shah and Al-Bargi, 2013) and furthermore the time involved in consummating the research may be too long and as such lead to higher cost implications. Besides, the nature of its methods makes it difficult for others to exactly replicate researches using its paradigmatic approach. Howe and Moses (1999) also argue that one of the nemeses of this philosophical approach to research is that its set-up leads to a situation where the personal views and idiosyncrasies of researchers may undermine and compromise their outcomes and results.

The critical research paradigm basically adopts an emancipatory approach to examining issues by altering the social, cultural and political environments within which people reside and in the words of Scott and Usher (2011) it endeavours to do away with the inherently strong attachment to certain beliefs and practices by people. The critical philosophical framework is therefore an approach which attacks both the positivist and interpretivist research paradigms in their analytical outlooks. The paradigm thus does not accept anything whose meaning is socially constructed because it argued that such things are usually created within the context of certain conditions and invariably to address certain concerns. According to Crotty (2008), this paradigm views a researcher as someone who is in the place to shape, liberate and transform people from their existing but long-established social conditions. For adherents of this approach to research, their path is one which allows them to systematically raise the consciousness of the people and ultimately have their lives improved.

The main criticism of the critical theoretical research approach is that its methods are structured in a way that researchers may be able to use them to push their own ideological positions rather than allowing objective situations to emerge.

After having rigorously scrutinized the basic tenets and the analytical frameworks of the various research paradigms, it is fair to say that each of them has strong points and of course limitations as well. In particular it is obvious that each paradigm is suited for particular research situation. In other words, the choice of a research philosophy by a researcher must be guided and informed by the circumstances, conditions and the settings within which the research is being carried out.

In this study, having regard to the fact that there are some specific objectives to be achieved and these are correspondingly accompanied by relevant hypotheses which have to be tested. The study therefore inevitably involves the application of some mathematical and statistical tools to the data set to embark on the appropriate estimations in order to be able to decipher and provide explanations of identified relationships. Accordingly, the determination of which of the research paradigms encountered in the literature is appropriate is based on the criterion ;which one of them would allow the defined objectives in the study to be achieved as much as possible and assessing the various paradigms, the positivist paradigm is adopted. This is because the limitations and weaknesses of the other paradigms when set against the objectives of this study by far put them below the positivist approach in terms of the appropriateness and empirical worthiness in the study. More specifically, the positivist method is chosen because it is the best suited to this current study in view of its ability to use the quantitative techniques as is also usually required in econometrics and in line with that, it enable the researcher to make sound arguments and put forward plausible explanations based on the mathematically derived evidence.

Clearly therefore the present study involves a systematized approach to investigating the phenomenon of interest and empirical evaluation of the statistical evidence which inevitably make use of the positivist principles.

Research Design

Every research requires a broad framework within which it is to be executed and this normally covers a broad spectrum of activities including the data collection procedures and the mechanisms to be used in the analysis of the data collected. This range of activities is what is usually referred to as the research design. Creswell (2003) characterizes research design as the overall plan that relates the problem identified to a set of activities which ultimately allows the researcher to achieve his/her research objectives. Saunders ,Lewis and Thornhill .(2007) underline the importance of the research design when they assert that a research design is basically a blueprint which is used for obtaining, measuring and analyzing data in a given research.

In the literature, two main types of research designs are encountered; quantitative and qualitative research designs. Qualitative research usually employs exploratory methods to be able to ascertain what exists in reality. Qualitative researches are more suited to situations where researchers want to discover new relationships in the real-world settings. Under this approach, researchers probe into issues by using well-structured questions and apply the inductive approach to synthesize knowledge. On the other hand, the approach of the quantitative research is different. In this case, researchers use data sets to validate some theoretically established hypothetical propositions by employing mathematical and statistical tools and estimation techniques. By this approach therefore, researchers are readily able to empirically test hypotheses and affirm or reject the propositions. In a sense whilst the qualitative studies usually rely on constructivist/interpretivist approach, the quantitative researchers normally resort to the positivist philosophical approach which guarantees objectivity.

The main preoccupation in this study is to empirically test whether business environment and firm innovation affect firm performance. The study therefore requires rigorous mathematical and statistical estimations which would make it possible to test the stated hypotheses. It is in this light that the study adopts the quantitative cross sectional research approach.

It adopts a cross sectional approach because the available data are in waves and each wave covers a different set of countries and firms. A cross sectional data set is one which is collected at a specified time and covers different people or locations

Analytical framework

This section is pre-occupied with laying out the various analytical models which are to be employed in analyzing the data taking into consideration the research objectives of the study. The framework has thus been structured to be in line with the three empirical chapters under which the data analysis is presented. In the first part, the parametric frontier methods for examining efficiencies of firms in Africa are discussed starting with the stochastic frontier model and its extension, the meta-frontier method which is used in the first empirical chapter.

The succeeding sections deal with the models and the methods which will be employed to be able to investigate and understand the business environment/innovation relationship and how these factors influence firm performance in Africa are carefully outlined It discusses the probit , instrumental variable and 2SLS approaches and then the endogenous switching regression, which would enable the efficiencies of innovating to be directly related to that of non-innovating firms ate discussed. In the last empirical chapter, attention is now shifted to the effect of efficiency on the capacity utilization, sales revenues and exports of firms in Africa using standard OLS and instrumental variable estimation approaches and finally the study adopts the dominance analysis and propensity score matching (PSM) to verify the influence of firm efficiency and other explanatory variables on capacity utilization, sales revenue and exports.

The Stochastic Frontier Model

This is the most popular modern method for estimating efficiency levels of productive units and it has evolved ,as a result of the seminal works of Aigner and Chu (1968), Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977) in which they defined a firm's production function simply as

$$Y_{it} = f(X_{it}, \beta) + \varepsilon_{it} \quad (1)$$

where Y_{it} represents output of the i-th firm in period t, and X_{it} denotes a matrix of quantities of inputs engaged in the production process by the i-th firm , β defines the vector of coefficients which are to be estimated and ε_{it} describes the error term of the function which are composite in character, in other words,

$$\varepsilon_{it} = v_{it} - u_{it} \quad (2)$$

such that i=1,2,3,… , j = 1,2,3,4,….,N.

In the above, the $v_{it}s$ are defined usually as the measurement errors outside the control of the firm and which are symmetrical but with a normal distribution having a mean of zero and a variance σ_v . In (2) the $u_{it}s$ are defined however, to account for all factors within the control of the firm and which are called the technical inefficiency effects of the firms, usually asymmetrically distributed and assumed to have a half-normal or exponential distribution.

Under these established conditions therefore, the technical efficiency of the firms can mathematically be defined as

$$TE_{it} = \frac{Yit}{f(X_{it}, \beta) + v_{it}} \quad (3)$$

, where TE_{it} represents the technical efficiency of the *i*-th firm for specific quantities X_{it} of inputs defined in levels. However, in empirical situations where both inputs and outputs are expressed in logarithmic forms then the technical efficiency of the *i*-th firm would be defined by

$$TE_{it} = \frac{exp(Yit)}{expf[(X_{it},\beta) + v_{it}]]} = \exp(-u_{it}) \qquad (4)$$

Generally speaking the technical efficiency is so characterized such that $0 \leq TE_{it} \leq 1$, implying that the estimated technical efficiency of the *i*th firm has a maximum value 1 meaning that the firm is absolutely efficient but a minimum value of zero ,that is perfectly inefficient. If as noted the $u_{it}s$ follow a half-normal distribution with the variance parameters defined as σ and λ, then the marginal density function of the error term, $\varepsilon_{it} = v_{it} - u_{it}$ is defined differently in the form

$$f(\varepsilon_{it}) = (2/\sigma).\ \text{ö}(\varepsilon_{it}/\text{ó}).\Phi(\varepsilon_{it}.\lambda/\sigma), \text{ for all } -\infty \leq \varepsilon_{it} \leq \infty \qquad (5)$$

In this formulation, the parameters σ and λ are such that $\sigma = \text{ó}_u^2 + \text{ó}_v^2$ and $\lambda = \sigma_u / \sigma_v$ whilst ö (∗) and Φ (∗) are defined as the standard normal and cumulative density functions according to Kumbhakar and Lovell (2002.) From the above expressions, Nkegbe (2012) argues that a log-likelihood function can be derived and using this, the maximum likelihood estimates of ε, σ and λ are obtained.

Again, according to Jondrow *et al* (1982), the inefficiency aspect upon which the technical efficiency scores are estimated can be decomposed from the error term, ε_t and is expressed in the conditional mean functional form

$$E(\mu_1/\varepsilon_1) = \frac{\text{óë}}{1+\text{ë}^2}\left[\frac{\emptyset\left(\frac{\varepsilon_{ij}\text{ë}}{\text{ó}}\right)}{1-\emptyset\left(\frac{\varepsilon_{ij}\text{ë}}{\text{ó}}\right)} - \frac{\varepsilon_{ij}\text{ë}}{\text{ó}}\right] \qquad (6)$$

Also, because the stochastic frontier approach is a parametric method of estimating firm efficiency, it is normally based on a chosen functional form. In the literature, two main functional forms employed in frontier analysis are the Cobb-Douglas which is log-linear and the translog/transcendental which embodies quadratic and interactive terms. Whilst the Cobb-Douglas form is noted for its simplicity, it is argued to be restrictive and its structure does not enable the inclusion of interactive and quadratic terms of inputs (Dasmani, 2015). The alternative, the translog form of the function is also plagued with some few challenges.

Nkegbe (2011) in assessing the translog functional form identifies the presence of excessive numbers of the parameters to be estimated as a major drawback as it would normally lead to the a situation where the potential for multicollinearity is increased and in his words high multicollinearity causes increased variance of the parameters and this undermines the integrity of the parameter estimates. Another issue which has been canvassed in the literature against the translog function in terms of appropriateness relates to the interpretation of the parameter estimates that it yields.

Abatania (2013) opines that aside of the difficulty in its implementation; the estimated parameters from the translog functional form cannot directly be interpreted. Again, it is also strongly stressed by Henningsen and Henning (2009) that the translog functional specification does not have the advantage that the Cobb-Douglas possesses, which is that it does not easily satisfy the monotonicity conditions and for that reason researchers would normally have to resort to some complex and laborious statistical transformations in order to get it to satisfy the required conditions.

Even though the translog functional specifications have been vigorously criticized, a lot of researchers prefer their use because they generally encompass the Cobb-Douglas functional forms. In other words, once coefficients of the quadratic and interactive terms are confirmed to be insignificant, then it is taken that for a given production process, the Cobb-Douglas functional specification is the most appropriate.

Griffin, Montgomery and Rister (1987) intimate that ultimately there is always a trade-off between defining a functional form which is flexible and not restrictive as opposed to a getting a functional form which leads to the desired objectives of a given study.

Assuming a Cobb-Douglas functional form, the estimated equation is normally defined as

$$ln(Y_{it}) = \beta_0+\beta_1 ln(x_1) +\beta_2 ln(X_2)+\beta_3 ln (X_3)+\beta_4 ln (X_4)+\ldots\ldots\ldots+ \beta_n ln (X_n)+ V_{it}-U_{it} \quad (7)$$

In this expression , the Ys represent the output whilst X_1,X_2,X_3 ,……,X_n define the inputs and V_{it} and U_{it} respectively denote the stochastic random shocks affecting the output of the firm and the inefficiency effects of the firm and β_1 , β_2, , β_3 ,…….., β_n are parameter coefficients which are to be estimated.

On the other hand if a translog functional form is considered as the most appropriate mathematical form, then following Dasmani (2015), Awunyo-Vitor (2017) and Danso-Abbeam and Baiyegunhi (2020), the model which would be depended on is of the form

$$lnYi = \hat{a}_0 + \sum_{j=1}^{k} \hat{a}_i ln X_{ij} + 0.5 \sum_{j=1}^{k} \sum_{1}^{k} \hat{a}_{ij} lnX_{ij} * lnX_{ik} + (v_i - u_i) \quad (8)$$

In the equation above, the Y_i denotes the Sales revenue of firm i, the *Xs* represent the inputs of the firm, the $\hat{a}$s define the coefficients to be estimated whilst the v_i and u_i are the error terms associated with the model.

The v_i captures the random errors and shocks which are not within the control of the firm and are therefore taken to be independently but identically distributed, following a normal distribution $N(0, \sigma_v^2)$ whilst the u_i describes the one-sided random variable defining the technical inefficiencies of the firms, which have a half- normal distribution.

Following Coelli *et al.* (1998), the technical inefficiency effects is defined of the form,

$$U_{it} = Z_{it} + W_{it} \quad (9)$$

Specifically, we in this study formulate the above in the form;

$$TE_{it} = f(\text{ fsize, fage , Fcre, P*, O*, Mktf, BEnv, Innv, }) \quad (10)$$

Here, TE defines technical efficiency, fsize represents the firm size size and fage denotes the age of the firm ie , the period for which firm has been in operation measured in terms of years. Fcre, P*and O* also respectively describe firm access to credit, power outages and ownership of firm respectively, Mktf is the access to foreign market whilst BEnv and Innv are used to characterize business environment within which the firm operates and the level of innovation of the firm or the latter's innovation status.

The Z_{it} is the matrix of variables which explain the technical inefficiency of firms, δ denotes a vector of unknown parameters to be estimated whilst the W_{it} represent unobservable variables which are independently distributed and obtained from the truncation of the normal distribution. Indeed, in the words of Nkegbe (2012), the inefficiency part of the stochastic frontier can be specified as

$$\mu_{it} = \text{è}_0 + \delta \sum_{1}^{k} \text{è}_j Z_{il} + \epsilon_i \quad (11)$$

In this equation, the δs are used to represent the parameters to be estimated while the *Zs* describe the set of variables which influence the inefficiencies of the firms and ϵ denotes a term that captures the errors in the inefficiency model.

In order to properly put the study in its context, a number of statistical tests are conducted. The first relates to whether or not the frontier model functional specification is appropriate. Thus, the following hypothesis is tested;

$$Ho:\beta_{n=}\beta_{2........=}\ \beta_k = 0 \quad (12)$$

Secondly, a test to determine whether there is basis for assuming that there is an inefficiency in the model which has been employed is undertaken, the relevant test is of the form,

$$Ho: \text{ã} = \text{ä}_1 = \text{ä}_2 = \ldots = \text{ä}_n = 0 \quad (13)$$

Apart from the statistical tests elucidated above, another key issue is assessing which of the suspected determinants of technical efficiency is significant in the technical efficient model. In this regard the test is of the form;

$$Ho: \theta_1 = \theta_2 = \ldots\ldots\ldots\ldots\ldots = \theta_n = 0 \quad (14)$$

In the more general sense, the evaluation of the Stochastic Frontier Approach (SFA) to assess whether the restricted model should be adopted or not is usually undertaken with the assistance of the log likelihood ratio test (Wongnaa and Awunyo-Vitor,2017).

The log likelihood ratio test statistic is of the form

$$\lambda = -2\{ \ln[L(Ho)/L(H_1)] \} = -2[\ln L(Ho) - \ln L(H_1)] \quad (15)$$

In equation (15), L(Ho) and L(H_1) are estimated log likelihood function values generated from the Cobb-Douglas and Translog functional specifications in equations (7) and (8) respectively. In equation (15) the test is correctly specified when it is evaluated at the degrees of freedom defined as the difference between the number of parameters associated with the null and the alternative hypotheses respectively.

The Stochastic Meta-Frontier Production Model

The concept of the Stochastic Meta-frontier is an improved efficiency estimation technique which has generally evolved out of the pioneering work of Hayami (1969) and Hayami and Ruttan (1970) and further extended by Battase, Rao and O'Donnell (2004).

According to Danso-Abbeam and Baiyegunhi (2020),it is appropriately used to measure the efficiencies of firms in different groups or regions but operating under different technological sets and in their words ″the meta-frontier represents a boundless set of technology that may potentially exist in the industry while the group frontier is a representation of a grouped-confined set of technology″ The concept is therefore based on the theoretical arguments of Hayami(1969) and Hayami and Ruttan (1970) that all firms in the various production groups can potentially access a wide array of production technologies in a broad input-output space from which groups of firms may operate, but each may choose a particular technology, depending on their peculiar circumstances, such as regulation, the environments, production resources, or even relative input prices.

The meta-frontier is therefore regarded as a broader frontier which envelops all the stochastic frontier functions of all the firms belonging to different groups or regions and is able to measure the efficiencies and technological gaps for the firms producing in technological environments which are varied and different (Battase, Rao and O'Donnell, 2004).This is reinforced by Hayami and Ruttan (1971) who argued that the meta-production function is regarded as the envelop of commonly conceived neoclassical production functions.

In other words, what the meta-frontier function does is that it creates a boundary of absolutely efficient points which define the maximum output attainable by the firms given their input mixes and assuming all firms in various groups or regions have access to the best available technology and in the opinion of Bahta *et al* (2015) the advantage that the meta frontier approach has is that a firm in a group can be measured both relative to its own frontier and to the meta-frontier and hence output levels for producers who are completely efficient both in respective group frontiers and in the entire industry lie on the meta-frontier..

This is re-echoed by O'Donnell *et al.* (2008) who intimate that by the structure of the meta-frontier, the efficiencies relative to the meta-frontier production function can be broken into two separate components–a part which measures the distance between a defined input-output point and the group frontier measuring the firm specific efficiency relative to its group and the other which captures the distance between the group and the meta-frontier defining the technological gap between the meta-frontier and a given group, .

Given this framework therefore, firms in the Maghreb and Saharan African regions are assumed to operate under different technological environments and therefore the technological know-how available to each sub-group (Maghreb and Saharan African) represent a subset of the technology available to all the firms in Africa. According to O'Donnell *et al*.(2008), a simple but general stochastic meta-frontier equation can be represented by

$$Q^{*}=f(\,X_i\ ,\hat{a}^{*}),i=1,2,3,,,,,,,,,,,,,,N \qquad (16)$$

Where the X_I define the vector of inputs, Q^{*} represent the maximum meta-frontier output whereas ,$\hat{a}^{*}$ characterizes a vector of meta-frontier parameters such that

$$f(\,X_i\ ,\hat{a}^{*}) > f(X_i\ ,\hat{a}_j)\ \ ,\text{i=1,2, 3,…j} \qquad (17)$$

Therefore, according to O'Donnell (2008), this leads to a linear programming problem where there is an attempt to minimize the values of deviations of the group frontiers from the meta-frontier values. Thus, we minimize

$$\sum_{i=1}^{n} |\, lnf(\,X_i, \hat{a}^{*}) - lnf(X_i, \hat{a}_j)\,| \qquad (18),$$

such that.

$$lnf(\,X_i, \hat{a}^{*}) \geq lnf(X_i\,, \hat{a}_j) \qquad (19)$$

Following Bahta *et al* (2015), in terms of the meta-frontier, the output which is observed for the *ith* firm in the *jth* production system measured by the stochastic frontier in equation can be expressed as

$$Y_I=exp(-u_i)\times\frac{f(X_i\ ,\hat{a}_j)}{f(\,X_i\ ,\hat{a}^{*})}\times f(\,X_i, \hat{a}^{*})exp(v_{ij}) \qquad (20)$$

And from equation (19), we derive the technological gap ratio (TGR) according to O'Donnell (2008), as

$$\text{TGR} = \frac{f(X_i, \hat{a}_j)}{f(X_i, \hat{a}^*)} \tag{21}$$

In this formulation, 0 ≤TGR≤ 1 where the TGR measures the gap in the technology. Bahta *et al*(2015) emphasize that if the TGR value approaches 1, that is an indication of fact that firms in a given production and technological environment are employing the best technology available and producing at levels very close to the maximum output attainable given the technology available to the whole industry.

The last term in (20) captures the distance from the observed output of any individual firm to the maximum potential output attainable as defined by the meta-frontier. This can be specified as;

$$MTE_i = TE_i \times TGR_i \tag{22}$$

This equation simply means that the technical efficiency of the firm measured with respect to the meta-frontier function would be defined as the product of the technical efficiency of the stochastic frontier of a given group and the group's technological gap ratio /meta-technology ratio.

In essence, to derive the parameter estimates for the meta-frontier, the estimated meta-frontier function is obtained in a way that it envelops the non-stochastic components of the stochastic frontier function in the various groups of firms in the analysis.

With the complexity and difficulty involved in the implementation of this mathematical approach in mind, Huang, Huang and Liu (2014) developed a two-stage Stochastic Meta-frontier (SMF) approach to be able to estimate group frontiers and the meta-frontier. In the words of Huang,Huang and Liu

(2014), the new SMF approach has obvious advantages over the traditional method developed and introduced by Battese *et al* (2004) and improved by O'Donnell *et al.*(2008) in the sense that the new approach utilizes the traditional maximum likelihood approach to derive the parameter estimates of the stochastic meta-frontier (SMF) and as such makes it possible for statistical inferences to be executed without having to use simulations or bootstrapping techniques as are normally done in the case of the mathematical programming method and also allows for the direct estimation of the technological gaps by assuming and taking them as a one-sided error term and thus distinguishing the random shocks from the technological gaps. According to Huang *et al.* (2014), in view of the fact that the second stage of the SMF estimation is based on the stochastic frontier analysis, the technological gaps which is represented by the one-sided term can in turn be expressed in terms of the environmental variables usually beyond the control of the firms.

Huang *et al* (2014) defined the stochastic frontier of a typical firm belonging to a given production group in a given country, region or industry to be of the form

$$Y_{it}= f(Xi)e^{Vi-Ui} \quad ,i=1,2,3,\ldots\ldots\ldots,N \tag{23}$$

Upon which a group specific stochastic production frontier can be formulated as

$$Y_{it}=f(X_{it},\ldots\ldots\ldots X_{Mit}; \beta_i)e^{Vit-Uit} \quad , \quad i=1,2,\ldots\ldots\ldots,N \qquad (24),$$

where as already indicated, the V_{it}s represent the independently distributed random errors whilst the U_{it}s are used to define the normally distributed inefficiency effects within the firms.

Making use of the log transformation of the equation above, the maximum likelihood technique can be used to generate the technical efficiency of the firm in the form

$$TE_{it} = Y_{it}/f(X_{it})e^{Vit} = e\text{-}^{Uit} \quad (25)$$

In this equation, the X_{it}s define the inputs of the i*th* firm, hence a common frontier $f^{M}{}_{t}(X_{it})$ enveloping all the individual group frontiers $f(X_{it})$ is defined .Following these, the meta-frontier/group frontier relationship can be expressed below in the form,

$$f^{G}(X_{it})= f^{M}{}_{t}(X_{it})\ e\text{-}^{UMit}\ ,\ \forall it\ =1,2,\ldots\ldots\ldots..N \quad (26)$$

In the above equation (26), $U^{M}{}_{it} \geq 0$ which means that $f^{M}{}_{t}(.)\geq f^{G}(.)$ and using all the established premises, an important expression which can be derived is what is usually referred to as the technological gap ratio (TGR) by comparing each group production frontier function with meta-frontier and obtaining the relevant value less or equal to unity. Thus by definition,

$$TGR= f^{G}(X_{it})/\ f^{M}{}_{t}(X_{it})= e\text{-}^{\ UMit} \leq 1 \quad (27)$$

A number of implications can be drawn out of this equation (Huang *et al*,2014). First, when the TGR is equal to one, then a firm is said to have adopted the most advanced technology possible under the given circumstances for production. However, if the estimated TGR is less than one, the conclusion is that given the economic and environmental conditions, the firm is unable to utilize the best available technology for production. According to Huang *et al* (2014), the level of the TGR of a firm therefore depends on the extent to which it is able to gain access to and adopt the meta-frontier production technology.

Again, building upon our previous statements, the observed output of a firm with respect to the meta-frontier can be broken into three components; the TGR component, technical efficiency (TE) part and the random noise aspect.

Mathematically $Y_{it}/f^{M}_{t}(X_{it}) = TGR \times TE \times e^{Vit}$ (28)

where $TE = Y_{it}/f(X_{it})e^{Vit}$ and $TGR = f^{G}(X_{it})/ f^{M}_{t}(X_{it})$

In the words of Huang *et al* (2014), even though both the TGR and the TE of the firm are bounded i.e. $0 \leq TGR \leq 1$ and $0 \leq TE \leq 1$, the meta-frontier may not necessarily envelop the observed outputs of the firms.

To capture the effects of the random noise in the system, the above equation (28) is recalibrated as

$MTE_{it} = TGR_{it}^{g} \times TE_{it}^{g}$, where MTE_{it} represents the technical efficiency of the firm measured with respect to the meta-frontier production technology $f^{M}_{t}(.)$ as opposed to the one calculated with respect to the group production technology $f^{g}(.)$.

Huang *et al.* (2014) argue that the original meta-frontier technique introduced by Battese *et al* (2004) and O'Donnell *et al* (2008) employs the maximum likelihood estimation to derive the group specific frontiers and then subsequently engages linear mathematical programming to be able to minimize the sum of squares of deviations between $f^{M}_{t}(.)$ and $f^{g}(.)$ whilst using simulation and bootstrapping to calculate the standard errors to derive the meta-frontier .

Therefore in their approach however, Huang *et al* (2014) replace the second step ie. the programming technique by building on the first six equations and rewriting equation (26) in the form

$$\ln f_t^{g}(X_{it}) = \ln f_t^{M}(X_{it}) - U^{M}_{it} \quad (29)$$

However, $f_t^g(X_{it})$ cannot be observed but can be estimated from the first step maximum likelihood method and there is a difference between the fitted value of $f_t^g(X_{it})$ written as $\widehat{f}\,^g{}_t(\mathrm{X_{it}})$ and the actual value $f_t^g(X_{it})$ hence the last equation can be written in another form as

$$ln\widehat{f}\,^g{}_t(\mathrm{X_{it}}) = ln\, f_t^M(X_{it}) - U^M{}_{it} + V^M{}_{it}\ \forall\ i,t = 1,2,\ldots\ldots N, \tag{30}$$

where in the given representation above, $V^M{}_{it}$ is used to capture the statistical noise that shows the deviation between $\widehat{f}\,^g{}_t(\mathrm{X_{it}})$ and $f_t^g(X_{it})$ thus in the real terms

$$ln\widehat{f}\,^g{}_t(\mathrm{X_{it}}) - ln\, f_t^g(X_{it}) = V^M{}_{it} \tag{31}$$

which implies that $V^M{}_{it} = \varepsilon_{it} - \mathring{\hat{a}}_{it}$ by definition. This established equation from its outlook, presents and behaves just like the conventional stochastic frontier but is typically referred to as the stochastic meta-frontier (SMF) regression equation.

In the SMF equation above, the non-negative technological gap component is $U^M{}_{it} \geq 0$ and assumed to follow a truncated normal distribution such that $U^M{}_{it} \sim N^+(\mu^M\,(Z_{it}),\ \sigma^{M2}{}_\mu(Z_{it}))$ and independent of $V^M{}_{it}$ where the mode $\mu^M\,(Z_{it})$ is seen as a function of variables Z_{it} defining the production environment of a given firm whilst the heteroskedastic variance $\sigma^{M2}{}_\mu(Z_{it})$ represents the production uncertainties that the firm faces.

Now $ln\widehat{f}\,^g{}_t(\mathrm{X_{it}})$ is the maximum likelihood estimator and hence the estimation error $V^M{}_{it} = \varepsilon_{it} - \mathring{\hat{a}}_{it}$ is assumed to be asymptotically and normally distributed with mean zero but not necessarily independently and identically distributed ,premised on the fact that it contains the residuals obtained in the estimation of group frontiers implying that

$$\mathring{\hat{a}}_{it} = ln\ Yit - ln\ f_t^g(X_{it}) \tag{32}$$

Which equation is called the quasi-likelihood function and having consistent but asymptotic normal distribution, with invalid standard errors usually corrected using the White (1982) procedure. In the above Huang et al (2014) approach, two important points are critical in the estimation processes.

It is possible that $\widehat{f}^{\,g}_{t}(X_{it}) \geq f_t^M(X_{it})$ because of errors which may be inherent in estimating $f_t^g(X_{it})$ .However, $f_t^g(X_{it}) \leq f_t^M(X_{it})$ according to Huang *et al* (2014). The implication of the above statements is that the technological gap ratio (TGR) is always less or equal to 1, ie.

$$TGR^g{}_{it} = \widehat{E}\,(e\text{-}^{UM} \setminus \widehat{å}^M it) \leq 1 \qquad (33),$$

where $\widehat{å}^M it = ln\widehat{f}^{\,g}{}_t(X_{it})\text{-}\ ln\widehat{f}^M{}_t(X_{it})$ are residuals obtained from equation (30)

Identifying the determinants of Meta-frontier Efficiency

After deriving the meta-frontier technical efficiency scores, we proceed to apply the least squares approach to obtain the determinants of meta-frontier efficiency. We can specify the determinants of eta-frontier efficiency as

$$TE^* = \text{ɥ} + \theta\delta + \epsilon \qquad (34)$$

In this equation, TE^* denotes the meta-frontier efficiency, ɥ is the intercept component, δ represents firm level characteristics whilst θ represents a vector of parameters to be estimated.

The Likelihood Ratio Test for the Meta-frontier

In engaging in meta-frontier analysis, one of the major steps required is to perform a likelihood ratio test on similar lines as the previous one. This is meant to evaluate whether or not a meta-frontier function is the most appropriate approach given the data at hand.

Again, the likelihood ratio test is given by

$$\lambda = -2\{ \ln[L(Ho)/L(H_1)]\} = -2[\ln L(Ho)- \ln L(H_1)] \quad (35)$$

In this formulation, the likelihood ratio test is operationalized in a way that ln L(Ho) is used to capture the value of the likelihood function obtained by pooling the data across the defined regions in Africa whilst the ln $L(H_1)$ is derived by summing up the values of the log-likelihood functions derived separately where the degree of freedom is defined as the differences in the number of parameters which were obtained with respect to H_1 and H_0 .

The application of Endogenous Switching Regression

In this study, a major objective is to investigate the effects of innovation on firm performance. However, in classical econometrics, there are practical challenges which potentially bedevil this analysis for a number of reasons. First there is the issue of sample selectivity bias (see Heckman, 1979). This could happen when firms self-select into innovative firms who employ innovative strategies to be able to perform better i.e. be more efficient. Given this situation, using OLS estimation techniques may likely produce biased and inconsistent parameter estimates. The estimation challenges are exacerbated by the fact as innovation determines firm performance, it is itself in that process endogenously determined. Under this circumstance, the self-selection of firms into those who engage in innovation is based on the observed characteristics of the firm and therefore must be controlled for in addition to the unobserved firm heterogeneity which may likely affect the efficiency of firms

In the literature, a number of methods are available to resolve this problem, the most notable being the Heckman selection approach, Instrumental variable regression (IV) approach and the propensity score matching (PSM) method. While these methods are described to be able to deal with the problems , in the literature some limitations in respect of their ability to adequately deal with the problems of self-selection bias and endogeneity have been well articulated (Maddala, 1986). For instance the Heckman selection and the IV methods are said to be plagued with the issue of which functional form to impose while the PSM is affected by the assumption that the selection is based on some observable variables which assumption may produce inconsistent estimates especially when there are some unobserved characteristics which influence our main variables-innovation and firm efficiency (Asfaw, Shiferaw, Simtowe, & Lipper, 2012) .

Thus, in order to deal with problems of endogeneity and self-selection, Pisbuo, Baye and Tieguhong (2016) as well as Seck (2019) in cases of this nature have followed Maddala (1986). We also therefore follow this approach and model firm innovation and efficiency using the endogenous switching regression (ESR) model in a two-stage framework. In this framework, the first- stage equation is a probit specification of innovation and firm specific characteristics as well as other factors whilst the second stage assesses the determinants of firm level efficiency with respect to innovative and non-innovative firms conditional on firm specific and business environmental factors.

Using the two-stage approach proposed by Maddala (1986), we begin by defining a probit model of innovation which specifies the innovation decision making by firms. In this stage, we identify the factors which have the propensity to influence firm decision to innovate or not to innovate. This is called the decision function and is mathematically represented as

$Inn = \hat{o}Z_i + \varepsilon_i$ such that

$$Inn_i = \begin{cases} 1 & if\ inn_i^* > 0 \\ 0 & if\ inn_i^* \leq 0 \end{cases} \qquad (36)$$

In this equation , Z is used as a representation of a vector of all factors which have the propensity to influence firms' innovation decision and r defines a corresponding matrix of parameters associated with Z, whilst ε_i denotes the error term which is assumed to be normally distributed as N~(0, $\acute{o}_n^2$) and Inn_i^* is essentially a latent unobserved variable capturing the innovation behaviour of the firm..

In equation (36) therefore, Inn_1 functions as a dichotomous variable such that if a firm engages in innovation, $Inn_i *= 1,$ meaning that the firm is innovation unconstrained whereas when $Inn_i *=0$,then that firm is innovation constrained.

Our equation (36) could be rewritten in structural form as

$$Inn_i = \acute{a}_0 + \acute{a}_1 Z_1 + \acute{a}_2 Z_2 + \acute{a}_3 Z_3 + \cdots \acute{a}_n Z_n + \mathring{a}_i \qquad (37)$$

In this formulation ,the Zs represent firm- specific as well as external factors which have the potential of influencing the firm's ability to innovate and $\acute{a}_1$, $\acute{a}_2$,………., $\acute{a}_n$ represent change in probability of firm's decision to undertake innovation ,estimated using the probit maximum likelihood approach. In this model above, we assume that firm innovation is motivated by the desire of the firm to be more efficient.

Following this, we define an efficiency function for the firm as

$$Eff=f(X) \qquad (38)$$

In other words, the efficiency of the firm depends on firm specific /internal factors as well as external factors, under conditions in which firms innovate and the opposite situation where firms do not innovate.

To capture the effect of innovation on firm efficiency, we specify two separate functions - efficiency when the firm innovate and the efficiency when the does not innovate. Accordingly, we have

Regime1: $Eff_1 = X_{1i}\beta_1 + \mu_{1i}$, when firm innovates (39a)

Regime2: $Eff_2 = X_{2i}\beta_2 + \mu_{2i}$ when firm does not innovate (39b)

Where Eff_1 and Eff2 represent the efficiency of the firm under conditions of innovation unconstraint and constraint respectively and $\beta_{11}$and β_2 are parameters estimated for innovation and no innovation regimes respectively. X_i represents a vector of explanatory variables such as firm and country level characteristics (e.g., age of the firm, manager's experience, firm size, type of firm etc). From (39a, 39b), firm efficiency is further empirically presented as;

$$Eff = \hat{a}_1 X_1 + \hat{a}_2 X_2 + \hat{a}_3 X_3 + \ldots + \hat{a}_n X_n + u_i \qquad (40)$$

In the equation (39) above, again the $\hat{a}_1, \hat{a}_2 \ldots, \hat{a}_{2n}$ are parameters which can be estimated, Xs are the variables which explain the efficiency of the firm whilst u_i defines the error term.

Again our μ_{1i} and μ_{2i} in equation (39) as well as the ε_i in equation (36) are assumed to be consistent with normal distributions and hence having a mean of zero and variance θ that is

$(\varepsilon_i \ \mu_{1i} \ \mu_{2i}) \sim N(0, \theta)$ where θ is square matrix of the form

$$\text{cov}(\varepsilon_i, \mu_{1i}, \mu_{2i}) = \begin{bmatrix} ó_n^2 & ó_{n1} & ó_{n2} \\ ó_{1n} & ó_1^2 & . \\ ó_{2n} & . & ó_2^2 \end{bmatrix} \qquad (41)$$

From the above matrix, the variance term $ó_n^2$ defined in the selection equation (36) has been found to assume a value of 1 (Maddala,1986) ,the $ó_1^2$ and $ó_2^2$ are respectively used to represent the error terms in our first and second efficiency equations in (39a,39b) whilst $ó_{1n}$ represents the covariance of ε_i and u_{1i} and $ó_{2n}$ are the covariance of ε_i and u_{2i}. However, Eff_{1i} and Eff_{2i} are not observed simultaneously hence the covariance of u_{1i} and u_{2i} are not defined and therefore indicated as dots.

Now since the error terms of the decision equation are correlated with the efficiency equation, we can proceed to define the conditional expectation functions of μ_{1i} and μ_{2i} as

$$\left[E(u_{1i}/F_i^* \quad = 1) = ó_{\boldsymbol{n1}} \frac{\emptyset(\boldsymbol{Z_i t})}{ö(\boldsymbol{Z_i t})}\right] = ó_{n1}ã_{\boldsymbol{1i}} \qquad (42a)$$

$$\left[E(u_{2i}/F_i^* \quad = 0) = -ó_{\boldsymbol{n2}} \frac{\emptyset(\boldsymbol{Z_i t})}{\boldsymbol{1}-ö(\boldsymbol{Z_i t})}\right] = ó_{n2}ã_{\boldsymbol{2i}} \qquad (42b)$$

following Lokshin and Sajaia (2004).

In these formulations, given that the estimated covariance σ_{n1} and σ_{n2} are statistically significant, then it can safely be assumed that the efficiency of the firm is correlated with the innovation status of the firm which provides evidence of endogeneity and self-selection issues (Maddala *et al* ,1975). Accordingly, our equations (39a) and (39b) can be reformulated as

$$E(\langle y_{1i} | I_i^* \quad = 1, X_i \rangle) = X_{1i}â_1 + \sigma_{1n}\gamma_{1i} \qquad (43a)$$

$$E\ (\langle y_{1i} | I_i^* \quad = 0, X_i \rangle) = X_{2i}â_1 + \sigma_{1n}\gamma_{2i} \qquad (43b)$$

$$E(\langle y_{2i} | I_i^* \quad = 1, X_i \rangle) = X_{1i}â_2 + \sigma_{2n}\gamma_{1i} \qquad (43c)$$

$$E(\langle y_{2i} | I_i^* \quad = 0, X_i \rangle) = X_{2i}â_2 + \sigma_{2n}\gamma_{2i} \qquad (43d)$$

However, in the view of Lokshin and Sajaia (2004), in order to satisfy the identification criterion, some exclusion restriction would have to be imposed which means that in the efficiency equation, there must be at least a variable which does not directly influence it but affects the innovation behaviour of the firm. Finally, with the assumptions underlying the error terms in equations (39a) and (39b) respectively, Lokshin and Sajaia (2004) have defined the log-likelihood function in the form

$$\ln L_I = \sum_{i=1}^{N} I_i \left[ln\emptyset\left(\frac{u_{1i}}{\sigma_1}\right) - ln\sigma_1 + ln\ddot{o}(\grave{e}_{1i})\right] + (1-I_i)\left[ln\emptyset\left(\frac{u_{2i}}{\sigma_2}\right) - ln\sigma_2 ln\ddot{o}(\grave{e}_{2i})\right] \quad (44)$$

where $\grave{e}_{ji} = \frac{(Z_i t + \tilde{n}_j u_{ji}/\acute{o}_j)}{\sqrt{1-\tilde{n}_j^2}}$ and j=1,2…but $\tilde{n}_{ij}$ refers to the correlation coefficient between the error term in the selection equation ε_i and the error terms u_{1i} and u_{2i} in the outcome equations of the innovative and the non-innovative firms. It must be noted as indicated by Fuglie & Bosch (1995) that $\tilde{n}_{1j}$ and $\tilde{n}_{2j}$ empirically have some economic interpretations. Whilst $\tilde{n}_{1j}$ denotes the correlation between the unobserved latent attributes of the innovation function with the observed innovation unconstrained efficiency equation, $\tilde{n}_{2j}$represents the correlation between the unobserved latent attributes of the innovation equation with the innovation constrained efficiency equation.

The OLS and Instrumental Variable (Lewbel) estimation

Given that in the study the key research issues are to determine the extent to which business environment impacts on firm innovation and indeed how business environment and innovation separately and jointly influence firm, a key challenge that arises is the issue of endogeneity because of the relationship between business environment, innovation on one side and efficiency on the other. To help resolve this, a number of approaches and techniques have been adopted in addition to the endogenous switching regression to achieve that.

In furtherance of that two estimation methods have been employed; Standard IV and the Lewbel 2SLS. Although the Standard IV and the 2SLS appear as distinct methods, they are actually obtained from the Lewbel IV estimation process which produces three estimation outputs –one with only an internal instruments, another with only an external instrument (the Standard IV) and the last with both internal and external instruments (2SLS).

In the empirical analysis, the innovation variable has been defined and operationalized in two ways – on a continuous scale by creating an innovation index and as dichotomous variable, by considering those firms whose innovation indices are above the average innovation index in the sample and assign each of them a value of 1 whilst those firms whose innovation whatsoever are assigned 0.

Thus in this study therefore, the innovation variable is assessed from two standpoints. First, firm innovation is considered as a binary variable because, a firm either undertakes innovation or does not undertake innovation meaning that a firm may choose to employ any of strategies regarded as innovation or may choose not to employ any of these strategies. Thus, in the former, when the firm undertakes innovation its innovation status is assigned a value of one but in the case of the latter, the firm is assigned a value of zero.

In the second scenario, however, the dependent variable, innovation is calibrated as a continuous variable in view of the fact that in the data set, a number of elements which are all innovation variables are encountered and, are used to construct an innovation index for each firm.

Generally the Instrumental variable regressions are based on the following equations.

Business environment = $f(IV, firm$ characteristics;$e)$

Efficiency = f(Business environment, $firm$ characteristics;u), (45)

$innovation$ = $f(IV, firm$ characteristics;$e)$

Efficiency = $f(innovation, firm$ characteristics;u), (46)

In these equations, IV represents the instrument used in the analysis.

These equations are motivated by a plethora of studies; Abazi-Alili (2014), Abazi-Alili Ramadani, V., & Ratten, V., Chaushi, B., & Rexhepi *et.al*,(2016) and Abazi-Alili,(2014); Bayudan-Dacuycuy and Baje(2018).

In the instrumental variable analysis, two tests are of relevance; these are the under-identification and over-identification as they determine the validity of the instruments employed.

In the under-identification test, the hypothesis that the instrument does not induce a change in efficient is tested whereas in the over-identification tests, the null hypothesis that the instrument is not correlated with the error term and hence other instruments are correctly excluded in the estimation process is tested.

The OLS

The OLS is the simplest estimation tool of economists and it basically assumes that there exists a linear relationship between one variable called the dependent variable and other variables, usually referred to as explanatory variables. .

According to Wooldridge (2006), assuming y and x are linearly related where the x is assumed to explain y, then the simple linear regression model connecting y and x is of the form

$$Y = \text{â}_0 \ + \text{â}_1 X_1 + \text{ì} \quad (47)$$

where $â_0$ defines the intercept parameter of the model and $â_1$ denotes the slope parameter which describes the marginal change in Y with respect to a given unit change in X. An extension of this model is when Y is explained by the variables X_1 , X_2 , ………,X_n. In this general case, our regression model would be defined as

$$Y = â_0 + â_1X_1 + â_2X_2 + \cdots + â_nX_n + ì \qquad (48)$$

In this formulation $â_1$,$â_2$.. , $â_{3,}$ ….,$â_n$ represent the slope parameters associated with the explanatory variables X_1 , X_2 , X_3 ,…….., X_n . Thus, in this equation, the $\hat{a}s$ are used to show the partial derivative of the Xs with respect to Y and more succinctly described by Gujarati (2006) as the partial regression/slope coefficients and in his words the partial regression coefficient explains the partial effect of one explanatory variable on the mean value of the dependent variable assuming that the values of the other explanatory variables in the model are held constant. In this model, the Xs are assumed to be uncorrelated with the disturbance term whilst the expected value of the disturbance term is zero, besides other classical laws that the model is assumed to follow.

To make inferences about the equation above, statistical tests of significance are undertaken to determine whether the Xs are individually and collectively significant.

In this study, using the OLS approach firm innovation is modelled as a function of both business environmental and firm specific factors in the form;

Inn_i= f(business environment factors, firm specific factors) (49),

which can be presented as

$$Inn_i = ábusenv_i + W_iâ + å_i \qquad (50)$$

Inn_i represents firm innovation,$busenv_i$ denotes the business environment within which the firm operates; W_i characterizes a matrix of the firm specific and country level factors which influence firm innovation whilst á and â are parameters to be estimated.

Determining the likelihood of business environment influencing firm innovation

In the previous section, having considered innovation as a continuous variable and could therefore model it using the OLS method.

However when innovation is regarded as a binary variable the application of the OLS may not be appropriate. Under the circumstance, we adopt the probit estimation technique which accommodates a dependent variable to be binary in nature.

The Probit model is a probabilistic model which uses the maximum likelihood estimation approach to derive efficient estimates of the relevant coefficients. The starting point of the probit function is the equation (49) below,

$$Y_i{*} = â_0+â_1X_1 + ... + â_nX_n + å_i \qquad (51)$$

Where $Y_i{*}$ is a latent unobserved variable such that

$$Y_i{*} = \begin{cases} 1 & if\ Yi*> 0 \\ 0 & if\ Yi*\leq 0 \end{cases}$$ which is in line with equation (23)

Hence each outcome *variable* Y_i is defined by a density function

$$f(Y_i{*}) = P_i^{Yi}\,(I\text{-}P_i)^{1\text{-}Yi} \qquad (52)$$

In the above function, each event ` Y_i takes the value 0 or 1. When Y_i =0,

$$f(0)= (I\text{-}P_i) \text{ and } f(1)= (P_i) \qquad (53)$$

And indeed, since Y_i takes values from 1 to n, then if the likelihood function is ζ, we therefore define

$$ζ,= f(Y_1,Y_2,\ldots\ldots,Y_n)$$

$= f(Y_1)f(Y_2)\ldots\ldots f(Y_n)$

$=P_1^{Y1}\,(1\text{-}P_1)^{1\text{-}Y1}\;\; P_2^{Y2}\,(1\text{-}P_2)^{1\text{-}Y2}\,\ldots\ldots\ldots P_n^{Yn}\,(1\text{-}P_n)^{1\text{-}Yn}$

$$= \prod_{i=1}^{n} P_i^{Yi}\,\left((I - P_i)\right)^{1-Yi} \qquad (54a)$$

Following this likelihood density function, the probit marginal effects can be obtained and the marginal effects of the probit function is defined by

$$\frac{\partial Pi}{\partial Xi} = \emptyset(\,X_t{}'\beta)\beta_k \qquad (54b)$$

Generally the marginal effect of a probit function defines the effect of a percentage change in the predictor variable on the odds or the likelihood of the dependent variable.

Although in empirical situations the probit maximum likelihood estimator enables us to determine the likelihood of one variable being responsible for another, there are occasions where their application may not yield robust estimates. This is particularly so when in the regression model, there exist explanatory variables which are also endogenous. Under such circumstances, econometricians usually recourse to the instrumental variable estimation methods because the use of the OLS technique leads to inconsistent parameter estimates owing to the fact that at least one of the explanatory variables may be related to the error term. In a sense the use of the instrumental variable method enables the researcher to solve problem by circumventing that correlation that exists between the explanatory variables and the error term of a given equation.

According to Pokropek (2016), the IV technique is used to determine an exogenous or random part of the variability from the endogenous predictor and by that effectively estimate the causal relationship between the outcome variable and the predictor.

Typically, according to Rassan *et al* (2009), the instrumental variable estimators are presented in a system of structural equations which are estimated simultaneously such that the first equation estimates the treatment variable as a function of the observed confounders and variables that are related to the treatment but unrelated to the outcome (i.e., instruments) whilst the second equation is a model for the outcome variable defined to encompass the treatment and the observed confounders.

In our estimations we have employed two variants of the IV estimation technique -the standard IV and the Lewbel 2SLS to be able examine the effect of business environment and innovation on efficiency. Whilst the standard IV approach measures the outcome variable on a continuous scale and uses external instruments, the Lewbel 2SLS employs both internal and external instruments for estimations. Indeed, the importance of the IV methods is underlined to be mainly for robustness checks (Awaworyi Churchill & Mishra, 2017).

Using the IV approach, we also assess the effects of efficiency and other control factors on capacity utilization, sales revenue and exports. The estimation would be based on the following basic equations;

$$Cpx=f(eff,fsize,fage,MEx,Ft,Mktf,.) \tag{55}$$

$$Sr= f(eff,fsize,fage,MEx, Ft,Mktf) \tag{56}$$

$$Ex=f(eff,fsize,fage,MEx, Ft,Mktf,.....) \tag{57}$$

In the above equations, Cpx ,is the capacity utilization of the firm, eff denotes firm eff;, fsize and fage represent the firm size and age respectively.

MEx defines the experience of the manager of the firm, Ft stands for foreign technology while Mktf describes firm access to foreign markets and other predictors.

Now given that the unobserved characteristics of efficiency nay be correlated correlated with sales, capacity utilisation and exports, these are modelled using the instrumental variable approach thus

$$\text{Efficiency} = f(IV, firm\ \text{characteristics}; e)$$

$$\text{Sales revenue} = f(\text{efficiency\_p}, firm\ \text{characteristics}; u) \quad (58)$$

$$\text{Efficiency} = f(IV, firm\ \text{characteristics}; e)$$

$$\text{Capacity utilization} = f(\text{efficiency\_p}, firm\ \text{characteristics}; u) \quad (59)$$

$$\text{Efficiency} = f(IV, firm\ \text{characteristics}; e)$$

$$\text{Exports} = f(\text{efficiency\_p}, firm\ \text{characteristics}; u) \quad (60)$$

Identifying the relative importance of predictors which affect Capacity Utilization, Sales Revenue, and exports

The study also delves into the main factors which affect capacity utilization, sales revenues, and exports of the firms in Africa. To be able to do this we employ dominance analysis as well as propensity score matching which are not common in economic researches.

In empirical studies, researchers may also be interested in determining the relative importance of variables in a multiple regression framework and under such circumstances, the use of the conventional correlation and least squares equations may not suffice. This is because correlation values only show which predictors are associated with a given dependent variable whilst the multi regression equation enables researchers to explore relationship between a set of predictors and a given outcome variable (Tighe and Schatschneider, 2014).

Budescu (1993) has therefore developed the concept of dominant analysis to deal with the ineffectiveness of the correlation and multiple regression equation approaches in handling situations where determining the relative importance of variables in multiple regression framework is the objective of the researcher. This technique often enables researchers to measure the extent of the importance of each predictor judging by how much each contributes to the prediction of the dependent variable (Chao et al., 2008). According to Budescu (1993), a variable is said to be dominant over other variables if its predictive ability is more than the predictive ability of any other variable in all possible subset models.

Broadly speaking, in the classical dominant analysis, a given predictor is said to be more important than another in a given model if it increases the model's R^2 than the other.

Mathematically, in a model in which y is a response variable whereas x_1, x_2 , x_3 , x_4 are its predictors, if

$$R^2_{yx_1x_2x_3} - R^2_{yx_1x_2x_4} > 0, \qquad (61)$$

then it can be concluded that the variable , x_3 is more important than x_4

Following from Budescu (1993), Azen and Budescu (2003) have identified three types of dominance in a given model. These are the complete, conditional and general dominance. Budescu (1993) characterizes complete dominance as a situation where a predictor's marginal contribution to each subset model is more than the contribution of the other competing predictors in a given model. The conditional dominance is however defined in such a way that it occurs when on the average a given predictor add much more to the variance within every model than any other predictor and in a general dominance situation, however, a given variable's/predictor's extra contribution is more across the average of all conditional values as compared with other predictors.

In empirical analysis, the general dominance statistic of a given variable within a model would be defined by the mathematical expression

$$C_x = \sum_{i=1}^{p} \sum_{j=1}^{n_i} \begin{cases} \dfrac{F_{ij}}{i(C(p,i))} & if\ x\ is\ in\ model\ ij \\ \dfrac{F_{ij}}{-i(C(p,i-1))} & if\ x\ is\ in\ model\ ij \end{cases} \tag{62}$$

In this formulation, the fit metric associated with model ij is F_{ij} whilst p denotes the number of predictors. Also, n_i is used to represent all possible combinations of a given size i that there are p independent number of predictors in a model and $C(m, k)$ is employed to define all possible subsets of size k given any set size m.

The general dominance approach employs what is referred to as the additive approach to the decomposition of the fit metric derived from the model encompassing all the independent variables thereby allowing the comparison between independent variables and thus showing the relative importance of the variables in the model. Conceptually, in a given model if the share of one variable x in a model is more than its share which is closely associated with a different variable y, then the variable x is reckoned to be more important when compared with y.

Once the dominance analysis is essentially an ensemble statistic, a general dominance statistic integrates all the various fit statistics which relate to the independent variable *x* and yet also adjusts the sum for models which do not have nothing to do with the independent variable *x*. Thus, in a typical situation, the dominance statistic is a representation of the average extra contribution of variable *x* to a given identified fit metric which overlaps with other independent variables in the model. In the words of Azen, &Traxel (2009) and Nimon, & Oswald (2013) the major advantage of the general dominance is that it is able to integrate and encompass several coefficients /statistics at the same time and by it is able incorporate the fit metric are related to the entire set of dummy codes for all subgroupings into a unified statistic which then efficiently defines the total sub group differences in a given model.

Propensity Score Matching

This method of dealing with non-experimental studies is usually employed when randomization in particular studies may be difficult to pursue. Austin (2011) defines propensity score as the probability of a given treatment item given that certain observed baseline characteristics prevail and further contends that it is a method that enables the researcher to design and analyze an empirical (nonrandomized) situation in a way that it takes after or copies some particular characteristics as would be found in a randomized controlled trial. Rubin (2001) reinforces Austin (2011) by characterizing propensity score matching (PSM) as exposing treatment and control units in a given study to similar values or characteristics on the propensity score, and all other covariates, and then doing away with all unmatched units.

According to Rosenbaum and Rubin (1983), the propensity score which is measured for a given e(xi) for a subject i,($i = 1,\ldots, N$) is the probability of being assigned to a particular treatment group given that the treatment group is exposed to a vector of observed covariates *xi* presented mathematically as

$$e(x_i) = \Pr(z_i = 1 / xi)) \qquad (63)$$

such that

$$\Pr((z_1\ldots\ldots,z_n/x_1,\ldots\ldots,x_n) = \prod_{i=1}^{N} e(xi)^s \{1-e(x_i)\}^{1-s} \qquad (64)$$

In this formulation, zi=1 denotes the treatment group whilst zi=0 represents the control; *xi* is the observed covariates for the i[th] subject. In this case the covariates refer to the variables which are not affected by the allocation of treatments to the subjects (Rosenbaum and Rubin, 1983).

The PSM is essentially an extra tool engaged by researchers to effectively resolve issues of endogeneity and selection bias which usually occur in non-experimental studies (Zhang & Posso, 2017; Churchill & Marisetty, 2020).

In the specific case of this study, given the sales revenues, capacity utilization and exports status of each firm, we define the sales revenue, capacity utilization and exports constraints respectively in the form

$$Efficiency = \begin{cases} 1 \ \ if \ \ there \ is \ \ treatment \\ 0 \ if \ \ there \ is \ no \ \ treatment \end{cases} \qquad (65)$$

Accordingly given that exp_1 and exp_0 are defined for instance to represent the export propensity of firms which are efficiency unconstrained and efficiency constrained, then the exports equation would be specified as

$$exp_i = exp_0 + eff_i(exp_1 - exp_0) \qquad (66)$$

from which we derive the average treatment effect(ATET) and average treatment effect on the treated (ATT).

$$\text{Mathematically, ATET} = E(\alpha) = E(exp_1 - exp0) \qquad (67)$$

$$\text{and} \qquad \text{ATT} = E(\,exp_1 - exp0/eff = 1) \qquad (68)$$

Similarly in relation to sales revenue and capacity utilization, the average treatment effect(ATET) and average treatment effect on the treated (ATT) are specified as

$$\text{ATET} = E(\alpha) = E(cpx_1 - cpx0) \tag{69}$$

$$\text{ATT} = E(cpx_1 - cpx0/eff = 1) \tag{70}$$

$$\text{ATET} = E(\alpha) = E(cpx_1 - cpx0) \tag{71}$$

$$\text{ATT} = E(cpx_1 - cpx0/eff = 1) \tag{72}$$

Data for the Study

For this study, secondary data is drawn from the World Bank Enterprise Survey (WBES), a survey which enumerates firms on a wide range of issues including inputs, the prevailing business environment, application of innovation as well as performance variables. In view of the fact that the survey does not include every country in each wave, the issue that had to be dealt with was which wave to employ in the analysis. To deal with that challenge the researcher examined the most recent waves and picked the 2013 wave because till date it is the one that covered and included the highest number of African countries (and firms as well) and merged it with the data from the Maghreb(North) Africa extracted from MENA survey 2013 , the equivalent of the WBES for the Mediterranean countries .In line with the objective of studying firms across the entire African continent, all the African countries in the WBES 2013 and MENA 2013 were included in our sample. The surveys cover private sector firms which operate mainly in the manufacturing areas of the economies within which they find themselves.

The composite data obtained from the above merger covers more than 9,019 firms.

Theoretical framework

The study draws on the theory of production which assumes that the producer behaves like the typical utility maximizing firm which always strives to maximize its output given the resources and the inputs that it has available. In other words, with a given certain quantity of resources and inputs, there is a maximum attainable output that the producer can achieve. The assumption therefore is that with a given array of choices, the rational producer would always opt for more output than less subject to the constraints that confront him/her. In this case the producer may be seen as a decision maker, whose ultimate business is to mobilize and organize the resources in a strategic but different ways to maximize his objectives,

The evolution of the classical production theory has culminated in the emergence of the endogenous growth theory which stresses that the firm is typically able to optimize its performance when attention is paid to the initiation of innovation through the development of technologies within the firm. This theory therefore positions innovation as the fulcrum around which the momentums are created within firms to propel growth. Innovation thus triggered creates a competitive edge for firms over their peers and enables them to perform better.

Chapter summary

In this chapter, the researcher critically examined all the philosophical and methodological issues relating to the study and made it clear that every research is provided a clear sense of direction by the scientific approach and the analytical framework it adopts usually taking a leaf from the objectives which have been outlined. It is in line with this that the study opted for the positivist paradigm as the overall framework within which the empirical analyses are situated. The most appropriate econometric approaches have thus been chosen to ensure that we are able to achieve the objectives of this research. The econometric techniques for analysis discussed include the stochastic Meta frontier, probit, OLS, the Standard IV, Lewbel 2SLS, Endogenous switching regression, Propensity Score Matching (PSM) .The IV estimation techniques are particularly included to deal with the problems of endogeneity which we could potentially encounter in the analysis .

CHAPTER FIVE

PRODUCTIVE EFFICIENCIES, TECHNOLOGICAL GAPS, OUTPUT ELASTICITIES IN AFRICA

Introduction

This chapter deals with two main issues ; Measuring the efficiency of firms in Africa, in the sub regions –SSA and Maghreb and determining and comparing the extent to which firms in the two regions are able to attain the potential output in Africa. The chapter consists of a number of sections. The first part presents production functions and technical efficiency of firms using stochastic frontier approach in Sub-Sahara and the Maghreb regions and subsequently reports on the stochastic meta-frontier function for Africa..

The second part of the Chapter deals with the measurement of technology gap ratios (TGR) and the meta technology efficiency (MTE) which define the efficiencies of the firms in the sub regions subject to the overall technology available in Africa and the efficiencies of the firms in each region with respect to the potential output attainable in Africa respectively. Finally, the response of output to changes in inputs are also examined and used to determine the returns to scale of production of the sub regions and the entire African continent

Assessing Firm Efficiency in Africa

The results of the production functions are presented in this section and based on that the efficiency of firms in Africa are examined. The researcher proceeds further to analyze regional subsamples (SSA versus Maghreb) using the stochastic meta-frontier framework. The rationale behind this technique is to create the basis for effectively comparing the efficiencies of the firms in the two sub regions .of Africa.

Considering the issues at stake in this chapter, two main preliminary tests are of significance. These are the tests for the determination of the appropriate functional form of the production function and to determine whether firms in the two sub-regions in Africa –SSA and Maghreb employ the same technology in their productive activities.

The test results are summarized below:

Table1: Test for Functional form

	$\ln L(H_0)$	$\ln L(H_1)$	Test Statistic	Critical Value	Decision
SSA	-146.23	-121.003	50.454	31.14	Reject H_0
Maghreb	-240.76	-211.654	58.212	31.14	Reject H_0
Africa	-368.450	-297.080	71.370	31.14	Reject H_0

Source: Author's computations (2020)

Table 2: Test for differences in Technology (Between SSA and Maghreb)

$\ln L(H_0)$	$\ln L(H_1)$	Test Statistic	Critical Value	Decision
-1268.21	-429.06	1678.3	29.14	Reject H_0

Source: Author's computations (2020)

Following these preliminary tests above, Table 3 presents estimates of the region –specific stochastic frontiers. In general, the region-specific frontier models are well fitted and it is realized that most inputs have their coefficients statistically significant. The striking feature about the estimates is that there are substantial variations in the coefficients across the two sub regions in Africa.

Table 3: Parameter estimates for the regional stochastic production functions in Africa (SSA and MAGHREB)

Inputs variables	SSA	MAGHREB
Log labour	-0.204**	-0.403**
	(0.036)	(0.045)
Log electricity	-1.163***	-0.954***
	(0.108)	(0.018)
Log equipment	-0.892***	-0.6122
	(0.110)	(.264)
Log land	0.803***	0.738**
	(0.118)	(0.015)
Log raw materials	-0.314**	-0.212**
	(0.0136)	(0.011)
Log fuel	- 0.566***	-0.567***
	(0.046)	(0.043)
Square of Log labour	0.005***	-0.051**
	(0.000)	(.046)
Square of Log electricity	-0.500**	-.041**
	(0.147)	(0.001)
Square of Log equipment	-0.703**	-0.281**
	(0.003)	(0.555)
Square of Log land	-0.118***	-0.01597**
	(0.002)	(0.0128)
Square of Log raw material	-0.1817**	-0.067
	(0.101)	(2.76)
Square of log fuel	0.304***	0.304***
	(0.045)	(0.045)
Log labour × Log electricity	-1.704***	-0.219
	(0.120)	(1.11)
Log equipment × Log land	-0.108**	0.105**
	(0.039)	(0.060)
Log labour× Log fuel	-0.201**	-0.307**
	(0.084)	(0.004)
Log equipment × Log electricity	-0.144**	-0.025**
	(0.094)	(0.246)
Log labour × Log raw materials	-0.123**	-0.101**
	(0.080)	(0.032)
Log raw materials× Log electricity	-0.126***	-0.112**
	(0.086)	(0.003)
Log fuel × Log raw materials	-0.597***	-0.566***
	(0.042)	(0.046)
Log fuel × Log land	-0.001***	-0.006***
	(0.007)	(0.001)
Log fuel × Log electricity	-0.007	-0.010**
	(0.004)	(0.005)
Medium size firm(ref=small size)	0.787***	-0.902***
	(0.116)	(0.110)
Larger firm (ref=small size)	0.089***	-0.273***
	(0.123)	(0.117)
Manager experience	0.044***	0.0135*

	(0.0149)	(0.014)
Experience squared	-0.001	-0.005
	(0.000)	(0.000)
Female top manager	-0.454***	-0.493***
	(0.159)	(0.148)
power outages	0.009***	0.003**
	(0.003)	(0.003)
foreign owner	0.0220***	0.018***
	(0.002)	(0.002)
Industry productivity	-0.124***	-0.312***
	(0.003)	(0.093)
Intensity of foreign technology use	-0.212**	-0.012**
	(0.001)	(0.101)
GDP per capita	-0.060**	-0.023**
	(0.034)	(0.033)
Inflation	-0.010**	0.009**
	(0.034)	(0.033)
Other industry fixed effects	Yes	Yes
Country-year fixed effect	Yes	Yes
Country location year fixed effects	Yes	Yes
Constant	0.126***	0.112**
	(0.086)	(.003)
Variance and other model statistics		
Sigma_u	1.759***	1.915***
Sigma_v	0.389**	0.295***
Theta (θ)	–0.160***	0.321
Lambda	4.522***	6.492***
Log simulated likelihood	–121.003	–211.654

Robust Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: Author’s computations (2020)

To achieve the study objectives, a number of other specification tests are performed. The first test relates to checking whether or not we can find technical efficiency effects in the two sub regions in Africa separately as well as in the pooled data. The null hypothesis that there are no technical inefficiency effects experienced by firms in Africa was rejected at 1% significance level. This is seen from the value of lambda in table 3. There is evidence therefore that the technical inefficiency effect contributes a greater share of the total error variance implying that the stochastic frontier rather than an OLS model is the appropriate approach to employ to analyze the data.

The second test, the likelihood ratio (LR) test was performed to choose between a Cobb-Douglas and Translog approximation to the data. Again the test rejected the null hypothesis that appropriate functional form is Cobb-Douglas for the alternative hypothesis that the translog specification fits that data for both SSA and Maghreb. (See Table 1)

The other important test is the likelihood ratio test which determines whether or not the data provides evidence that the firms in the two regions – Sub Sahara and Maghreb Africa operate in different sectors of the available technological set. From the results captured in Table 2, the test statistic is 1678.3 and the critical value is 29.14 at 5% level of significance. The researcher therefore fails to accept the null hypothesis that the firms do not produce from different sectors of the technological set and rather go with the alternative hypothesis.

The implication of this result is that firms in the two sub regions of Africa do not employ the same technology in their lines of production and therefore operating within different sectors of the technological set and hence justifying the estimation of separate region specific stochastic frontiers for the sub regions and ultimately a meta-frontier function to provide the basis for comparing efficiencies of the firms in the two areas of Africa.

Since it is difficult to interprete the parameter estimates for the translog production function, a way out was to compute output elasticities of inputs and returns to scale as shown in Table 4. In deriving the output elasticities the sample means were employed while returns-to-scale were calculated as the sum of the output elasticities. The output elasticities as presented are heterogeneously distributed across the two regions, but as the results in Table

4 indicate electricity and raw materials have the highest output elasticity in each region. From the estimated results we find an interesting observation with respect to the estimated results in that production in each region exhibits increasing returns to scale of production which implies that firms in Africa can be said to operate in the first stage of the classical production where inputs are not being optimally harnessed and they are therefore yet to attain the stage of production which enables them most optimally utilize their inputs and attain maximum outputs..

In the production function, the output is measured in terms of sales revenue whereas the inputs are all captured in terms of their cost. From the estimated equation, we realize that coefficients of electricity, equipment and raw materials are all negative indicating that the marginal increase in the cost of any these inputs leads to a drop in output. This implies that physical increase in these inputs lead to increased output which partly aligns with Abotsi (2016).

The regression results relating to the region-specific variables are reported in Table 3. In general, most of the variables included in the region-specific regressions are observed to have a positive but significant effect on technical efficiency in the two regions which were expected *a priori*.

Table 4: Estimated output elasticities of the various inputs and returns to scale

Variable	SSA	Maghreb	Africa
Log labour	0.254	0.376	0.6123
Log electricity	1.305	0.812	2.7651
Log equipment	0.243	0.027	0.3329
Log land	0.218	0.284	0.3303
Log fuel	0.342	0.226	0.3602
Log raw material	0.602	0.402	0.6632
Returns to scale	**2.964**	**2.127**	**5.0648**

Source: Author’s computations (2020)

Table 4 presents the output elasticities of the various inputs in the SSA and the Maghreb regions of Africa obtained from the stochastic frontier functions. The calculated results from the estimated functions indicate that in both SSA and Maghreb, electricity has the highest impact on output among all inputs, though the output elasticity in SSA is higher than pertains in Maghreb. This means that increased availability of electricity to firms positively influences firm output in both regions. From the results it is also observed labour and land trigger higher output returns in the Maghreb region than SSA. Ultimately total output elasticity in SSA and Maghreb are 2.964 and 2.167 respectively highlighting increasing returns to scale in both regions.

Using the parameter estimates in Table 3, the fitted output values for each region were derived. This provided the basis upon which the stochastic meta-frontier (SMF) is derived, having already shown that the functional form is a translog specification. In Table 5, the parameter estimates of the SMF are presented and from that it can be realized that majority of parameter estimates are statistically significant at 1 per cent level. The statistically significant coefficients of electricity and raw materials from the analysis highlight the important roles that these variables play in affecting TGR in the production process.

In the stochastic meta-frontier function in table 5, the coefficient of lambda (λ) measures the extent to which the approach is appropriate compared with the linear programming method of estimating the stochastic meta-frontier. Hence, the value of lambda, 9.057 from the estimate which is statistically significant at 1% probability level indicates that the SMF is a better technique than the programming method which under the circumstances would yield biased results.

Examining the environmental variables, it is obvious that most of them significantly affect technical efficiencies of firms in both SSA and Maghreb regions of Africa.

From the estimated results, it is observed that the effect of the variables such, the intensity of use of foreign technology, industry productivity as well as increasing per capita GDP is the similar as they all trigger a reduction in technical inefficiencies of firms.

Table 5: Parameter estimates of the stochastic meta-frontier function

Input Variable	Coefficient
Log labour	-0.185** (0.002)
Log electricity	-0.278*** (0.021)
Log equipment	-0.084** (0.046)
Log land	0.171** (0.061)
Log raw materials	-0.081** (0.005)
Log fuel	0.033** (0.007)
Square of Log labour	-0.06** (0.000)
Square of Log electricity	-0.120** (0.064)
Square of Log equipment	0.002*** (0.002)
Square of Log land	0.009*** (0.001)
Square of Log raw material	0.058 (0.084)
Square of log fuel	-0.481** (0.150)
Log labour × Log electricity	-0.663** (0.092)
Log equipment × Log land	-0.285** (0.115)
Log labour× Log fuel	0.108** (0.006)

Log equipment × Log electricity	-0.054**
	(0.005)
Log equipment × Log fuel	-0.163**
	(0.092)
Log labour × Log raw materials	-0.109***
	(0.026)
Log electricity× Log fuel	0.262***
	(0.059)
Log fuel × Log raw materials	0.084**
	(0.0461)
Log fuel × Log land	0.681***
	(0.066)
Log electricity× Log raw material	0.221***
	(0.019)
Log raw materials × Log labour	0.124***
	(0.012)
Log labour × Log equipment	0.578***
	(0.028)
Log land × Log raw materials	0.198***
	(0.034)
Log Land × Log labour	0.318**
	(0.059)
Log electricity × Log land	0.133*
	(0.09)
Sigma_u	1.431***
	(0.836)
Sigma_v	0.158***
	(0.0155)
Theta (θ)	0.469***
	(0.0825)
Lambda	9.057***
	(0.182)
Log simulated likelihood	-1268.9
Other industry fixed effects	**Yes**
Country-year fixed effect	**Yes**
Country location year fixed effects	**Yes**
Constant	**.301****
	(.002)

Source: Author's computations (2020)

Table 6 shows that firms in SSA are more technically efficient (43.2 percent) than firms in Maghreb (35.9 percent). Table 6 further examines how technically efficient firms in each region are in terms of their operations with respect to the overall output. This is evidenced by the meta-frontier technical efficiency (MTE) results. From the results, it is observed that SSA is more technically efficient in their operations with respect to the overall output (34.7 per cent) compared to their counterparts in Maghreb (22.9 percent). The implication of these statistics is that the overall production efficiency by firms in SSA is superior to those in Maghreb.

From the estimated results, none of the two regions-SSA or Maghreb has their value of TGR at the maximum that is one. This highlights the fact that none of the stochastic frontiers of the regions in Africa is tangential to or coincides with the meta-frontier. The interpretation of this is that there no firms in both regions are able to adopt the most advanced techniques in their production activities implying that promotion or adoption of more superior technologies is required to boost productive efficiency of firms in both regions and hence in Africa as a whole .From the results, it is also obvious that, with the technology available to them, SSA firms are able to produce higher potential output than their peers in Maghreb.

Overall the meta-frontier technical efficiency (MTE) values measure and represent the technical efficiency of the firms in a given region in relation to all firms in Africa. In that respect, SSA firms are thus found to be more efficient relative to the entire continent Africa than their Maghreb counterparts

Table 6: Summary statistics of TEs, MTEs and TGRs between SSA and Maghreb

Region	Statistic	Mean	St. deviation	Minimum	Maximum
SSA	TE	0.4328	0.1116	0.2987	0.6300
	MTE	0.3470	0.2271	0.0132	0.7585
	TGR	0.7914	0.3210	0.0287	0.8811
Maghreb	TE	0.3590	0.2409	0.1099	0.5760
	MTE	0.2289	0.1945	0.0105	0.6212
	TGR	0.6467	0.1611	0.0010	0.7207

Source: Author's computations (2020)

As Table 6 shows, there are differences in the mean values of TE, MTE and TGR values across the two regions because SSA regions experienced higher TE compared to Maghreb.

From the results, in SSA, the highest TGR, 88% whilst that of Maghreb is 72% implying that the level of technological application by firms in SSA and Maghreb given the overall technology which is accessible is below the maximum/best which can be attained or employed.

Table 7: Meta-level technical efficiency and technological gap ratios between SSA and Maghreb

Region	Statistic	Coefficient
SSA	TE	0.4328
	MTE	0.3470
	TGR	0.7914
Maghreb	TE	0.3590
	MTE	0.2289
	TGR	0.6467

Source: Author's computations (2020)

Given the efficiency statistics, a test of difference between two means (SSA vrs Maghreb) is conducted using the test statistic t = $\bar{X}_1$- $\bar{X}_2$$-(\mu_1$-$\mu_2)$ /$\sqrt{(}\frac{S_1^2}{n_1}$ + $\frac{S_2^2}{n_2}$) yielding a value of approximately 151279 implying that the null hypothesis that there is no significant difference between the efficiencies of the two sub regions is rejected at 5%. This reinforces the point that firms in the Maghreb averagely operate at significantly lower efficiency levels than those in SSA meaning there is quite some effort which need to be applied to get them to improve and catch up with SSA, though firms in SSA themselves are not efficient enough and have a long wat to go.

Chapter Summary

In this chapter, the main focus has been to measure the efficiencies of firms in Africa and identify firm specific characteristics which influence their efficiency/inefficiency.

The stochastic meta-frontier approach developed by *Huang et al.* (2014) was employed to estimate the stochastic meta-frontier for Africa, determine the technological gaps that exist between firms in Sub-Saharan and Maghreb Africa regions, measure the extent to which firms in the two regions are employing the best available technology for production and hence ascertain how much of the potential output is being achieved by the two regions in Africa.

Generally the estimates obtained from the analysis show that on the average, firms in the SSA have employed better technologies than their counterparts in the Maghreb region given the technology available to them. Whereas firms in the SSA employ on the average 79% of available technology, those in the Maghreb were found to utilize about 64% of the available technology and these reflect in SSA achieving higher outputs relative to the potential output than Maghreb.

Finally we examined the output elasticity of the various inputs of firms in Africa and measured the returns to scale of production with respect to them and found that generally firms experience increasing returns to scale in Africa as a whole and also its sub regions.

CHAPTER SIX

BUSINESS ENVIRONMENT, INNOVATION AND FIRM EFFICIENCY IN AFRICA

Introduction

The chapter presents and discusses the data analysis relating to the second empirical objective of the study which mainly considers how business environment and innovation impact on technical efficiency (TE) of firms. The chapter therefore focuses on testing the hypothesis that there is no statistically significant effect of the interaction between business environment and innovation on firm technical efficiency (TE). The chapter is divided into three different sections. The first section assesses how business environment influences firm innovation in Africa whilst in the second section the researcher investigates the separate effects of business environment and innovation on efficiency of firms in Africa. The last part of the chapter explores the impact of the interaction of business environment and innovation on the efficiency of firms in Africa.

Descriptive Statistics

Table 8: Summary Statistics of Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
BE	9,019	3.47E-10	1.000002	-1.24424	1.872064
Innov	9,019	3.69e-09	1.000002	.6245506	1.600985
firm_age	9,019	23.72957	14.55146	5	150
manager_ex~r	9,019	17.98924	11.05984	1	90
manager2	9,019	445.9195	525.3083	1	8100
female_top~g	9,019	0.110323	0.313309	0	1
poweroutages	9,019	23.44871	17.16691	0	365
firm_size	9,019	1.526555	0.818964	0	3
ownerfemale	9,019	0.004879	0.06968	0	1
finance	9,019	1.526555	0.818964	0	3
capital_city	9,019	0.318882	0.466069	0	1
busi_city	9,019	0.405921	0.491097	0	1
market	9,019	0.491851	0.620503	0	2
foreignowner	9,019	10.64966	28.90305	0	100

Source: Author’s computations (2020)

Table 8 above provides a snapshot of the variables which are employed in the estimations. The business environment and innovation variables are derived using the MCA technique (see appendix). The researcher employed the MCA approach in this study because of its obvious advantages over the PCA and the factor analysis. According to Aslan *et al* (2017) and Tuesta *el al* (2015), the PCA and factor analysis are appropriate in situations where the variables involved are continuous but the MCA is better able to handle nominal and ordinal variables which are largely non-parametric and do not have to satisfy the conditions of linearity and normality.

From the descriptive statistics, it is seen that for the sample of firms the average age is about 24 years in operation. However, the youngest firm had operated for only 5 years whilst the oldest firm had worked for the last 150 years at the time of the survey. Another important variable in the summary statistics is power outages. The mean of the variable suggests that on the whole the during the year each firm in our sample suffered almost about 24 days of power interruption which is not very high compared with the operational number of 365 days in the year. The standard deviation however shows a wide variability of the variable around its mean implying the experience of power outages by firms in Africa showed very high variations in their occurrence in the firms in the samples.

Business environmental and Firm Specific determinants of Innovation by Firms

In this analysis two sets of results are presented: OLS and Probit. In the OLS results, innovation is constructed and measured on a continuous scale using multi correspondence analysis. In the probit estimates however, innovation is characterized as a dichotomous variable with the value 1 if the firm innovates and 0 otherwise. While the OLS result gives the effect of business environment on innovation, the probit estimates determines the probability/odds of engaging in innovation conditioned on business environment and other firm specific characteristics.

In Table 9 the multiple regression models for the OLS estimation are presented and the model from the results clearly satisfy specification tests at 5 percent (see last 4 row of Table 9) implying that the model does not suffer any issues of omitted variable bias. Another important diagnostic statistic is the mean VIF which was at estimated 3.12 which is considerably less than the conventional maximum threshold of 10. With this 3.12<10, according to Myers (1990) and Bowerman and O'Connel (1990), then this guarantees that the principle of non-presence of multicollinearity is not violated, going by the existing rule of the thumb. Finally, the p-value for the homoscedasticity test was estimated not be significant at 5 percent also implying that at 5 percent significance level the model has no heteroscedasticity issue. The model diagnostics from the probit estimation also appear strong using the estimated values under the last two columns. The estimated values of hat, hatsq and Hosmer-Lemershow from the model also provide evidence of good fit.

With the diagnostics of the models providing confirmation of their robustness, the discussion of the results generated in the regression analysis is proceeded with using Table 9.

Table 9: Effect of business environment on firm innovation in Africa

	Innovation	
	OLS	Probit
Variables	Coeff.	ME
Business environment	0.2695***	0.385***
	(0.0103)	(0.0368)
firm age	0.0431**	0.0470***
	(0.0019)	(0.0017)
Firm age squared	0.085**	0.0613**
	(0.005)	(0.060)
Small firms	0.844***	0.0444**
(ref: micro firms)	(0.0388)	(0.0181)
Medium firms	0.628***	0.103***
	(0.0421)	(0.0199)
Large firms	0.577***	0.224***
	(0.0477)	(0.0277)
Manager’s experience	0.0208***	0.0241**
	(0.0029)	(0.0012)
Manager’s experience squared	0.0261***	0.025
	(0.005)	(0.005)
Female top manager	0.147***	0.0282**
	(0.0322)	(0.0118)
power outages	-0.0270**	-0.0550**
	(0.0005)	(0.0002)
owner female	-0.0121**	-0.0393***
	(0.132)	(0.0618)
Access to finance	0.136***	0.101***
	(0.0269)	(0.0123)
capital city	0.0831**	0.0223
	(0.0395)	(0.0163)
Business city	0.00208	0.0375**
	(0.0365)	(0.0153)
Access to Market	0.286***	0.1040***
	(0.0188)	(0.0844)
foreign owner	0.0675**	0.0142***
	(0.0374)	(0.0018)
Access to foreign Technology	0.554***	0.242***
	(0.0390)	(0.0310)
Constant	-0.415***	-0.210***
	(0.0498)	(0.0002)
R-squared	**0.116**	
N	**9,019**	**9,019**
Mean VIF	**3.12**	
Homoscedasticity	**0.0523**	
_hat		**P>|z|=0.000**
hatsq		**P>|z| =0.102**
Hosmer-Lemershow test		**0.8121**

Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Author’s computations (2020)

In Table 9, it is observed that as the business environment becomes more favourable, firm's innovation increases by 27 percent and statistically significant at one percent. Turning to the probit estimates, it is obvious that the firm becomes 38.5 percent more likely to innovate as the business environment becomes more favourable. The implication of this finding is that, business environment significantly influences firm's innovativeness such that as the business environment becomes more favourable, their innovations increases and vice versa. Blagova and Tokhtarova (2014) found that competitive environment is the most important business factor driving innovation in Eastern Europe and Central Asia. Similarly findings were also reported by Fabová and Janáková (2015) in respect of Slovak companies.

The age of the firm is a significant factor which affects firm innovation regardless of how innovation is being measured. For instance, using OLS, an additional year of the firm increases innovation by 4.3 percent and it is statistically significant at five percent level of significance. Using the probit model however, an additional year of the firm is measured to increase the likelihood of the firm being innovative by 4.7 percent and significant at one percent. This is contrasts with the theoretical position espoused by some researchers that when firms have stayed around for long ,they tend to become comfortable, complacent and relaxed and hence adopt a lax attitude toward innovation because they may have firmly established themselves in the market space and therefore captured a certain market share.

The implication of this finding is that age of the firm is an important factor which influences firm innovation. With the age squared variable, older firms are found to be more innovative than younger ones implying the firm do not relent on their innovativeness even as they are growing older and older.

Compared to micro enterprises, innovation increases by 84.4 percent for small firms, 62.8 percent for medium firms and 57.7 percent for large firms. Along the same lines, small, medium and large are 4.4 percent, 10.3 percent and 22.4 percent more inclined to innovate respectively compared to micro-firms. By implication, size of the firm determines the firm's level of engagement in innovation. This is consistent with the findings of Choi and Lim (2017) who found that size of the firm has a significant influence on innovation. Barata and Fontainha (2017) found that firm size is more relevant for innovation than other factors. This goes in tandem with the view that larger firms have a higher propensity to innovate than smaller sized firms rather the reverse as put forward in the first Schumpeterian thesis known as Mark I.

Every additional year of the manager's experience increases the firm's innovation by 2.1 percent and the firms is 2.4 percentage points more likely to engage in innovation. This underlines the fact firms whose managers are more experienced are more likely to be or are innovative than less experienced ones. Naidu, Chand and Southgate (2014) has found that the experience of manager significantly impacts on the level of innovation found in the handicraft sector of Fiji and Tonga. In the same vein, Hjalager (2010) observes that entrepreneur's experience in small business is an important factor which underlines the level of innovation undertaken by the firm. Rutashobya and Jaensson (2004) also argued that experience of handicraft owners in Tanzania impacts significantly on internationalization of SMEs sector. Being a female top manager increases firm innovation by 14.7 percent compared to being a male top manager. Besides, compared to male top managers, female top managers are 2.8 percentage points more likely to innovate. The implication is that gender heterogeneity counts in firm's innovativeness with males slightly disadvantaged.

Power outages significantly decreases firm's innovation by 12.7 percent and the firm is 45.5 percentage points less likely to innovate. What this finding means is that power outages significantly undermine firms' level of innovation as entities. Similar findings had been reported by, Park, and Kim (2018), Klinger, Owen Landeg (2014) and Reichl, Schmidthaler and Schneider (2013) in Australia. Compared to male firm owners, female owners' innovation decreases by 1.2 percent and their firms are 3.9 percent less likely to innovate compared to male owners. This finding means that male owners of firms are more innovative than female firm owners.

Access to finance positively influences firm's innovativeness. In the regression results, it is observed that for a firm that has access to finance, its innovativeness increases by 13.6 percent and the likelihood of the firm innovating is 10 percent more compared to a firm without access to finance. Relative to firms that are not located in the business and capital cities, innovation increases by 8.3 percent and 2.2 percent for those located in the capital and business cities respectively and all of these are statistically significant indicating the relevance of the variables in influencing innovation.

Again, firms that have access to foreign market are able to increase their innovation by 28.6 percent and the likelihood of the firm engaging in innovation increases by 10.4 percent compared to firms without access to market. The meaning of this finding therefore is that having access to markets for sales of products engenders firm's ability to be innovative. In the case of firms that are owned by foreigners' their innovations increase by 6.7 percent and the firm is 8.4 percent more likely to innovate compared with those that are not owned by foreigners and what this finding shows is that foreigner owners of firms in Africa strive to be more innovative in order to compare and compete favourably with the firms owned by indigenes or even to out-compete the locally owned firms. This may largely be on the account that the foreign owners of firms may have certain advantages that indigenously owned firms would normally not have.

Table 10: Effect of business environment on firm innovation (Sub-regional analysis—SSA versus MAGHREB)

	SSA		Maghreb	
	OLS	Probit	OLS	Probit
Variables	Coeff.	ME	Coeff.	ME
Business environment	0.107***	0.129***	0.000	0.003***
	(0.020)	(0.027)	(0.001)	(0.001)
Controls	Yes	Yes	Yes	Yes
Constant	-0.415**	-0.210***	0.023**	0.021**
	(0.0498)	(0.0002)	(0.002)	(0.011)
R-squared	**0.248**		**0.267**	
N	**4,857**	**4,857**	**4,162**	**4,162**
Mean VIF	**2.12**		**2.08**	
Homoscedasticity	**0.2017**		**0.152**	
_hat		**P>|z|=0.000**		**P>|z|=0.000**
hatsq		**P>|z| =0.102**		**P>|z| =0.125**
Hosmer-Lemershow test		**0.8121**		**0.857**

Source: Author's computations (2020)

In Table 10, the focus is on investigating how the overall business environment affects firm innovation in the Sub-Saharan and Maghreb areas of Africa. Both the OLS and Probit estimates show that a favourable business environment tends to promote greater innovation in Sub-Sahara than in the Maghreb. From the estimated OLS regressions, a unit improvement in business environment in Sub-Sahara Africa leads to about 11% increase in the innovativeness of firms. However in the Maghreb region, it does not significantly influence firm innovation. The probit results which measure the likelihood of good business environment precipitating increased firm innovation show that the likelihood of a good business environment impacting on innovation by firms is greater in Sub-Sahara than in the Maghreb. Thus the marginal effect for Sub-Sahara Africa from the estimation is just under 0.13 whereas that of Maghreb is only a paltry 0.003.

Robustness checks

As an additional approach to check on robustness of the result and to gain deeper insights into how business environment influences firm innovation, the study employed disaggregated elements of the business environment characterizing them in these classifications- no obstacle, minor obstacle, moderate obstacle, major obstacle and severe obstacle and sought to investigate their impacts on firm innovation from the standpoint of Africa as a whole, Sub-Sahara Africa and Maghreb/North Africa. The estimated regression results are displayed in tables 11 and 12 below.

Table 11: Effect of Business Environment (BE) on firm innovation (Overall Africa)

Variable	BE Overall	Disaggregated Business Environment (DBE) on Innovation						
		Electricity	Finance	Tax rates	Tax administration	Political instability	Land	corruption
Minor obstacle	-0.123**	-0.0690**	-0.0182**	-0.015**	-0.0270**	-0.117**	-0.086**	-0.145**
	(0.0846)	(0.0276)	(0.0271)	(0.0258)	(0.0243)	(0.0308)	(0.0269)	(0.0291)
Moderate obstacle	-0.0472**	-0.0648**	-0.0638**	-0.0272**	-0.0884***	-0.0112**	-0.1108**	-0.2248***
	(0.0772)	(0.0275)	(0.0262)	(0.0245)	(0.0245)	(0.0301)	(0.0274)	(0.0278)
Major obstacle	-0.0168***	-0.0447**	-0.124***	-0.0303	-0.0138**	0.00764**	-0.3034**	-0.2112**
	(0.0744)	(0.0250)	(0.0255)	(0.0260)	(0.0271)	(0.0267)	(0.0267)	(0.0257)
Severe obstacle	-0.5902**	-0.6681**	-0.4841**	-0.101***	-0.2997**	-0.2185**	-0.1250***	-0.2827**
	(0.0743)	(0.0298)	(0.0313)	(0.0378)	(0.0398)	(0.0259)	(0.0375)	(0.0266)
Constant	0.751***	0.746***	0.681***	0.712***	0.721***	0.720***	0.705***	0.724***
	(0.0873)	(0.0501)	(0.0486)	(0.0494)	(0.0489)	(0.0507)	(0.0487)	(0.0491)
Controls?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
N	**9,019**	**9,019**	**9,019**	**9,019**	**9,019**	**9,019**	**9,019**	**9,019**
R-squared	**0.295**	**0.295**	**0.297**	**0.295**	**0.296**	**0.296**	**0.296**	**0.295**

Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1 the reference group for business environment is no obstacle

Source: Author's computations (2020)

Examining the Table 11, it is evident that under all the various individual elements of business environment, there is a greater and greater reduction in the likelihood of firms engaging in innovation as the environment gets more and more unfavourable.

From our generated regression results that when the overall business environment is considered as a minor barrier, the likelihood of firm innovation declines by about 12% however, when it is reckoned as a severe obstacle, the probability of firm innovation reduces by close to 60%, compared with firms with no obstacles.

Similarly, when electricity is seen as a minor obstacle, it leads to a decline in the likelihood of firm innovation by about 7% relative to firms without obstacles but as electricity becomes a severe obstacle, the likelihood of firm innovating takes a drastic nose dive and declines by a whopping 67%. In the same vein, when finance is considered as a minor obstacle, the probability of firms innovating declines by less than 2% whereas when it presents as a severe obstacle, the magnitude of decline is as much as 48%.

Again, the effect of tax administration compared with tax rates when considered as an obstacle leads to greater decline in likelihood of firm innovation compared with firms with no such obstacles implying that tax administration is much more relevant for policy purposes than tax rates.

Another conspicuous obstacle to firm innovation is corruption. From the estimated results, we are able to adduce evidence that as corruption becomes more serious, it further and further reduces to propensity of firms engaging in innovation. More specifically, when corruption is regarded as a minor obstacle, it triggers about 15% reduction in the likelihood of firm but as a severe obstacle, the likelihood of the firm innovating declines further to 28%. The finding of corruption negatively affecting firm innovation supports Bukari and Anaman (2020).

To sum up it is instructive to note that the estimated results show that among the various business environmental factors, electricity and finance in all the different dimensions tend to affect the likelihood of firm innovation than the other factors.

To gain additional insights concerning the impact of business environment on firm innovation, the sub-regional situations are presented and examined in the table 10 below.

From the estimated equations, evidence is generally adduced that in SSA, corruption is the greatest barrier to firm innovation. The table shows that the likelihood of the firm innovating declines by about 10% when corruption is regarded as a minor problem but by over 26% in the case where corruption is seen as a severe obstacle. The next factor which follows corruption in terms of its hindrance to firm innovation is finance. The estimated results indicate that when seen as a severe obstacle, finance leads to over 22% decline in the propensity of firms in SSA engaging in innovation.

In the Maghreb region, the estimation shows that the greatest obstacle to firm innovation is finance followed by the cost of electricity. Another important observation from the regression estimates is that political instability presents as a more severe impediment to firm innovation in the Maghreb area than in SSA. The same can be said of tax rates and tax administration but corruption as a severe obstacle is estimated to have a more negative effect on firm innovation in SSA than the Maghreb region.

Table 12: Effect of Business Environment (BE) on firm innovation (Sub-regional analysis—SSA versus Maghreb)

Variable	BE Overall	Disaggregated Business Environment (DBE) on Innovation						
		Electricity	Finance	Tax rates	Tax administration	Political instability	Land	corruption
					SSA			
Minor obstacle	-0.016*	-0.043**	-0.085**	-0.073*	-0.043	-0.051**	-0.108*	-0.096**
	(0.003)	(0.005)	(0.003)	(0.003)	(0.031)	(0.003)	(0.035)	(0.000)
Moderate obstacle	-0.001***	-0.009***	-0.005**	-0.005	-0.034***	-0.026*	-0.003**	-0.173***
	(0.005)	(0.003)	(0.006)	(0.006)	(0.009)	(0.031)	(0.002)	(0.036)
Major obstacle	-0.065*	-0.082**	-0.075**	-0.078**	-0.092***	-0.119***	-0.062***	-0.165**
	(0.035)	(0.007)	(0.031)	(0.031)	(0.000)	(0.067)	(0.000)	(0.002)
Severe obstacle	-0.101***	-0.123***	-0.221**	-0.142**	-0.126***	-0.139***	-0.1250***	-0.2627**
	(0.000)	(0.031)	(0.001)	(0.056)	(0.031)	(0.033)	(0.0375)	(0.0266)
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	**4,857**	**4,857**	**4,857**	**4,857**	**4,857**	**4,857**	**4,857**	**4,857**
R-squared	**0.352**	**0.312**	**0.353**	**0.355**	**0.349**	**0.351**	**0.313**	**0.307**
					MAGHREB			
Minor obstacle	-0.108*	-0.041*	-0.117	-0.108*	-0.151**	-0.146*	-0.181*	-0.112**
	(0.035)	(0.000)	(0.027)	(0.027)	(0.0873)	(0.0501)	(0.0486)	(0.0494)
Moderate obstacle	-0.003*	-0.173***	-0.030***	-0.121***	-0.121***	-0.120***	-0.105***	-0.124***
	(0.002)	(0.036)	(0.006)	(0.025)	(0.0489)	(0.0507)	(0.0487)	(0.0491)
Major obstacle	-0.002***	-0.002	0.107***	-0.018***	-0.127***	-0.043***	-0.125	-0.182***
	(0.000)	(0.002)	(0.020)	(0.006)	(0.035)	(0.030)	(0.158)	(0.021)
Severe obstacle	-0.499***	-0.339***	-0.393***	-0.243	-0.203**	-0.141***	-0.230***	-0.124***
	(0.055)	(0.065)	(0.095)	(0.088)	(0.002)	(0.031)	(0.011)	(0.005)
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	**4,162**	**4,162**	**4,162**	**4,162**	**4,162**	**4,162**	**4,162**	**4,162**
R-squared	**0.295**	**0.295**	**0.297**	**0.295**	**0.296**	**0.296**	**0.296**	**0.295**

Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1 the reference group for business is no obstacle

Source: Author's computations (2020)

Business environment and Firm Efficiency in Africa

In this section the concentration of the study is on examining the extent to which the overall business environment influences firm efficiency in Africa. To correct for endogeneity in the estimations, customs delays in clearance and time spent on government regulations as instruments.

The first item to be looked is the general African situation and then following that, the sub regional analysis with respect to SSA and Maghreb is addressed.

The following tables 13 and 14 provide the estimation results for the entire Africa and its two sub regions-SSA and Maghreb.

Table 13: Effect of business environment on firm efficiency (Overall Africa)

	(1)	(2)	(3)
Variable	OLS	Standard IV	Lewbel 2SLS
Business environment	0.014**	0.026**	0.038**
	(0.0001)	(0.0014)	(0.0014)
Firm age	0.00322***	0.003**	0.0303***
	(0.0005)	(0.0005)	0.0005
Firm age squared	0.0130***	0.0231**	0.0331***
	(0.011)	(0.0022)	0.0021
Manager's experience	0.0107***	0.0163**	0.0165**
	(0.000254)	(0.00026)	(0.0026)
Experience squared	0.0611**	0.027***	0.027***
	(5.36e-06)	(0.006)	(0.006)
Female top manager	0.00501*	0.0043**	0.0437***
	(0.00273)	(0.0027)	(0.0027)
power outages	-0.0255***	-0.0231**	-0.1240**
	(4.77e-05)	(0.0005)	(0.0005)
Small firms	0.109***	0.0463***	0.149***
	(0.0531)	(0.00489)	(0.0531)
Medium firms	0.168***	0.0306***	0.168***
	(0.0532)	(0.00534)	(0.0532)
Larger firms	0.192***	-0.00399	0.2141**
	(0.0533)	(0.00599)	(0.0112)
owner female	0.0181***	0.0197**	0.0195***
	(0.00649)	0.00684	0.0677**
Access to Finance	0.00461**	0.0017**	0.0153**
	(0.00192)	0.0122**	0.1112***

capital city	-0.0405***	-0.04097	-0.0492**
	(0.00260)	(0.0027)	(0.0026)
Business city	0.0519***	0.0519**	0.0555***
	(0.00245)	(0.0025)	(0.0024)
Foreign market	0.0174***	0.0164**	0.0163**
	(0.00138)	(0.0014)	(0.0014)
Foreign owner	0.000445***	0.0433***	0.014**
	(2.76e-05)	(0.005)	(0.0005)
foreign technology	0.0169***	0.1369**	0.2850**
	(0.003)	(0.1105)	(0.015)
First stage			
Customs delays in clearance		-0.412***	-0.412**
		(.050)	(.006)
Time spent on gov't regulation		-0.285**	-0.476***
		(.001)	(.002)
Constant		0.2997**	0.3001**
		(0.003)	(0.003)
N	**9019**	**9019**	**9019**
R-squared	**0.4243**	**0.4897**	**0.4916**
F-statistic	**113.71**	**106.12**	**106.62**
Hausman		**832.11(0.000)**	**332.22(0.000)**
Under identification test		**1243.18(0.000)**	**1243.38(0.000)**
Weak identification test (Cragg-Donald Wald F statistic)		**141.131**	**143.101**
Stock-Yogo weak ID test critical values: 10% maximal IV size		**119.93**	**119.93**
Hansen J statistic (over identification test of all instruments)		**46.548 (0.054)**	**46.548 (0.054)**

Column 2 represent (Standard IV) estimates. Column3 represent Lewbel 2SLS results which makes use of internal and external instruments. The Robust standard errors adjusted for heteroscedasticity are in parenthesis. ***p<0.01, **p<0.05, *p<0.1

Source: Author's computations (2020)

From the regression results when we compare the OLS, standard 2SLS and Lewbel 2SLS estimates, it is observed that the effect of business environment on innovation in 2SLS and Lewbel 2SLS are significantly higher implying that endogeneity causes a downward bias in OLS estimates. Given that the Lewbel 2SLS technique employs internal and external instruments, it is regarded as a more efficient estimator under situations of endogeneity and therefore provides a more robust and better analysis on how firm efficiency is influenced by the business environment.

Specifically, the effect of innovation from Lewbel 2SLS estimates with internal and external instruments are generally lower than results from the standard IV with delays in customs clearance and number of times managers engage in regulations used as instruments. Comparing however, with OLS estimates, it is observed that they are relatively higher confirming the downward bias in the OLS estimates.

The diagnostics also affirm that the instruments are appropriate and hence the model is quite good. This is evidenced by the Cragg-Donald Wald statistics which is significant at 5% implying that the instruments satisfy the condition that it should not be weakly correlated with efficiency (Stock & Yogo, 2005).

In the analysis presented, the dependent variable (efficiency) was defined as a continuous variable and all the independent variables in this analysis were captured similarly whilst the coefficients are interpreted using semi-elasticities.

From the estimated equation, the overall business environment increases firm's efficiency by 3.8 percent and statistically significant at 5% probability level. This means that business environment positively influences firm's efficiency implying that favourable business environment enhances firm's efficiency and unfavorable business environment undermines efficiency. This is consistent with extant literature, (Wang, Huang & Shou, 2015; Prabowo, & Cabanda, 2011; Stuebs & Sun, 2010; Kaya, 2009) which suggest that while favourable business environment enhances firm efficiency and growth, usually precipitated by improved labour efficiency and labour productivity, unfavourable business environment negatively affects firm efficiency.

Again the estimated equation shows that the age of the firm is positively associated with efficiency of the firm. Every additional year of the firm increases efficiency by 3.0 percent and older firms (age squared) are able to increase their efficiencies by 3.3 percent. By implication older firms are estimated to operate at higher level of efficiency compared with younger firms. In Singh, Goyal and Sharma, (2013) age of the firm is demonstrated to positively impact on both technical efficiency (PTE) and scale efficiency (SE) significantly. Faruq and Yi (2010) in their study of the factors which influence technical efficiency of manufacturing firms in Ghana also confirmed that key firm characteristics such as age impacts positively on firm efficiency. These results are also corroborated by Setiawan, Effendi, Heliati and Waskito (2019) who found that the technical efficiency is positively influenced by firm age.

In terms of experiences of the manager, from the regression results, for every additional year of the manager in that position, gains in terms of experiences increases the firm's efficiency by 1.6 percent and that more experienced managers (experience squared) are able to increase their firm's efficiency by 2.7 percent. This result is largely in line with the intuition. In a sense, what this finding means is that although experiences increase efficiency, more experienced managers are efficient than the less experienced ones. In a previous study, (Alvarez, & Crespi, 2003) efficiency is determined to be positively influenced by the experience of workers as well as innovation in products.

As shown in Table 13, power outages have a deleterious effect on firm's efficiency. Power outages from our regression results decreases efficiency by 12.4 percent meaning that in Africa power outages make firms less efficient. Similarly, Klinger and Owen Landeg (2014) and Reichl Schmidthaler and Schneider (2013) have reported the negative effect of power outages on productivity. The result is not very surprising since in Africa, supply of power is a big challenge and most firms are dependent on the erratic supply from state institutions.

Another important aspect of the analysis relates to assessing the effect of firm size on efficiency. From the results generated, it is seen that generally in Africa, firm efficiency increases by 14.6 percent for small firms, 16.8 percent for medium firms and 21.4 percent for larger ones compared to the micro enterprises. By implication, the size of the firm in Africa matters in its efficiency in that the larger the firm, the more efficient it becomes. Biener, Eling and Wirfs (2016) in their analysis of show that small and large firms operate at an optimal level from an efficiency point of view, while mid-size companies are not able to achieve that. Sinani, Jones and Mygind (2007) found that the size of firm and better quality of labour enhances efficiency, whereas soft budget constraints leads to an adverse effect on the level of efficiency of firms. Tecles and Tabak (2010) in their study also showed that large banks are more cost and profit efficient compared with small and medium ones, which finding appeared to substantiate the concentration process observed in recent years. Faruq and Yi (2010) in their study of the key factors which affect the technical efficiency of manufacturing firms in Ghana found that firm size has a significant but positive effect on firm efficiency.

Parte-Esteban and Alberca-Oliver (2015) also demonstrate that regional and corporate factors, such as the tourist flow driven by each region, hotel location and hotel size significantly impact hotel efficiency scores. Gardener, Molyneux and Nguyen-Linh (2011) showed that firm size leads to higher technical efficiency both across countries and across industries. All these results above are confirmed by Setiawan, Effendi, Heliati and Waskito (2019) who also found that the technical efficiency of firms is positively influenced by firm size.

Compared to male firm owners, female owners' are able to increase their efficiency by 19 percent. This finding means that firms in Africa owned by females are more efficient than those owned by firms owned by males. Access to finance, another important business environmental variable is estimated to positively influence firm efficiency. More succinctly in the regression analysis, the results show that a firm that has access to finance is able to achieve enhanced and improved efficiency by 11.5 percent compared to a firm without access to these avenues of finance. This finding is very plausible since access to finance empowers the typical firm to be in a position to markedly improve its processes and procedures as well as its human resource.

Relative to firms that are not located in the business and capital cities, efficiency increases by 4.9 percent and 5.6 percent for those located in the capital and business cities respectively. These results are all positive and statistically significant indicating the relevance of their influence and underscores the fact that in Africa the location of firms is a critical factor in determining firm efficiency. Evidence by Parte-Esteban and Alberca-Oliver

(2015) indicates that the hotel efficiency scores are impacted significantly by location of hotel with those in rural areas largely disadvantaged. Other studies (Setiawan, Effendi, Heliati & Waskito, 2019) have also found that the technical efficiency is positively influenced by location with firms in the cities recording higher returns. Shang, Wang, and Hung (2010) also find that the location of firm is a significant but a positive determinant of efficiency scores. Firms that have access to market increase their efficiency by 1.6 percent compared to firms without access to market. By implication having access to markets for sales of products engenders the efficiency of firms in Africa,

Again, the efficiency of firms which are owned by foreign nationals increases by 1.4 percent compared to those that are not owned by foreigners. What this finding means is that foreign owned firms are propelled to be more efficient when compared with the indigenous counterparts. In this regard, Sinani, Jones and Mygind (2007) found that compared to firms which are owned by employees and by the state, the technical efficiency of foreign ownership increases. These results have also been buttressed by Tecles and Tabak (2010) who also showed that foreign owned banks achieve a higher efficiency through either the establishment of new affiliates or the acquisition of local banks. Also, Faruq and Yi (2010) in their study of the key factors which affect technical efficiency of manufacturing firms in Ghana found that foreign ownership, an important firm specific characteristic positively impacts on firm efficiency

From the regression analysis, it is observed that firms which can access foreign technology are able to enhance their level of efficiency by 28.5 percent compared to firms that do not have access to foreign technology. Barassa, Vermeulen, Knoben, Kinyanjui and Kimuyu (2019) demonstrated that adoption of foreign technology by firms tend to promote technical efficiencies of the firms under study. Their results also underline the complementarity between foreign technology and in-housel R&D and shows that the positive effect of externally developed technology on firm efficiency depends on the firms' absorptive capacity with respect to the technology.

Table 14: Effect of business environment on firm efficiency (Sub-regional analysis—SSA versus Maghreb Africa)

Explanatory Variables	**SSA**			**Maghreb**		
	OLS	Standard IV	Lewbel 2SLS	OLS	Standard IV	Lewbel 2SLS
Business environment	0.256***	0.248***	0.215***	0.159**	0.142***	0.171*
	(0.026)	(0.027)	(0.023)	(0.024)	(0.000)	(0.021)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Frist stage						
Customs delays in clearance		-0.107	-0.110**		-0.215**	-0.221***
		(0.030)	(0.031)		(0.008)	(0.008)
Time spent on gov't regulation		-0.121**	-0.141**		-0.233**	-0.334***
		(0.001)	(0.002)		(0.022)	(0.000)
N	**4,857**	**4,857**	**4,857**	**4,162**	**4,162**	**4,162**
R-squared	**0.4243**	**0.4897**	**0.4916**	**0.368**	**0.369**	**0.3760**
F-statistic	**113.71**	**106.12**	**106.62**	**213.13**	**201.11**	**201.01**
Hausman		**832.11(0.000)**	**332.22(0.000)**		**832.11(0.000)**	**332.22(0.000)**
Under identification test		**1243.18(0.000)**	**1243.38(0.000)**		**943.18(0.000)**	**943.38(0.000)**
Weak identification test (Cragg-Donald Wald F statistic)		**133.152**	**135.143**		**133.152**	**135.143**

Controlled for Country-location-year fixed effect, Country-year fixed effect and Industry fixed effects. Standard errors are in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Source: Author's computations (2020)

In table 14, the diagnostics again indicate a well behaved model and the estimated equations show how overall business environment influences firm efficiency in the two sub regions of Africa- Sub-Sahara and the Maghreb.

From the table, one of the key observations is that a favourable business environment in Sub-Sahara Africa region positively affects firm efficiency and more precisely leads to about 22% increase in the firm efficiency at less than 1% significance level. Similarly, a favourable business environment in the Maghreb region precipitates about 17% improvement in the efficiency of firms but only at 10% level of significance. This implies that comparatively, a favourable business environment creates the conditions for higher efficiency by firms in SSA than Maghreb area. These results suggest that the business environment in Maghreb needs to be worked on and improved further so that it can generate/trigger a better response in terms of firm efficiency and thus project them to levels comparable or even better than those in SSA .Firms in SSA also have room to improve upon their efficiencies.

Table 15: Effect of innovation on firm efficiency (Overall Africa)

Variable	OLS	Standard IV	Lewbel 2SLS
Innovation	0.0241***	0.0467***	0.0437***
	(0.0015)	(0.0041)	(0.0036)
Controls	.Yes	.Yes	.Yes
	SSA		
Innovation	0.276**	0.267**	0.243**
	(.037)	(.006)	(.066)
Controls	Yes	Yes	Yes
	Maghreb		
Innovation	0.213**	0.115**	0.123**
	(0.0015)	(0.0041)	(0.0036)
Controls	Yes	Yes	Yes

Source: Author’s computations (2020)

In Table 15, the researcher employed research and development (R&D) as the instrument for innovation because it influences efficiency through innovation consistent with Bayudan-Dacuycuy and Baje (2018).

As already indicated, the presence of endogeneity renders the OLS results biased and for that reason the researcher depended on and interpreted the IV estimates especially the Lewbel 2SLS results because of its advantage. The results show that the effect of innovation from Lewbel 2SLS estimates with internal and external instruments are considerably lower than results from the standard IV with customs delays in clearance and number of times managers engaged in regulations as instruments. However, they are comparatively higher than the estimate for the OLS which again validates the downward bias in the OLS estimates.

Thus, relying on the OLS estimates, it could be said that innovation generates a positive effect on firm efficiency and thus, increases firm efficiency by 2.4 percent in Africa. From the estimated equation, research and development positively affects firm's engagement in innovation by 41.2 percent and 27.6 percent respectively. This finding is consistent with the existing literature (Bayudan-Dacuycuy and Baje 2018; Seck, 2019). The Cragg-Donald Wald F statistics are significant at the 5 percent level and imply that our instruments satisfy the relevant condition of not being weakly correlated with efficiency (Stock & Yogo, 2005). The 2SLS results suggest that the endogeneity of innovation renders the results in OLS misleading and hence yields an upward biased results by OLS while the 2SLS estimates are negative and relatively bigger than the OLS estimates in absolute terms.

From the results shown in Table 15, two key issues emerged. First, considering all the two estimation techniques, innovation positively and significantly affects firm efficiency. Specifically, a unit increase in innovation increases firm's efficiency by 4.37 percent per the Lewbel 2SLS estimates. These effects are even much greater (4.67%) going by the going the standard IV estimation. The implication of this finding is that, innovation engenders firm efficiency. This finding is consistent with extant literature which emphasizes that innovation significant affects firm's efficiency (Salinas-Jiménez, 2011, Salinas-Jimenez and Salinas-Jimenez, 2006; Mahagaonkar, 2008, 2010, 2010; Asiedu and Freeman, 2009; Goedhuys, Mohnen and Taha, 2016; Gan and Xu,2019). Barassa, Vermeulen, Knoben, Kinyanjui and Kimuyu (2019) also reported that innovation inputs positively affect firm efficiency within Sub-Saharan region

Table 16: The effect of disaggregated components of business environment and innovation on firm efficiency (Overall Africa)

	(1)	(2)	(3)
Variable	OLS	Standard IV	Lewbel 2SLS
Disaggregated indicators of innovation			
Process innovation	0.331***	0.207***	0.218***
	(0.177)	(0.091)	(0.022)
Product innovation	0.543***	0.584***	0.523***
	(0.037)	(0.035)	(0.038)
Market innovation	0.402***	0.544***	0.505***
	(0.0402)	(0.0196)	(0.0929)
Technological innovation	0.260***	0.286***	0.270***
	(0.0820)	(0.0882)	(0.0912)
Disaggregated indicators of Business environment			
Cost of Electricity	0.0262	-0.652***	-0.736***
	(0.0368)	(0.179)	(0.149)
Finance	0.0249**	0.343	0.781**
	(0.0070)	(1.335)	(0.487)
Tax rates	-0.0130**	-0.052	-0.017*
	(0.005)	(0.091)	(0.0375)
Tax administration	0.212***	0.007	-0.001
	(0.102)	(0.001)	(0.001)
Political instability	-0.214***	0.110	-0.140***
	(0.168)	(0.145)	(0.053)
Corruption	-0.138***	-0.003	-0.002**
	(0.009)	(0.003)	(0.001)
Controls	Yes	Yes	Yes
First stage			
Customs delays in clearance		-0.638	-1.357***
		(1.369)	(0.511)
Time spent on gov't regulation		-0.2997**	- 0.312**
		(0.003)	(0.011)
N	**9019**	**9019**	**9019**
R-squared	**0.4243**	**0.4897**	**0.4916**
F-statistic	**113.71**	**106.12**	**106.62**
Hausman		**832.11(0.000)**	**332.22(0.000)**
Under identification test		**1243.18(0.000)**	**1243.38(0.000)**
Weak identification test (Cragg-Donald Wald F statistic)		**141.131**	**143.101**

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

Source: Author's computations (2020)

In measuring the effect of business environment and innovation, the focus of the researcher has been looking at their overall, broad effects which though useful may not provide all the relevant policy based information. It is therefore imperative that the research also averts its attention to examining the different aspects of business environment and innovation.

In the case of business environment, the key aspects examined are cost of electricity, access to finance, tax rates, tax administration, political instability and corruption .The significance of this is that each of this may affect firm efficiency in different ways. All of the factors mentioned here consistently feature in business barometers which gauge the kind of environment which is spoken of by people in business

However, in respect of innovation, the researcher identifies process innovation, product innovation, marketing innovations and then technological innovations which may not produce the same effects on firm efficiency.

Tables 16 and 17 thus provide more policy focused empirical evidence on how these aspects of the business environment and innovation influence firm efficiency.

Table 17: disaggregated components of business environment and innovation on firm efficiency (Sub-regional analysis—SSA versus Maghreb)

	SSA			Maghreb		
Variable	OLS	Standard IV	Lewbel 2SLS	OLS	Standard IV	Lewbel 2SLS
Process innovation	0.403	0.205**	0.1156***	0.481**	0.118**	0.113**
	(0.040)	(0.060)	(0.050)	(0.150)	(0.027)	(0.045)
Product innovation	0.254	0.201**	0.184***	0.663**	0.301**	0.343**
	(0.018)	(0.003)	(0.008)	(0.092)	(0.044)	(0.099)
Market innovation	0.122	0.307**	0.297***	0.285**	0.078**	0.213**
	(0.024)	(0.004)	(0.010)	(0.015)	(0.032)	(0.085)
Technological innovation	1.938	0.225**	0.209**	0.243**	0.557**	0.164**
	(0.015)	(0.046)	(0.017)	(0.135)	(0.044)	(0.095)
		BUSINESS	**ENVIRONMENT**			
Cost of Electricity	0.546	-0.497***	-0.421***	-0 281**	-0.011***	-0.427**
	(0.378)	(0.001)	(0.101)	(0.156)	(0.033)	(0.087)
Finance	0.008	0.001	0.005	0.108**	0.011**	0.106**
	(0.009)	(0.001)	(0.003)	(0.006)	(0.00198)	(0.005)
Tax rates	-0.012**	-0.001**	-0.011**	-0.054**	-0.011***	-0.076**
	(0.011)	(0.005)	(0.010)	(0.005)	(0.005)	(0.005)
Tax administration	0.051	0.052**	0.015***	0.043***	0.008**	0.027**
	(0.046)	(0.035)	(0.014)	(0.018)	(0.005)	(0.099)
Political instability	-0.201	-0.205**	-0.221**	-.356***	-0.310**	-0.338***
	(0.001)	(0.005)	(0.001)	(0.002)	(0.005)	(0.002)
Corruption	-1.281	-0.520**	-0.486***	-0.204**	-0.304***	-0.301**
	(0.555)	0(.441)	(0.148)	(0.029)	(0.047)	(0.031)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
First stage						
Customs delays in clearance		-0.218**	-0.104***		-0.131**	-0.118**
		(0.011)	(0.003)		(0.001)	(0.004)

Time spent on gov't regulation		-0.285** (0.405)	-0.2326** (0.180)		-0.160** (0.063)	-0.185** (0.100)
R&D		0.185*** (0.053)	0.226*** (0.018)		0.205** (0.095)	0.118*** (0.026)
N	**4,857**	**4,857**	**4,857**	**4,162**	**4,162**	**4,162**
R-squared	**0.4243**	**0.4897**	**0.4916**	**0.4011**	**0.4120**	**0.4161**
F-statistic	**113.71**	**106.12**	**106.62**	**115.18**	**213.25**	**1156.06**
Hausman		**832.11(0.000)**	**832.22(0.000)**		**332.11(0.000)**	**332.22(0.000)**
Under identification test		**1243.18(0.000)**	**1243.38(0.000)**		**1113.18(0.000)**	**1231.12(0.000)**
Weak identification test (Cragg-Donald Wald F statistic)		**241.131**	**243.101**		**144.131**	**144.054**
Stock-Yogo weak ID test critical values: 10% maximal IV size		**212.33**	**212.31**		**119.93**	**119.93**
Hansen J statistic (over identification test of all instruments)		**98.511 (0.142)**	**98.140 (0.124)**		**46.548 (0.054)**	**46.548 (0.054)**

Source: Author's computations (2020)

The disaggregated aspects of business environment and innovation and firm efficiency

The tables above (16 and 17) throw light on how the individual disaggregated aspects of business environment and innovation impact on firm efficiency. The first one, table 16, highlights the overall African situation whereas the second, table 17 shows the sub-regional analysis.

The diagnostic test results generally indicate that the model satisfies the conditions for interpretation. Specifically, the Hausman and all the identification tests yielded good results. In other words the Hausman statistic confirmed endogeneity whilst the identification tests showed that the instruments used R&D and Customs delays in clearance and time spent on government regulations are valid and appropriate and the exclusion condition is also satisfied.

Looking at Africa as a whole, the various individual elements of both business environment and innovation influence firm efficiency by different degrees. In respect of the business environment, the regression estimates show that the cost of electricity, taxes rates, political instability and corruption are the factors which negatively affect firm efficiency in Africa. Of these, the cost of electricity most negatively affects firm efficiency at less than 1% level of significance. This is not strange because over the years a good number of countries in Africa have experienced challenges in electricity generation and supply and have not been able to diversify their electricity generation mixes making electricity supply erratic and expensive. What this means is that the availability of affordable electricity is an important plank of an overall business environment that is required for efficient operations of firms .The results also suggest that political instability is a considerable problem to fostering firm efficiency in Africa. This finding falls in line with the results of a good number of studies.

Corruption reflects a certain level of institutional weakness especially of critical state institutions with which firms must interface from time to time. The reported estimated effect of corruption clearly indicates that corruption significantly undermines the efficiency of firms in Africa at less 5% probability level, This finding conforms with Commander and Svejnar(2011) and Nguimkeu (2013) which also established that corruption negatively affects firm performance.

The other business environmental factor which negatively impacts on firm efficiency is the tax rate albeit that the estimated effect is only significant at 10% probability level. This means that higher marginal tax rates leads to a decline in firm efficiency in Africa. However, access to and the availability of finance from the estimated equation generates a positive response from firm efficiency at 5% significance level.

In the two sub regions in Africa, the cost of electricity just as it is in the estimated results for the entire Africa reflects the situation that it is a very formidable stumbling block to firm efficiency .The impact is significantly negative in both regions. Again the effect of political instability on firm efficiency is also negative in both areas though its estimated measured impact in the Maghreb region more profound. This is expected because the Maghreb countries have witnessed considerable political turbulence and turmoil within the last 10 years and have been the hotbed of what has been described as the 'Arab Spring'. Access to and availability of finance however registers a positive impact only in the Maghreb region whereas in the Sub Saharan Africa, the effect of finance does not significantly influence the efficiency of firms.

Tax rates also appear to be a challenge to efficiency of firms across both sub regions though the estimated effect is greater in Maghreb than Sub Sahara. This signals that the reform of tax rates is needed in African economies to make firm efficiency more responsive to them,

The measured effect of corruption in the two sub regions is negative and expected but the results from the two regions show that corruption is more of a problem to firm efficiency in Sub-Sahara Africa than in the Maghreb area.

With regard to innovation, all the various aspects- Process innovation, Product innovation, marketing innovation and technological innovation positively influence firm efficiency in Africa at 1% significance level. However the measured impacts are greater in Product and Marketing innovation than process and technological innovations. This is not entirely surprising because firms in Africa are relatively lagging in terms of R&D which leads to the development of improved processes and new technologies.

At the sub regional level, all the aspects of innovation precipitate increased firm efficiency in both Sub-Sahara(SSA) and Maghreb areas with marketing innovation having the highest impact on firm efficiency in the Sub Saharan area while product innovation triggers the biggest increase in firm efficiency in the Maghreb area.

Joint Effect of innovation and business environment on firm efficiency

As has been argued earlier, firm growth may usually be propelled by a mixture of factors which are interconnected and complementary. In Table 18 therefore we seek to address two main questions: Is the combined effect of innovation and favourable business environment on firm's efficiency greater than the separate individual effects? And what is the extent and size of this effect? This section focuses on the effect of interaction of the innovation and business environment on firm's efficiency. Table 18 provides estimates on the interaction of the innovation and business environment on firm's efficiency.

The estimates in Table 18 validates the hypothesis that the complementary role of innovation and business environment on efficiency cannot be overemphasized. Again the results shown in Table 18 from the robustness checks further buttresses the hypothesis that innovation and favourable business environment is complementary and thus, have higher efficiency outcomes vis-à-vis their individual effects. Specifically, if innovative firms operate in a favourable business environment, their efficiency increases by 61.92% compared to when the business environment is unfavourable. What all these results show is that the joint effect of innovation and business environment on firm's efficiency is greater than their independent effects. They also give credence to the view that the effect of innovation on firm efficiency in Africa is better experienced by entrepreneurs within a favourable business environment.

Interactions

Table 18: Joint effects of business environment and innovation on firm efficiency (Overall Africa)

Variable	OLS	Standard IV	Lewbel 2SLS
Innovation	0.0241***	0.0467***	0.0437***
	(0.0015)	(0.0041)	(0.0036)
Favourable Business environment	0.007**	0.0017	0.0017***
	(0.00036)	(0.0014)	(0.00014)
Innovative firms in favorable business environment (ref: unfav. Bus, env.)	0.1281***	0.6128***	0.6192***
	(0.00205)	(0.0003)	(0.0003)
Small firms	0.000569*	-0.0398**	-0.03195
	(0.0002)	(0.0035)	(0.0358)
Medium firm	0.0325***	0.0218**	0.0121**
	(0.00362)	(0.0413)	(0.0037)
Large firm	0.0126***	0.00562	0.0168**
	(0.00379)	(0.004)	(0.004)
Firm age	.0049***	0.0501**	0.0489**
	(0.0003)	(0.0016)	(0.0016)
Firm age squared	-0.006***	-0.006**	-0.016**
	(0.0012)	(0.006)	(0.0006)
Manager's experience	0.0165**	0.0147	0.0256**
	(0.0044)	(0.0124)	(0.0002)
Experience squared	0.01561**	0.0248	0.1721**
	(0.00242)	(0.0006)	(0.0016)
Female top manager	0.0170	0.0034**	0.0139***
	(0.0216)	(0.0027)	0.00271
power outages	0.00414	-0.1102	-0.1123***
	(0.0027)	(0.005)	(0.0005)
Owner female	-0.0223**	0.023**	0.0238***
	(4.80e-05)	(0.0068)	(0.006)
Finance	0.0205***	0.0215**	0.0365***
	(0.0065)	(0.0020)	(0.0019)
Located in capital city	0.00364*	0.0216**	0.0234**
	(0.00190)	(0.0029)	(0.00278)
Located in Business city	-0.0235**	0.0338**	0.0367**
	(0.0028)	(0.0025)	(0.0025)
Access to Foreign market	0.0366***	0.0156**	0.0171**
	(0.0026)	(0.0014)	(0.0013)
foreign owner	-0.0169**	0.000369	0.000385
	(0.0013)	2.80E-05	2.80E-05
foreign technology	0.1169***	0.2369**	0.3850**
	(0.003)	(0.0005)	(0.005)
Constant	0.0004***	0.3504	0.349
	(2.78e-05)	0.00413	0.00409
First Stage			

Customs delays in clearance		-0.412***	-0.433***
		(0.030)	(0.020)
Time spent on gov't regulation		-0.250**	-0.254**
		(0.001)	(0.021)
R&D		0.431**	0.289***
		(0.225)	(0.057)
N	**9,019**	**9019**	**9019**
R-squared	**0.4243**	**0.4897**	**0.4916**
F-statistic	**113.71**	**106.12**	**106.62**
Hausman		**812.0(0.000)**	**312.11(0.000)**
Under identification test		**123.18(0.000)**	**1203.38(0.000)**
Weak identification test (Cragg-Donald Wald F statistic)		**141.131**	**143.101**
Stock-Yogo weak ID test critical values: 10% maximal IV size		**119.93**	**119.93**
Hansen J statistic (over identification test of all instruments)		**56.41 (0.054)**	**61.81 (0.043)**

Column 3 represent 2SLS (Standard IV) estimates. Column 4 represents Lewbel 2SLS results that combine internal and external instruments. Robust standard errors adjusted for heteroscedasticity in brackets. ***p<0.01, **p<0.05, *p<0.1
Source: Author's computations (2020)

In table 19, the sub regional analysis are presented below to provide a more detailed appreciation of the interactions between innovation and the business environment.

Generally the estimated models for the sub regions reflect the situation in the whole Africa

When taken separately, both innovation and business environment impact positively in the sub regions of Africa. However, the analysis shows that with respect to innovation and business environment, Sub Sahara Africa enjoys higher efficiency than the Maghreb area. More accurately an increase in innovation in Sub Sahara elicits about 27% increase in firm efficiency whereas the increase in efficiency in Maghreb is only 12% .Similarly the positive effect of improving business environment triggers a higher level of efficiency in firms in SSA than in Maghreb with SSA registering about 26% against

Maghreb's 12% increase in firm efficiency. With these, it is not surprising that the interactive effect of innovation and the business environment engenders a higher level of efficiency in SSA than in Maghreb. The implication of these results is that even though firm innovation by itself precipitates higher efficiency in the sub regions of Africa, the effect of the two variables – innovations and business environment when combined have a greater effect than their separate impact

Table 19: Joint effects of business environment and innovation on firm efficiency (Sub-regional analysis—SSA versus Maghreb)

	SSA			**Maghreb**		
Variable	OLS	Standard IV	Lewbel 2SLS	OLS	Standard IV	Lewbel 2SLS
Innovation	0.276**	0.267**	0.274**	0.213**	0.115**	0.123**
	(0.037)	(0.006)	(0.066)	(0.060)	(0.045)	(0.031)
Favourable Business environment	0.269**	0.230**	0.260**	0.194**	0.143**	0.118**
	(0.060)	(0.056)	(0.049)	(0.082)	(0.099)	(0.004)
Innovative firms in favorable business environment	0.282**	0.303**	0.291**	0.210**	0.213**	0.202**
(ref unfavourable bus. environment)	(0.046)	(0.056)	(0.003)	(0.002)	(0.085)	0(.001)
Controls?	Yes	Yes	Yes	Yes	Yes	Yes
First Stage						
Customs delays in clearance		-0.120**	-0.101**		-0.105**	-0.106**
		(0.017)	(.001)		(.005)	(.010)
Time spent on gov't regulation		-0.103**	-0.186**		0.104**	-0.110**
		(0.003)	(.148)		(.041)	(.004)
R&D		0.308 ***	0.275**		0.237**	0.299***
		(0.068)	(0.120)		(0.099)	(0.089)
N	**4,857**	**4,857**	**4,857**	**4,162**	**4,162**	**4,162**
R-squared	**0.5899**	**0.691**	**0.173**	**0.273**	**0.345**	**0.355**
F-statistic	**113.71**	**106.12**	**106.62**	**107.71**	**108.73**	**107.03**
Hausman		**812.01(0.000)**	**312.42(0.000)**		**614.0(0.000)**	**614.11(0.000)**
Under identification test		**123.18(0.000)**	**1203.38(0.000)**		**123.18(0.000)**	**1203.38(0.000)**
Weak identification test (Cragg-Donald Wald F statistic)		**141.131**	**143.101**		**141.131**	**143.101**
Stock-Yogo weak ID test critical values: 10% maximal IV size		**119.93**	**119.93**		**119.93**	**119.93**
Hansen J statistic (over identification test of all instruments)		**56.41 (0.054)**	**61.81 (0.043)**		**56.41 (0.054)**	**61.81 (0.043)**

Robust standard errors adjusted for heteroscedasticity are in brackets. ***p<0.01, **p<0.05, *p<0.1
Source: Author's computations (2020)

Robustness Checks

In the section of the study, two additional robustness estimations were used to serve as checks on the results already discussed mainly on two grounds. The first reason is that from experience there is a potential that by simply changing the way innovation and business environment are calibrated, their measured impacts on firms' efficiency might substantially be different. Given these circumstances, it may well be that the effect of innovation and business environment on efficiency become sensitive to measurement and conceptualization issues. Secondly, there might be a potential issue of selection biases in a firm's decision to innovate or operate in certain kinds of business environments. Thus, to address the former concern, the study now measured innovation in the form of a dummy with values 1 if the firm innovates and 0 otherwise.

Accordingly in tables 20,21and 22, business environment is then measured as a categorical variable and characterized in the form of no obstacle, minor obstacle, moderate obstacle, major obstacle and severe obstacle in order of increasing severity. To address the issue of self-selectivity into innovation, the study employs the endogenous switching regression (ESR) technique. Innovation and business environment were then interacted to determine whether or not the effect of innovation on efficiency varies across different aspects of the business environment as well as firm specific characteristics. Fundamentally, these checks are important to be able to take care of any unobserved heterogeneity that could be found among the sampled firms. The regression estimates for these additional robustness checks are presented in Tables 20, 21 and 22. From these checks, two key issues emerged: First, across all indicators and estimation, the positive effect of innovation and business environment is significantly substantial. Secondly, although innovation and business environment individual positively influence firm's efficiency but their combined (joint) effect is greatest.

Table 20: Effect of business environment and innovation on firm efficiency (Overall Africa)

Variable	OLS	Standard IV	Lewbel 2SLS
Innovative firms (ref=un-innovative)	0.239**	0.639**	0.562**
	(0.0032)	(0.0032)	(0.0034)
Favourable Business environment (ref=unfavorable)	0.107**	0.109***	0.118***
	(0.00036)	(0.0014)	(0.0014)
Innovative firms in a favorable business environment	0.285**	0.682***	0.619***
	(0.0205)	(0.0003)	(0.0003)
Innovative firms in Minor obstacle business environment	-0.0098	-0.096**	-0.0711**
	(0.0319)	(0.019)	(0.0066)
Innovative firms in Moderate obstacle business environment	-0.0028	- 0.115**	- 0.151***
	(0.0305)	(0.0761)	(0.0058)
Innovative firms in Major obstacle business environment	-0.0116	-0.343**	-0.311***
	(0.009)	(0.161)	(0.0055)
Innovative firms in Very severe obstacle business environment	-0.096***	-0.412***	-0.486***
	(0.0301)	(0.0764)	(0.0055)
Firm age	0.0058**	0.0291	0.0586**
	(0.0162)	(0.0159)	(0.0016)
Firm age squared	-0.061**	-0.1061**	-0.0116**
	(0.0016)	(0.0106)	(0.0016)
Small firms	-0.022**	0.04125	0.0249
	(0.0033)	(0.0257)	(0.0352)
Medium firms	-0.0017	0.0229**	0.0119**
	(0.0031)	(0.0203)	(0.0036)
Larger firms	0.0280**	0.0229**	0.0285**
	(0.00395)	(0.0223)	(0.0039)
Manager's experience	-0.092**	-0.0148**	-0.0921**
	(0.0052)	(0.0011)	(0.0025)
Manager experience squared	0.0016**	0.0006**	0.006**
	(0.006)	(0.005)	(0.006)
Female top manager	0.0459*	0.0185**	0.0047**

	(0.0027)	(0.001)	(0.0027)
Power outages	-0.0270**	0.0051**	0.0025**
	(0.005)	(0.0001)	(0.005)
Owner female	0.0170**	-0.08699	0.0174**
	(0.00636)	(0.085)	(0.0063)
Access to Finance	0.0067**	0.0095**	0.0679**
	(0.00192)	(0.0101)	(0.0019)
Located in capital city	-0.025**	-0.0015	-0.02584
	(0.0028)	(0.0202)	(0.0029)
Located in business city	0.0387**	0.0190*	0.0399**
	(0.0025)	(0.0203)	(0.0027)
Access to foreign Market	0.0190**	0.0575**	0.0191**
	(0.0014)	(0.013)	(0.0016)
Foreign owner	0.0405**	-0.00015	0.0041**
	(0.017)	(0.0002)	(0.005)
foreign technology	0.0321**	0.124**	0.2150**
	(0.003)	(0.0509)	(0.2105)
First Stage			
Customs delays in clearance		-0.302***	-0.355***
		(0.030)	(0.020)
Time spent on gov't regulation		-0.150**	-0.145**
		(0.002)	(0.005)
R&D		0.1207**	0.3364**
		(0.0675)	(0.0047)
N	**9,013**	**9013**	**9013**
R-squared	**0.540**	**0.501**	**0.4912**
F-statistic	**113.11**	**106.12**	**106.11**
Hausman		**732.11(0.000)**	**332.22(0.000)**
Under identification test		**1243.18(0.000)**	**1243.38(0.000)**
Weak identification test (Cragg-Donald Wald F statistic)		**141.131**	**143.101**
Stock-Yogo weak ID test critical values: 10% maximal IV size		**119.93**	**119.93**
Hansen J statistic (over identification test of all instruments)		**46.548 (0.054)**	**46.548 (0.054)**

Column 3 represent 2SLS (Standard IV) estimates with external instrument. Column 4 represent Lewbel 2SLS results that combine internal and external instruments. Robust standard errors adjusted for heteroscedasticity in brackets. ***p<0.01, **p<0.05, *p<0.1

Source: Author's computations (2020)

Table 23 also presents result of an additional robustness check (first part of the switching regression) on factors which push firms to engage in innovations. As shown in the table, it is evident that research and development, business environment, access to finance, firm size and age, firm location and manager's experience that are crucial in firm exposure to innovation in the industry. For instance from the results, firms that are into research and development and firms which have access to finance are more likely to engage in innovation than firms that are finance constrained (Wellalage et al., 2019b). Again in the results evidence is led to show that larger firms have a higher propensity to engage in innovation than the smaller firms. This is consistent with the findings of (Nguyen, 2019) that increase in firm size engenders innovations. Besides, it is demonstrated that firms located in the business cities are more prone to innovation than their counter parts located outside business cities.in conformity with extant literature (Boudreaux et al., 2018) which argue that distance from state capitals moderates the adverse effect of innovation on firm growth. Again the estimates show that less experienced managers are also more likely to engage in innovative practices compared with their experienced managers, top female managers are also less likely than males to engage in innovation whilst additional year of the firm increases the likelihood of the firm engaging in innovation (Wellalage et al., 2019b).

In tables 20, 21 and 22, relevant preliminary tests are performed as required in an instrumental variable estimation process. The Hausman tests that there is no endogeneity is rejected at less than one percent implying that instrumental variable technique is the appropriate estimation method to be employed, The under-identification and over-identification tests for the validity of instrument and exclusion of other instruments indicated that our instruments-customs delays, time spent on government regulation and R&D are valid and appropriate for the analysis.

In this analysis, the business environment variable is broken down into categories from minor obstacle business environment to severe obstacle environment and interacted with innovation to determine the extent to which these interactions influence firm efficiency with firms which do not encounter no such obstacle as the reference category. The estimated efficiencies of firms which innovate are compared to those which innovate and operating in no such levels of business environmental obstacles.

The fact of the interaction between innovation and business environment having a profound on firm efficiency is corroborated when the results are considered along the different dimensions of the business environmental obstacles. Along all the various dimensions of the business environmental obstacles, it is clear that the efficiency of all innovative firms increase when compared with their peers which do not innovate.

Table 21: Interactive effects of innovation and business environment on firm efficiency (SSA)

Variable	OLS	Standard IV	Lewbel 2SLS
Innovative firms (ref=un-innovative)	0.336**	0.712**	0.5687**
	(0.037)	(0.006)	(0.064)
Favourable Business environment (ref=unfavorable)	0.269***	0.230**	0.260**
	(0.060)	(0.056)	(0.049)
Innovative firms in a favorable business environment	0.485**	0.7821***	0.6922***
	(0.051)	(0.056)	(0.003)
Innovative firms in Minor obstacle business environment	-0.0102***	-0.126***	-0.151**
	(0.0011)	(0.079)	(0.0068)
Innovative firms in Moderate obstacle business environment	-0.0019	-0.283**	-0.251**
	(0.0105)	(0.0761)	(0.0078)
Innovative firms in Major obstacle business environment	-0.0316*	-0.383**	-0.346**
	(0.0101)	(0.0761)	(0.0055)
Innovative firms in Very severe obstacle business environment	-0.009	-0.476**	-0.516**
	(0.0502)	(0.0687)	(0.0095)
Controls?	Yes	Yes	Yes
First Stage			
Customs delays in clearance		-0.302***	-0.355***
		(.030)	(.020)
Time spent on gov't regulation		-0.150**	-0.145**
		(.002)	(.005)
R&D		0.1207**	0.3364**
		(0.0675)	(0.0047)
N	**4,857**	**4,857**	**4,857**
R-squared	**0.5605**	**0.5850**	**0.4980**
F-statistic	**123.11**	**108.13**	**112.22**
Hausman		**732.11(0.000)**	**332.22(0.000)**
Under identification test		**1243.18(0.000)**	**1243.38(0.000)**
Weak identification test (Cragg-Donald Wald F statistic)		**142.133**	**141.101**
Stock-Yogo weak ID test critical values: 10% maximal IV size		**120.63**	**118.75**
Hansen J statistic (over identification test of all instruments)		**48.543 (0.052)**	**47.546 (0.051)**

Source ;Author's computations (2020)

Table 21 displays the results of the interaction between innovation and business environment defined on the scale of minor obstacle to severe obstacle in Sub Saharan Africa. The results show that firms which innovate but operating in a minor obstacle business environment experience about 15% drop in their efficiency levels compared to the counterparts which do encounter no obstacles. Similarly when the business environment within which an innovative firm is operating presents as a moderate obstacle, then the efficiency of firm declines by about 25% when related to contemporaries which do not experience any such obstacle. From the results, innovative firms operating in a major obstacle business environment experience an efficiency decline of about 35% when compared with peers which do not encounter such a disenabling business environment.

Finally for innovative firms which have to operate in a very severe obstacle environment, the decline in their efficiency when compared their peer operating without such an obstacle is as much about 50% .

Table 22: Interactive effects of innovation and business environment on firm efficiency (Maghreb Africa)

Variable	OLS	Standard IV	Lewbel 2SLS
Innovative firms (ref=un-innovative)	0.302**	0.587**	0.461**
	(0.0027)	(0.0061)	(0.0053)
Favourable Business environment (ref=unfavorable)	0.194**	0.143**	0.118**
	(0.0018)	(0.0014)	(0.0014)
Innovative firms in a favorable business environment	0.389**	0.624***	0.598***
	(0.0061)	(0.085)	(0.0052)
Innovative firms in Minor obstacle business environment	-0.025**	-0.205***	-0.188***
	(0.012)	(0.0492)	(0.0091)
Innovative firms in Moderate obstacle business environment	-0.220*	-0.269***	-0.278**
	(0.0125)	(0.0544)	(0.0458)
Innovative firms in Major obstacle business environment	-0.213*	-0.398**	-0.414**
	(0.0107)	(0.0161)	(0.0251)
Innovative firms in Very severe obstacle business environment	-0.0184	-0.606**	-0.595***
	(0.0488)	(0.0732)	(0.0187)
Controls?	Yes	Yes	Yes
First Stage			
Customs delays in clearance		-0.302***	-0.355***
		(.030)	(.020)
Time spent on gov't regulation		-0.150**	-0.145**
		(.002)	(.005)
R&D		0.1207**	0.3364**
		(0.0675)	(0.0047)
N	**4,162**	**4,162**	**4,162**
R-squared	**0.5530**	**0.5820**	**0.4526**
F-statistic	**122.14**	**110.20**	**112.22**
Hausman		**738.16(0.000)**	**387.26(0.000)**
Under identification test		**1240.20(0.000)**	**1240.20(0.000)**
Weak identification test (Cragg-Donald Wald F statistic)		**141.123**	**142.133**
Stock-Yogo weak ID test critical values: 10% maximal IV size		**121.24**	**119.65**
Hansen J statistic (over identification test of all instruments)		**49.346 (0.052)**	**47.982 (0.051)**

Source ; Author's computations (2020)

The results for the Maghreb Africa region appear to follow the same pattern as was found in the Overall Africa and the SSA estimates, the severer the business environmental obstacle, the deeper the decline in the efficiency level of the firm. From the results, it can be seen that innovative firms which operate in a minor obstacle business have to contend with close to about 20% decline in their efficiency compared with their contemporaries whilst innovative firms operating in a moderate obstacle business environment record a dip in their efficiency levels up to about 26% when related to their peers which encounter no such business environmental obstacle. Again when the business environment presents as a major obstacle to firms which innovate, they experience as much as 40% reduction in efficiency compared to their peers which contend with no such business environmental obstacle.

Finally, with a very severe business environment obstacle facing them, innovative firms experience 59% decline in efficiency.

All in all it is very clear that business environment complements innovation by firm in influencing the effects on firm efficiency.

Table 23 displays the results of the first part of the switching regression usually referred to as the decision equation. From the estimated equation, the key result of note here is the fact that research and development (R&D) and business environment both tend to increase the likelihood of a firm engaging in innovation., From the results when firms employ R&D, it increases the likelihood of engaging in innovation by close to 50% compared to firms which do not engage in R&D.

Table 23: Probability of Engaging in Innovation-first part of the switching model (Overall Africa)

Variables	Innovation
RD	0.482***
	(0.0424)
Business environment	0.215***
	(0.0026)
Firm age	0.0779
	(0.0011)
Firm age squared	0.0077**
	(0.0011)
Manager's experience	-0.0039
	(0.0047)
Experience squared	-0.005
	(0.0005)
Female top manager	0.0496
	(0.0500)
power outages	-0.0029***
	(0.001)
Small firms	0.209***
	(0.0531)
Medium firms	0.168***
	(0.0531)
Larger firms	0.271***
	(0.0218)
owner female	0.319***
	(0.0377)
Access to Finance	0.0128
	(0.0570)
Located in capital city	0.116**
	(0.0549)
Located in Business city	-0.163***
	(0.0275)
Access to Foreign market	0.0554
	(0.0533)
Foreign owner	-0.279
	(0.212)
Constant	-1.203***
	(0.0588)
N	9,019

Reference group for firm size is micro enterprises. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source ;Author's computations (2020)

In Table 24, the ESR results on the interactive effect of innovation and business environment on firm efficiency are shown .The coefficients of rho_1 and rho_2 are all negative and statistically significant implying that there is an inverse correlation between innovation constraints and firm efficiency. It also means that estimating the model by pooling the firms which are innovation constrained and unconstrained respectively may yield misleading and unreliable results.

The results underscore the hypothesis that innovation and business environment when interacted promote firm efficiency. For instance, favourable business environment enhances firm efficiency by 21 percent given that the firm innovates. However, if the firm does not innovate, favourable business environment increases efficiency by less than four percent. Moreover, firms which are innovative and also have access to finance, are able to efficiency by 18.6 percent while for non-innovating firms with access to finance, their efficiency increases by 4.7 percent and the magnitude of 13.9 percentage points in favour of innovative firms is statistically significant indicating the advantage of innovation on firm operations. By implication innovation enhances firm efficiency. Consistent with extant literature, we find that increased firm's innovativeness promotes their efficiency (see Asiedu & Freeman, 2009a; del Mar Salinas-Jiménez & Salinas-Jiménez, 2011; Gan & Xu, 2019; Goedhuys et al., 2016; Mahagaonkar, 2008, 2010, 2010; Michailova *et al.*, 2013; Salinas-Jimenez & Salinas-Jimenez, 2006)

Table 24: ESR Results on the impact of interaction between innovation and business environment on Firm efficiency (Overall Africa)

Variables	Innovation	No innovation
Business environment	0.213***	0.003***
	(0.000271)	(0.00067)
Access to Finance	0.186***	0.0474***
	(0.00525)	(0.00375)
Firm age	0.0431***	0.0204***
	(0.0001)	(7.85e-05)
Firm age squared	0.1431***	0.1210***
	(0.0011)	(0.0005)
Manager's experience	-0.0490	-0.0561*
	(0.00447)	(0.0002)
Experience squared	0.0721	0.0170**
	(9.37e-06)	(5.89e-06)
Female top manager	0.0661**	0.0264**
	(0.00472)	(0.0034)
power outages	-0.00189*	-0.0211***
	(0.0005)	(0.015)
Small firms	0.149***	-0.0463***
	(0.0531)	(0.00489)
Medium firms	0.168***	-0.0306***
	(0.0532)	(0.00534)
Larger firms	0.192***	-0.00399
	(0.0533)	(0.00599)
owner female	-0.0572*	0.011
	(0.00342)	(0.00281)
Located in capital city	0.0568***	0.0339***
	(0.00507)	(0.00356)
Located in Business city	-0.0104***	-0.0168***
	(0.00247)	(0.00185)
Access to Foreign market	0.1318***	0.046***
	(4.93e-05)	(3.52e-05)
Foreign owner	0.0441	0.0232*
	(0.0227)	(0.0140)
Foreign technology	0.2041	0.2320*
	(0.0227)	(0.0111)
Constant	0.320***	0.297***
	(0.00704)	(0.00383)
Rho 1	-0.106**	
	(0.0427)	
Rho 2		-0.561***
		(0.0748)
N	**9,019**	**9,019**

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source ;Author's computations (2020)

From the regression results, clearly for each specific variable, firms which innovate are demonstrated to be more efficient than those which are not and this is definitely in consonance with intuition and what has been reported by most researchers. This therefore reinforces earlier results that innovation promotes firm performance in Africa. In the results, it is also observed that the efficiency of firms which are medium given that innovates increases by 17% but the efficiency of firms of the same size decreases by 3% given that they do not innovate. There are similar results for small and larger firms with the level of efficiency of larger firms which innovate increasing by 19% compared with the fact larger firms which do not innovate do not experience any significant increase or decrease in their efficiency. The results broadly demonstrate that for every variable firms which innovate are able to achieve higher efficiency levels than those which do not innovate.

In Tables 25 and 26, the sub-regional results have been presented to help analyze and compare the situations in the two sub regions of Africa.

Table 25: Sub-regional ESR Results (Interaction between business environment and Innovation)-Second part of the Switching Regression

	SSA		Maghreb	
Variable	No Innovation	Innovation	No Innovation	Innovation
Business environment	0.170	0.293**	0.021**	0.061***
	(0.207)	(0.074)	(0.000)	(0.000)
Access to Finance	0.109***	0.212***	0.010	0.064*
	(0.049)	(0.023)	(0.105)	(0.035)
Firm age	0.020**	0.208***	0.139***	0.182***
	(0.001)	(0.002)	(0.049)	(0.023)
Firm age squared	0.182	0.292***	0.058***	0.113***
	(0.003)	(0.002)	(0.156)	(0.077)
Manager's experience	-0.027**	0.014***	0.013***	0.043**
	(0.115)	(0.016)	(0.005)	(0.002)
Experience squared	-0.010**	0.111***	0.024	0.058***
	(0.001)	(0.002)	(0.019)	(0.008)
Female top manager	-0.047**	0.168**	0.000	0.001***
	(0.182)	(0.093)	(0.001)	(0.002)
power outages	-0.196*	-0.048***	-0.047	-0.168*
	(0.167)	(0.080)	(0.182)	(0.093)
Small firms	-0.002*	0.022**	-0.296*	0.018***

Variable	SSA No Innovation	SSA Innovation	Maghreb No Innovation	Maghreb Innovation
	(0.001)	(0.001)	(0.067)	(0.080)
Medium firms	-0.103**	0.394***	0.102*	0.202**
	(0.004)	(0.060)	(0.001)	(0.001)
Larger firms	0.016***	0.319***	-0.120	0.024***
	(0.003)	(0.001)	(0.004)	(0.160)
owner female	0.166**	0.184*	0.016***	0.019***
	(0.182)	(0.100)	(0.003)	(0.001)
Located in capital city	0.034	0.036**	0.266**	0.284*
	(0.036)	(0.016)	(0.182)	(0.100)
Located in Business city	0.023*	0.135***	0.0347	0.213***
	(0.013)	(0.005)	(0.004)	(0.043)
Access to Foreign market	0.028***	0.098***	0.080***	0.155***
	(0.008)	(0.017)	(0.001)	(0.005)
Foreign owner	0.021	0.101***	0.046	0.021**
	(0.001)	(0.000)	(0.041)	(0.017)
Foreign technology	0.009	0.105	0.042	0.069**
	(0.000)	(0.004)	(0.003)	(0.045)
Constant	0.056	0.112**	0.010	0.032***
	(0.0531)	(0.021)	(0.000)	(0.001)
Rho _1	-0.101**		-0.089**	
	(0.002)		(0.001)	
Rho_ 2		-0.214***		-0.204***
		(0.002)		(0.007)
N	**4857**	**4857**	**4162**	**4162**

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source : Author's computations (2020)

Table 25 shows the outcome equations of the region specific switching regression. Again the Rho_ 1 and Rho_ 2 which show the relationship between the innovation constraints and efficiency in each region are measured to be negative implying that when firms experience innovation constraints, it generally leads to a decline in the efficiency of firms in both SSA and Maghreb Africa.

In the results shown in table 25, in SSA, when firms innovate and encounter improving business environment, their efficiency increases by close to 30% whereas the efficiency of the firm increases by about 17% given that operates in an improving business environment but does not innovate,

Similarly for firms which have access to finance and innovate , their efficiency increases by about 21% as opposed to about 11% increase in efficiency of firms with access to finance but not innovating. Generally there is evidence from the results that for all variables, firms which innovate experience higher efficiency levels when compared with their peers which do not innovate.

With regard to Maghreb Africa, the results obtained are consistent with that in SSA. Thus for firms which innovate but operating in a improving business environment, their efficiency levels increase by just over 6% compared with their peers which do not engage in any kind of innovation who record an increase in efficiency of 2%,.In the same vein, firms with access to finance experience a 6% increase in efficiency levels whereas firms with the same access to finance but do not engage in innovation record 1% increase in efficiency. Again across all variables the results provide evidence that innovation promotes higher firm efficiency, In sum, it can be said that though there appears to be some consistency between the results of the two sub-regions, the results also show that across most of the variables , firms in SSA perform better .

Table 26: First part of the Switching regression for SSA and Maghreb

Explanatory Variables	SSA	Maghreb
RD	0.256***	0.059**
	(0.026)	(0.024)
Business environment	0.034***	0.021***
	(0.009)	(0.008)
Firm age	0.007	0.334***
	(0.030)	(0.000)
Firm age squared	-0.001**	-0.129***
	(0.001)	(0.027)
Manager's experience	0.016***	0.013***
	(0.003)	(0.001)
Experience squared	-0.010***	-0.051***
	(0.005)	(0.003)
Female top manager	-0.065*	0.003
	(0.035)	(0.003)
power outages	-0.098***	-0.005
	(0.030)	(0.006)
Small firms	0.001***	-0.027
	(0.000)	(0.031)
Medium firms	0.051	0.042
	(0.063)	(0.056)
Larger firms	0.002***	0.139***
	(0.000)	(0.033)
owner female	0.108***	0.108***
	(0.035)	(0.027)
Access to Finance	0.203*	0.121***
	(0.002)	(0.025)
Located in capital city	0.102***	0.018***
	(0.000)	(0.006)
Located in Business city	0.099***	0.043
	(0.055)	(0.088)
Access to Foreign market	0.059**	0.027***
	(0.024)	(0.020)
Foreign owner	0.121***	0.093***
	(0.008)	(0.005)
Constant	0.129***	0.245**
	(0.027)	(0.006)
N	**4857**	**4162**

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source ;Author's computations (2020)

Table 26 lays out the decision equations of the ESR for both SSA and Maghreb Africa and it again shows that R&D increases the likelihood of firm innovation in both SSA and Maghreb Africa. Whereas R&D increases the likelihood of innovation in the SSA by over 25%, it triggers only about 6% increased likelihood of innovation by firms in Maghreb Africa. The positive effect of the business environment on the likelihood of firm innovating is also demonstrated in both sub-regions of Africa; a unit increase in business environment increases the odds of firm innovation by 3% and 1% respectively in SSA and the Maghreb Africa. Also when firms have access to finance it increases the odds of them innovating by 20% in SSA and 12% though at 10% and 1% significance level.

For the firm age variable, it induces an increased likelihood of firm innovation in the Maghreb by about 33% but does not significantly affect the likelihood of firm innovation in SSA.

Again power outages from the decision equation has a more profound negative effect on the likelihood of firm innovation in SSA than in Maghreb as the results indicate that unit increase in power outages triggers close to 10% decline in the odds of firm innovating at 1% significance level whilst it does not significantly influence the likelihood of firm innovation in Maghreb Africa.

Chapter Summary

This chapter basically focused on and analyzed extent to which business environment and innovation influence the technical efficiency of firms from a number of perspectives- in the analysis, the individual effects of business environment and innovation on firm efficiency, the interactive effects as well as the effect of innovation in different dimensions of business environment and the conditional effects of innovation on firm efficiency in Africa were considered. The main hypotheses tested related to whether there is a significant positive relationship between business environment and innovation and firm efficiency respectively. Using the Standard IV, Lewbel 2SLS, endogenous switching regression (ESR) and OLS estimation techniques, it was established that the null hypotheses that innovation and business environment do not significantly influence firm's technical efficiency should be rejected. Similarly, the study finds supportive evidence that the firm's age, size, location, access to foreign market and technology are important in explaining variations in firm's technical efficiency. Other important findings reported in the study include the strong and positive relationship between firm's access to finance and efficiency. The study also observed that, although, innovation and business environment independently and significantly contribute to firm's efficiency, their combined effect on efficiency is greatest lending credence to the view that strong complementarity between innovation and favourable business environment is important for optimizing the advantages of favourable business environment and innovation.

CHAPTER SEVEN

FIRM EFFICIENCY AND ITS EFFECTS ON FINANCIAL AND NON-FINANCIAL PERFORMANCE INDICATORS

Introduction

In the last two chapters of the study, the attention was focused on examining the performance of the firms in Africa from a very panoramic view of efficiency and investigating the effects of firm specific characteristics on efficiency. In addition, it analyzed and discussed the nexus between business environment and innovation from various dimensions as well as their separate and interactive effects on firm efficiency. In this chapter however, the concentration of the analysis is on specific aspects of performance of firms in Africa. Thus the chapter's main preoccupation is to examine the effect of efficiency on firm performance indicators – Sales revenue, capacity utilization and exports employing the OLS, standard IV, Lewbel 2SLS regression estimation techniques. In the analysis therefore the most important objective is to test whether efficiency significantly influences these specific aspects of firm performance mentioned above.

In the latter sections of the chapter, the researcher seeks to identify the relative importance of efficiency and other control variables with respect to capacity utilization, sales revenue and exports using dominance analysis and propensity score matching (PSM) to enhance and reinforce or as robustness check on the results obtained earlier in the chapter.

Table 27: Summary statistics of the variables

Variable	Obs	Mean	Std. Dev.	Min	Max
TE	9,019	0.39875	0.053441	0.119896	0.628598
Sales	9,018	4.55e+09	1.47e+11	0	1.20e+13
Investment	9,019	5.44e+08	8.83e+09	0	8.00e+1
exports	9,019	10.47422	26.92034	-18	100
TE	9,019	0.467975	0.053441	0.119896	0.628598
BE	9,019	3.47E-10	1.000002	-1.24424	1.872064
Inov	9,019	3.69e-09	1.000002	-.624550	1.600985
firm_age	9,019	23.72957	14.55146	5	150
manager_ex~r	9,019	17.98924	11.05984	1	90
manager2	9,019	445.9195	525.3083	1	8100
female_top~g	9,019	0.110323	0.313309	0	1
poweroutages	9,019	23.44871	17.16691	0	365
firm_size	9,019	1.526555	0.818964	0	3
ownerfemale	9,019	0.004879	0.06968	0	1
finance	9,019	1.526555	0.818964	0	3
capital_city	9,019	0.318882	0.466069	0	1
busi_city	9,019	0.405921	0.491097	0	1
market	9,019	0.491851	0.620503	0	2
Foreign owner	9,019	10.64966	28.90305	0	100
capacity ut.	9,019	64.49975	17.72708	0	100
Sales Rev.	9,019	4.55e+09	1.47e+11	0	1.20e+13
exports	9,019	10.47422	26.92034	-18	100

Source: Author's computations (2020)

Gleaning the summary statistics in Table 27, it could be inferred that on the whole sales revenues are quite high which could be interpreted to mean that firms are spending a lot and so may not be making the margins that they probably desire. In other words, returns on the investments of firms may not as appreciable as they probably would want.

The average capacity utilization of firms across Africa is close to 65% which means that on the whole firms are unable to utilize up to 35%, more than a third of their installed capacity. This also implies that a lot needs to be done to address problems of firms in order to get them to increase their capacity utilization.

Even though firm age ranges from 5 to 150 years in the study sample, the average age of the firms in the sample is about 24 years .This means that most firms have been around for quite some time.

Also the average of firm size which is computed to be about 1.52 is an indication that most of the firms in Africa are medium sized. Again the average of the access to finance at 1.52 highlight the fact that firms' access to finance and credit lines

The effect of efficiency on Capacity utilization, Revenues and Exports of Firms in Africa

In this section, OLS, Standard IV and the Lewbel 2SLS techniques are employed to consider and discuss the effect of efficiency on Capacity Utilization, Revenues and exports of firms in Africa. To get a good picture of the situation, the study examines the overall Africa picture and then follows up with the sub-regional analysis.

In the regressions, the Standard IV and Lewbel 2SLS are employed in addition to the OLS in order to deal with the potential problems of endogeneity and hence avoid the possibility of the compromise of the estimated equations.

In all the estimated equations, the model diagnostics are good and the various tests- under-identification, Wald, Stock-Yogo and Hansen J tests are passed.

In tables 28, 29 and 30, the rejection of the null hypothesis in the test for under-identification implies that the instruments induce changes in the endogenous variables- capacity utilization, sales revenue and exports. Similarly the over-identification test shows that excluded instruments are correctly excluded from the models.

Even though the results for all the three techniques satisfy the model diagnostics and are reliable, the Lewbel 2SLS and the Standard IV estimates are more preferred in that order for interpretation because they make use of instruments, which guarantee that the possibility of biased results on account of endogeneity is reduced or even eliminated. The reason for preference of the Lewbel 2SLS is that it makes use both external and internal instrument as opposed to the Standard IV which accommodates only an external instrument

Table 28 shows the estimated equations for entire Africa in respect of capacity utilization, revenues and exports whilst in tables 29 and 30 the results for the two sub regions SSA and Maghreb are reported,

Considering the estimated equation for capacity utilization, the measured impact of the main variable –efficiency is significant at less than 1% probability level which implies that generally in Africa firms, a unit increase in firm efficiency leads to about 2.2% increase in capacity utilization. The margins of increase in SSA and Maghreb are also positive at 2.0% and 0.2% respectively in response to the same marginal increase in efficiency. These findings imply that the impact of efficiency on capacity utilization in SSA is greater than in Maghreb. Generally the finding that efficiency positively impacts on capacity utilization of firms in Africa diverges from Ahiakpor, Asmah and Andoh (2014) who discovered that labour productivity negatively influences capacity utilization in Ghanaian firms.

The effect of age of firm is significantly positive across Africa as a whole as well as the sub regions-SSA and Maghreb though the positive effect is much higher in SSA than in both the Maghreb and entire Africa. Generally the positive effect of firm age on capacity utilization is plausible because as firms grow in age, they may accumulate the necessary expertise and the competencies which empower them to achieve higher and higher outputs, closer to the maximum potentials of the firm.

In SSA however, all the different sized firms are able to utilize higher capacities relative to micro firms.

In looking at firm performance, one critical factor which is often discussed in the literature is the regularity of power supply. The estimated equations in tables 28, 29 and 30 provide evidence of the effect of power outages on the performance of firms in Africa. In the overall Africa equation, a unit increase in power outages causes about 20% decline in capacity utilization of firms at 5% significance level. The effects of power outages on capacity utilization as measured in the sub-regional analysis are similar to the pattern in the overall Africa analysis though the effect of the power outages on capacity utilization in Maghreb is more profound than in SSA at 5% level of significance. In other words, our analysis shows that power outages cause a greater decline in capacity utilization of firms in Maghreb than in SSA.

Access to finance from the estimated results has a positive effect on capacity utilization by firms in Africa implying that increased access to finance triggers an expanded utilization of installed capacity of firms in Africa. From the regression results, a 100% increased access to finance by a firm enhances their capacity utilization by about 23% as opposed to those which do not have access to market. Although at the sub-regional level, the effect of access to finance is also positive, its positive effect appears greater in Maghreb than in SSA with a 100% increase in access to finance leading to over 18% and less than 2% upswing in capacity utilization in the Maghreb and SSA areas respectively.

Table 28: Effect of efficiency on capacity utilization, sales revenue and exports of firms in Africa

	Capacity Utilization			Rvenues			Exports		
Variable	OLS	Standard IV	Lewbel 2SLS	OLS	Standard IV	Lewbel 2SLS	OLS	Standard IV	Lewbel 2SLS
Efficiency	0.282**	0.234***	0.220***	0.337***	0.331***	0.312***	0.289***	0.282***	0.324**
	(0.022)	(0.177)	(0.012)	(0.122)	(0.1200)	(0.0862)	(0.020)	(0.022)	(0.010)
firm age	0.0351**	0.019**	0.0356***	-0.019**	-0.0085	0.0250**	0.025***	-0.178***	-0.098***
	(0.0003)	(0.0089)	(0.0003)	(0.0089)	0.00089	(0.00703)	(0.00703)	(0.048)	(0.017)
Firm age squared	-0.0222*	0.071**	-0.0222*	0.0071**	0.017***	-0.0133*	-0.0141*	-0.012	0.250***
	(0.0015)	(0.0006)	(0.0015)	(0.0006)	(0.006)	(0.005)	(0.005)	(0.001)	(0.000)
Small firms	-1.121***	0.04396	-1.121***	0.04396	0.044**	-0.107**	-0.117**	-0.011**	-0.003
	(0.162)	0.0268	(0.162)	0.0268	(0.0268)	(0.162)	(0.162)	(0.005)	(0.002)
Medium firms	-0.2011**	0.086**	-0.2011**	0.0887*	0.086***	0.153***	0.161***	0.001	0.005
	(0.001)	(0.0275)	(0.001)	(0.0475)	(0.028)	(0.167)	(0.016)	(0.000)	(0.004)
Large firms	0.324***	0.1305**	0.324***	0.140**	0.131***	0.116***	0.114***	0.056	-0.005
	(0.0401)	(0.029)	(0.0401)	(0.029)	(0.019)	(0.008)	(0.008)	(0.053)	(0.021)
Manager's experience	0.322***	0.019	0.322***	0.019	0.0199**	0.035***	0.042***	0.001**	0.002***
	(0.0111)	(0.0013)	(0.0111)	(0.0013)	(0.0013)	(0.0131)	(0.0111)	(0.000)	(0.000)
Manager's exp. squared	0.4305	0.205**	0.432***	0.205**	0.211***	0.0023**	0.0025**	0.110	0.064*
	(0.0002)	(0.005)	(0.0002)	(0.005)	(0.005)	(0.009)	(0.006)	(0.105)	(0.035)
Female top manager	0.333	-0.00708	0.333	-0.00708	-0.0072	0.149	0.144	-0.000	-0.001**
	(0.183)	0.0129	(0.183)	(0.0109)	(0.0129)	(0.118)	(0.159)	(0.001)	(0.000)
power outages	-0.211***	-0.17**	-0.212***	-0.171**	-0.27***	-0.30***	-0.310**	0.025	-0.199***
	(0.000)	(0.0002)	(0.006)	(0.0002)	(0.0002)	(0.00257)	(0.0207)	(0.051)	(0.022)
owner female	0.425**	-0.1307	0.425**	-0.140	-0.139	0.626**	0.626**	0.064	0.059***
	(0.0812)	(0.0748)	(0.0812)	(0.198)	(0.748)	(0.278)	(0.278)	(0.0474)	(0.018)
Access to finance	0.213***	-0.03096	0.228***	-0.03096	-0.03096	0.238***	0.248***	0.0257	0.154***
	(0.0824)	(0.0101)	(0.0824)	(0.0301)	0.0401	(0.0824)	(0.0824)	(0.115)	(0.016)
capital city	0.284***	-0.00464	0.2841***	0.0469	-0.00464	-1.08***	-1.09***	21.59***	21.79***

	(0.124)	(0.0166)	(0.124)	0.0166	0.0166	(0.124)	(0.124)	(0.130)	(0.025)
Business city	1.689***	-0.011**	1.689***	-0.011**	-0.011***	1.689***	1.679***	1.732***	1.726***
	(0.113)	(0.0159)	(0.113)	(0.0159)	(0.0159)	(0.122)	(0.113)	(0.116)	(0.103)
Access to Market	0.324***	0.0242**	0.465***	0.0242**	0.0442**	0.925**	0.624**	0.614**	0.518***
	(0.0615)	(0.0072)	(0.0625)	(0.0072)	(0.0052)	(0.067)	(0.062)	(0.0611)	(0.0611)
foreign owner	0.218***	-0.00026	0.318***	-0.00026	-0.00026	0.218***	0.217***	0.120**	0.179***
	(0.0012)	(0.0001)	(0.0015)	(0.0001)	(0.0015)	(0.00123)	(0.00125)	(0.0012)	(0.0012)
Access to foreign Tech.	0.1162***	0.1226	0.2132***	0.1226	0.026**	0.178***	0.277***	0.195**	0.289**
	(0.002)	0.0015	(0.002)	(0.0015)	(0.0001)	(0.002)	(0.001)	(0.001)	(0.012)
Constant	1.030***	3.076***	1.075***	4.078***	4.062***	1.052***	1.04***	17.12***	17.45***
	(0.124)	(0.0296)	(0.152)	(0.0296)	(0.0296)	(0.122)	(0.129)	(0.194)	(0.164)
N	**9,013**	**9013**	**9,013**	**9013**	**9013**	**9,013**	**9,013**	**9013**	**9013**
R-squared	**0.432**	**0.501**	**0.432**	**0.501**	**0.4912**	**0.432**	**0.432**	**0.531**	**0.4933**
F-statistic	**143.33**	**106.43**	**143.33**	**106.43**	**106.11**	**143.33**	**143.33**	**106.43**	**106.10**
Hausman		**831.43**		**831.43**	**332.11**			**831.43**	**332.00**
		(0.000)		**(0.000)**	**(0.000)**			**(0.000)**	**(0.000)**
Under identification test		**1241.22**		**1241.22**	**1242.30**			**1241.22**	**1242.33**
		(0.000)		**(0.000)**	**(0.000)**			**(0.000)**	**(0.000)**
Weak identification test (Cragg-Donald Wald F statistic)		**141.131**		**141.131**	**143.101**			**141.131**	**143.22**
Stock-Yogo weak ID test critical values: 10% maximal IV size		**119.93**		**119.93**	**119.93**			**119.93**	**119.96**
Hansen J statistic (over identification test of all instruments)		**46.548** (0.054)		**46.548** (0.054)	**46.548** (0.053)			**46.548** (0.054)	**46.581** (0.051)

Source: Author's computations (2020)

The regression results also show that access to market contributes significantly to increased capacity utilization of firms in Africa. At the continental level, the regression results show that firms which have access to markets are able to increase their capacity utilization by about 47% compared to their counterparts which do not have such access. The effect of access to market on capacity utilization in SSA from the estimated results for firms which have that opportunity relative those which do not is higher that estimated for the Maghreb area. Whereas in SSA, a 1% increase in access to market precipitates about 2.5% increase in capacity utilization, in Maghreb, the increase is just around 1.2% at 1% significance level.

Again, at the aggregate level in Africa, foreign ownership and the acquisition of foreign both positively impact on the capacity utilization of firms. The regression result shows firms which have foreign ownership are able to increase their capacity utilization about 0.318 units compared with firms which do not have any foreign ownership. Again the use of foreign technology triggers about 21% increase in the firm's capacity utilization relative to the firms which do not make use of foreign technology. It is plausible that foreign owners are better able to mobilize and coordinate the utilization of resources in the line of production. By the same token the availability of foreign technology to firms generally in Africa increases their capacity utilization understandably so because the application of foreign technology allows firms to be much more able to galvanize productive resources within to pursue productive activities more rapidly and thus become more productive.

Table 29: Effect of efficiency on capacity utilization, sales revenue and exports of firms in SSA

Dependent variable:	Capacity Utilization			Rvenues			Exports		
	OLS	Standard IV	Lewbel 2SLS	OLS	Standard IV	Lewbel 2SLS	OLS	Standard IV	Lewbel 2SLS
Efficiency	0.230***	0.201***	0.204***	0.046*	0.035**	0.028**	0.103***	0.109***	0.298***
	(0.043)	(0.034)	(0.036)	(0.032)	(0.039)	(0.039)	(0.019)	(0.019)	(0.019)
firm age	1.527***	1.165***	1.163***	0.364***	0.323***	0.322***	0.306***	0.307***	0.304***
	(0.118)	(0.108)	(0.108)	(0.094)	(0.100)	(0.099)	(0.043)	(0.045)	(0.048)
Firm age squared	0.787***	0.902***	0.892***	0.136	0.176**	0.201**	0.092***	0.082**	0.092**
	(0.116)	(0.110)	(0.110)	(0.084)	(0.084)	(0.084)	(0.032)	(0.032)	(0.032)
Small firms	2.089***	2.273***	2.253***	-0.027	-0.149	-0.144	-0.597***	-0.566***	-0.567***
	(0.123)	(0.117)	(0.118)	(0.098)	(0.095)	(0.094)	(0.042)	(0.046)	(0.043)
Medium firms	0.0113***	0.004*	0.005*	0.002	0.001	0.101**	0.001***	0.006***	0.006***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.007)	(0.001)	(0.001)
Large firms	0.044***	0.0135*	0.014**	0.010**	-0.025**	-0.023**	0.007	0.010**	0.009**
	(0.0149)	(0.014)	(0.0136)	(0.009)	(0.010)	(0.001)	(0.004)	(0.005)	(0.004)
Manager’s experience	-0.001	-0.005	-0.005	0.001	0.004*	0.011**	0.021***	0.301**	0.002**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.005)	(0.005)	(0.005)
Manager’s experience squared	-0.454***	-0.493***	-0.500***	-0.101	0.021	0.018	0.093**	0.100**	0.100**
	(0.159)	(0.148)	(0.147)	(0.129)	(0.130)	(0.130)	(0.046)	(0.041)	(0.047)
Female top manager	-0.009***	-0.003**	-0.003***	-0.007**	-0.008**	-0.018**	-0.001*	-0.011**	-0.021
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)	(0.001)
power outages	-0.0220**	-0.018***	-0.018***	0.001	-0.002*	-0.021**	0.251*	-0.300**	-0.325***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
owner female	0.409***	0.312***	0.346***	0.409***	0.122**	0.126***	0.329***	0.060**	0.023**
	(0.001)	(0.093)	(0.093)	(0.001)	(0.086)	(0.086)	(0.001)	(0.034)	(0.033)
Access to finance	0.014***	0.012**	0.0117**	0.098**	0.438***	0.438***	0.078**	0.010**	0.009**
	(0.066)	(0.101)	(0.101)	(0.047)	(0.087)	(0.080)	(0.007)	(0.034)	(0.033)
capital city	-0.088**	0.429***	1.704***	0.043**	0.095**	0.260**	0.032**	0.421***	0.118**

	(0.051)	(0.001)	(0.120)	(0.050)	(0.041)	(0.118)	(0.040)	(0.031)	(0.047)
Business city	0.037**	0.097**	-2.003***	0.063**	0.123**	-0.139**	0.293***	0.097**	-0.046
	(0.045)	(0.047)	(0.115)	(0.110)	(0.004)	(0.0952)	(0.021)	(0.047)	(0.034)
Access to Market	0.119**	0.109**	0.259**	0.747**	0.687**	0.681**	0.345**	0.457**	0.612**
	(0.027)	(0.026)	(0.036)	(0.066)	(0.066)	(0.066)	(0.001)	(0.001)	(0.000)
foreign owner	0.288***	0.262***	0.462***	0.001	0.001	0.001	0.144**	0.121*	0.123*
	(0.060)	(0.0598)	(0.059)	(0.001)	(0.001)	(0.001)	(0.064)	(0.064)	(0.064)
Access to foreign Technology	0.102**	0.089*	0.084**	0.003*	0.231**	0.541**	0.032**	0.034**	0.232**
	(0.046)	(0.046)	(0.0461)	(0.007)	(0.007)	(0.007)	(0.002)	(0.001)	(0.002)
N	**4,857**	**4,857**	**4,857**	**4,857**	**4,857**	**4,857**	**4,857**	**4,857**	**4,857**
R-squared	**0.432**	**0.501**	**0.432**	**0.501**	**0.4912**	**0.432**	**0.432**	**0.531**	**0.4933**
F-statistic	**143.33**	**106.43**	**143.33**	**106.43**	**106.11**	**143.33**	**143.33**	**106.43**	**106.10**
Hausman		**831.43**		**831.43**	**332.11**			**831.43**	**332.00**
		(0.000)		**(0.000)**	**(0.000)**			**(0.000)**	**(0.000)**
Under identification test		**1241.22**		**1241.22**	**1242.30**			**1241.22**	**1242.33**
		(0.000)		**(0.000)**	**(0.000)**			**(0.000)**	**(0.000)**
Weak identification test (Cragg-Donald Wald F statistic)		**141.131**		**141.131**	**143.101**			**141.131**	**143.22**
Stock-Yogo weak ID test critical values: 10% maximal IV size		**119.93**		**119.93**	**119.93**			**119.93**	**119.96**
Hansen J statistic (over identification test of all instruments)		**46.548**		**46.548**	**46.548**			**46.548**	**46.581**
		(0.054)		**(0.054)**	**(0.053)**			**(0.054)**	**(0.051)**

Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Author's computations (2020)

The effects of foreign ownership and the use of foreign technology on capacity utilization within SSA and Maghreb are similar, i.e., they are generally positive. In both SSA and Maghreb areas of Africa, the effect of foreign ownership appears more impactful than the use of foreign technology .Whilst foreign ownership of firms in SSA leads to about 46% increase in capacity utilization, access to foreign technology is accompanied by only just around 85% increase in capacity utilization. For Maghreb, foreign ownership of firms triggers nearly 0.03% increase in capacity utilization relative to indigenously owned firms whilst access to foreign technology causes less than 5% increase in capacity utilization.

In relation to revenue, the key explanatory variable, efficiency registers an expected positive effect at the aggregate Africa and sub-regional levels. At the aggregate level, a 100 unit increase in efficiency is estimated to lead to about 33 units increase in revenue yields at one percent level of significance whilst in SSA and Maghreb, the same quantum increase in efficiency triggers about 3 and 2 units increase in revenues at 5% significance level respectively. This finding is not exactly in line with Kerimadou *et al*. (2012) who found that among Greek meat producers that efficiency does not necessarily reflect improved profitability but consistent with Ngoc Phu Tran and Duc Hong Vo (2020).

The impact of firm age on revenue yields is also largely positive at both the aggregate and sub- regional African levels. From the estimated equation for overall Africa, we observe that a 1% increase in age of firm brings about 3% increase in revenue at 1% significance level. This is inconsistent with Regasa,

Table 30 Effect of efficiency on capacity utilization, sales revenue and exports of firms in Maghreb Africa

	Capacity Utilization			Revenues			Exports		
Variable	OLS	Standard IV	Lewbel 2SLS	OLS	Standard IV	Lewbel 2SLS	OLS	Standard IV	Lewbel 2SLS
Efficiency	0.010	0.034	0.029**	0.013	0.017***	0.016**	-0.004**	0.071***	0.159**
	(0.207)	(0.036)	(0.014)	(1.271)	(0.002)	(0.006)	(0.045)	(0.021)	(0.024)
firm age	0.039***	0.023*	0.012***	0.052***	0.736***	0.135***	-0.002**	0.033***	-0.021***
	(0.049)	(0.013)	(0.023)	(0.379)	(0.149)	(0.005)	(0.015)	(0.007)	(0.008)
Firm age squared	0.858***	-0.178***	-1.113***	0.343	0.781	-0.098***	0.055	0.124***	-0.334***
	(0.156)	(0.048)	(0.077)	(1.335)	(0.487)	(0.017)	(0.041)	(0.017)	(0.000)
Small firms	-0.013***	-0.012	-0.140**	0.052	0.017	0.250***	-0.001	0.020**	-0.129***
	(0.005)	(0.001)	(0.002)	(0.091)	(0.0375)	(0.000)	(0.002)	(0.001)	(0.027)
Medium firms	-0.024	-0.011**	-0.058***	0.007	-0.001	-0.003	0.011*	0.008***	0.003***
	(0.019)	(0.005)	(0.008)	(0.001)	(0.001)	(0.002)	(0.006)	(0.002)	(0.001)
Large firms	0.000	0.001	0.001***	0.110	0.140***	0.005	-0.001	-0.001**	0.051***
	(0.001)	(0.000)	(0.002)	(0.145)	(0.053)	(0.004)	(0.000)	(0.005)	(0.003)
Manager’s experience	-0.047	0.056	-0.168*	-0.003	-0.002**	-0.005	0.035	-0.024	0.003
	(0.182)	(0.053)	(0.093)	(0.003)	(0.001)	(0.021)	(0.062)	(0.026)	(0.003)
Manager’s exper. squared	-0.296*	0.001**	-0.548***	0.944	0.260	0.001***	0.046	0.121**	-0.005
	(0.167)	(0.000)	(0.080)	(1.515)	(0.586)	(0.000)	(0.041)	(0.017)	(0.006)
Female top manager	0.002*	0.110	0.002**	-0.638	-1.357***	0.064*	-0.062	-0.069	-0.027
	(0.001)	(0.105)	(0.001)	(1.369)	(0.511)	(0.035)	(0.123)	(0.045)	(0.031)
power outages	-0.203	-0.198***	-0.594***	-0.012	0.007	-0.001**	-0.000	-0.001***	0.042
	(0.354)	(0.036)	(0.160)	(0.011)	(0.004)	(0.000)	(0.001)	(0.0001)	(0.056)
owner female	0.016***	0.025	0.019***	-6.553**	0.228	0.099***	-0.001	0.001	0.139***
	(0.003)	(0.051)	(0.001)	(3.058)	(1.006)	(0.022)	(0.001)	(0.003)	(0.033)
Access to finance	0.466**	0.064*	0.184***	0.031	0.104***	0.059***	-0.173***	0.133***	0.108***
	(0.182)	(0.0374)	(0.010)	(0.021)	(0.008)	(0.018)	(0.059)	(0.028)	(0.027)

capital city	-0.0347	0.0257	-0.213***	0.853***	0.671***	0.854***	0.0771	0.160***	-0.121***
	(0.274)	(0.115)	(0.043)	(1.509)	(0.647)	(0.016)	(0.114)	(0.054)	(0.025)
Business city	14.28***	21.59***	13.95***	-10.020	-9.508***	21.79***	-0.118	0.284***	0.018***
	(1.501)	(0.130)	(0.115)	(6.311)	(0.852)	(0.025)	(0.193)	(0.032)	(0.006)
Access to Market	0.001***	0.123***	0.001	0.042	0.142***	0.171**	-0.233**	0.134***	0.042
	(0.000)	(0.031)	(0.001)	(0.056)	(0.000)	(0.021)	(0.022)	(0.000)	(0.056)
foreign owner	0.002***	0.199***	0.026	0.139***	0.007	0.010**	0.107***	-0.019***	0.139***
	(0.000)	(0.067)	(0.031)	(0.033)	(0.030)	(0.031)	(0.020)	(0.027)	(0.033)
Access to foreign Tech.	0.108***	0.041***	0.027	0.108***	0.101**	0.120**	0.140	0.203***	0.108***
	(0.035)	(0.000)	(0.027)	(0.027)	(0.001)	(0.002)	(0.001)	(0.001)	(0.027)
N	**4,162**	**4,162**	**4,162**	**4,162**	**4,162**	**4,162**	**4,162**	**4,162**	**4,162**
R-squared	**0.323**	**0.302**	**0.432**	**0.401**	**0.491**	**0.432**	**0.432**	**0.431**	**0.493**
F-statistic	**143.33**	**106.43**	**143.33**	**106.43**	**106.11**	**143.33**	**143.33**	**106.43**	**106.10**
Hausman		**831.43**		**831.43**	**332.11**			**831.43**	**332.00**
		(0.000)		**(0.000)**	**(0.000)**			**(0.000)**	**(0.000)**
Under identification test		**1241.22**		**1241.22**	**1242.30**			**1241.22**	**1242.33**
		(0.000)		**(0.000)**	**(0.000)**			**(0.000)**	**(0.000)**
Weak identification test (Cragg-Donald Wald F statistic)		**141.131**		**141.131**	**143.101**			**141.131**	**143.22**
Stock-Yogo weak ID test critical values: 10% maximal IV size		**119.93**		**119.93**	**119.93**			**119.93**	**119.96**
Hansen J statistic (over identification test of all instruments)		**46.548**		**46.548**	**46.548**			**46.548**	**46.581**
		(0.054)		**(0.054)**	**(0.053)**			**(0.054)**	**(0.051)**

Controlled for Country-location-year fixed effect, Country-year fixed effect and Industry fixed effects. Standard errors are in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Author's computations (2020)

Fielding and Roberts (2017) who found a negative effect of firm age on sales growth but in line with Okafor (2017).The sub-regional analysis however shows that firms which have been in existence longer are able to increase their revenues in SSA than in Maghreb. More succinctly, a 100% increase in age of the firm leads to about 33% increase in revenue in SSA whereas under the same conditions in Maghreb, the increase is just under 14%.

When the firm age variable squared is considered, it is observed to impact negatively on firm revenues at the aggregate Africa level. This implies that beyond a certain age threshold in Africa, firm revenue yields begin to decline suggesting that there is non-linear relationship between firm age and revenue yields. The sub-regional situation is a mixed one. While the general Africa situation reflects in the Maghreb, in SSA, the firm age squared variable registers a positive impact on revenue yields

.Firm size is also an important factor which is discussed in the literature in relation to firm performance .The estimated results for the overall African region show that the medium and large firms experience increase in revenues compared with micro firms. These results are consistent with Isogawa, Nishikawa and Ohashi (2013) and Njikam and Alhadji (2017), In the Maghreb region however, medium and large firms do not experience any significant change in their revenue yields compared with but smaller firms rather experience increase in revenues. The results for SSA show that whereas small firms do not experience any significant change in their revenue yields, medium firms record increases in their revenue and large firms rather strangely experience a decline in their revenues compared with the micro counterparts.

Managerial experience is estimated to have a positive effect on firm revenues in the aggregate Africa regression equation at 1% significance level. This situation reflects in SSA though in Maghreb, the effect of managerial experience on firm revenues is not markedly felt.

Another factor which has been considered in the literature is how power outages affect the revenues of firms. Power is usually seen as an important driver of productive activities in every economy. Results from the regressions clearly indicate that at both the aggregate and sub-regional African level, power outages cause decline in firm revenues. At the aggregate African level, a 10% increase in power leads to about a 3% decline in revenue yield at 1% significance level. The estimated decline in revenues in the SSA and Maghreb areas as a result of increase power outages are lower. Whereas a 1% increase in power outages tends to cause about 0.021 units decline in revenue, in Maghreb, the same margin of power outages only leads to a decline of 0.001 units in revenue at 1% probability level. These findings generally contradict Regasa *et al* (2017).

As expected, access to market exerts a positive effect on the revenues of firms at the aggregate African as well as the sub-regional areas of SSA and Maghreb at 1%, 1% and 5% significance level respectively. At the aggregate African level, firms which have increased market access relative to which do not derive over 80% improvement in their revenues .However access to market by firms relative to those which do not have that same access is estimated to have a much lower effect on firm revenues in the Maghreb than in SSA, triggering about 17% increase in the former and close to 70% increase in the latter.

Our estimation also shows that firms which are owned by foreigners are able to achieve higher revenues compared with those owned by indigenes. At the aggregate African level, the increase in revenues is about 22% whilst in SSA, it reaches just under 15%. In the Maghreb area however; the recorded increase in revenue is only a paltry 1%.Finally the estimated equation provides evidence that the firms which use foreign technology are able to achieve a higher revenue yield compared with those firms which do not employ foreign technology. This reflects at the aggregate African level as well as the SSA and Maghreb sub regions.

Exports represent the ability of firms to be able to gain access to external markets. Exports therefore used as one of the key measures of the performance and growth. The main pre- occupation in this export analysis is to determine the effect of efficiency on the exports. Generally in the literature, empirical analysis leans towards either the hypothesis that firm efficiency provides the impetus for exports participation and performance or the other view that the participation of firms in exports activities leads to the increase in their efficiencies through learning by doing.

In this analysis however there is the conviction that efficiency influences exports participation and performance and hence efficiency is regarded as a predictor variable in our estimation. In doing so notice is taken of the fact that there is high likelihood of endogeneity as a result of the correlation between efficiency and exports,, therefore, in addition to the traditional OLS estimation which may produce biased estimates, the researcher resorted to IV estimations(standard IV and Lewbel 2SLS) to serve as checks on the conventional OLS results.

In the estimation therefore because of the possibility of selection bias in the estimation, all firms (exporters and non-exporters) were included in the model. The estimated results for export performance are shown in tables 28, 29 and 30.

From the estimates, the efficiency variable registers a positive impact on export performance at the aggregate African level across all the estimation techniques employed meaning that in Africa, there is no ambiguity about the effect of efficiency on export performance. This corroborates Rachbini *et al.* (2020) who found productivity to be positively related to export performance and highlights the theoretical view that firms which are efficient perform better when it comes to exports and also aligns with Bernard and Jensen (1999). The measured effect of efficiency on exports is substantial and more succinctly, a 100% increase in efficiency of the firm precipitates over 30% upswings at 5% significance level in the export performance of firms on the whole in Africa. The positive effect of efficiency also reflects at the sub-regional level-SSA and the Maghreb though the estimated results show the export performance of firms in SSA is much better than in Maghreb. Whilst a 1% increase in firm efficiency in SSA leads to 0.298% improvement in exports performance and significant at 1% probability level, in the Maghreb it is about 0.16 % increase significant at 5% probability level. This is not surprising since firms in the Maghreb were found to be less efficient than their peers in SSA and this suggests that firms in the Maghreb have some work to do to be able to improve upon their export performance.

At the aggregate Africa level, firm age records a negative impact on export performance implying that as firms advance in the number of years of existence, their export performance decreases. In real terms a year increase in in age of firm triggers about 0.098 units decline in export performance. Though this finding falls in line with Rachbini (2017), it is not entirely an expected outcome since in the literature the preponderant view is that the more years that an entity exists, the more experience that the firm builds up and that all things being equal, this must promote the firm's export performance. However, it goes contrary to Wengel and Rodriguez (2006) who adduced evidence of positive relationship between firm age and export performance. At the sub-regional level, firm age of firms within SSA exerts a positive impact on their export performance but negatively influences exports performance of firms in Maghreb region. In the estimated regression equation, an additional year of existence by a firm in SSA improves the exports performance of the firm by 0.3 units at less than 1% level of significance but under the same conditions, firms in Maghreb rather experience a decline in their exports performance by about 0.021units.

Again the sign returned by the firm age squared variable in our regression at the aggregate African level is positive and this indicates that at the latter stages of their existence, firms' export performance improves implying that in Africa in general there is a quadratic relationship between firm age and the exports performance of firms. However in the Maghreb, the effect of the firm age squared variable is still negative meaning that even at the advanced stages of their existence, firms in Maghreb record decline in their exports performance but firm age squared triggers a positive response from exports performance in SSA. This underlines the fact that in the two sub regions of Africa, the firm age factor plays out differently.

With regard to firm size, the estimated results indicate that in both SSA and Maghreb areas, there is evidence which shows that as firm size increases, their export performance improves from the estimated equations. In fact the results in both areas indicate that small firms experience decline in their export performance compared with micro firms. Our finding in the sub regions appear to be consistent with Wignaraja (2006) who discovered a positive relationship between firm size and export shares in a sample of Sri Lankan firms. Even though firm size is generally found to be positively related to exports performance in SSA and the Maghreb at 1% significance level, the impacts are very marginal and this may probably account for the fact in the estimated equation for Africa, firm size is measured not to significantly influence export performance.

Managerial experience is mentioned in the literature as an important factor which affects firm performance on account of the fact that managerial experience drives and empower firms in directions that others may probably not be able to achieve and this positively affects performance. In the estimation in this study therefore, one of objectives was to ascertain the effect of managerial experience on the export performance of firms. From the estimated regressions it is observed that managerial experience has no significant effect whatsoever on export performance of firms in the Maghreb. However in SSA our estimated equation indicates a marginal positive impact of managerial experience on the export performance of firms. At the overall Africa level, the effect of managerial experience on export performance is positive but also marginal. More precisely, firms with managerial experience are measured to achieve less than 1% increase in their export performance compared with firms without managerial experience.

The negative impact of power outages on export performance is palpable at the aggregate Africa level as well as SSA. However, in the Maghreb area, power outages appear not to have a significant impact on export performance. At the aggregate Africa level, a 10% increase in power outages causes about 2% decline in export performance. In SSA, a 1% upswing in power outages leads to almost an 0.33% reduction in the export performance of firms These results at the aggregate Africa level and SSA substantiate the conclusion of Gupta and Singh (2021). The effect of power outages on exports in the Maghreb Africa area however does not conform to Fakih, Ghazalian and Ghazzawi (2020) which empirically found a negative impact of power outages on firm performance in the entire MENA region.

Again the analyses also show that access to finance positively but significantly influences export performance at the aggregate Africa as well as the sub levels, which results concurs with Fowowe (2017) who showed that firms which are unconstrained financially through access perform better than their peers which are financed constrained. In precise terms, firms which have access to finance at the aggregate African level are able to increase their exports by over 10% compared with their counterparts without access at 1% level of significance implying access to finance is relevant to firm export performance in Africa. In SSA, the measured effect of access to finance shows that the advantage that firms with access to finance over those which do not have is less than 1% point in terms of export performance at 5% significance level, which situation may be indicative that probably there are some rigidities in the finance arrangements which have to be dealt with to enable such facilities to have the desired effect on export performance. In Maghreb Africa, the estimated effect of access to finance registers a greater impact than in SSA with those firms with access to finance having about 10% ability to perform over and above their colleagues without such access.

The regression results clearly underline the relevance of market access in boosting greater export performance. From the SSA sub regional point of view, firms which have access to markets are able to obtain over 60% advantage in export performance over their counterparts which do not have easy market access. The overall picture at the aggregate Africa level shows that firms which have market access get over 50% better performance in exports compared with those firms which do not have that privilege though the effect of access to market in the Maghreb is a bit tempered with firms having market access being only about 13% better performers in terms of exports relative to the firms without access. The regression results here generally coincide with the conclusions of Fugazza and McLaren (2013) in respect of the Peruvian firms.

Regarding how ownership status influences export performances of firms, our results show that in Maghreb, the results are mixed; While the Lewbel 2SLS estimates indicate a positive impact of foreign ownership of firms on export performance, the standard IV result shows a marginal decline in export performance compared with firms which do not have foreign ownership albeit at 5% level of significance. The measured effect of foreign ownership on export performance in SSA is however unambiguous as the regression estimates reveal that firms which have foreign owners outperform others which do not have by about 12% margin in respect of export performance. Similarly, the overall Africa regression estimates also underline the positive effect of foreign ownership of firms on their export performance with foreign owned firms registering little under 18% increase in export performance over the export performance of the firms without foreign ownership thus buttressing the findings of Duong *et al.* (2021).

Regarding access to foreign technology, all the estimations –the overall and the sub-regional regressions adduce evidence to the effect that it improves firms' export performance. This means that firms which have access to foreign technology achieve better export performance compared with the other firms which do not have access to such technology. From the aggregate Africa perspective, at 5% significance level, firms with access to foreign technology are able gain almost 29% higher export outturn relative to their peers without the foreign technology. The measured impact of access to technology on export performance within SSA is about 23% also significant at 5% probability level, implying that in SSA, firms which have access to foreign technology achieve a 23% higher exports performance compared with their counterparts without that access while in the Maghreb region, the gain in export performance by firms with access to foreign technology over their peers without that opportunity is about 11%. The plausible reason may be that access to foreign empower firms to be able to satisfy the specifications of foreigners and hence produce at given quality levels which have been established especially in areas of the world where the gate keepers are ensure that

Table 31: Dominance Statistics for Capacity Utilization, Revenue and Exports (Overall Africa)

Dominance	Capacity utilization		Sales revenue		Exports	
Variables	Domin. Stat.	Ranking	Domin. Stat.	Ranking	Domin. Stat.	Ranking
Innovation	0.0471	5	0.1544	2	0.4823	2
Business environment	0.0473	4	0.0473	3	0.0769	5
firm age	0.0287	9	0.0287	9	0.0287	6
Manager’s experience	0.0211	11	0.0211	11	0.0033	10
Efficiency	0.0482	3	0.0391	6	0.4989	1
Female top manager	0.0131	13	0.0131	13	0.0022	11
Power outages	0.0424	6	0.0471	4	0.0013	13
Firm size	0.4991	1	0.4991	1	0.0021	12
Owner female	0.0387	7	0.0387	7	0.0008	14
Access to finance	0.0383	8	0.0383	8	0.2650	3
Capital city	0.0130	14	0.0130	14	0.0133	9
Business city	0.0232	10	0.0424	5	0.0891	4
Access to foreign market	0.1544	2	0.0232	10	0.0158	8
Foreign owner	0.0210	12	0.0210	12	0.0172	7
Overall Fit Statistic	**0.161**		**0.256**		**0.1989**	
N	**9019**		**9019**		**9019**	

Source: Author’s computations (2020)

Assessing the Relative Importance of the Variables which Influence Firm Performance

In trying to get a fuller and more comprehensive understanding of how the predictor variables affect the performance variables, the study employed an approach which has gained currency recently in contemporary literature -the dominance analysis. In the dominance analysis therefore the preoccupation was to determine the relative importance of the predictor variables. In all, there are fourteen predictor variables which are employed to rank their impacts on three performance variables- capacity utilization, sales revenue and exports. In the analysis, the effect of the predictor variables is determined through a ranking procedure from the most influential to the least influential predictor variable.

Looking at the dominant analysis of the capacity utilization variable in table 31, it is observed that the most influential predictor variable in Africa is firm size followed by access to foreign market; the implication of these results is that in assessing to what extent firms optimize their capacity utilization in Africa, the most pressing fundamental factors to consider are the size of the firm and the extent of firms' access to the external market. The size of the firm may be very important because that is significantly affects how a firm is able to marshal its productive resources and optimize their use. Thus a bigger firm may be more successful at attracting the relevant human capital which have the requisite skills to mobilize the other required resources into the form that

Table 32: Dominance Analysis for Sub-Sahara Africa

Dominance	Capacity utilization		Sales revenue		Exports	
Variables	Domin. Stat.	Ranking	Domin. Stat.	Ranking	Domin. Stat.	Ranking
Innovation	0.0471	5	0.1544	2	0.4823	1
Business environment	0.0473	4	0.0473	3	0.0769	5
firm age	0.0287	9	0.0287	9	0.0287	6
Manager's experience	0.0211	11	0.0211	11	0.0033	10
Efficiency	0.4997	1	0.0385	7	0.0899	3
Female top manager	0.0131	13	0.0131	13	0.0022	11
Power outages	0.0424	6	0.0471	4	0.0013	13
Firm size	0.4991	2	0.4993	1	0.0021	12
Owner female	0.0387	7	0.0387	6	0.0008	14
Access to finance	0.0383	8	0.0383	8	0.2650	2
Capital city	0.0130	14	0.0130	14	0.0133	9
Business city	0.0232	10	0.0424	5	0.0891	4
Access to foreign market	0.1544	3	0.0232	10	0.0158	8
Foreign owner	0.0210	12	0.0210	12	0.0172	7
Overall Fit Statistic	**0.159**		**0.234**		**0.1967**	
N	**4857**		**4857**		**4857**	

Source: Author's Computations (2020)

Again the access to foreign markets generally gives an indication of the scope of the market extent that firms are able to play within and being able to access foreign market means that firms have wider market environment to operate within, which situation influences capacity utilization.

Gleaning the statistics for the dominance analysis, it is obvious that our policy variables are quite influential in the capacity utilization of firms in Africa. It explains why the efficiency, general business environment and innovations are ranked 3rd, 4rd and 5th respectively. The implication of this outcome is that efficiency, innovation and general business environment clearly are among top factors which influence firms' ability to utilize their installed capacities.

In the dominance analysis, power outages come in as the 6th most important factor which affects the capacity utilization of firms in Africa. This is a little surprising because power outages is linked to capacity utilization especially within the context of developing countries by a good number of firm level researchers.

Clearly the analysis also shows that in examining the extent of capacity utilization, access to foreign market is much more important than the location of the firm and that access to credit/finance is only fairly influential. This is probably the case because once firms have the necessary resources, they require much less financing.

Another interesting result in the analysis relates to that of the foreign ownership of firms, which ranked 12th in the dominant analysis thereby deemphasizing the importance of foreign ownership in relation to other predictors when one looks at their overall effect on capacity utilization.

Table 33: Dominance Analysis for Maghreb Africa

Dominance	Capacity utilization		Sales revenue		Exports	
Variables	Domin. Stat.	Ranking	Domin. Stat.	Ranking	Domin. Stat.	Ranking
Innovation	0.0471	4	0.1544	2	0.4823	2
Business environment	0.0473	3	0.0473	3	0.0769	5
firm age	0.0287	9	0.0287	9	0.0287	6
Manager's experience	0.0211	11	0.0211	11	0.0021	12
Efficiency	0.0432	5	0.0472	4	0.4897	1
Female top manager	0.0131	13	0.0131	13	0.0022	11
Power outages	0.0424	6	0.0471	5	0.0013	13
Firm size	0.4991	1	0.4991	1	0.0033	10
Owner female	0.0387	7	0.0387	7	0.0008	14
Access to finance	0.0383	8	0.0383	8	0.2650	3
Capital city	0.0130	14	0.0130	14	0.0133	9
Business city	0.0232	10	0.0424	6	0.0891	4
Access to foreign market	0.1544	2	0.0232	10	0.0158	8
Foreign owner	0.0210	12	0.0210	12	0.0172	7
Overall Fit Statistic	**0.154**		**0.228**		**0.1958**	
N	**4162**		**4162**		**4162**	

Source : Author's computations (2020)

The intuition here is that firm ownership may not be a very critical factor which affects capacity utilization. This result seems not to support Ahiakpor *et al.* (2014) who found a significantly higher capacity utilization by foreign owned firms in Ghana.

The dominance analysis of sales revenue for Africa is very similar to that of capacity utilization. This time round however, the statistics indicate that the key policy variables – efficiency, innovation and business environment are the 6th, 2nd and 3rd most influential variables and just like capacity utilization, firm size is the most influential determinant of firms' sales revenue. Power outages are ranked as 4th most important dominant factor. This is understandable because power supply is a critical ingredient for productive activities and that a lot of outages undermines firm production and hence sales. The influence of access to finance is rather very fair since it is ranked 8th. This may suggest that after production; finance may not be a big factor in the promotion of sales of firms.

In the dominant analysis for exports, the most dominant predictor is efficiency, meaning that the most important variable that drives exports in Africa is efficiency and this is consistent with preponderant view in the literature that efficient firms are much empowered to export . The results also show that innovation is the next most important predictor. This is consistent with what exists in the literature that the successful firms in terms of exports are firms which usually innovate, since innovation is able to create competitive edge for firms. The results also show that finance is a critical factor in promoting exports.

The other policy variable in our study, the general business environment from the result is the 5th influential variable. Though it is ranked 5th out of the fourteen predictors, it can be seen as quite important in conditioning firm exports. However, firm size and power outages from the analysis do not appear as very influential as expected in driving firm exports. Access to foreign markets and foreign ownership expectedly are fairly influential factors in respect of firm exports and the least influential variables are power outages and gender of owner of firm. The former factors may be very important because they are instrumental in paving the way and also providing the basis for external connections to be established.

In Sub-Saharan Africa, the dominance statistics as shown in table 32 indicate that efficiency ranks as the most dominant factor in respect of capacity utilization whilst firm size is the second most important factor then followed by access to foreign market. Innovation and business environment are also ranked 5th and 4th respectively by the dominance statistics. The statistics rank power outages as the 6th dominant factor driving capacity utilization.

The dominance results in respect of revenue suggest the firm size is the most important factor driving revenue followed by innovation .and business environment in that order. Efficiency however appears not to be very strong in its influence on revenue as the dominance results indicates that it is the 7th most important driver.

Again the dominance statistics identify innovation as the number one predictor which influences exports in Sub-Saharan Africa .It is followed by access to finance. Efficiency predictably is also estimated to be very influential in driving exports and according to the dominance statistics it is the 3rd most

Table 34: PSM estimates on the Effect of efficiency, business environment and innovation on firm capacity utilization, revenue and exports (Overall Africa)

		Caliper			Nearness neighbourhood			Kernel	
Treatment Variable	**Treated**	**Control**	**Difference**	**Treated**	**Control**	**Difference**	**Treated**	**Control**	**Difference**
					Capacity utilization				
Innovation	4.170	4.128	0.042 (3.2)	4.252	4.124	0.128(4.08)	4.347	4.121	0.226(2.7)
BE	4.131	4.119	0.012 (5.2)	4.131	4.077	0.054(3.24)	4.131	4.082	0.049(4.5)
Efficiency	4.158	4.124	0.034 (4.3)	4.168	4.098	0..070(3.15)	4.235	4.096	0.139(2.5)
					Sales Revenue				
Innovation	17.355	16.917	0.438(4.31)	17.274	17.100	0.173(2.89)	17.296	17.090	0.201(1.3)
BE	17.441	16.953	0.489(5.06)	17.436	17.372	0.064(3.21)	17.413	16.910	0.504(2.9)
Efficiency	17.302	16.898	0.404(4.55)	17.166	16.989	0.177(2.56)	17.235	16.987	0.248(2.8)
					Exports				
Innovation	0.652	0.648	0.005(2.48)	0.655	0.652	0.041(0.62)	0.552	0.538	0.014(3.43)
BE	0.668	0.644	0.025(2.83)	0.668	0.657	0.011(1.20)	0.740	0.734	0.008(3.85)
Efficiency	0.686	0.638	0.027(2.88)	0.677	0.649	0.028(1.34)	0.735	0.709	0.026(3.40)

Source: Author's computations (2020)

leading factor affecting exports. However business environment from the statistics is measured to be the 5th dominant factor affecting exports.

In the Maghreb area, the leading driving factor in respect of capacity utilization is firm size followed by access to foreign market, innovation and business environment in that order. Revenues in the region are mainly driven by firm size, innovation, business environment and efficiency in that sequence. For exports, efficiency is estimated to be the most important force which drive it. Innovation and business environment ranked 2nd and 5th important influencing factors.

Robustness checks

As an additional measure to address endogeneity, the study employed Propensity Score Matching (PSM). PSM is often employed to determine the average effect of a given treatment (in this study context, firms that are efficient, innovate or operate in a favourable business environment) on the outcome variable (capacity utilization a sales revenue). PSM has been effectively used in the literature to address problems of endogeneity and selection bias in non-experimental studies (see Churchill & Smyth, 2017; Dehejia & Wahba, 2002; Zhang & Posso, 2017; Churchill & Marisetty, 2020) and in this study context, it can help us draw causal inferences about the effect of efficiency, innovation and business environment on capacity utilization, exports and sales revenue. Specifically, the study employed the PSM technique of Rosenbaum and Rubin (1983) and therefore, the researcher, consistent with the discussion in the literature make use of the different matching algorithms in PSM (See Caliendo & Kopeining, 2005). The matching techniques employed under the PSM included nearest neighbourhood, Caliper and kernel matching methods and the results are presented in Tables 34.35 and 36.

Table 35: PSM analysis of the Effect of efficiency, business environment and innovation on firm capacity utilization, revenue and exports (Sub-Sahara Africa)

		Caliper			Nearness neighbourhood			Kernel	
Treatment Variable	**Treated**	**Control**	**Difference**	**Treated**	**Control**	**Difference**	**Treated**	**Control**	**Difference**
				Capacity utilization					
Innovation	3.170	3.129	0.041 (3.1)	3.232	3.124	0.108(4.03)	3.347	3.123	0.224(2.6)
BE	3.151	3.129	0.022 (4.9)	3.211	3.074	0.137(4.26)	3.135	3.062	0.073(2.1)
Efficiency	3.231	3.185	0.046 (3.8)	3.161	3.076	0..085(3.17)	3.198	3.096	0.102(2.3)
				Sales Revenue					
Innovation	12.355	12.117	0.238(3.21)	12.274	12.100	0.174(2.89)	12.298	12.090	0.208(1.6)
BE	13.441	12.933	0.508(5.12)	12.417	12.362	0.055(3.19)	13.415	12.906	0.510(3.0)
Efficiency	12.348	12.286	0.062(5.75)	12.214	12.135	0.079(2.16)	12.235	12.108	0.127(2.7)
				Exports					
Innovation	0.452	0.421	0.031(2.16)	0.485	0.392	0.093(0.62)	0.352	0.307	0.045(2.13)
BE	0.388	0.329	0.057(2.61)	0.468	0.398	0.070(1.27)	0.453	0.426	0.027(2.65)
Efficiency	0.374	0.316	0.058(2.75.)	0.434	0.386	0.048(1.30)	0.512	0.465	0.047(2.72)

Source: Author's computations (2020)

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In the propensity score matching (PSM) technique, the idea is to determine the effect of the treatment variables- efficiency, innovation and business environment on firm performance by using an experimental set up approach by creating treatment and control groups within the target variables-capacity utilization, sales revenue and exports. The object here was to determine how significantly the treatment effect influences the performance variables across all different types of the PSM-the caliper, nearness neighbourhood and kernel as against the control groups which are not subjected to the effects of efficiency, innovation and business environment

Thus in the PSM, the researcher fundamentally seeks to match firms which have the treatment characteristic with those firms which do not have the treatment characteristic

The results for all the performance variables indicate that the target variables when exposed and subjected to the treatment effects produce outcomes which are significantly different from the outcomes produced within the control groups (without treatment) in the performance variables. In a sense, it is demonstrated from the tables 34, 35 and 36 that efficiency significantly affects all the outcome variables across Africa and its sub regions-Sub Saharan Africa and the Maghreb. These results underline and reinforce the results of our earlier analyses which have largely demonstrated that efficiency, business environment and innovation significantly drive the performance of firms in Africa.

Table 36. PSM estimates of the Effect of efficiency, business environment and innovation on firm capacity utilization, revenue and exports (Maghreb Africa)

	Caliper			Nearness neighbourhood			Kernel		
Treatment Variable	**Treated**	**Control**	**Difference**	**Treated**	**Control**	**Difference**	**Treated**	**Control**	**Difference**
				Capacity utilization					
Innovation	2..926	2.899	0.027 (2.8)	3.124	3.009	0.115(3.62)	3.155	2.978	0.173(2.5)
BE	2.867	2.815	0.052 (4.5)	3.086	2.988	0.098(3.52)	3.054	2.997	0.057(2.0)
Efficiency	4.158	4.124	0.034 (4.3)	4.168	4.098	0..070(3.15)	4.235	4.096	0.139(2.5)
				Sales Revenue					
Innovation	11.899	11.652	0.247(3.07)	11.655	11.400	0.255(2.13)	11.916	11.753	0.163(1.2)
BE	11.946	11.726	0.237(3.02)	11.683	11.589	0.094(2.07)	11.558	11.205	0.353(2.4)
Efficiency	12.123	11.872	0.251(4.63)	12.166	11.998	0.168(2.13)	12.088	11.887	0.201(2.3)
				Exports					
Innovation	0.313	0.287	0.023(1.96)	0.344	0.326	0.018(0.25)	0.318	0.302	0.016(2.05)
BE	0.297	0.276	0.021(1.83)	0.366	0.349	0.017(1.13)	0.290	0.278	0.012(2.44)
Efficiency	0.335	0.307	0.028(1.67)	0.386	0.366	0.020(1.06)	0.346	0.317	0.029(2.25)

Source: Author’s computations (2020)

Chapter Summary

In this chapter the main objective was to investigate how efficiency impacts on specific financial and non-financial firm performance indicators-capacity utilization, revenues and exports .Conventional OLS and instrumental variable estimations showed that efficiency influences capacity utilization, revenues and exports hence showing that overall firm efficiency is very important in explaining financial and non-financial performance. It particularly underscores the fact that in Africa, for firms to get engaged in exports, they must generally be efficient in their operations. In other words, in Africa firms which are able to gain a foothold in the exports markets are those which are efficient.

Using the dominance analysis and the Propensity Score Matching techniques, there is a confirmation of the importance of efficiency relative to capacity utilization, revenues and exports.

CHAPTER EIGHT

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

While there is a consensus that economic growth and development are propelled mainly by systematic growth of the firm, business environment and innovation are argued to be the most critical elements in enhancing performance and growth of firms according to the contemporary viewpoint. However, with the recent rapidly increased access to information and new markets owing to availability of advanced technology as well increasing globalization, developing economies now have to grapple with turbulence in the markets and unprecedented levels of competition for market share for their products (Wadho & Chaudhry, 2018). Against this background, the business environment especially in developing world and Africa for that matter continues to worsen and make the prevailing market conditions even more torrid and difficult to navigate and survive. As a consequence, a near obligation has been placed on firms to improve their competitiveness in order to survive in the highly torrid milieu. Under these circumstances, there is a need for countries especially in Africa to strive to create conducive business environments while firms strive to improve their competitiveness by the infusion of innovation which allows them to be relevant in the market spheres. In light of these, this study sought to examine the how and the extent to which business environment and innovation impinge on firm performance and growth by employing World Enterprise Survey (2013).

The last three preceding chapters presented and discussed efficiency of firms in Africa, the influence of business environment and innovation on firm performance and growth and then finally the effect of efficiency on exports, capacity utilization and revenues. This chapter presents the summary of the entire study, outlines the main conclusions of the study and then proceeds to offer policy recommendations based on the conclusions before suggesting the way forward for research in this firm level domain. The chapter is written in three main sections. The first part is devoted to the synopsis of the entire research. This is followed by the presentation of the key findings and conclusions of the study. The concluding section outlines the policy implications and recommendations, the limitations of the study and then points to areas for future research.

Summary of Research

The overall objective of the study was to investigate and ascertain the effects of business environment and innovation on firm performance in Africa and to properly execute it; the study sought to present the various aspects of the study in eight distinct chapters with each highlighting and elucidating specific aspect of the broad study. In chapter one, an introduction to the study covering the background to the study, the statement of the problem, the objectives of the study , our research hypotheses, the motivation behind the research as well as the significance of the research.is provided Chapter two covered aspects of the literature which explains all the performance concepts-efficiency, sales revenue, capacity utilization, exports and also provided a comprehensive overview of the business environment and innovation in Africa,

The third chapter concentrated on the theoretical basis of the study and laid out the various theories which underpin the topic .It discussed theories which explain firm performance and explored all issues around firm innovation and business environment. The final section of the chapter was devoted to the review of empirical literature.

In the Chapter four, the various research approaches were discussed and on that basis, the researcher chose and rationalized the philosophical paradigm, positivism as the broad research approach to guide the study. Subsequently in the chapter, the various analytical techniques that were to be employed in the empirical analysis were outlined

The next three chapters- five, six and seven encompass the body of the empirical analysis of the study. Chapter five dealt with the estimation of efficiencies of firms in Africa and determined whether or not there are significant differences between efficiencies of businesses in Sub-Saharan Africa and the Maghreb Africa regions. It then proceeded to assess if differences in efficiency can be attributed to technological differences.

Chapter six considered the effects of the business environment on firm innovation and proceeded to examine the individual and the interactive effects of the business environment and innovation on firm efficiency in Africa and in the final empirical chapter; Chapter seven, the study investigated the extent to which firm efficiency affects key performance indicators-capacity utilization, sales revenue and exports.

The last chapter is a synopsis which isolates the thrust of the study and outlined the key findings and conclusions. The remainder of the chapter tackled the new insights and contributions which the study had generated and the policy implications of the findings which had been uncovered.

Generally, all the objectives of the study were assessed within the three empirical chapters. Thus in the study, objectives one, two and three were pursued in chapters five, six and seven respectively.

To achieve the first objective, the stochastic Meta –frontier framework was used to ascertain and explain the variations in technical efficiency among the firms in SSA and the Maghreb and then measure technological gaps. The concluding part of the chapter dealt with the derivation of output elasticities of the various inputs to measure the returns to scale of firms in the two regions of Africa.

In the second empirical chapter, the issue of the effects of the business environment on innovation by firms in Africa was addressed and dealt with using the OLS and probit regression techniques. Under this section, two hypotheses were formulated. These were: (1) there is no significant relationship between business environment and innovation, and (2) No differential effect of business environment on innovation exists among various dimensions of business environment. These hypotheses were tested to contribute and add to existing knowledge on the significance of business environment both at the aggregated and disaggregated levels on firm innovation. To test the two hypotheses, a multiple regression model (OLS) was used to examine the effects of business environment on innovation while a probit model was also applied to determine the likelihood of a firm engaging in innovation or being innovative conditioned on certain firm specific characteristics and business environmental factors.

The second part of the empirical chapter provided insights into the interaction and complementarity between business environment and innovation. It therefore ascertained the extent to which favourable business environment and innovation jointly affect firm efficiency. It also estimated and presented robustness checks to increase the policy options. Given the potential endogeneity between innovation and efficiency, two approaches of the instrumental variable estimation procedures were employed for the analysis in this chapter - the standard IV and Lewbel 2SLS estimation techniques. An additional estimation procedure employed was the endogenous switching regression (ESR) to provide further elucidation of individual and joint effects of business environment and innovation on firm efficiency.

Finally, the third empirical chapter (Chapter seven) probed the effect of efficiency and other control variables on firm's capacity utilization, revenues and exports. In this chapter, the analysis involved estimating the impact of the efficiency on the performance variables in the first section. The concluding section of the chapter dealt with the relative effects of efficiency, business environment and innovation on the performance variables using the dominance analysis and Propensity Score Matching (PSM) technique and these estimation methods were employed in testing the chapter's hypothesis.

Key Findings and Conclusions

The efficiency analyses show that there are differences in efficiencies of firms in Sub-Saharan Africa (SSA) and Maghreb Africa with those in the SSA region being more efficient than their counterparts in Maghreb region and it is also observed from the results that the average technical efficiency in SSA is higher than the average technical efficiency in Maghreb region.

Again from the estimation it is discovered that of the potential output which can be produced by African firms, the average potential output in SSA is only

35% and that of the Maghreb Africa is around 23%. The implication of these findings is that firms in Africa are very far away from attaining their potential output levels.

With respect to the key determinants of technical efficiency of firms in Africa, the regression estimates indicate that use of foreign technology, per capita GDP, rate of inflation, access to finance, size of firm, the number of power outages and age of firm are all significant determinants of firm efficiency in Africa.

Again from the meta-frontier analysis, evidence is adduced that no firm in the two regions in Africa is operating at the most optimum technological frontier though the estimates show the firms within SSA are closer to the available technological frontier than their counterparts in the Maghreb region.

Another important result which emanated from the regression analysis is that firms in the two regions –SSA and Maghreb are experiencing increasing returns to scale in their operations implying that they are operating within the classical first stage of production and that there is room for them to scale up to reach the most optimum production levels.

The results from the probit regression analysis revealed that favourable business environment positively increases the probability of firms engaging in innovative activities and that the more and more the business environment becomes unfavorable, the less innovative firms become.

In addition, the results revealed that certain firm specific characteristics promote or hinder firm innovation. For example it is found that firms which engage in research and development are much more likely to be innovative than those which are not. Again from the empirical results, the older a firm is, the more likely it would innovate implying that the more experience that a firm gathers as it operates, the more it takes innovation as important. Also firms which use foreign technology and are owned by foreigners have a higher chance of innovating.

The empirical analysis of the relationship between the business environment and innovation on firm efficiency conditioned on firm characteristics showed that business environment and innovation individually enhance firm efficiency but their combined effect is measured to have a greater effect.

The findings of the study also reveal that of the disaggregated elements of the business environment, taxes, cost of electricity, political instability and corruption negatively affect efficiency of firms in Africa. Whilst the effect of corruption appears more severe in SSA, in respect of political instability, its negative impact is felt much more in the Maghreb Africa region.

Again even though all aspects of innovation are estimated to positively affect firm efficiency, product and marketing innovations are measured to have greater impact on the efficiency of firms in Africa.

Further, it is shown from the regression estimates that efficiency significantly and positively influences financial and non-financial performance indicators –capacity utilization, revenues and exports of firms in Africa. However, power outages are found to cause a decline in these performance indicators of the firms but access to finance and adoption of foreign technology impact positively on firm performance.

The dominance and propensity score matching (PSM) analysis in Africa and its sub regions reinforce the effect efficiency, business environment and innovation have on capacity utilization, revenue and exports.

Another finding of this study which is also important is that a great majority of the hypotheses tested in the study were validated and supported. Among others, the assertion that firms in Africa are operating below the optimum technological frontier was validated. Again we corroborated the hypothesis that firms in Africa are operating below their production potentials

The hypothesis that there is positive relationship between favourable business environment and innovation and firm technical efficiency was confirmed. Also the hypothesis that there is a positive relationship between business environment and innovation was supported. Finally, the hypothesis that there is a positive relationship between efficiency and firm performance indicators (capacity utilization, sales and exports) was supported. In table 37, the results of the tests of hypotheses are presented.

Table 37: A summary of the tests of hypotheses

Hypothesis	Decision	Remarks
1	Rejected	Firms in SSA are found to employ a higher level of technology than those in the Maghreb
2	Rejected	Firms in SSA are measured to achieve a higher level of output given the available technology than their counterparts in the Maghreb
3	Rejected	
4	Rejected	Firm specific characteristics influence their efficiencies.
5	Rejected	Business environment in both its aggregated and disaggregated forms significantly affects firm innovation.
6	Rejected	The aggregated and disaggregated forms of both innovation and business environment influence firm efficiency
7	Rejected	There is a marked complementarity between business environment and innovation which has a more profound effect on firm efficiency

		than when they are considered separately.
8	Rejected	Capacity utilization is significantly influenced by firm efficiency
9	Rejected	Efficiency of firms is a key factor which drives exports
10	Rejected	Efficiency significantly determines the level sales revenue achieved by firms.

Source: Author’s extractions.

Policy Recommendations

Based on the findings from the study, the following recommendations are categorized into those which lie within the purview of firms and the others which have to be taken up by external actors- governments and or institutions of government.

Firm specific Recommendations

- Firms in Africa have been established to be operating below their technological potentials and besides they from the estimated results, are measured to be generally inefficient in their operations with those in SSA and Maghreb producing about 34% and 22% of the potential output that is output using the best available technology implying that when they employ better technologies they can be more efficient. One of the most plausible ways of ensuring this is for firms to rely on foreign or imported technology which have been proven by the empirical analysis to reduce firm inefficiencies. By and large, firms in Africa would have commit to increasing their adoption of foreign technology to be able to drastically improve upon their levels of efficiencies.
- Firms operating in Africa have to intensify and activate their internal research and development activities so that they can create new ideas and technologies as well as novel ways of undertaking their business

activities. This is because R&D has been found to positively but significantly lead to innovation and innovation has also been determined to positively lead to firm efficiency. For firms which do not have R&D units, they would have to establish them to help in their drive towards innovations .This would help increase their efficiencies.

- Again firms in Africa have been found to be generally operating in the first stage of production implying that they are not being able to combine resources and factors in the most optimum proportions .What this means is that there is room for the firms to recalibrate their employment of factors and resources in order to be able to attain these optimal combinations of inputs. This therefore requires that firms reorder their in-house processes and mechanisms so as to be in a position to effectively harness their resources.
- Even though the regression analysis in the study shows in the overall Africa estimates that all the various types of innovation positively influence firm efficiencies, the sub-regional analysis indicate that firms in both sub regions would have increased efficiency if those in SSA concentrate more on process and marketing innovations while the firms in the Maghreb put their emphasis on product innovations.

Recommendations to Government and other state institutions

- It has been discovered from the analyses that firms which are located in capital and business cities are measured to perform more efficiently than firms in other areas. The implication is that firms operating in rural and peri-urban areas may be disadvantaged in so many respects. There is therefore the need for governments in Africa to initiate fiscal specific policies –like tax waivers, subsidies and also create conducive financial environment which make it easier for such firms to access cheaper credit lines as well as make available other incentives like low tariffs for utilities w etc. designed to create opportunities for firms in areas outside of the major cities to enable them catch up with their counterparts.

- Again, African firms from the empirical analysis have been generally shown to be operating at the levels where they are unable to optimally utilize their resources. For this problem to be tackled, some kind of government intervention is required A way out of this situation may be for .governments in Africa to set up specialized technically oriented institutions which can train in-house staff and advise firms on the most advantageous and optimal utilization of resources.
- Another finding in the study which may not be very good for African economies is the fact foreign owned firm are measured to perform at higher efficiency levels compared to their local counterparts .This generally signals lower or a certain lack of capacity of indigenous people when it comes to managing businesses. To resolve this problem also requires that African governments think about putting in place mechanisms and structures for improving the capacities of local entrepreneurs so that they can easily rub shoulders and compete favourably with foreign owned firms in terms of their efficiency. In countries where such institutional structures exist but are not delivering what is expected of them, these institutions need to be revamped and reenergized to be alive to their mandates.

- From the empirical analysis, it has been established that in Africa, the business environment matters a lot for firms to be innovative and indeed shown that uncongenial business environments inhibit firm innovation. To help support and build the innovation capacity of firms in Africa therefore would require governmental actions since most of the factors which are captured under the business environment are within the purview of governments In particular, governments would be have to as a matter of urgency initiate and pursue policies which promote firm innovation and one strategy which governments can employ is the creation of institutions or centres in the various countries to be able to rapidly promote innovation. Another strand of actions which may contribute to engendering innovation relate to governments specifically tackling key issues within the business environment –high taxation and poor tax administration, lack of access to finance , deal with the supply and the cost of electricity ,corruption and turbulent political environment through specific interventions by governments. With respect tax administration, governments would have look at simplifying tax systems and making it easier for firms to comply with tax provisions. In addition, governments have to reduce tax rates to serve as incentives for firms to continue pursue innovative production. The issue of electricity comes in two dimensions –the frequency of power disruptions and then the cost of electricity. African governments need to invest more in the energy generation sectors of their economies and also embark on strategies to diversify the sources of power so as to increase supply of electricity. In respect of the cost of power, governments may have to deal with the pervasive inefficiencies in their electricity production and distribution systems as well as deal with problem of the expensive power contracts they enter into. Governments can also provide subsidized tariffs to firms to enable them innovate, be more productive and ultimately support the economy. The lack of access to finance can be tackled when governments deliberately set up special and dedicated financial institutions for example to provide venture capital to service different sectors and which can provide firms with credit at concessionary rates.

- For corruption to be comprehensively addressed, African governments are required to deal with the systemic bureaucratic rigidities and do away with excessive red-tapeism especially in public institutions and institute strong and deterring penal measures against public bureaucrats and pliant private sector actors. Political instability can be avoided when governments in Africa become more accountable and open up the democratic space and make governance more inclusive and participatory. Thus with increased accountability and openness in the governance space countries would become stable and hence allow for the development and strengthening of the institutions needed to support robust private sector activities.
- Governments must direct more efforts at improving the technological base of their countries by investing and promoting research and development in the Universities and other knowledge generating institutions to support firm innovation. The innovation creation activities of firms would also have to be consciously promoted and

facilitated through a system of incentives and reinforcing packages. Governments can also support firm innovation by making it easier for firms to have access to foreign technology through the reduction of import taxes on technological items which are brought in especially from outside or even providing subsidies for firms to be able to generate their own knowledge and innovation systems instead of relying on foreign technology.

- To be able to increase their efficiency levels and catch up with their counterparts in Sub-Saharan Africa, firms in Maghreb Africa need to be much more aggressive at being technologically oriented. To be able to comprehensively deal with the problem of the use of the most up – to-date technologies, governments across Africa need to consciously support firms in that direction through various mechanisms like financial systems or even tax waivers on equipment and other technological items which are brought in by firms for their operations.

Contribution to knowledge

Even though there is a plethora of studies specifically examining the effect of innovation on firm performance, studies which have comprehensively investigated the interaction between business environment and firm innovation how this influences firm performance are hard to find. The few which exist did not conceptualize interaction as important part of their analyses. This study therefore represents the first which has tackled the interaction between the business environment and firm innovation and how that affects firm efficiency and performance.

In being able to pursue the above, the study so far is the first to have constructed indices(using MCA) for both business environment and innovation and employed them as continuous variables in the analyses and hence determine improving business environment and deteriorating environment as well as increasing and decreasing firm innovation. This enabled the researcher to provide new insights in the area of firm performance especially as most of the previous studies treated innovation as a dichotomous variable thereby restricting how it could be used in regression analyses. Thus, this approach has yielded additional dimensions which hitherto had been missing in the literature. Besides, in this study the business environment is also considered at different levels from minor to severe obstacle and these were used to examine how differently they impact on innovation and ultimately firm efficiency, which technique is a novelty in the literature.

Again, when one examines the literature on innovation-firm performance relationship, it is obvious the CDM model has been the prevailing framework of analysis. However, in this study because of the researcher’s conviction that the typical “black-box" principle does not generally apply in Africa in our estimation, the decision was taken to rather opt for the endogenous switching regression (ESR) model which allows us to compare the performance of innovating versus non-innovating firms for every business environmental or firm specific characteristic and this is represents a very different but significant perspective in the innovation-firm performance analysis which enriches the literature.

It is also instructive to note that the stochastic meta-frontier approach has conventionally been employed in the field of agriculture .However this study is to best to our knowledge is the first to employ the approach in a general firm level setting in Africa and therefore has provided a foundation in the literature which can serve as the basis for other firm level analysis to be conducted.

Limitations of the study

This study has provided insight into business environment-innovation-firm performance nexus in Africa. However, the analysis could not include firms in all African countries. This was because the researcher relied on the World Bank Enterprise Survey (WBES) which is a representative sample involving a fixed number of countries. Though the researcher employed the full set of data in the African survey, it is the belief that the results would have been more generalizable if the survey covered a sample of firms in all countries across Africa.

Again this study had initially conceptualized a panel analysis. However, examining the WBES, the researcher came to the realization that the study does not track the same firms in the different waves and for that reason a proper panel analysis is impossible to pursue. It is for that reason that the study opted for the cross-sectional analysis. And to make the analysis more generalizable and acceptable the researcher critically looked at all the waves which have been conducted in the last ten years and chose the one with the widest coverage of countries and firms for our analysis.

Another issue which in the estimation of the researcher represented a problem is that in the WBES data set, a good number of variables were not objectively constructed but were derived from the subjective responses received from the firms. This in therefore likely made the estimations susceptible to problematic or inconsistent answers.

In the estimation of the efficiency of firms, we had to resort to the use of the sales revenue as a proxy for the output variable and the monetary values of inputs because these were the most readily available forms they were captured in the survey. Also this approach appeared to us as the most plausible by reason of the fact the analysis cut across different productive sectors and using the monetary values was a good way of standardizing both inputs and outputs.

Areas for future studies

In the study, the researcher relied on cross-sectional data for the empirical analysis looking at the data available. However, as already indicated, it is believed that an analysis based on a strict panel framework would be more advantageous and provide more illuminating evidence with respect to the topic. We therefore recommend that in the future when a very comprehensive panel data set becomes available, other researchers may pick up from this study and broaden the scope of the analysis by integrating into the system dynamic relationships to advance the frontiers of knowledge.

Again, in the analysis of the business environment-innovation-firm performance relationship this study looked at the overall picture in Africa and on basis of the Sub Saharan versus Maghreb African firms. However, another dimension to such an analysis would be by dividing Africa into strict geographical areas-West, East, Central, Southern and North Africa and pursuing a comparative study of the regions when sufficient data is available. Again, a broader comparative study could be executed between firms in Africa and other continents in the World.

Another area which may potentially improve knowledge on the business environment-innovation-firm performance nexus is pursuing the analysis on the basis of specific areas of production in Africa so that a lot of insights peculiar to each productive area may be unearthed to allow policy makers to respond directly to the specific needs of the firms in particular areas of endeavour.

Another dimension in the area which the current study did not focus on but may be interesting to look at is how the performance variables that were at the centre of this study/investigation are related to each other. This it is believed may provide additional insights.

Finally, the current study was unable to cover all the relevant factors and aspects which can be captured under both business environment and innovation. Future studies may want to extend this study by roping in more factors and variables to add more value to the literature.

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APPENDIX

Variable	Obs	Mean	Std. Dev.	Min	Max
Does Establishment Have An Internationally-Recognized Quality Certification?	9,019	.1894889	.3919182	0	1
Time to employees to develop/try out new approach /idea about products/services/marketing	9,019	.2806298	.4493318	0	1
Spend on formal R&D activities in-house; or contracted with other companies	9,019	.1644306	.3706865	0	1
Establishment has its own website	9,019	.4043686	.4907966	0	1
Financial Statements Checked & Certified By External Auditor In Last Fiscal Yr?	9,019	.6056104	.4887463	0	1
Do You Currently Communicate With Clients And Suppliers By E-Mail?	9,019	.1387092	.2106445	0	1
Do You Use Technology Licensed From A Foreign-Owned Company?	9,019	.5970728	.4905135	0	1
technology	9,019	.0952434	.2935671	0	1
Innovation index	**9,019**	**7.65e-09**	**1.000055**	**1.29921**	**2.75404**

Appendix : Multiple correspondence analysis: Burt/adjusted inertias for innovation

Dimension		principal inertia	Percent	Cumul percent
Dim 1		.0504724	83.25	83.25
Dim 2		.0016593	2.74	85.99
Number of obs		9,019		
Total inertia		.06062442		
Number of axes		2		

Variable	Obs	Mean	Std. Dev.	Min	Max
How Much Of An Obstacle is Electricity To Operations Of This Establishment?	9,019	1.872381	1.412727	0	4
How Much Of An Obstacle: Access To Finance	9,019	1.63588	1.381861	0	4
How Much Of An Obstacle: Tax Rates	9,019	1.597073	1.283576	0	4
How Much Of An Obstacle: Tax Administrations	9,019	1.336844	1.281454	0	4
How Much Of An Obstacle: Political Instability	9,019	2.077281	1.517443	0	4
How Much Of An Obstacle: Access To Land?	9,019	1.172746	1.358253	0	4
How Much Of An Obstacle: Corruption	9,019	1.915068	1.487023	0	4

Appendix : Multiple correspondence analysis: Burt/adjusted inertias for business environment

Dimension		principal inertia	Percent	Cumulative percent
dim	1	.0763213	40.11	40.11
dim	2	.0573689	30.15	70.26
dim	3	.0239914	12.61	82.87
dim	4	.0053927	2.83	85.71
dim	5	.0014753	0.78	86.48
dim	6	.0004744	0.25	86.73
dim	7	.0002836	0.15	86.88
dim	8	.0000788	0.04	86.92
dim	9	.0000104	0.01	86.93
Number of obs		9,019		
Total inertia		.19026945		
Number of axes		2		

Summary

Variable	Obs	Mean	Std. Dev.	Min	Max
Business environment	9,019	-9.57e-10	1.000055	-3.429486	1.674843

Sub regional breakdown of firms

	Frequency	Percent
SSA	4857	53.85
MENA	4162	46.15
Total	9019	100.00

Variable	Obs	Mean	Std. Dev.	Min	Max
capacity	9,019	64.49975	17.72708	0	100
logsales	9,018	17.44271	3.589141	0	30.11593
g30a	9,019	1.172746	1.358253	0	4
firm_age	9,019	23.72957	14.55146	5	150
Firm size	9,019	1.526555	.8189639	0	3
manager_ex~r	9,019	17.98924	11.05984	1	90
manager2	9,019	445.9195	525.3083	1	8100
female_top~g	9,019	.1103227	.3133089	0	1
poweroutages	9,019	13.44871	17.16691	0	365
ownerfemale	9,019	.0048786	.0696802	0	1
finance	9,019	.2090032	.4066192	0	1
capital_city	9,019	.3188824	.4660692	0	1
busi_city	9,019	.4059208	.4910966	0	1
market	9,019	.4918505	.6205034	0	2
foreignowner	9,014	10.64966	28.90305	0	100

Summary Statistics for input variables used

Variable	N	Mean	Std. Dev.	Min	Max
Labour	9,019	2.86e+08	1.05e+10	0	9.77e+11
Electricity	9,019	1.98e+07	4.10e+08	0	3.00e+10
Equipment	9,019	4.90e+08	8.73e+09	0	8.00e+11
land	9,019	5.41e+07	5.89e+08	0	4.59e+10
Production cost	9,019	7.42e+07	1.97e+09	0	1.50e+11
Fuel	9,019	1.09e+08	3.61e+09	0	3.35e+11
Raw materials	9,019	6.78e+08	1.22e+10	0	9.30e+11

DEFINITION AND MEASUREMENT OF VARIABLES

Variable	Measurement
Efficiency	It is derived as a percentage with a minimum of 0 and a maximum of 100 from the frontier analysis.
Capacity utilization	Measured as a percentage of the maximum potential capacity of the firm and scaled from 0 to 100.
Sales	Sales is a continuous variable measure as the total annual sales last fiscal yr .
Exports	Exports is a continuous variable consisting of total direct and indirect exports as a % of total annual sales. Innovation is measured as a continuous variable consisting of a composite index constructing using multiple correspondence analysis.
Innovation	Innovation is measured as a continuous variable consisting of a composite index constructing using multiple correspondence analysis using the indicators of innovation
Sex	Sex: is the gender of the respondent measured as a dummy with 1 if respondent is a male and 0 if female.
Manager experience	Manager’s experience is a continuous variable measured as the top Manager's total number of years of experience working in the sector.
Female Top manager	Female top manager is a dummy captured as 1 if the top manager is a female and 0 otherwise.
Power outages	Power outages is a continuous variable continuous variable measuring number of power outages over last fiscal year.
Political instability	It is measured as dummy variable measured as 1 when an economy experiences political instability but 0, otherwise.
Business city	Business city is a dummy with values 1 if the firm is located in main business city and 0 if otherwise.
Capital city	. Capital city is a dummy with values 1 if the firm is located in the official capital city and 0 if otherwise
Tax administration	It is calibrated as a binary variable taking a value of 1 when the mechanism for the administration of tax is smooth and motivating enough, and 0 otherwise.
Customs delays	It captures the average number of days it takes for an official to clear customs.
Foreign Technology	It refers to firms which make use of or do not make use of foreign technology. Those which employ foreign technology are assigned 1 and those which do not are allocated 0.
Ownership	It is defined as binary variable as either foreign or indigenous .When foreign, it is assigned 1 whilst it scaled as 0 when it is indigenous,
Access to finance	It is measured as a dummy variable; 1 for firms which have access to finance and 0 for those which do not have access to finance.
Access to Market	It is measured as 1 or 0, 1 for firms which have access to the market and 0 for those which do not.
Firm size	It is classified categorically as large, medium and small..
Tax rate	Measured as a continuous variable.
Manager experience	Measured as a continuous variable.