Innovation Economics, Productivity, and Internationalization

Evidence from Emerging Market Firms

Doctoral student:

Jude Ndubuisi Edeh

Director:
Prof. Dr. Francisco José Acedo González

To my parents:

Nwatu and *Ifeoma*

ACKNOWLEDGMENTS

During my doctoral education, I have worked with a great number of people whose different contributions deserve special mention. It is a pleasure to express my heartfelt gratitude to them all in this acknowledgment.

This dissertation would not have been possible without the help and support of supervisors: Professors Francisco José Acedo González and Encarnación Ramos Hidalgo. I am tremendously thankful to you for giving me the opportunity and guiding me to explore my area of interest with clarity and working on it with full flexibility. I sincerely appreciate your generosity with your time, energy, and support. Above all, thank you very much for your trust in my abilities.

I owe, in addition, a significant debt of gratitude to the co-authors of one of the papers in this dissertation: Prof. Ramos and Divine Obodoechi. It is always a stimulating and productive experience working with you.

I would never have made it this far without my family. I will always remain indebted to you for your undying care, love and encouragement and support. This is for you: Ezi n’ ulo Edeh, n'ezie e nweghị m ike i kele unu nke ọma màkà ị me m ihe m bụ taa màkà na ọ bụ agụkata agba awaa. Màkà na ọ na abụ e kelee nwaanyị akịdị ọ gwọta ọzọ; ma e too dike na nke o mere o mekwaa ọzọ. Ọfọ m bụ kà Chineke nye unu ihe unu ga-eri na ọ bụghị ihe ga-eri unu, ihe unu ga-achịrị ọchị na ọ bụghị ihe ga-achị unu ọchị. Unu ga-adị kà echi, màkà na echi a naghị agwụ agwụ. Ọ ga-adịrịrị anyị mma n'Eke, Orie, Afọ na Nkwọ.

“An economist is an expert who will know tomorrow why the things he predicted yesterday didn't happen today.”
L.J. Peter (1919-1988)

CONTENT

CONTENT (Extended)

Chapter 5: Innovation Efforts, External Supports and Productivity

Chapter 6: Innovation Strategies and Export Growth

Chapter 7: Conclusion, Limitations and Future Research

Appendix

List of Figures

List of Tables

List of Abbreviations

AMCOST: African Union Ministerial Conference of Science and Technology

ASTII: African Science, Technology and Innovation

CDM Model: Crépon, Duguet, and Maires

EC: European Commission

EU: European Union

FDI: Foreign Direct Investment

ICT: Information and Communication Technology

ISIC: Industrial Classification of all Economic Activities

ISO: International Organization for Standardization

ITC: International Trade Centre

NACETEM: National Centre for Technology Management

NBS: National Bureau of Statistics

NIS: Nigeria Innovation Survey

NSE: Nigerian Stock Exchange

OECD: Organisation for Economic Co-operation and Development

R&D: Research and Development

SME: Small and Medium-sized enterprise

SSA: Sub-Saharan Africa

STI: Science, Technology and Innovation

SBA: Small Business Administration

SPRU: Science Policy Research Unit

Chapter 1

Introduction

1.1. Introduction

In this study, I examine the impacts of firm innovation efforts on labour productivity on one hand; and export growth, on the other hand. Innovation and technological change occur within a context, firms originate from countries, belong to regions, and come in different sizes. In this work, I focus on the small and medium-sized enterprise (SME) sector in a lower-middle income country of Nigeria. I have chosen to study these firms because of their significance to the Nigerian economy. Even though they face high challenges linked to the institutions and business environment, evidence shows that these firms are increasingly investing in innovation activities. Thus, to achieve the goal of this research, I will explore the following issues: (1) determinants of innovations activities, (2) the linkages among external financial supports, research and development (R&D), innovation and labour productivity; and (3) the innovation types driving both labour productivity and export growth of Nigerian SMEs in the manufacturing sector.

In the remaining part of this chapter, I will present the background of the study as well as the research aims and objectives. In addition, I will briefly discuss the method of the investigation used in this study. Finally, I will discuss the significance of the study and then outline the structure of this study.

1.2. Background of the study and research problem

There is a substantial body of literature on issues relating to technology and innovation (Hoffman et al., 1998; Limaj and Bernroider, 2019). Most studies on innovation focus on regional, national, international, and firm levels (e.g. Aguirre-Bastos and Weber, 2018; Li, Liu, and Xie, 2019; Min et al., 2020). Technological change, especially through innovation has been central to the world economic growth, especially since the industrial revolution. More precisely, with the emergence of the industrial revolution, technology accelerated economic prosperity, bringing about a range of new machines and tools, which revolutionised labour, production, and resource use. These new technologies change how we live, think, and work, replacing crude production methods with sophisticated and new methods of managing productions and distributions. In other words, the industrial revolution, powered by technologies, gave birth to modern economic growth.

However, the impact of technologies on economic growth varies widely across countries, regions, and firms. For example, while some countries continue to experience steady economic growth, others still remain at the lowest rung of socio-economic development. This reality shows that there are certain crucial factors underlying productivity gains. Research largely agrees that the level of a country's productivity growth depends on both exogenous and endogenous factors such as physical resources, entrepreneurs, technological change, knowledge, human capital, labour, education, and R&D investment, foreign capital inflows (Acemoglu, Aghion, and Zilibotti, 2006; Aghion, Howitt, and Mayer-Foulkes, 2005). Even though these factors may be common to most of the economies, they

do not always translate into economic prosperity as evident in some countries. This, among other things, implies that productivity growth depends on the ability of a country to transform its resources into outputs, measured commonly in terms of income per capita. Historically, comparisons of productivity across firms, countries, regions of the world have revealed considerable gaps, with some of them converging or catching up over time and others persistently lagging behind. Thus, leaving many scholars struggling to explain the causes.

The differences in productivity growth continue to attract a great deal of attention among many economics, researchers, and policymakers who have focused on examining the determinants of productivity growth. One of the dominant modern economic growth theories examining the differences in income and growth rates between countries, and between regions within countries is the neoclassical growth model. In this model, the dynamics of capital accumulation, together with the exogenous force of technological change, explain the persistent rise of living standards. In other words, the proponents of neoclassical theory argue that the cross-country differences in income per capita depend on capital accumulation and how it is put into use. Contrary to this view, the endogenous theories of growth (such as Schumpeterian theory, new growth theories, evolutionary growth theory) posit that technological change is not only an internal driver of economic growth and development but also it affects outcomes such as life expectancy, levels of democracy, health outcomes, poverty rates, and literacy.

While these theories differ in the conception of technological change, they widely agreed that technology through innovation is central economic growth. As a result, the productivity gap between developing countries has been largely linked to the intensity of investments in knowledge and technologies. In most of the

developing countries such as in the Sub-Saharan African (SSA) region, there are overwhelming challenges that hinder their growth such as inadequate infrastructure, insufficient provision of basic services, inequality, high unemployment and level of illiteracy, among others. The SSA region is well known for its abundant resources; however, the low economic growth in the region clearly reveals the inability of most countries of the region to transform them into outputs. Akisik, Gal, and Mangaliso (2020:1) argue that the coexistence of abundant natural resources with large-scale poverty, squalor, and human deprivation has led to describing the continent as the "paradox of Africa's natural resource wealth" (Panford, 2017). However, given the rich evidence supporting the linkage between technological change and productivity growth, it is believed that the countries of the region can achieve superior economic growth if they invest more in technologies, knowledge, and human capital through high-quality education (Das and Drine, 2020; Shenkoya and Kim, 2020). In other words, the SSA region can solve its economic growth paradox by fully embracing technological change.

The interconnectedness between macroeconomics and microeconomics shows that various factors at the national level hugely influence the behaviour of firms. There are many factors that influence the speed of productivity growth of firms, such as national structures, institutions, and policies. The report of the Growth Competitiveness framework, which is used by the World Economic Forum's Global Competitiveness Report (GCR) to assess the capacity of the world's economies to achieve sustained economic growth, shows that the SSA region is the least competitive region, with 25 of the 34 countries assessed in 2019 scoring below 50 (Schwab, 2019). In its analysis, the GCR focuses on 12 pillars, which centres on enabling environment, human capital, markets, and innovation ecosystem. As

shown in Table 1, the SSA region is at the lowest performance in all the pillars, except in the labour market, where it slightly outperformed South Asia.

Table 1: Regional Performance by Twelve Pillars of Economic Growth

	Enabling Environment				Human Capital		Markets				Innovation Ecosystem	
Region (alphabetical order)	Institutions	Infrastructure	ICT adoption	Macroeconomic stability	Health	Skills	Product market	Labour market	Financial system	Market size	Business dynamism	Innovation capability
East Asia and the Pacific	61.6	74.8	70.3	89.6	83.8	67.3	62.2	66.6	74.3	67.9	66.1	54.0
Eurasia	53.8	67.7	59.5	74.9	71.3	66.1	56.1	63.5	52.0	50.3	61.9	35.5
Europe and North America	64.7	79.7	70.4	92.6	89.1	74.6	60.0	66.4	70.9	60.1	68.3	58.1
Latin America and the Caribbean	47.1	61.3	50.9	73.7	82.2	58.7	51.6	55.9	60.3	51.2	53.8	34.3
Middle East and North Africa	55.5	70.5	57.6	75.3	80.8	62.9	56.7	54.8	63.7	59.9	58.2	41.3
South Asia	50.0	59.2	35.1	74.7	68.4	50.1	45.8	51.5	60.0	67.7	57.8	36.3
Sub-Saharan Africa	46.9	45.0	34.3	69.4	50.8	44.3	49.3	54.6	50.8	40.4	51.8	29.4

Source: World Economic Forum analysis, 2019

In terms of enabling environment, which includes institutions, infrastructure, information, and communication technology (ICT) adoption, and macroeconomic stability, Europe and North America have the overall highest performance with an aggregate of 307. 4 points, followed by East Asia and the Pacific with 296.3 points. When compared to Latin America and the Caribbean (227 points), the survey shows that the SSA region (195.3 points) not only lags behind the developed economies but also other developing countries. The results are similar also in the areas of financial systems, business dynamism, and innovation capability. In other words, these results clearly reveal the SSA region is still underperforming in the core determinants of economic growth; namely technology, high-quality public institutions, and a stable macro-economic environment.

Research shows that these factors to a large extent influence the entrepreneurial activities and innovation performance of firms, especially SMEs (McArthur and Sachs, 2002). Firms supported by well-functioning and efficient

institutional systems not only achieve superior performance but also contribute immensely to national economic growth. More precisely, productivity at the national level depends on the underlying productivity of all firms in the economy. This implies that the countries in the SSA region can increase their aggregate productivity by improving the institutional systems, business environment, and promoting policies that improve the productivity of firms, especially SMEs.

The contributions of SMEs to the economic growth of many countries are undisputed. These firms account for most of the enterprises globally and are major contributors to job creation and economic growth. According to the Annual Report on European SMEs, there are more than 25 million SMEs in 28 EU-member states, accounting for 99.8% of all enterprises and contributing 56.4% of value added and 66.6% of employment in the non-financial business sector. It is predicted that these firms will grow by 4.1% in 2019 and 4.2% in 2020, while the employment rate is expected to grow by 1.6% in 2019 and 1.4% in 2020. These firms are responsible for a significant share of economic growth and new-job generation in developed economies (Bianchi, and Wickramasekera, 2016).

In the Latin American and Caribbean region, the SME sector makes up over 99.5 percent of all firms and generate 60 percent of formal productive employment (OECD/CAF (2019). Across sub-Saharan Africa (SSA), SMEs are an important driver of growth, accounting for over 95% of all enterprises and 60% of total employment (ITC, 2018). They contribute, for example, 49 percent to GDP in Ghana, and 49.78 percent in Nigeria. While the SME sector has been experiencing growth over the past three decades, they still considerably lag behind their peers

not only in the developed countries but also in other developing countries (Quartey et al., 2017).

There are numerous factors linked to the low productivity of the SME sector in the SSA region, ranging from lack of managerial skills, poor infrastructure, and access to the capital market to corruption among others. It is argued that improvements in macro-economic and public institutional policies will enable a conducive business environment and consequently enhance the competitive capabilities of SMEs. OECD Policy Note states that "governments can support innovation in SMEs by fostering a sound business environment, helping SMEs to develop and use their internal strategic resources effectively, and building an innovation system that is effective in the commercialisation of research and inclusive of a large range of SMEs" (OECD, 2018:3). While a significant percentage of SMEs engage in various innovation strategies, especially firms from higher-income countries, most of the countries in the SSA region are yet to invest enough resources in technological change to stimulate innovation and enhance the productivity of SMEs. In other words, efficient public policies and investment in R&D at the national level can enable SMEs to build their internal strategic resources, innovation capabilities, and competitiveness, thereby closing the productivity gap between them and their peers in other parts of the world.

1.3. Research aims and objectives

Even though these firms in general experience a high degree of challenges than their peers in developed countries, evidence shows that they are evolving and engaging in various types of innovation activities (Tekin and Hancioğlu, 2018). Thus, the main objective of this current study is to examine the innovation efforts of these firms in relation to their labour productivity and export growth. Nigeria is an interesting setting given its place in the African economy. Nigeria is not only the most populous country, but also considerably the largest economy in Africa as it overtook South Africa with 2.3% GDP growth in 2019. Besides, Nigeria has the highest number of SMEs in Africa. According to the Nigerian Bureau of Statistics (NBS), SMEs account for 48% of national GDP and account for 96% of all enterprises. They contribute about 50% of industrial jobs and approximately 90% of the manufacturing sector.

The SMEs in the manufacturing sector is selected for empirical investigations in this study. The choice is made for the following two reasons. First, the SMEs in the manufacturing sector represents a high proportion of all SMEs in Nigeria. In terms of employment rate, out of about 2, 889, 714 million persons employed by the SMEs in 2017, the SME in the manufacturing sector employed 606,839.94 thousand persons, resulting in 21 percent of the workforce. Second, manufacturing has traditionally played a key role in economic growth, especially through export intensity. Nigerian SMEs in the manufacturing sector reported the highest number of entities with exportable product entities compared to other sectors. Research has identified export shares as a source of growth for developing

countries. Export growth contributes hugely to capital inflows, employment, expansion of industry, and widening the production base.

The motivation for innovation among Nigerian SMEs in the manufacturing sector can be explained as follows. First, studies suggest that firms from a weak business environment have a higher tendency of entering foreign markets where efficient institutions allow for increased learning opportunities and technology sourcing (Dunning, 1998). This supports the claim that international expansion enables SMEs to explore new resources and capabilities (Fu, Mohnen, and Zanello, 2018). Technology spillover in the context of international expansion allows SMEs from developing countries to make up for the lack of resources (e.g. technology knowledge, human capital) required for innovation activity (Buckley, 1997; Del Giudice et al., 2019). The effect of knowledge spillover enabled by internationalization is both supported theoretically (Romer, 1987; Grossmann and Helpman, 1991) and empirically (Keller, 2004; Buturac, Mikulić, and Palić, 2019). Thus, the motivation to enhance their technological capabilities in the international markets reflects the critical role of innovation on firm growth (Radicic and Djalilov, 2018).

Second, the manufacturing sector consists of a large number of firms producing and marketing a variety of products. The dynamics of the sector is such that there is a high degree of obsolescence and the ensuing situation of a short product life cycle (Koren, 2010). In other words, product life cycles are getting shorter and customers' demands are becoming more diverse, thus spurring SMEs in the manufacturing sector to innovate efficiently and more frequently (Sommer et al., 2015; Nafisi et al., 2019). In recent years, a growing number of empirical studies suggest that the success and failure of SMEs depend largely on their ability

to introduce both new or significantly improve products as well as bring them to the marketplace faster (O'Regan et al., 2006; Mishra, 2016). As manufacturing SMEs in developing countries such as Nigeria are latecomers, they are pressurized to invest in various innovation types to secure competitive parity.

The main objectives of the study are:

1) To examine the determinants of innovations in Nigerian SMEs in the manufacturing sector.
2) To investigate the linkages among external financial supports, innovation efforts, and productivity growth of these firms.
3) To explore the innovation types used by these firms in pursuit of growth strategies.

To achieve these aims and objectives, I will address the following issues:

1) Estimate the impacts of firm-level characteristics as well as exogenous factors determining the innovation capabilities of Nigerian SMEs in the manufacturing sector.
2) Evaluate the effect of financial supports acquired from external sources on the various innovation stages of these firms using a structural modelling approach.
3) Empirically analyse the significance of technological and non-technological innovations to ascertain the innovation types contributing most to the productivity and export growths of these firms.

1.4. Research methodology

This work follows a quantitative deductive method; and uses Nigeria Innovation Survey (NIS) collected by the National Centre for Technology Management (NACETEM). The survey covers firm-level data on innovation activities from wave 1 (2005-2007) and wave 2 (2008-2010). I considered different econometric issues such as heterogeneity, multicollinearity, endogeneity, simultaneity, and selection bias, etc. Furthermore, I develop conceptual frameworks based on the literature review to implement the two empirical strategies used in this study, namely econometric model based on CDM approach and Dynamic Least Square (DOLS) model.

1.5. Significance of the study

This study makes various contributions. First, in contrast to previous studies that relied on innovation indicators such as R&D investment or patents as proxies for innovation output (Aw, Roberts and Winston, 2007), this study uses innovation output variables to better understand the competitive capacity of SMEs in Nigeria. Scholars suggest that productivity and export growth to a large extent depends on the firm's ability to introduce new or improved products and production methods, rather than mere R&D investments (Ganotakis and Love, 2011). Moreover, relying solely on R&D investment as a measure of innovation has a disadvantage of

underreporting the innovative behaviour of firms that do not have a separate R&D department, which nonetheless innovates (Wakelin, 1998). This is particularly true for developing countries, which are dominated by SMEs. Thus, by using innovation output variables as measures of technological innovations, this study contributes to this stream of research by offering new evidence from developing country SMEs. As most of the existing evidence focused on large manufacturing firms in industrialized economies (Higón and Driffield, 2010), this study enhances our understanding of the dimension of technological innovation that affects productivity and export growth of SMEs in developing economies.

Second, the traditional view of innovation is increasingly criticized for ignoring other types of innovations (Grimpe et al., 2017). Technological innovation does not fully explain the innovation activities of firms (Geldes et al., 2016). Mothe and Nguyen (2010) called for more studies explaining the impact of other types of innovation on firm performance. Radicic and Djalilov (2018) note that the lack of empirical evidence on the effect of non-technological innovation is even more prominent in the context of SMEs. To fill this research gap, this study integrates the significance of marketing innovation on the growth performance of SMEs in Nigeria. Thus, by focusing on both technological and non-technological innovations, this study offers a more comprehensive analysis of what innovation types have more significance on the firm's performance. As there are relatively few studies adopting a broad perspective of innovation in the context of developing economies, this study is among the first in SSA to provide empirical evidence on both the individual and joint effects of innovation types on SME growth performance.

Third, there is a substantial body of empirical literature on the relationship between innovation and productivity using the CDM modelling approach. However, the majority of them either focus mainly on developing economies or large firms. Thus, there are still few studies in the context of SSA (e.g. Goedhuys, Janz and Mohnen, 2008; Cirera, Lage and Sabetti, 2016; Fu, Mohnen and Zanello, 2018; Morsy and Amira El-Shal, 2020). Despite the valuable contributions of these studies, surprisingly, there is a dearth of empirical studies explicitly exploring the relationship between innovation efforts and productivity of SMEs notwithstanding their immense contributions to the SSA economy. By filling this research gap, this study makes the following contributions: (1) even though there are prior studies that empirically analysed the impact of innovation on firms using the NIS (e.g. Oluwatope et al., 2016; Sanni, 2018; Medase and Barasa, 2019), to date, there are no studies estimating the linkage between innovation efforts and productivity in Nigeria using the CDM modelling approach. (2) Research shows that the effect of financial constraints on SMEs is more pronounced in developing countries such as Nigeria. It is argued that financial supports from external sources and donors enable these firms to overcome these constraints. However, we know very little about the influence of these supports on the innovation activities and performance of SMEs in SSA regions. To this end, following Griffith et al. (2006) and Aldieri et al. (2019), this study adjusted the original version of the CDM model to accommodate the impacts of external financial supports in the regressions. However, unlike prior studies (Raffo et al., 2008), this study included external financial supports from the state, federal, and foreign governments in the four equations of the CDM model to understand their impacts on the knowledge input stage all the way to productivity.

1.6. Structure of the thesis

This study is organised into 7 chapters. Following this chapter, Chapter 2 provides a theoretical background and reviews the literature on innovation, technological change, and economic growth. I begin by offering some preliminary remarks on the concepts of innovation and productivity measurements. Next, given the importance of understanding the determinants of economic growth, I review four main modern economic theories of growth, highlighting the role of technological change in productivity growth. Finally, I explore the implications of technological change on the economic growth of the SSA region.

Chapter 3 presents the profile of SMEs in Nigeria and discusses their significance to the Nigerian economy. While innovation is the main driver of productivity gains of firms, there are several factors influencing both the decision and innovation capabilities of firms. In this chapter, I will discuss the impacts of both the country-specific factors (lack of access to a reliable power supply, ill-functioning legal system and lack of access to financial resources) and firm-characteristics (firm size, firm age, company training, cooperation, and international trade) on the innovation activities of SMEs in Nigeria.

The measurement of innovation activities is a very challenging task due to the availability of appropriate data as well as the choice of innovation indicators. The task is even more daunting in the context of developing country SMEs, where firm-level data are not readily available and comprehensive compared to the developed countries. In chapter 4, I will discuss the two main approaches used in the collection of innovation data; in turn, highlight the main challenges of collecting innovation data in developing countries. In addition, I will present the

data as well as discuss the three innovation output variables used in the empirical section of this research.

Furthermore, research suggests that public financial supports help improve the innovation capabilities and productivity performance of SMEs. In chapter 5, I will empirically answer the following question: 'to what extent does external financial supports affect the various innovation stages – knowledge input, innovation output, and productivity – of Nigerian SMEs? To answer this question, I will estimate an econometric structural model. In so doing, I will also identify other determinants of innovation efforts as well as the types of innovation that exert a more significant impact on the productivity of SMEs in Nigeria.

On one hand, international markets allow these firms to explore new resources and capabilities that are absent in their home markets. On the other hand, innovation is the main source of competition and dynamic market efficiency. However, given the challenges hampering the internal capabilities of SMEs in Nigeria, it is unclear whether these firms grow faster and are more efficient in the export markets. Thus, in chapter 6, I will estimate the impacts of various innovation types on export growth. In so doing, this study will enhance our knowledge of the relationships among dynamics of technology, market domains, and export growth in the context of developing country SMEs.

Finally, in chapter 7, I will discuss the empirical results and the contributions of the research to knowledge. I will outline the limitations of the studies as well as provide future research directions.

References

Acemoglu, D., Aghion, P., and Zilibotti, F. (2006). Distance to frontier, selection, and economic growth, Journal of the European Economic Association, 4,1, 37-74.

Aghion, P. Howitt, P., and Mayer-Foulkes, D (2005). The effect of financial development on convergence: Theory and evidence, Quarterly Journal of Economics, 120,1,173-222.

Aguirre-Bastos, C., and Weber, M. K. (2018). Foresight for shaping national innovation systems in developing economies, Technological Forecasting and Social Change, 128, 186-196.

Akisik, O., Gal, G., and Mangaliso, M. P. (2020). IFRS, FDI, economic growth, and human development: The experience of Anglophone and Francophone African countries, Emerging Markets Review. DOI: https://doi.org/10.1016/j.ememar.2020.100725.

Aw, B. Y., Roberts, M. J., and Winston, T. (2007). Export market participation, investments in R&D and worker training, and the evolution of firm productivity. World Economy, 30(1), 83–104.

Bianchi, C, and Wickramasekera, R. (2016). Antecedents of SME export intensity in a Latin American Market, Journal of Business Research,69, 10, 4368-4376.

Buturac, G., Mikulić, D., and Palić, P. (2019). Sources of export growth and development of the manufacturing industry: empirical evidence from Croatia, Economic Research-Ekonomska Istraživanja, 32:1, 101-127.

Das, G.G, and Drine, I. (2020). Distance from the technology frontier: How could Africa catch-up via socio-institutional factors and human capital? Technological Forecasting and Social Change, 150. DOI: https://doi.org/10.1016/j.techfore.2019.119755.

Del Giudice, M., Scuotto, V., Garcia-Perez, A., and Messeni Petruzzelli, A. (2019). Shifting Wealth II in the Chinese economy. The effect of the horizontal technology spillover for SMEs for international growth. Technological Forecasting and Social Change, 145,307-316.

Dunning, J.H. (1998). Location and the multinational enterprise: a neglected factor? Journal of International Business Studies 29(1): 45–67.

Fu, X., Mohnen, P., and Zanello, G. (2018). Innovation and productivity in formal and informal firms in Ghana, Technological Forecasting and Social Change,131(C),315-325.

Ganotakis, P. and Love, J.H. (2011), R&D, product innovation, and exporting: evidence from UK new technology-based firms, Oxford Economic Papers, Vol. 63 No. 2, pp. 279-306.

Geldes, C., Felzensztein, C., and Palacios-Fenech, J. (2016). Technological and non-technological innovations, performance, and propensity to innovate across industries: The case of an emerging economy. Industrial Marketing Management, 61,55 – 66.

Grimpe, C., Sofka, W., Bhargava, M., and Chatterjee, R. (2017). R&D, Marketing Innovation, and New Product Performance: A Mixed Methods Study. J Prod Innov Manag, 34: 360-383.

Grossman, G. M., and Helpman, E. (1991). Innovation and Growth in the Global Economy. Cambridge: MIT Press.

Higón, D., and Driffield, N. (2011). Exporting and innovation performance: Analysis of the Annual Small Business Survey in the UK. International Small Business Journal. 29. 10.1177/0266242610369742.

Hoffman, K., Parejo, M., Bessant, J., and Perren, L. (1998). Small firms, R&D, technology, and innovation in the UK: a literature review, Technovation,18, 1, 39-55.

Keller, W. (2004). International technology diffusion. Journal of Economic Literature, 42(3), 752–782.

Koren, Y. (2010). The Global Manufacturing Revolution: Product-Process-Business Integration and Reconfigurable Systems, John Wiley & Sons.

Li, Y., Liu, Y. and Xie, F. (2019). Technology directors and firm innovation, Journal of Multinational Financial Management,50,76-88.

Limaj, E., and Bernroider, E. W.N. (2019). The roles of absorptive capacity and cultural balance for exploratory and exploitative innovation in SMEs, Journal of Business Research, 94,137-153.

Maruf Sanni, M. (2018). Drivers of eco-innovation in the manufacturing sector of Nigeria, Technological Forecasting and Social Change, 131,303-314.

McArthur, J. W., and Sachs, J. D. (2002). 'The Growth Competitiveness Index: Measuring Technological Advancement and the Stages of Development', in M. E. Porter, J. D. Sachs, P. K. Cornelius, J. W. McArthur and K. Schwab (eds.), The Global Competitiveness Report 2001–2002, New York: Oxford University Press, 28–51.

Medase, K., and Barasa, L. (2019). Absorptive capacity, marketing capabilities, and innovation commercialisation in Nigeria, European Journal of Innovation Management,22, 5, 790-820.

Min, S. Kim, J., and Sawng, Y-W. (2020). The effect of innovation network size and public R&D investment on regional innovation efficiency, Technological

Forecasting and Social Change, 155. DOI: https://doi.org/10.1016/j.techfore.2020.119998.

Mishra, R. (2016); A comparative evaluation of manufacturing flexibility adoption in SMEs and large firms in India, Journal of Manufacturing Technology Management, 27, 5,730-762.

Mothe, C., and Nguyen, T. (2012). The impact of non-technological on technological innovations: do services differ from manufacturing? An empirical analysis of Luxembourg firms, Post-Print, HAL.

Nafisi, M., Wiktorsson, M., Rösiö, C., and Granlund, A. (2019). Manufacturing Engineering Requirements in the Early Stages of New Product Development—A Case Study in Two Assembly Plants. Advanced Applications in Manufacturing Engineering, 141–167.

Oluwatope, O. B., Adeyeye, A. D., Egbetokun, A., Sanni, M., Aremu, F. S., and Siyanbola, W. O. (2016). Knowledge sources and innovative performance: evidence from Nigerian manufacturing firms, International Journal of Business Innovation and Research, 10, 2/3, 209-224.

O'Regan, N., Ghobadian, A., and Gallear, D. (2006). In search of the drivers of high growth in manufacturing SMEs, Technovation,26,1,30-41.

Panford, K. (2017). The Paradox of Africa's Natural Resource Wealth: How Ghana's Petroleum Can Create Sustainable Economic Prosperity, Palgrave MacMillan, New York, NY.

Quartey, P., Turkson, E., Abor, J. Y. and Iddrisu, A. M (2017). Financing the growth of SMEs in Africa: What are the constraints to SME financing within ECOWAS? Review of Development Finance,7, 1,18-28.

Radicic, D. and Djalilov, K. (2019), The impact of technological and non-technological innovations on export intensity in SMEs, Journal of Small Business and Enterprise Development, 26, 4,612-638.

Romer, P. M. (1987). Growth based on increasing returns due to specialization. The American Economic Review, 77(2), 56–62.

Schwab, K. (2019). The Global Competitiveness Report, World Economic Forum, Cologny/Geneva Switzerland.

Shenkoya T. and Kim, E. (2020). The impact of technology transfer/policies on the economic catch-up of the Korean National Innovation System and its implications for Nigeria, African Journal of Science, Technology, Innovation and Development, DOI: 10.1080/20421338.2020.1799536.

Sommer, A.F., Hedegaard, C., Dukovska-Popovska, I., and Steger-Jensen, K. (2015). Improved product development performance through agile/stage-gate

hybrids: the next-generation stage-gate process? Research-Technology Management 58, 34–45.

Tekin, E., and Hancıoğlu, Y. (2017). The effects of innovation on export performance in developing countries. In Bilici, N., Akgül, B., and Pehlivanl, R. (eds.). Global Issues in Social Sciences Different Perspectives–Multidisciplinary Approaches, Peter Lang GmbH.

Chapter 2

Technological Progress, Innovation and Productivity Growth

Productivity isn't everything, but in the long run, it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker.
Paul Krugman (1994)

2.1. Introduction

Productivity is important because it helps us understand how efficiently a country or firm transforms its available resources into economic values in the long run. In this regard, productivity growth is probably one of the most crucial ingredients of economic prosperity. It improves a country's standards of living and quality of life in several ways. For example, productivity growth can enhance the situations of a country facing development challenges such as inadequate infrastructure, poor access to basic services, widening inequality, rising unemployment, etc. While there is no single path *per se*, technological change has been widely identified as a major source of sustained economic growth (Mokyr, 2005; Bogliacino and Pianta, 2011; Zhou, Song, and Cui, 2020). Generally, technological change refers to the rate at which new ideas are generated, new products and methods of production are introduced and adopted by nations as well as firms. This definition highlights the three main elements of technological change, namely invention, innovation, and diffusion (Jaffe, Newell and Stavins, 2003). In other words, it is the interplay of these elements that improve the real output, social conditions, and wellbeing of society. Similarly, a faster rate of growth of technological change leads to a faster

rate of productivity growth, all other things being equal. In addition, technological change confers competitive advantages and superior economic performance in both nations and firms (Grossman and Helpman, 1991). Wurth (1993: 230) argues that "growth in productivity growth has become a measure, if not a definition, of technological progress and economic advance". The persistent and wide difference in productivity over time and between countries largely explains why this subject-matter continues to attract the attention of both scholars and policymakers (Palma and Reis, 2019). Given the evidence from developed countries, it is argued that the productivity gap in developing countries is largely due to insufficient investments in technology through innovations (Cirera, Lage and Sabetti, 2016; Niebel, 2018).

Thus, the purpose of this chapter is to review the relevant literature supporting the linkages between technological change and productivity growth. The chapter is structured as follows: In Section 2.2, I will offer some preliminary remarks on the concepts of innovation and productivity measurements. In Section 2.3, I will present the modern economic growth theories, highlighting the role of technological change in productivity growth. Finally, in Section 2.4, I will explore the implications of technological change in the economic growth of the SSA region.

2.2. Concept of Innovation

Scholars and practitioners across a wide range of disciples have focused much attention on the concept of innovation (Damanpour and Schneider, 2006; Baregheh, Rowley, and Sambrook, 2009). The term innovation is from a Latin word *'innovare'*, which literally means 'to renew' or 'to make something new'. Even though innovation in itself is not a new phenomenon, it is only in the 20th century

that it received systematic documentation in the literature. More precisely, the *opus* of an Austrian economist, Joseph Alois Schumpeter is widely regarded as a seminal contribution to modern innovation research (Michaelides and Milios, 2009; Eggink, 2013; Cantner and Dopfer, 2015). In 'Theory of Economic Development' (originally published in 1911 under the title *Theorie der wirtschaftlichen Entwicklung*) Schumpeter (1934) defined innovation as follows:

> (1) The introduction of a new good – that is one with which consumers are not yet familiar – or a new quality of a good.
> (2) The introduction of a new method of production, that is one not yet tested by experience in the branch of manufacture concerned, which need by no means be founded upon a discovery scientifically new, and can also exist in a new way of handling a commodity commercially.
> (3) The opening of a new market, that is, a market into which the particular branch of manufacture of the country in question has not previously entered, whether or not this market has existed before.
> (4) The conquest of a new source of supply of raw materials or half-manufactured goods, again irrespective of whether this source already exists or whether it has first to be created.
> (5) The carrying out of the new organization of any industry, like the creation of a monopoly position (for example through trustification) or the breaking up of a monopoly position.

Schumpeter stresses the role of new combinations of existing elements and forces in the innovation process, especially within the industrial context (Malerba and McKelvey 2020). Kurz (2012: 883) suggests that new combinations are "the systematic production of new, economically useful knowledge out of existing knowledge". Schumpeter highlights the multifaceted nature of innovation by distinguishing the different types of innovations, ranging from technological innovation to non-technological innovation. Over the years, innovation has been

conceptualized variously by scholars. Thompson (1965: 2) defines innovation as "the generation, acceptance, and implementation of new ideas, processes products or services". Plessis (2007) notes that: "innovation as the creation of new knowledge and ideas to facilitate new business outcomes, aimed at improving internal business processes and structures and to create market-driven products and services." According to Damanpour (1996, p. 694):

> Innovation is conceived as a means of changing an organization, either as a response to changes in the external environment or as a pre-emptive action to influence the environment. Hence, innovation is here broadly defined to encompass a range of types, including new product or service, new process technology, new organization structure or administrative systems, or new plans or program pertaining to organization members.

Furthermore, the Oslo Manual refers to it as “the implementation (commercialization) of a new or significantly improved product (good or service), or process, or a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (OECD, 2005: 31). This definition, which is rooted in Schumpeter's ideas, clearly distinguishes between four types of innovation, namely, product, process, marketing, and organizational innovations. The Oslo Manual's definition shifts the emphasis of innovation from being merely an in-house activity to include external relations. In other words, it emphasizes the importance of collaborations with other external agents in the introduction and commercialization of innovations (Hartley, Sørensen, and Torfing, 2013).

While there are some differences in the various definitions, they largely agree on the following basic features of innovation. First, *novelty* – innovation emerges from "the doing of new things or the doing of things that are already done, in a new way" (Schumpeter, 1947: 151). However, it is good to note that the notion of novelty includes both 'new-to-the-world', 'new-to-the-market', and 'new-to-firm' (OECD, 2009). Against a restrictive notion of novelty, Van du Ven et al. (1986) argue that "as long as the idea is perceived as new to the people involved, it is an 'innovation' even though it may appear to others to be an 'imitation' of something that exists elsewhere". This has important implications for developing countries, where incrementalism and imitation dominate innovation activities (Li and Huang, 2019; Wang and Chen, 2020). Nonetheless, the Oslo Manual does not recognize minor and insignificant changes or those with insufficient level of novelty as innovation (OECD, 2005: 37). The second feature is the distinction between innovation and invention. Innovation is not a mere invention, that is, the initial generation of new ideas. For example, a firm may generate and develop new ideas; however, they must be realized and commercialized to be regarded as innovations. In other words, innovation is the realization and the extraction of (economic) values from generated ideas.

2.3. Measurement of Productivity

Productivity is the ability to convert inputs (e.g. labour, capital, land, raw materials, and information) into output. It is an increase in the value of outputs produced for a given level of inputs, typically over a specific period of time. Thus, the productivity

of a firm or country grows when they produce more outputs per unit of input. Moss (1979: 276) writes that "efficient production of goods and services is a primary goal of economic effort, and statistical measurement of productivity is an important tool for monitoring and promoting its advances". The measurement of productivity is not always straightforward given that scholars consider productivity growth both as exogenous and endogenous factors. However, it has become common in the literature to measure it in two main ways.

2.3.1. Total factor productivity

Total factor productivity (TFP) is regarded as a part of output growth that cannot be explained by input growth (Comin, 2008). The unexplained portion is often referred to as the Solow residual, which captures the impact of technological change on productivity when the variations in capital and labour inputs are subtracted from the output growth per head (Solow, 1957). TFP is the ratio of total output to total production inputs. Thus, growth in TFP implies that more output is being produced from a constant amount of resources used in the production process. We shall return to the assumptions of this productivity measurement later in this chapter when we discuss the Solow's model of economic growth. Suffice to say that one of the challenges of estimating TFP is the difficulty of capturing all the factors of productivity in a single model. Besides, scholars suggest that it is not fitting for measuring technological change, especially improved technologies

embedded in new machinery and equipment (Jorgenson and Stiroh, 1999; Lipsey and Carlaw, 2004).

2.3.2. Partial Factor Productivity

Partial factor productivity (PFP) refers to the measure of produced output per unit of each input used. Unlike the TFP, this measurement calculates each input (i.e. factor of productivity such as capital productivity, labour productivity, or energy productivity) separately. For example, capital productivity measures how efficiently physical capital is used in producing goods and services. It is expected that an improvement in physical capital will lead to an increase in output. For the purpose of this work, I will focus on labour productivity at the firm level, which is the total volume of output produced per unit labour. Labour productivity is assumed to grow, when the output grows faster than the inputs, which, in turn, makes the existing inputs more productively efficient. We shall return to this measurement in the subsequent section.

Taken together, the choice of either TFT or PFP depends on the study's objective, availability, as well as the nature of data in question. In our case, PFP is more fitting in ascertaining the impact of innovation activities on the growth performance of firms. In addition, the availability of microdata from the innovation survey allows us to estimate these relationships.

2.4. Modern Theories of Economic Growth

The relationship between economic structure and productivity growth has received a sustained attention. Due to the significance of productivity growth to the wellbeing of a country or a firm, economists have attempted to explain why some countries grow fast and enjoy long-term economic prosperity, while others lag behind. For example, these scholars are interested in understanding whether economic growth is a static or dynamic process; whether technological change determines productivity growth exogenously or endogenously? Thus, in this section, I will discuss four main modern economic theories dealing with the linkage between technological progress and productivity growth.

2.4.1. Schumpeter' Theory of Economic Growth

As pointed out above, Schumpeter's work is of great interest to technological change in the process of economic growth. By moving away from the notion of market equilibrium, Schumpeter explains why and how a disruptive disequilibrium force, which enables growth in the economy, is created. According to him, new combinations of forces and materials creates a continuous market disequilibrium. He writes "the development is a spontaneous and discontinuous change in the channels of the circular flow, disturbance of equilibrium which forever displaces the equilibrium state previously existing" (Schumpeter, 1934: 64). Unlike the

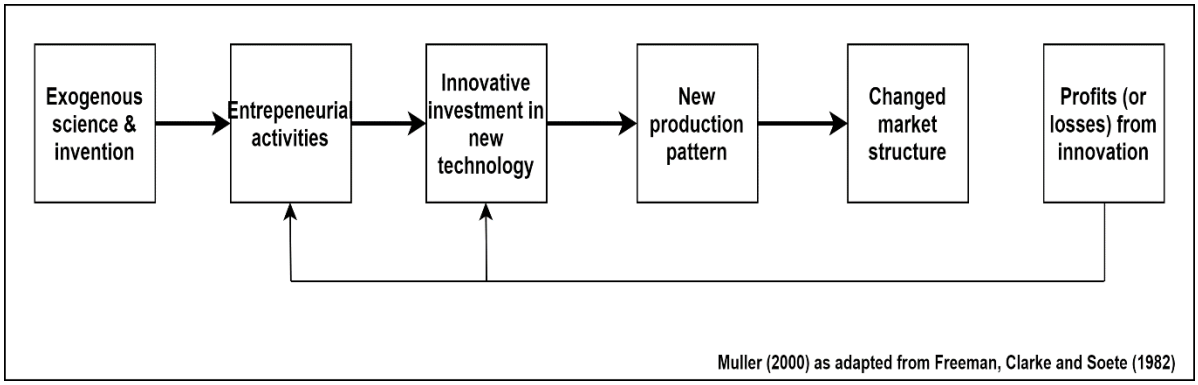
concept of circular flow based on perfect competitive equilibrium, he argues that a change in the existing production system, embodied in new and radical innovations, determines productivity growth. Schumpeter's thoughts have been categorized into two main patterns of innovation activities, namely, Schumpeter Mark I and Schumpeter Mark II (Nelson and Winter, 1982; Kamien and Schwartz, 1982).

In the former, Schumpeter argues that the entrepreneur is the main agent of disequilibrium. That is, agents (e.g. entrepreneurs and new small firms) creatively destroy existing systems in search of profits. Hérbert and Link (1989:39) note that entrepreneurship "pertains to the actions of a risk-taker, a creative venturer into a new business or the one who revives an existing business". More precisely, equipped with new products, new processes, or new sources of supply, the entrepreneurs can launch new enterprises that challenge the established firms. In so doing, they open up markets, defeat monopoly, and thus, win the price competition. Thus, unlike a competitive equilibrium condition, where the price of each product equals its cost of production, Schumpeter argues that dynamic changes from innovations create profits for entrepreneurs in an industry. He writes:

> It is not ...[price] competition which counts but the competition from new commodity, the new technology, the new source of supply, the new types of organisation ... competition which commands a decisive cost or quality advantage and which strikes not at the margins of the profits... of the existing firms but at their foundations and their very lives (Schumpeter, 1943:84).

In short, innovation is essentially a competitive process that shapes the market structure through creative destruction. On Schumpeter Mark I, economic growth is driven by the demand for innovative goods and services, and the profit-seeking entrepreneurial firms lead this process by replacing old technologies with ones (Acemoglu, 2009; Batabyal and Yoo, 2018). Malerba, (2007: 353) writes that the Schumpeter Mark I is characterized by "high technological opportunities, low appropriability, and low cumulativeness (at the firm level) conditions and a limited role of generic knowledge are more likely to lead to low degrees of concentration of innovative activities with a relatively large number of innovators, high rates of entry and high instability in the hierarchy of innovators".

Figure 2.1: Schumpeter Mark I Model



Furthermore, in the second pattern of innovation activities (Schumpeter Mark II), Schumpeter shifts his emphasis from small firms/entrepreneurs to the roles of in-house R&D and large firms in technological innovation activities.[1] According to

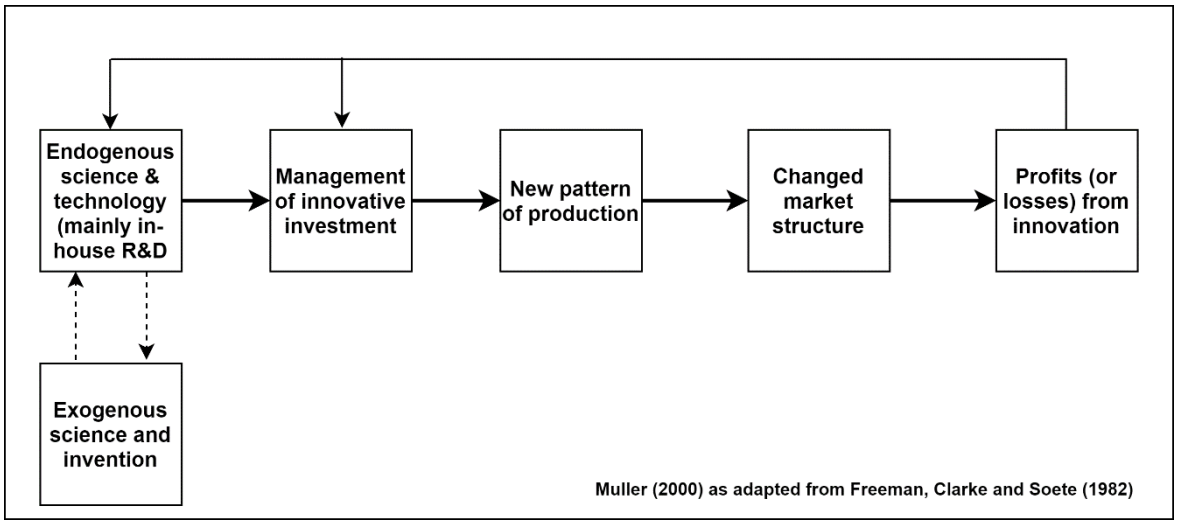
[1] In contrast to Mark I, Malerba (2007: 353) notes that Schumpeter Mark II is characterised by "high appropriability and cumulativeness (at the firm level) conditions and a generic knowledge are more generally associated with high degrees of concentration of innovation activities, low rates of

him, in concentrated markets, larger firms possess more capability to be innovative than smaller firms. For example, they enjoy the advantages of economic scale, high market shares, and financial resources more than the smaller firms. These factors not only enable large firms to innovate more efficiently, but also create entry barriers to new entrepreneurs and small firms (Malerba and Orsenigo, 1995). Galbraith (1952) suggests that implementing successful R&D activities are costly; and they often involve high risks that are unfavourable to small firms. Similarly, Arrow (1962) argues that uncertainty as well as the high cost linked to protecting innovation against potential rivals are more likely to reduce the innovative propensity of small firms. Malerba and Orsenigo (1995:48) likened Schumpeterian Mark I and Mark II to the concepts of widening and deepening:

> A widening pattern of innovative activities is related to an innovative base, which is continuously enlarging through the entry of new innovators, and to the erosion of the competitive and technological advantages of the established firms. A deepening pattern of innovation, on the contrary, is related to the dominance of a few firms which are continuously innovative through the accumulation over time of technological and innovative capabilities.

entry and remarkable stability in the hierarchy of innovators. Given the above conditions, this patter is compatible both with low and with high technological opportunities".

Figure 2.2: Schumpeter Mark II Model



Although Schumpeter's research occupies a pride of place in the economic growth literature, it has been criticised on several grounds. First, it fails to recognise the role of incremental innovations in economic growth. Research shows that changes via the gradual improvement of existing products or production methods can increase both competitiveness and productivity gains (Witt, 2002; Wojan, Crown and Rupasingha, 2018). This omission has implications for small firms, especially in developing countries where firms innovate incrementally to survive and grow (Woschke, Haase, and Kratzer, 2017).

Second, concerning Schumpeter Mark II Arrow (1962) argue that innovation intensity is higher in competitive industries. More precisely, he argues that the incentives to invest in innovation under a monopolistic context is lesser than in a competitive market. This is because the monopolist firm is reluctant to introduce new products or methods of production that will replace its existing ones. However, under a competitive context, firms with new knowledge can replace the status quo (that is, the products and goods of its rivals) and take over the market.

In other words, Schumpeter's Mark II would hold only in monopolistic markets and concentrated industries with high entry barriers. Nonetheless, in reality, small and entrepreneurial firms with radical innovations can still overcome the entry barriers and achieve superior performance (Pavitt, Robson, and Townsend, 1987; Acs and Audretsch, 1988; Saunila, 2019). In summary, even though large firms have more resources, small firms can leverage the advantage of adaptability and entrepreneurial orientation to implement different types of innovation.

Third, scholars argue that Schumpeter's analysis does not fully explain how important factors such as international knowledge diffusion and government interventions affect economic growth (Fagerberg, 2003). As we shall see later in chapter 5, government supports can influence both innovation and productivity (Garcia and Mohnen, 2010; Wei and Liu, 2015). Regardless of these limitations, Schumpeter's theory of economic growth continues to shape both conceptual and empirical studies on entrepreneurship, innovation, competitiveness, and productivity growth (Bodrožić and Adler, 2018).

2.4.2. From Keynesian to Neoclassical model of economic growth

Harrod (1939) and Domar's (1946) works were one of the earliest spin-offs of Keynes' (1936) General Theory. These scholars were interested in understanding under what conditions an economy achieves a steady-state growth. In their view, instability in economic growth is due to the gap between a 'warranted rate of growth' and 'natural' rate of growth. The former is determined by the savings rate and a given capital requirement per unit of output. The latter, which is the optimal

long-run growth rate, is dependent on the growth rate of the workforce and growth rate of output per employee. The Harrod-Domar model posits that economies can achieve rapid growth by a continued increase in the savings rate and investment. However, this model is rigid as it does not accommodate any exogenous changes in the investment rate as well as other shocks to all the parameters of its production function. In other words, the so-called knife-edge property does not explain the actual observed income growth rates.

The next stream of modern economic growth theory, championed by Robert M. Solow (1956) and Trevor W. Swan (1956), launched the neo-classical agenda. Building on Harrod-Domar model, Solow transformed the output-capital ratio parameter into an endogenous variable and added labour as a factor of production. He was "devoted to a model of long-run growth which accepts all the Harrod-Domar assumptions except that of fixed proportions" (Solow, 1956: 66). This approach not only allows for the substitution between capital and labour but also assumes that a constant portion of the output is invested. In its basic form, Solow model posits that capital accumulation and how it is deployed determines economic growth, albeit temporarily. Put differently, economic growth is driven in the short and medium run by capital accumulation via savings rate. This implies that countries that succeed in increasing their savings rate will grow faster and achieve a higher level of growth than their counterparts. Besides, given that growth rate declines as the economy progresses towards its steady state, the model predicts that developing countries will grow relatively faster and converge with the developed countries. Solow (1988: 308) states that:

> A developing economy that succeeds in permanently increasing its saving (investment) rate will have a higher level of output than if it had not done

> so, and must therefore grow faster for a while. But it will not achieve a permanently higher rate of growth of output. More precisely, the permanent rate of growth of output per unit of labour input is independent of the saving (investment) rate and depends entirely on the rate of technological progress in the broadest sense.

In other words, technological change, which Solow termed "any kind of shift in the production function"[2], is central to the long-term productivity growth in the neoclassical model. The Solow's growth model can be represented as an aggregate production function thus:

$$Q=F(K, L; t) \qquad (1)$$

Where Q is the aggregate output, K and L are the factors of production capital and labour in physical units; and *t* is time, representing the level of technology available at the moment. Nonetheless, unlike Schumpeter's model, the impact of technological change on growth is independent of the model, that is, it is an exogenous force. Solow assumes that technological change is a Hicks-neutral, implying that shifts in the production function does not affect the marginal rates of substitution between factors at given ratios of capital and labour (Solow, 1957: 312 and 316). Analysing this model, scholars argue that technology becomes a "manna from heaven", such that for any given ratio of input (i.e. capital or labour), there is a proportionally increase in the total output (Reati, 2012; Domjahn, 2016). Thus,

[2] Solow adopts an idea of technological change to account for economic growth: "Slowdowns, speed-ups, improvements in the education of the labour force, and all sorts of things will appear as technical change" (Solow, 1957:312).

the aggregate production function for the composite final output is written as follows:

$$Q = A(t)\, f(K, L) \qquad (2)$$

Where the multiplicative factor A (t) estimates the cumulated effect of shifts over time; and represents technological change (more precisely TFP growth). As we noted above, TFP captures all the factors (inputs) of productivity that affect aggregate output Q, with the exception of labour and capital. However, it is worth noting that A is exogenous to the model. When equation (2) is differentiated in terms of time and divided by Q, the following is obtained:

$$\frac{\dot{Q}}{Q} = \frac{\dot{A}}{A} + w_K \frac{\dot{K}}{K} + w_L \frac{\dot{L}}{L}$$

Where the relative share of capital and labour is represented as:

$$w_K = \frac{\partial Q}{\partial K}\frac{K}{Q} \quad and \quad w_L = \frac{\partial Q}{\partial L}\frac{L}{Q}$$

Assuming that factors are paid, their marginal product is equivalent to the hypothesis of Euler's theorem

$$w_K + w_L = 1$$

Then let

$$Q/L = q \quad K/L = k \quad w_L = 1 - w_K$$
$$\dot{q}/q = \dot{Q}/Q - \dot{L}/L$$

Thus, equation (3) is can be written as follows:

$$\frac{\dot{q}}{q} = \frac{\dot{A}}{A} + w_K \frac{\dot{k}}{k}$$

The main drivers of the Solow's growth model are the notions of pure and perfect competition in product as well as in capital, constant returns to scale, perfect substitutability between capital and labour, and diminishing marginal productivity of labour and capital. In this view, there is no need for investing in the capital beyond the constant return to scale point due to the impact of the law of diminishing returns. In contrast to this position, the labour productivity theory assumes that economic growth is a function of not only investments in physical capital, but also human capital and technology. The neoclassical model of growth continues to influence economic analysis (Li and Tanna, 2019; Neto, Claeyssen, and Júnior, 2020). Acemoglou (2009: 37) writes that 'this model has shaped the way we approach not only economic growth but the entire field of macroeconomics".

2.4.3. New Growth Theory

The Solow-Swan model has been criticised, especially for its inability to fully explain the role of technological change in economic growth (Ruttan, 1998). More precisely, by treating technological change and knowledge as exogenous factors, Solow-Swan failed to explain the process underlying the long-term growth with the Keynesian tools (Cavusoglu and Tebaldi, 2006). Regarding this, Barro and Sala-i-Martin (1995: 11) writes "we end up with a model of growth that explains everything

but long-run growth, and obviously unsatisfactory situation". Thus, the main motivation of the new growth theorists is to propose models that ensure that the long-run economic growth depends on endogenous forces (Romer, 1986, 1991, Lucas, 1988).[3] According to Romer (1986: 1003), what is required is “an equilibrium model of endogenous technical change in which long-run growth is driven primarily by the accumulation of knowledge by forward-looking, profit-maximizing agents". This assumption brings back the image of the Schumpeterian entrepreneurs who in the hunt for profit causes changes through her innovations. Here, knowledge is not only an input to the production of new goods, but also production creates further knowledge. [4] Even though the creation of new knowledge may display diminishing returns at the firm level, it has positive spillover effects on the technology production of other firms (Romer, 1986). This implies that knowledge is a public good, which can be exploited by others repeatedly and indefinitely (Grossman and Helpman, 1991). Barro and Sala-i-Martin (1995: 12) argue that the "spillovers of knowledge across producers and external benefits from human capital are parts of this process, but only because

[3] It is worth noting that the new growth theorists departed from the neoclassical model by abandoning the idea of perfect competition and homogeneous products and constant returns in favour of imperfect competition and increasing returns. Ruttan (1998:5) states that "an important implication of the model is that the market equilibrium is suboptimal since the external effects of the accumulation of knowledge is not considered by the firm in making production decisions".

[4] Unlike in the neoclassical theory, where new production factors are exogenous and assumed to appear from time to time, the new growth theorists, similar to Schumpeter's thought, conceive production as a dynamic process that is determined by innovation embedded in the model.

they help avoid the tendency for diminishing returns of the accumulation of capital".

Another factor that plays a vital role in the new growth model is human capital. Lucas (1988) endogenizes human capital in the development of new knowledge and innovation. In this view, the level of human capital accumulation explains the variations in per capita output across countries. More precisely, due to the presence of the scale-effect of human and physical capitals, "economies that are initially poor will remain poor, relatively, though their long-run rate of income growth will be the same as that of initially (and permanently) wealthier economies" (Lucas 1988: 39). Similarly, Romer (1990: S99) argues that "an economy with a large total stock of human capital will experience faster growth" Therefore, unlike the neo-classical assumption, the endogenous model predicts the idea of divergence.

Moreover, scale-effect plays a vital role in the development of technology. As innovation is costly, the success of generating profit depends largely on the size of the market. For example, large markets enable profit-making firms to produce a large number of intermediate goods, increase production possibilities, and productivity growth. In other words, large economies investing in knowledge can generate technological progress and grow faster than small economies (Aghion and Howitt 1998; Peretto and Smulders 2002). This implies that policy intervention can have an impact on the long-run growth rate of the economy. Evidence shows that policy intervention subsidies for R&D initiatives or grants stimulate innovations (Shaw, 1992).

2.4.4. Evolutionary theory of economic growth

The new growth theory is limited in its explanation of the institutional complexity and economic growth at the macro-level. However, this limitation led to the development of alternative approaches, of which the evolutionary theory of economic growth has been found to be very influential. The most notable expression of this theory is found in the work of Richard Nelson and Sidney Winter (1982), who adopted and extended several aspects of Schumpeter and Thorstein Veblen's thoughts (Hodgson, 1996; Eggink, 2013). In 'An Evolutionary Theory of Economic Change' these authors regarded technological change and dynamic competition as the main drivers of economic growth in capitalist economies. They employed biological concepts and metaphors to study the capabilities and behaviour of firms. Just as animal species compete for survival and growth in the natural environment, the market environment, governed by the mechanism of selection and variety, determines the success of firms (Castellacci, 2008). In addition, the notion of bounded rationality is pivotal to Nelson-Winter's evolutionary theory (Simon, 1959). Given the complexity of the environment and cognitive limitations, it is not possible for firms to possess perfect information in their predictions and strategic decisions. As a result, firms strive to adapt to changes in the market environment through the process of routine, search, and selection. On one hand, routines refer to the capabilities and decision rules that change over time due to either deliberate problem-solving efforts or external events. Nelson and Winter suggest that routines determine firm behaviour roughly in the same way that genes determine animal and human behaviour (Castellacci, 2008). They outlined three kinds of routines: (1) operating characteristics

regarding the firm's short-term activity, (2) the rules of investment, and (3) higher-level procedures that influence lower-level procedures (Buensdorf, 2007). Unlike genes, however, firms can change their routines through a deliberate search (Nelson and Winter, 1977, 1984).

On the other hand, search mechanism kicks in when there are changes in the market environment, and firms are faced with the challenges of survival and growth. Nelson and Winter suggest that firms can survive either through the acquisition of new routines and techniques (innovation) or adoption of their rivals' existing superior routines (imitation). In other words, a firm can continually renew itself (especially through investments in knowledge) in line with the changes in the market environment and outperform their counterparts. Given the localized pattern of search, new knowledge and superior routines will at some point diffuse, benefiting firms in the same environment. However, it becomes obsolete, thereby spurring firms to engage in a new search. This circularity – never-ending and ever-changing process – explains how technological change drives economic growth in the evolutionary theory. Contrary to the neo-classical assumption, the economy is characterised by endogenous innovation activities. That is, the continuous creation of new varieties (enabled by innovation) in the economy serves as the engine oil of economic growth. In other words, the development of new variety and innovation occurs when firms actively attempt to discover routines that depart from established practice. The new variety manifests, on one hand, in forms of new product, process, organizational and market innovation. On the other hand, it shows up in form of radical and incremental innovations. Thus, it is the 'never-ending' introduction of innovation, varieties, search-for-information, and search-capacity of the firms that drive economic growth.

Nonetheless, the evolutionary theory is restrictive in its idea of localised search. This has implications in that it narrows the ability of firms to search beyond their boundaries. Studies show that external knowledge is critical to developing innovations (Lee et al., 2016; Asimakopoulos et al., 2020). Firms can complement their innovation capabilities by collaborating with other agents outside their environment. This is particularly true in today's knowledge-driven global business environment, where firms with more access to a variety of knowledge sources tend to perform better than their counterparts. In the context of developing country SMEs, searching beyond their immediate business environment is very critical to their survival and growth as it enables them to exploit and complement their resources (Hou and Mohnen, 2013; Medase and Abdul-Basit, 2020).

2.5. Implications of Economic Growth Theories on Developing Countries

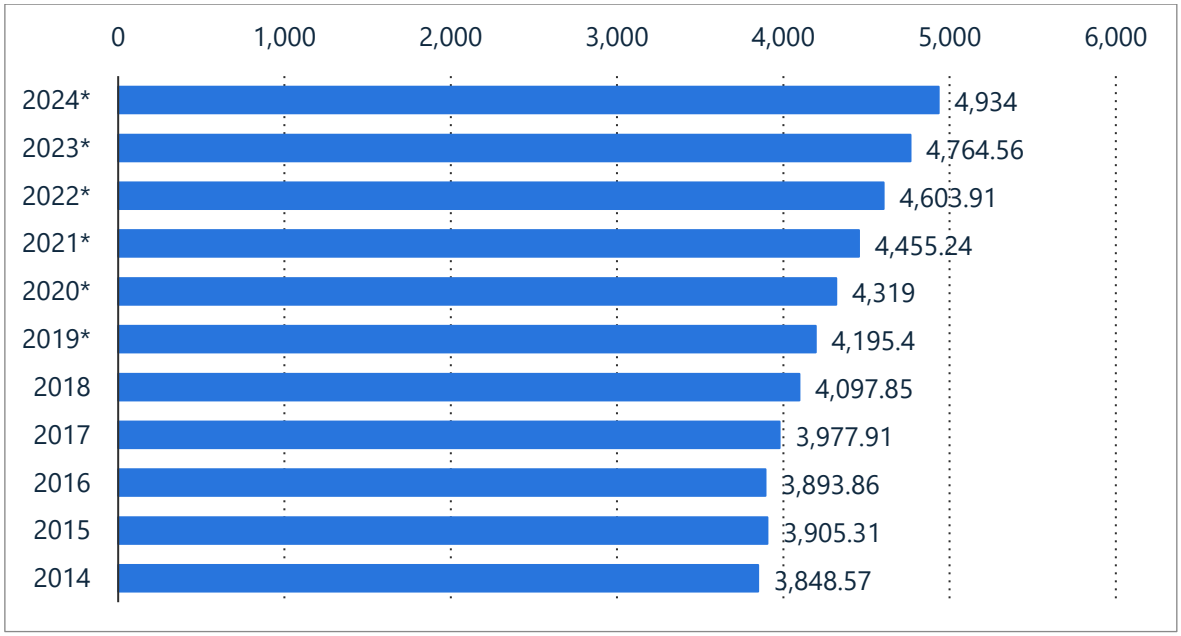
Productivity growth differs considerably not only over time but also between countries. Research reveals a ubiquitous, large, and persistent productivity gap between developed and developing economies (Maddison, 1983; Sanfilippo, 2015). As a consequence, it is important to understand the role of technological change and innovation on economic growth in the context of developing country economies. Thus, this section provides a systematic overview of productivity trajectories in the SSA region vis-à-vis a number of other regions of the world. This exercise is important to understanding how country/regional-specific factors influence the innovation activities of firms.

2.5.1. Productivity Growth at the Macro Level

In the previous section, I referred to the concept of partial factor productivity as the ratio of output to an input. Although no single measure provides a comprehensive picture of productivity performance, labour productivity is the most commonly used indicator due to its robust link to economic growth, competitiveness, and standards of living (Hall and Jones 1999). Labour productivity is the total output produced per unit of labour during a specific reference period. In statistics, it is measured in three main different ways: per person employed, per full-time equivalent, and per hour worked. Traditionally, labour productivity is measured as real GDP produced per hour of work.

As shown in figure 2.3, SSA region has been experiencing a consistent positive economic growth. In 2014, the region's GDP per capita growth rate amounted to around 3, 848.57 US dollars, and by 2019 it increased to 4,195,40 US dollars. It is forecasted to increase to 4, 934.00 US dollars in 2024. This notable economic performance is attributed to several factors such as capital intensity, high domestic demand, external debt reliefs, and fairly stable political conditions in many countries in the region (Heshmati and Rashidghalam, 2018).

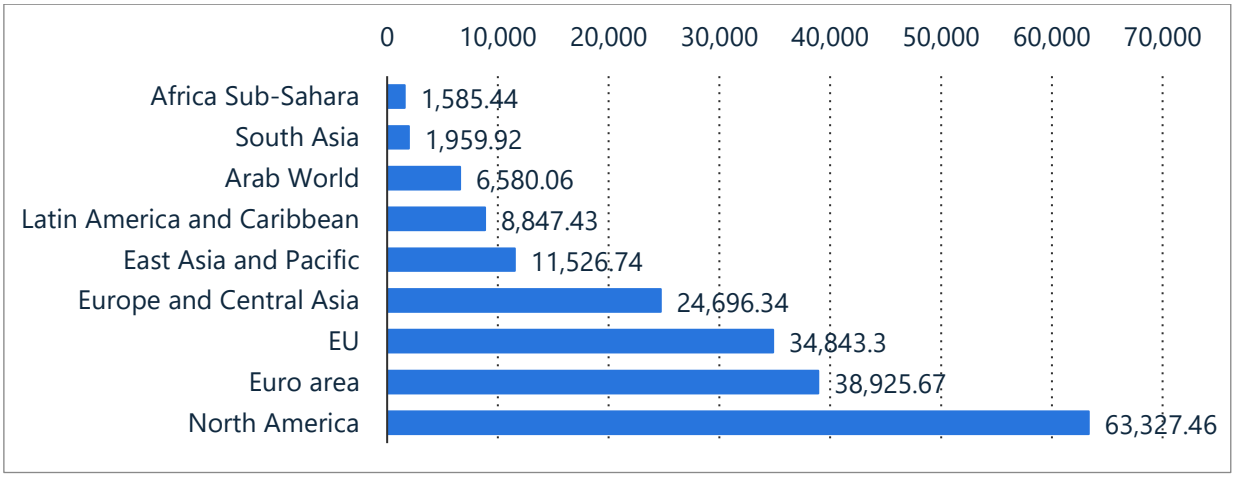
Figure 2.3: GDP per capita in Sub-Saharan Africa from 2014 to 2024(in US Dollars)



Sources: IMF, Statista, 2019

Nonetheless, the productivity growth rate in SSA still substantially lags behind those of other regions of the world as shown in figure 2.4, North American and European regions clearly outperform other regions of the world. The aggregate GDP per capita of Latin American and Caribbean region amounted to 8,847.43 US dollars, while that of the Arab world is 6, 580. 06 US dollar in 2019. Concretely, the statistics reveal that the SSA region not only lags behind developed economies but also other developing economies. In other words, SSA represents an interesting case for our study as it calls for investigation on the extent to which technological change affect the persistent productivity gap in the region.

Figure 2.4: GDP per capita in selected global regions at current prices in 2019 (in U.S. dollars)



Sources: IMF, Statista, 2019

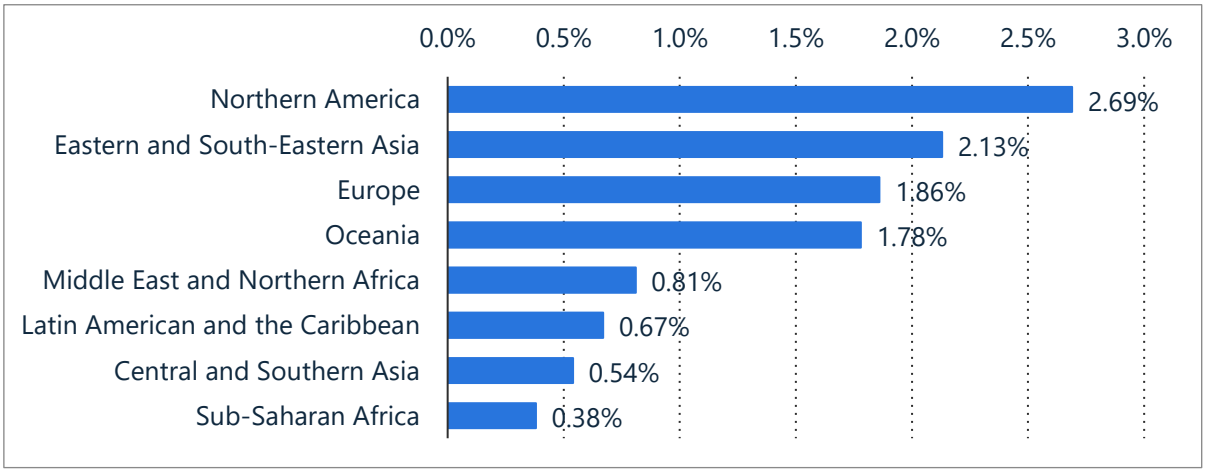
2.5.2. Technology, Innovation, and Economic Growth in SSA

According to the economic theories reviewed above, technological change is a vital agent of long-run productivity growth (Barro and Sala-i-Martin, 1992; Perez-Trujillo and Lacalle-Calderon, 2020). In developed economies, there is abundant literature on the relationship between technological progress and economic growth (e.g. Mokyr, 2005; Pradhan et al., 2020). For example, Aiginger and Falk (2005) find a statistically significant positive impact of business R&D intensity on GDP per capita in OECD countries. Huňady and Orviska (2014) examine the effect of R&D expenditures on economic growth using panel data of 26 EU countries. They find a positive impact of R&D expenditures on economic growth. In a recent study, Kurniawati (2020) finds strong endogenous relationships among innovation, ICT, globalization, and economic growth in both short and long run in OECD countries. In emerging economies, evidence shows that countries rapidly investing in technologies are achieving productivity gains (Seck, 2012; Acikgoz and Ali, 2019). For example, Yanrui (2010) finds that R&D activities and innovation are positively

related to economic growth in China. Likewise, Shen, Lin, and Wu (2019) find that R&D promotes growth in regional TFP by helping to absorb new technologies embodied in FDI and foreign trade.

Based on this evidence, there is a reason to believe that the SSA's technological gap is one of the main sources of its inability to catch up to the levels of per capita similar to advanced countries. SSA countries are behind other regions in terms of share of GDP spending on R&D as shown in Figure 2.5.

Figure 2.5. Share of GDP spent on research and development (R&D) in 2017, by region



Sources: IMF, Statista, 2019

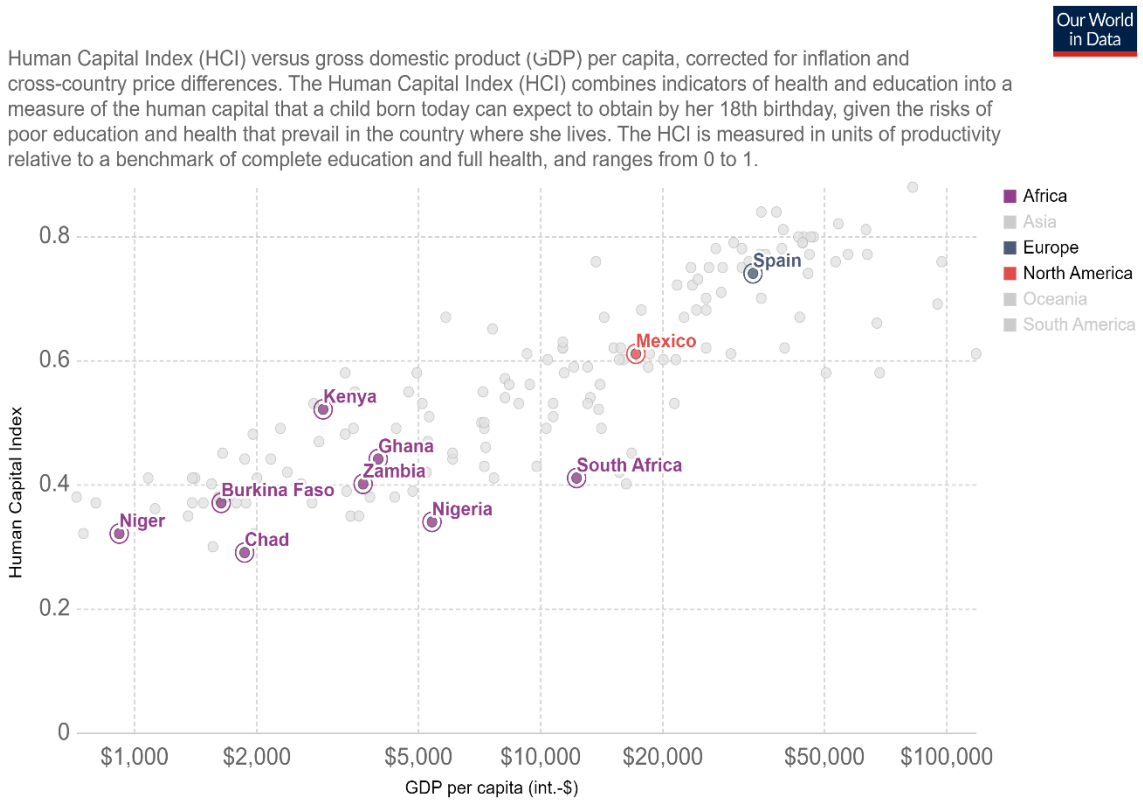
R&D expenditure is a key indicator of innovative activities for countries. According to statistics, northern America, eastern and south-eastern Asia, and Europe are top R&D performers. The economic growth trajectories in these regions confirm the impact of the technological change on the medium- and long-term economic growth as proposed by the endogenous growth theorists (Romer, 1986; 1990; Aghion and Howitt, 1992; 1997). Even if an absolute convergence between SSA and developed economies is difficult to achieve, evidence shows that investment in technology can enable the SSA countries leapfrog and thus achieve a higher level of growth that can enhance the standard of living and quality of life and its citizens

(Niebel, 2018). Thus, by stimulating productivity growth, investment in technology will help the SSA countries tackle some of the main socio-economic and environmental challenges facing the region.

Another factor linked to productivity growth is human capital. The Solow-Swan growth model posits that innovation and knowledge, leading to the capability for technological progress, are a global public good. According to Barro and Sala-i-Martin (1995: 12), "spillovers of knowledge across producers and external benefits from human capital are important parts of technological change and productivity growth". The new growth theorist singles out human capital accumulation as a deceive factor of economic growth (Romer, 1990; Aghion and Howitt, 1992). As a public good, knowledge can be exploited by many users without exhausting its benefits. Knowledge spillovers resulting from R&D performed by rivals facilitate the exchange of ideas and the adoption of technologies. However, human capital is crucial to searching, identifying, absorbing, and utilizing the benefits of such spillovers (Becker, 1964; Zhu, Peng, and Zhang, 2018). At the empirical level, Mankiw, Romer, and Weil (1992) find that augmenting the Solow growth model with measures of human capital improves its explanatory performance. By integrating human capital as a factor in the Cobb-Douglas production function, these authors find that it is markedly correlated with saving and population growth. Moreover, Fassio, Kalantaryan, and Venturini (2020) show that foreign human capital positively contributes to the productivity gains of France, Germany, and the United Kingdom. In the context of emerging economies, Bayarcelik and Tasel (2012) find a positive relationship among R&D expenditures, number of R&D employees, and economic growth in Turkey.

The level of investment in human capital varies across SSA countries. While some countries such as South Africa have reported an increase in human capital investments, the overall investment in most of the SSA countries is still below the world average as shown in Figure 2.6.

Figure 2.6: Human capital index vs. GDP per capita

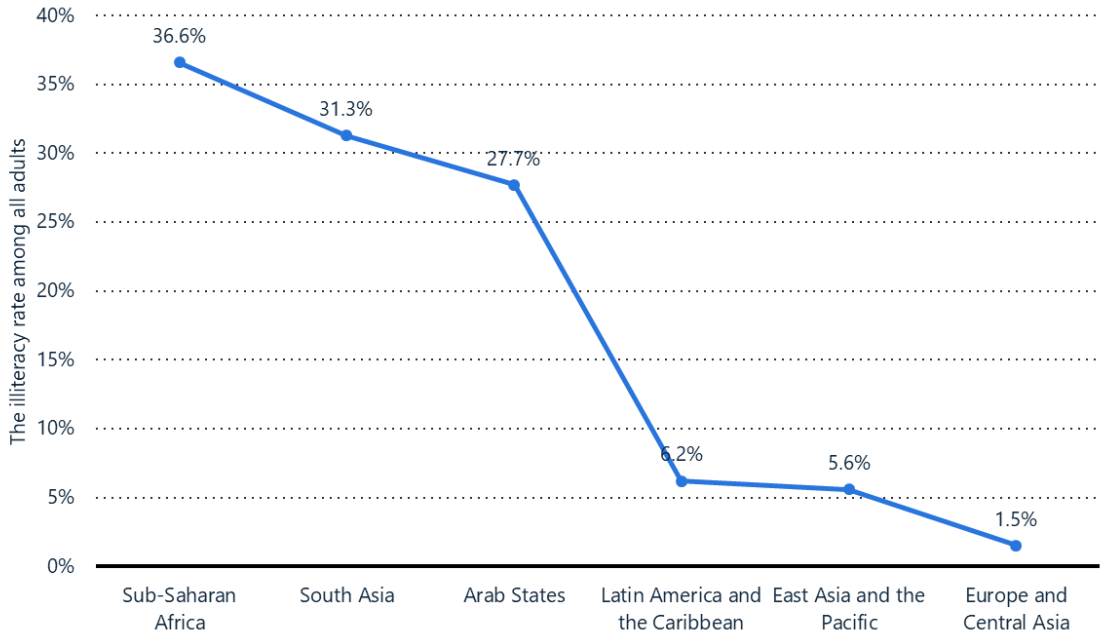


Source: The World Bank

As human capital determines an economy's capacity to carry out innovation (Romer, 1990), SSA countries must invest in it to achieve productivity gains. Studies clearly show that no country achieved faster growth with a literate workforce (Azariadis and Drazen, 1990; Romer, 1998). Human capital refers to the knowledge and skills embodied in people and acquired through schooling, i.e., educational attainment (Becker, 1964; Schultz, 1961; Danquah and Amankwah-Amoah, 2017). There is clear evidence that countries with a good standard of

education have a greater level of technology adoption and productivity growth (Easterlin, 1981; Krueger and Lindahl, 2001; Cohen and Soto, 2007).

Figure 2.7: Illiteracy rates by world region 2018



Sources: IMF, Statista, 2019

Figure 2.7 shows that the level of illiteracy in SSA is 35 percent larger than European and Central Asian region and 30 percent in Latin American and Caribbean region. Even when compared to other developing economies such as South Asian region, the statistics reveal that the SSA countries have the highest percentage of illiterate adults. Thus, it is not surprising that the region continues to experience low productivity. Regarding the link between quality of education and productivity, Glewwe, Maïga, and Zheng (2014:379) argue that "these two phenomena are almost certainly related. If education makes individuals more productive workers, the lack of progress in education outcomes in Sub-Saharan Africa may explain, at least in part, its low economic growth". Many education systems in SSA are unstructured and constrained by several factors such as poor

infrastructure, inadequate funding, and a conducive learning environment (Odia and Omofonmwan, 2007). Obviously, this situation calls for more investment in the area of human capital, in particular through education. It is without a doubt that such investments have the potential of speeding up the process convergence and productivity growth compared to the developed nations.

2.6. Conclusion

In the chapter, I discussed the importance of technological change and innovation on economic growth. I argued that countries facing overwhelming challenges that hinder its growth and living standard of its populations can benefit hugely from investing in innovation. Evidence from developed countries reveals that technologies and innovation can improve the quality of life, wealth, and employment creation. Besides, I discussed the major modern economic theories of growth. Even though these theories conceived the technological change differently (as both exogenous and endogenous factors), its impact on productivity growth remains undoubtable. I concluded by suggesting that in a developing region like SSA, investment in innovation, and human capital will go a long way in helping them close the productivity gap. This means the provision of adequate infrastructure, access to basic services, equality, sustainable employment, among others.

What's more, there is a substantial body of research exploring the impact of the macroeconomic condition on microeconomic activities such as the innovations, knowledge acquisition, and productivity of firms (e.g. Griffith et al., 2006; Glewwe et al., 2014; Shu and Steinwender, 2019). Evidence shows that country factors such

as quality of institutions, structures, etc. largely shape business environment, entrepreneurial activities, and productivity of firms. Thus, I will argue in the next chapter that innovation capabilities and growth potentials of firms, especially SMEs can be enhanced when the governments in SSA region focus more attention on improving business environment, investing more in R&D, and implementing policies. It is believed that such investment will stimulate innovation at a firm level. The more productive and competitive these firms are, the more they contribute to the economic growth of a country.

References

Acemoglu, D. (2009). Introduction to Modern Economic Growth, Princeton University Press.

Acikgoz, S., Ali, B., and Sami, M. (2019). Where does economic growth in the Middle Eastern and North African countries come from? The Quarterly Review of Economics and Finance, Elsevier, vol. 73(C), 172-183.

Acs, Z., and Audretsch, D. (1988). Innovation in Large and Small Firms: An Empirical Analysis. The American Economic Review, 78(4), 678-690.

Aghion, P., and P. Howitt. (1998). Endogenous Growth Theory. Cambridge, MA: MIT Press.

Aiginger, K.and Falk, M. (2005). Explaining Differences in Economic Growth among OECD Countries. Empirica 32, 19–43.

Arrow, K. (1962). Economic Welfare and the Allocation of Resources for Invention, p. 609-626 in the Rate and Direction of Inventive Activity: Economic and Social Factors, National Bureau of Economic Research, Inc.

Asimakopoulos, G., Revilla, A.J., and Slavova, K. (2020). External Knowledge Sourcing and Firm Innovation Efficiency. British Journal of Management, 31: 123-140.

Azariadis, C., and Drazen, A. (1990). Threshold Externalities in Economic Development, The Quarterly Journal of Economics, 105, issue 2, p. 501-526.

Baregheh, A., Rowley, J., and Sambrook, S. (2009). Towards a multidisciplinary definition of innovation, Management Decision,47,8,1323-1339.

Barro, R. J, and Sala-i-Martin, X. (1992). Convergence, Journal of Political Economy, University of Chicago Press,100(2), 223-251.

Barro, R. J. and X. Sala-i-Martin. (1995). Economic Growth. New York, McGraw Hill.

Bayarcelik, E.B., and Tasel, F. (2012). Research and Development: Source of Economic Growth, Procedia - Social and Behavioral Sciences, 8th International Strategic Management Conference, Barcelona, Spain, June 21-23, 104-111.

Becker, G. (1967). Human Capital and the Personal Distribution of Income: An Analytical Approach. In Human Capital. 2nd edition. University of Michigan, Institute of Public Administration, Ann Arbor, MI.

Bodrožić, Z., and Adler, P. S. (2018). The Evolution of Management Models: A Neo-Schumpeterian Theory. Administrative Science Quarterly, 63(1), 85–129.

Bogliacino, F., and Pianta, M. (2011). Engines of growth. Innovation and productivity in industry groups, Structural Change and Economic Dynamics, 22,1,41-53.

Cantner, U., and Dopfer, K. (2015). Schumpeter and his contemporaries—précis and road marks. Journal of Evolutionary Economics 25, 1–19.

Castellacci, F. (2008). Technological paradigms, regimes, and trajectories: Manufacturing and service industries in a new taxonomy of sectoral patterns of innovation, Research Policy, 37,6-7,978-994.

Cavusoglu, N., and Tebaldi, E. (2006). Evaluating growth theories and their empirical support: An assessment of the convergence hypothesis, Journal of Economic Methodology, 13:1, 49-75.

Cirera, X., Lage, F., and Sabetti, L. (2016). ICT Use, Innovation, and Productivity: Evidence from Sub-Saharan Africa. Policy Research Working Paper; No. 7868. World Bank, Washington, DC.

Cohen, D., and Soto, M. (2007). Growth and human capital: Good data, good results, Journal of Economic Growth, 12 (1) 51-76.

Comin D. (2008) Total Factor Productivity. In: Palgrave Macmillan (eds) The New Palgrave Dictionary of Economics. Palgrave Macmillan, London. https://doi.org/10.1057/978-1-349-95121-5_1681-2.

Damanpour, F. (1996). Organizational Complexity and Innovation: Developing and Testing Multiple Contingency Models. Management Science, 42(5), 693-716

Damanpour, F., and Schneider, M. (2006). Phases of the Adoption of Innovation in Organizations: Effects of Environment, Organization, and Top Managers1. British Journal of Management, 17: 215-236.

Danquah, M., and Amankwah-Amoah, J. (2017). Assessing the relationships between human capital, innovation, and technology adoption: Evidence from sub-Saharan Africa, Technological Forecasting and Social Change, 122, issue C, p. 24-33.

Domar, E. D. (1946). Capital Expansion, Rate of Growth, and Employment, Econometrica, Vol.14,2,137-147.

Domjahn, T. (2016). Economic Growth and Development: Theories, Criticism, and an Alternative Growth Model, The European Journal of Development Research, 28,2,352-354.

Eggink, M.E. (2013). The Components of an Innovation System: A Conceptual Innovation System Framework, Journal of Innovation and Business Best Practices,
DOI: 10.5171/2013. 768378.

Easterlin, R. A. (1981). Why Isn't the Whole World Developed? The Journal of Economic History, 41, issue 1, p. 1-17.

Fagerberg, J. (2003). Schumpeter and the Revival of Evolutionary Economics: An appraisal of the Literature, Journal of Evolutionary Economics 13: 125–59.

Fassio, C., Kalantaryan, S., and Venturini, A. (2020). Foreign Human Capital and Total Factor Productivity: A Sectoral Approach. Review of Income and Wealth, 66: 613-646.

Galbraith, J.K. 1952. American Capitalism: The Concept of Countervailing Power. Boston: Houghton Mifflin.

Garcia, A., and Mohnen, P. (2010). Impact of government support on R&D and innovation, MERIT Working Papers 2010-034, United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT).

Glewwe, P., Maïga, E., and Zheng, H. (2014). The Contribution of Education to Economic Growth: A Review of the Evidence, with Special Attention and an Application to Sub-Saharan Africa, World Development, 59, 379-393.

Griffith, R., Harrison, R., and Simpson, H. (2006). The link between product market reform, innovation and EU macroeconomic performance, European Economy - Economic Papers 2008 - 2015 243, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

Grossman, G., and Helpman, E. (1991). Trade, knowledge spillovers, and growth, European Economic Review, 35,2-3,517-526.

Guo, Y., Wang, L., and Chen, Y. (2020). Green Entrepreneurial Orientation and Green Innovation: The Mediating Effect of Supply Chain Learning. SAGE Open. https://doi.org/10.1177/2158244019898798.

Hall, R. E., and Jones, C. (1999). Why do Some Countries Produce So Much More Output Per Worker than Others? The Quarterly Journal of Economics, 114, issue 1, p. 83-116.

Harrod, R. F. (1939). An essay in Dynamic Theory. The Economic Journal, Vol.49, No.193,14-33.

Hartley, J., Sørensen, E., and Torfing, J. (2013). Collaborative Innovation: A Viable Alternative to Market Competition and Organizational Entrepreneurship. Public Administration Review, 73(6), 821-830.

Hérbert, R., and Link, A. (1989). Search for the meaning of entrepreneurship. Small Business Economics, 1(1), 39–49.

Heshmati, A., and Rashidghalam, M. (2016). Labour Productivity in Kenyan Manufacturing and Service Industries, IZA Discussion Papers, No. 9923, Institute for the Study of Labor (IZA), Bonn.

Hodgson, G. (1996). An Evolutionary Theory of Long-Term Economic Growth. International Studies Quarterly, 40(3), 391-410.

Hou, J., and Mohnen, P. (2013). Complementarity between internal knowledge creation and external knowledge sourcing in developing countries, No. 2013-010, MERIT Working Papers, United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT).

Huňady, J., and Orviská, M. (2014). The Impact of Research and Development Expenditures on Innovation Performance and Economic Growth of The Country—The Empirical Evidence, CBU International Conference Proceedings, ISE Research Institute, 2(0), 119-125.

Jaffe, A. Newell, R., and Stavins, R. (2003). Technological change and the environment, in Mäler, K. G. and Vincent, J. R. eds., Handbook of Environmental Economics, 1, Elsevier.

Jorgenson, D. W., and Stiroh. K.J. (1999). Information Technology and Growth. American Economic Review, 89 (2): 109-115.

Kamien, M.I., and N.L. Schwartz, 1982, Market structure and innovation, Cambridge University Press, Cambridge.

Keynes, J.M. (1936). The General Theory of Employment Interest and Money. New York: Harcourt Brace.

Kurniawati, M.A. (2020). The role of ICT infrastructure, innovation, and globalization on economic growth in OECD countries, 1996-2017, Journal of Science and Technology Policy Management, Vol. 11 No. 2, pp. 193-215.

Krueger, A., and Lindahl, M. (2001). Education for growth: Why and for whom? Journal of Economic Literature, 39 (4), 1101-1136.

Krugman, P. (1997). The Age of Diminished Expectations, 3rd Edition: U.S. Economic Policy in the 1990s, MIT Press Books, The MIT Press.

Kurz, H. (2012). Schumpeter's new combinations: revisiting his Theorie der wirtschaftlichen Entwicklung on the occasion of its centenary. Journal of Evolutionary Economics, 22(5), 871–899.

Lee, K., Yoo, J., Choi, M., Zo, H., and Ciganek, A.P. (2016). Does External Knowledge Sourcing Enhance Market Performance? Evidence from the Korean Manufacturing Industry. PLOS ONE 11(12): e0168676. https://doi.org/10.1371/journal.pone.0168676.

Li, B., and Huang, L. (2019). The Effect of Incremental Innovation and Disruptive Innovation on the Sustainable Development of Manufacturing in China. SAGE Open. https://doi.org/10.1177/2158244019832700.

Li, C., and Tanna, S. (2019). The impact of foreign direct investment on productivity: New evidence for developing countries, Economic Modelling,80,453-466.

Lipsey, R.G. and Carlaw, K.I. (2004). Total factor productivity and the measurement of technological change. Canadian Journal of Economics/Revue canadienne d'économique, 37 : 1118-1150.

Lucas, R. E., Jr. (1988). On the Mechanics of Economic Development. Journal of Monetary Economics, Vol. 22, No.4, pp.3-4.

Maddison, A. (1983). A Comparison of Levels of GDP Per Capita in Developed and Developing Countries, 1700-1980. The Journal of Economic History, 43(1), 27-41

Malerba, F. (2007) Schumpeterian patterns of innovation and technological regimes in The Elgar Companion to Neo-Schumpeterian Economics, Edward Elgar Publishing.

Malerba, F., and Orsenigo, L. (1995). Schumpeterian Patterns of Innovation, Cambridge Journal of Economics, 19,1,47-65.

Malerba, F., and McKelvey, M. (2020). Knowledge-intensive innovative entrepreneurship integrating Schumpeter, evolutionary economics, and innovation systems, Small Business Economics, Springer, 54(2) 503-522.

Mankiw, G.N. Romer, D., and Weil, D.N. (1992). A Contribution to the Empirics of Economic Growth, The Quarterly Journal of Economics, Volume 107, Issue 2, 407–437.

Medase, S.K., and Abdul-Basit, S. (2020). External knowledge modes and firm-level innovation performance: Empirical evidence from sub-Saharan Africa, Journal of Innovation & Knowledge,5, 2, 81-95.

Michaelides, P., and Milios, J. (2009). Joseph Schumpeter and the German Historical School. Cambridge Journal of Economics, 33(3), 495-516.

Mokyr, J. (2005). The Intellectual Origins of Modern Economic Growth, The Journal of Economic History, 65,2,285-351.

Moss, M. (1979). Welfare Dimensions of Productivity Measurement, in Measurement and Interpretation of Productivity, Washington, DC: National Academy of Sciences.

Muller, E. (2000). Innovation Interactions Between Knowledge-Intensive Business Services and Small and Medium-Sized Enterprises, Springer-Verlag Berlin Heidelberg.

Neto, J.P.J., Claeyssen, J.C.R., and Júnior, S.S. P. (2019). Returns to scale in a spatial Solow–Swan economic growth model, Physica A: Statistical Mechanics and its Applications,533, https://doi.org/10.1016/j.physa.2019.122055.

Nelson, R. R., and Winter, S. (1982). An evolutionary theory of economic change. Cambridge: The Belknap Press of Harvard University Press.

Niebel, T. (2018). ICT and economic growth – Comparing developing, emerging and developed countries, World Development, Elsevier,104, 197-211.

Odia, L.O., and Omofonmwan, S.I. (2007). Educational System in Nigeria Problems and Prospects. Journal of Social Science, 14, 81-86.

Palma, N., and Reis, J. (2019). From Convergence to Divergence: Portuguese Economic Growth, 1527–1850. The Journal of Economic History, 79(2), 477-506.

Pavitt, K., Robson, M., and Townsend, J. (1987). The Size Distribution of Innovating Firms in the UK: 1945-1983. The Journal of Industrial Economics, 35(3), 297-316.

Peretto, P., and Smulders, S. (2002). Technological distance, growth, and scale effect, The Economic Journal, 112: 603-624.

Perez-Trujillo, M. and Lacalle-Calderon, M., (2020). The impact of knowledge diffusion on economic growth across countries, World Development, Elsevier, vol. 132(C). DOI: https://doi.org/10.1016/j.worlddev.2020.104995.

Plessis, M. D. (2007). The role of knowledge management in innovation. Journal of Knowledge Management 11: 20–29.

Pradhan, R.P., Arvin, M.B., Nair, M., and Bennett, S.E. (2020). Sustainable economic growth in the European Union: The role of ICT, venture capital, and innovation. Review of Financial Economics. 38: 34– 62.

Reati, A. (2012). Total factor productivity - a misleading concept. PSL Quarterly Review, 54, 218,2037-3643.

Romer, P. M. (1986). Increasing Returns and Long-Run Growth. Journal of Political Economy,94: 1002-1037.

Romer, P. M. (1990). Endogenous Technological Change". Journal of Political Economy, Vol. 98, No.5, S71-S102.

Ruttan, V. W. (1998). The new growth theory and development economics: A survey, The Journal of Development Studies, 35:2, 1-26.

Sanfilippo, M. (2015). FDI from emerging markets and the productivity gap—An analysis on affiliates of BRICS EMNEs in Europe, International Business Review, 24,4, 665-676.

Saunila, M. (2019). Innovation capability in SMEs: A systematic review of the literature, Journal of Innovation & Knowledge. DOI: https://doi.org/10.1016/j.jik.2019.11.002.

Schultz, T. (1961). Investment in Human Capital. The American Economic Review, 51(1), 1-17.

Seck, A. (2012). International technology diffusion and economic growth: Explaining the spillover benefits to developing countries, Structural Change and Economic Dynamics, 23, issue 4, p. 437-451.

Shen, X., Lin, B, and Wu, W. (2019). R&D Efforts, Total Factor Productivity, and the Energy Intensity in China, Emerging Markets Finance and Trade, 55:11, 2566-2588.

Shu, P., and Steinwender, C. (2019). The Impact of Trade Liberalization on Firm Productivity and Innovation, Innovation Policy, and the Economy 19: 39-68.

Simon, H.A. (1959). Theories of decision making in economics and behavioral science. Am. Econ. Rev. 49 (3), 253–283.

Solow, Robert M. (1956). A Contribution to the Theory of Economic Growth. Quarterly Journal of Economics 70: 65-94.

Solow, R. M. (1957). Technical Change and the Aggregate Production Function. Review of Economics and Statistics, August 1957,39(3)312-20.

Shaw, G. K. (1992). Policy Implications of Endogenous Growth Theory, Economic Journal, 102, 412,611-21.

Thompson, Victor A. (1965). Bureaucracy and innovation. Administrative Science Quarterly 10: 1–20.

Van de Ven, A. H. 1986. Central problems in the management of innovation. Management Science, 32(5): 590-607.

Ulrich Witt (2002) How Evolutionary is Schumpeter's theory of Economic Development? Industry and Innovation, 9:1-2, 7-22.

Wei, J., and Liu, Y. (2015). Government support and firm innovation performance: Empirical analysis of 343 innovative enterprises in China, Chinese Management Studies,9,1,38-55.

Wojan, T. R., Crown, D., and Rupasingha, A. (2018). Varieties of innovation and business survival: Does pursuit or incremental or far-ranging innovation make

manufacturing establishments more Resilient? Research Policy, 47(9), 1801–1810.

Woschke, T., Haase, H., and Kratzer, J. (2017). Resource scarcity in SMEs: effects on incremental and radical innovations, Management Research Review, 40(2),195-217.

Wurth, A. H. (1993). Productivity growth or factor substitution? identifying technological change. Technology in Society, 15(2), 229–241.

Yanrui W. (2010). Innovation and Economic Growth in China, Economics Discussion / Working Papers 10-10, The University of Western Australia, Department of Economics.

Zhou, X. Song, M., and Cui, L. (2020). Driving force for China's economic development under Industry 4.0 and circular economy: Technological innovation or structural change? Journal of Cleaner Production,271. DOI: /doi.org/10.1016/j.jclepro.2020.122680.

Zhu, T.T., Peng, R.H., and J.Y. Zhang (2018). The influence of higher education development on economic growth: evidence from central China High Educ. Pol., 31 (2018), 139-157.

Chapter 3

SMEs, Innovation and Productivity Growth in Developing Countries

SMEs that grow have a considerable positive impact on employment creation, innovation, productivity growth and competitiveness.
(OECD, 2018)

3.1. Introduction

In recent years, the linkage between SMEs and economic growth has attracted increasing attention both from researches and policy-makers. SMEs play a vital role in most economies, accounting for 90% of businesses and more than 50% of employment worldwide. As discussed in the previous chapter, small entrepreneurial firms are both agents of innovation and economic growth in the Schumpeter Mark I (Aghion and Howitt, 1992; Lazonick, 2005). In a later work, Solow (2007: 11) recognizes the role of the entrepreneurial activity in bridging "the gap between specific pieces of technological knowledge and innovations in actual production, often through the creation of new firms". According to him, if the impact of small entrepreneurial firms on economic growth can be empirically accounted for, it would add immensely to the explanatory power of growth theory. In a seminal study, Beck, Demirguc-Kunt, and Levine (2005) estimated an adjusted standard growth model of relative size of the SME sector for a cross-section of countries. They find a positive and significant relationship between SMEs and economic growth, measured in terms of GDP per capita. Likewise, in an extended neoclassical model, Audretsch and Keilbach (2004) reveal that entrepreneurship

capital is a significant and important factor that shapes the output and productivity of German start-ups.

Despite the contributions of the extant studies, there is still paucity of studies exploring the significance of innovative SMEs on the economic growth in developing economies (Cravo, Gourlay and Becker, 2012), especially in the SSA region. This research gap is surprising given that the SME sector is an account for over 90% of all enterprises, employs up to 95% of the enterprise workforce, and generates more than 49% of domestic output of developing countries (World Bank Group, 2020). In the SSA region, the SME sector is an important driver of growth, accounting for over 90% of all enterprises and 60% of total employment (ITC, 2018). Thus, the goal of this chapter is to discuss the role of SMEs on the developing country economies; and how innovations can help them to be more competitive; and contribute to the economic growth of the SSA region. To achieve the objective of this chapter, I will focus on Nigeria because it offers an interesting representative case study. SMEs account for a greater share of all businesses in Nigeria. Besides, these firms share similar characteristics and challenges with their peers from other lower-middle-income countries.

The remainder of this chapter is organised as follows: In Section 3.2, I will present the definition of SMEs in Nigeria, and the contributions of the sector to the Nigerian economy. In Section 3.3, I will discuss the country-specific factors mitigating against the innovation and productivity performance of SMEs; while in Section 3.4, I will examine the firm-level determinants of innovation activities of Nigeria SMEs.

3.2. Definition of SMEs in Nigeria

While SMEs are the engine of growth, there is no universal definition of SMEs as it varies across countries, regions, and organisations (Storey, 1994). According to OECD (2005), "SMEs are non-subsidiary, independent firms which employ less than a given number of employees".

Table 3.1. Definitions of SMEs in OECD, China, South Africa, and Nigeria

Countries	Source	Micro	Small	Medium
OECD	OECD (2005)	Employee < 10 AND Turnover ≤ EUR 2 million OR balance sheet total ≤ EUR 2 million	Employee < 50 AND Turnover ≤ EUR 10 million OR balance sheet total ≤ EUR 10 million	Employee < 250 AND Turnover ≤ EUR 50 million OR balance sheet total ≤ EUR 43 million
China (Manufacturing industry as reference)	Ministry of Finance, China (2011)	Employee < 20 OR Revenue ≤ RMB 3 million (~ EUR 377,315)	Employee < 300 AND Turnover ≤ RMB 20 million (~ EUR 2,516,219 million) > Revenue ≥ RMB 3 million (~ EUR 377,446.98)	Employee < 1000 AND Turnover ≤ RMB 400 million (~ EUR 50,308,700 million) > Revenue ≥ RMB 20 million (~ EUR 2,516,219 million)
South Africa (Manufacturing industry as reference)	National Small Business Amendment Act (2003)	Employee < 5 AND Turnover ≤ ZAR 0.20 million (~ EUR 10,184) OR balance sheet total ≤ ZAR 0.10 million (~ EUR 5,072)	Employee < 50 AND Turnover ≤ ZAR 13 million (~ EUR 659,360) OR balance sheet total ≤ ZAR 5 million (~ EUR 253,600)	Employee < 200 AND Turnover ≤ ZAR 51 million (~ EUR 2,586,723 million) OR balance sheet total ≤ ZAR 19 million (~ EUR 963,681)
Nigeria	Small and Medium Enterprises Development Agency of Nigeria (2013)	Employee < 10 AND Total Asset ≤ NGN 5 million (~ EUR 11,263.74)	Employee < 50 AND Total Asset ≤ NGN 50 million (~ EUR 112,714.)	Employee < 200 AND Total Asset ≤ NGN 500 million (~ EUR 1,127,145 million)

Note: The exchange rate between Euro and RMB (1 EUR = 7.95 RMB), Euro and Naira (1 EUR = 443.60 NGN), and Euro and ZAR (1 EUR = 19.74 ZAR) are based on the figures as of September 25, 2020.

In Nigeria, the most commonly used criteria for the classification of SMEs are the size of employment, annual turnover, total assets, loan amount, etc. The Bank of Industry (BOI) defines a micro firm as an enterprise with less than ten employees, with an annual turnover of less than 20 million Naira and assets (including plants, machinery, and buildings) worth less than 5 million Naira and a loan amount of less than 10 million Naira. Small enterprise is a firm with less than 50 employees, an annual turnover of less than 100 million Naira; assets worth less than 100 million Naira; and a loan amount of less than 100 million Naira. Medium-sized enterprise is a firm with less than 200 employees, with an annual turnover of less than 500 million Naira; assets worth less than 500 million Naira; and a loan amount of less than 500 million Naira.

According to the Central Bank of Nigeria (CBN), SMEs are firms with asset base of N5 million Naira and not more than N500 million Naira (excluding land and buildings) with employees between 11 and 200. The Small and Medium Enterprises Development Agency of Nigeria (SMEDAN), on the other hand, defines SMEs as entities with employees between 10 and 200; with an asset base of N5 million Naira and not more than N500 million Naira (excluding land and buildings). However, the definitions of both CBN and SMEDAN do not include the turnover volumes criteria.

As shown in Table 3.1. above, what is defined as an SME in any of the OCED countries would certainly not fit the definitions of SMEs in the SSA region. For example, the OCED's definition of micro-enterprise includes entities two times larger by turnover than the largest medium-sized enterprise in Nigeria. Similarly, the Chinese definition of small enterprise is larger than the SSA medium-sized enterprises in terms of turnover. These differences highlight the difficulty of

reaching a universal definition of SMEs. This study adopts the SMEDAN's definition of SMEs, however, it draws as well from BOI's definition to complement the turnover volumes criteria. Therefore, for the purpose of this study, SMEs are entities with an employee strength not exceeding 200, with an asset base of N5 million Naira and not more than N500 million Naira; and annual turnover volume between 100 and 500 million Naira.

3.3. Contributions of SME to the Nigerian economy

Nigeria is a multinational state located in West Africa. It is the most populous country in Africa with an estimated 206 million inhabitants of 2019. While Nigeria and South Africa make up half of the SSA's GDP, in 2019 Nigeria surpassed South Africa with 2.3% GDP growth, thereby becoming the largest economy in Africa (IMF, national statistical office, Annual GDP for 2019). Nigeria is the 24th largest economy (with 1,181,399 USD) and 49th largest export economy in the world (IMF, 2020). Nigeria, alongside Mexico, Indonesia, and Turkey, is among the next most powerful emerging markets in the world (Lin and Benjamin, 2018). SMEs contribute to the Nigerian economy in various ways. However, we shall focus on four major aspects: size of SMEs, contribution to GDP, contribution to employment, and contribution to export market.

According to the Nigerian Bureau of Statistics (NBS), SMEs are an essential part of the Nigerian economy. The number of SMEs in 2013 was 37,067,416 (micro 36,994,578; small 68,168, and medium 4,670) or approximately 96 percent of all enterprises. The results of the survey conducted in 2018 show that micro firms are 41,543,028, whereas SMEs are 73,081 firms. Concerning the ownership structure,

73 percent of these enterprises are sole proprietorships, while 14 percent are private limited liability companies. The remaining 13 percent are 6 percent partnerships, 5 percent faith-based organisations, 1 percent cooperatives, and 1 percent others. In terms of distribution of gender, 77 percent are operated by male, while 23 percent operated by female in the formal sector (NBS and SMEDAN, 2018).

Table 3.2. Distribution of SMEs number by economic sectors in 2013 and 2017

Economic sector	Small 2013	Small 2017	Medium 2013	Medium 2017
Manufacturing	13,109	16,322	528	772
Mining & Quarrying	213	172	32	28
Accommodation & Foodservice	6,953	5,940	155	168
Agriculture	1,389	386	146	0
Wholesale/Retail Trade	14,870	12,889	249	241
Construction	487	423	65	83
Transport & storage	800	699	39	49
Information & communication	437	573	30	48
Education	24,034	19,587	3,250	132
Administrative & support activities	2,883	956	99	15
Arts, entertainment & recreation	245	188	15	1
Other services activities	2,724	1,924	62	34
Water supply, sewerage, waste management & remediation act	23	9	1	0
Real estate		1,073		0
Human health & social works		7,377		219
Professional, scientific and technical works		2,772		1
Total	**68,168**	**71,288**	**4,670**	**1,793**

Source: NBS and SMEDAN, 2018

Table 3.2 shows the distribution of SMEs across economic sectors in 2013 and 2017. Unlike most of the sectors that experienced a decrease in 2017, SMEs in the manufacturing sector increased from 13, 109 to 16, 322 (small firms), and 528 to

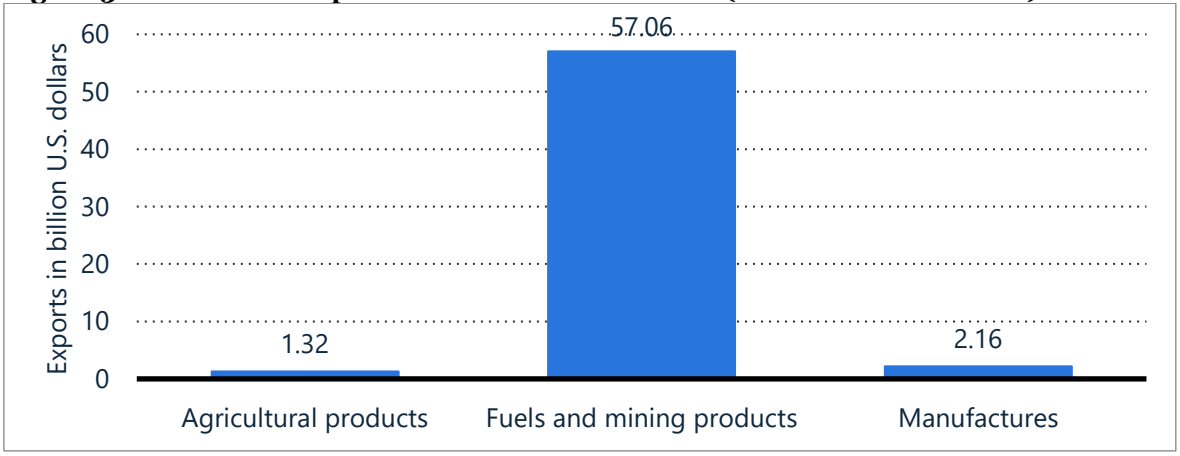
772 (medium-sized firms) respectively. This is largely attributed to the key role that the manufacturing sector plays in the economic development of developing countries. (Abor and Quartey, 2010; Jabbour, Ndubisi, and Seles, 2020). The importance of SMEs to economic development in Nigeria is almost undisputed. According to NBS, SMEs' GDP contribution is around 49.78 percent in 2017, which is slightly above 1 percent growth from 2013 (48.47%). The values are similar with the SMEs' contribution to GDP not only in other developing countries such as Ghana but also high-income countries (Quartey et al. 2017).

Another key contribution of SMEs is in the area of employment. As of the end of 2017, 73, 081 SMEs employed about 2, 889, 714 million persons, which is, on average, 39.5 persons per enterprise. When compared to 2010 (1,066,766 persons) and 2013 (1,903,820 persons), SMEs contribution to employment grew by 100 percent. In terms of economic sectoral distribution, the education sector contributed 36.9 percent, whereas human health and social works contributed (21.2 percent), manufacturing, (21.0 percent), accommodation and food services (7.3 percent), and wholesale/retail trade (5.3 percent). However, there is still a gender gap in the employment rate with 56.6 percent (male) and 43. 4 percent (male). With the exception of the education sector, other sectors tend towards employing more males than females (NBS and SMEDAN, 2018).

Finally, export plays a pivotal role in the economic growth of countries. In 2017, $46.8 billion accrued to Nigeria from the exportation of 45 products, resulting in a positive trade balance of $12.7B in net exports. However, the contribution of SMEs to export is relatively very low as most of the growth is driven by the oil sector (Olayungbo, 2019; Yunusa, 2020). In 2018, the fuels and mining products contributed 57.06 percent, while manufacturers (2.16 percent) and

agricultural products (1.32 percent) respectively as shown in Figure 3.1. When compared to the number of SMEs (72,838 enterprises) reported in 2017, only 2, 529 enterprises reported exportable products and services, which represents 3.5 percent (NBS and SMEDAN, 2018).

Figure 3.1. Estimated export of commodities in 2018 (in billion U.S. dollars)



Sources: IMF, Statista, 2019

In terms of sectoral breakdown, SMEs in the manufacturing sector reported the highest number of entities with exportable products at 1176 entities compared to other sectors – accommodation and food services (124 entities), wholesale/retail trade (540), transport and storage (341 entities), education (95 entities), agriculture (13 entities), construction (13 entities), and other service activities (24 entities) (Survey of MSMEs, 2017). This implies that the majority of these SMEs rely on local and national markets to sell their goods and services. One possible explanation for the low export propensity of Nigerian SMEs is competition. Research shows that changes in the international market environment are currently raising entry barriers and survival challenges, especially for SMEs with less innovation capacity. Put alternatively, international competition is so fierce

that only the innovative firms are equipped to engage and compete in the export markets.

Table 3.3: Export of Product(s)/Service by economic sector in 2017

Sectors	Number of enterprises with exportable products	Overall number of enterprises
Manufacturing	1176 (6.9%)	17,094
Mining & Quarrying	21(10.5%)	200
Accommodation & Foodservice	124(2.0%)	6,108
Agriculture	13(3.4%)	386
Wholesale/Retail Trade	540(4.1%)	13,130
Construction	13(2.6%)	506
Transport & storage	341(45.6%)	748
Information & communication	36(5.8%)	621
Education	95(0.5%)	19,719
Administrative & support activities	14(1.4%)	971
Arts, entertainment & recreation	5(2.6%)	189
Other services activities	24(1.2%)	1,958
Water supply, sewerage, waste management & remediation act	2(22.2%)	9
Real estate	0(0.0%)	1,073
Human health & social works	93(1.2%)	7,595
Professional, scientific and technical works	32(1.2%)	2,773
Total	2,529(3.5%)	73,081

Source: NBS and SMEDAN, 2018

This is in line with the contingency theory approach, which posits that a firm can use its internal resources, especially innovation capabilities, to manage and respond to the external challenges in a market environment (Yeoh and Jeong, 1995; Robertson and Chetty, 2000; Safari and Saleh, 2020). I will return to this issue in chapter 6.

3.4. Innovation as Engine of Productivity Growth in SMEs

Even though the SME sector plays a significant role in the Nigerian economy, its growth potential is yet to be fully realised due to some factors hindering the prospects for the development of innovation capabilities. As we saw above, the export propensity of SMEs in Nigeria is still very low. Despite the export development and promotion programmes in Nigeria, they have not succeeded in enhancing the exporting capacity of SMEs (Leigh and Blakely, 2016). One of the most plausible explanations is the insufficient attention of given to the role of innovation on export growth and productivity of SMEs. As we saw in the previous chapter, countries in the SSA region are not investing enough in R&D activities. In contrast, countries with sufficient level of R&D investment can achieve higher economic growth by promoting innovations activities of SMEs. Substantial evidence shows that innovation is a key driver of competition and dynamic market efficiency (Plessis, 2007). Innovation can create sustainable growth that confers competitive advantages on SMEs operating both in domestic and international markets.

On the other hand, SMEs are the engines of technological change, innovation, and economic growth (Acs and Audretsch 1988, 1990). Rosenbusch et al. (2011) argue that their smaller, nimbler structures and entrepreneurial orientation enable them to engage in successful innovation activity. In today's global market, SMEs possessing a strong source of competitive advantages are more likely to survive and achieve superior performance. On this basis, one would expect innovative SMEs from developing countries such as Nigeria to grow faster and become more efficient than non-innovative counterparts (Ratten, 2015).

However, there are series of both internal and external factors mitigating against the innovation activities and productivity of SMEs in Nigeria. Srholec (2011) argues that the characteristics of a firm and the institutional settings within which it operates do matter for innovation activities. Thus, in this section, I will focus on country-specific barriers and firm-specific determinants of SMEs' innovation in Nigeria.

3.5. Country-Specific Determinants of Innovation

The institution plays an important role in the innovation structure and performance of firms (Jackson and Deeg, 2008). Pindado et al. (2015) reveal that country-level institutions have a significant impact on the market valuation of the firm R&D investment. This is in line with the institutional theory, which suggests that the institutional settings of a country enable investment by providing incentives and supports, creating a stable environment, reducing transaction costs, risk, and uncertainty. Firms operate and innovate within an environment, which can either promote or impede innovation and productivity (Alam, Uddin, and Yazdifar, 2019). Research shows that country-specific factors to a large extent determine the innovation and entrepreneurial activities of firms (Waarden, 2001). Allred and Steensman (2005) argue that a country's level of development has a direct effect on firms' innovation investments.

Countries differ in several aspects such as economic size, infrastructure, level of development, etc. As a result, the innovation activities of firm can be affected by institutions through laws, regulations, and policies on one hand; and by structures through infrastructure, education system, on the other hand (Wang et

al., 2015). For example, in developing economies, SMEs face numerous factors mitigating against their innovation capabilities. It is no surprise that their SMEs operating in an environment supported by advanced legal systems, low levels of bureaucracy, and ease of access to financial services achieve higher performance. Alam, Uddin, and Yazdifar (2019) find that institutional quality has a strong influence on R&D investment. More precisely, these authors observe that government effectiveness, rule of law, and regularity quality have a positive impact, whereas corruption and political instability have a negative impact on R&D investment. The majority of developing countries, especially the SSA countries, have underdeveloped or less-efficient institutions to support the activities of SMEs (Lee et al. 2015; Medase and Barasa, 2019). In what follows, I will consider how lack of access to reliable power supply, inefficient legal and financial systems hinder the innovation capacity and productivity of SMEs in Nigeria.

3.5.1. Access to Power Supply

In recent years, the government in Nigeria both at the national and state levels is increasingly providing infrastructure as a way of enabling a better business environment and economic growth. Electricity is an important factor in economic activities. Research shows that firms with access to stable power supply can achieve rapid and sustained growth, technological progress and in turn, create more employment opportunities. Conversely, lack of access to electricity leads to low productivity (Fakira, 1994; Alby, Dethier, and Straub, 2010). Goedhuys and Sleuwaegen (2010) find that frequent electricity cut is the main barrier to the growth of entrepreneurial firms in 10 manufacturing sectors of 11 Sub-Saharan

African countries. Grimma, Hartwig, and Lay (2013) suggest that a stable power supply can exert a positive influence on performance, with electricity contributing to the uptake of modern machinery and business operation in the SSA region.

Lack of electricity has been a chronic challenge bedeviling the business environment and productivity in Nigeria. Olayemi, (2012) find that electricity generation and supply have a significant and negative effect on the productivity growth of manufacturing sector in Nigeria. The IMF survey shows that lack of access to reliable electricity costs the Nigerian economy an estimated USD29 billion every year (IMF, 2019). This is consistent with the recent World Bank Enterprise Surveys (WBES), which shows that the time and cost of accessing stable electricity connection is very high in Nigeria (World Bank Group, 2019). The current situation is so bad that firms have to heavily rely on power generators. However, given the high cost linked to the installation and maintenance of power generators, only firms with stable financial resources can afford it. This situation has intensified the operation and productivity problems of the SME sector. Even though there are several policies and projects both in Nigeria and across the SSA region to accelerate access to electricity through alternative energy supply, access to reliable energy remains a key barrier to the productivity of firms, especially SMEs. Innovation and technology development largely depend on sustainable energy supply and as such, it does not come as surprising that the lack of it is one of the main factors mitigating against the innovative activities and productivity growth of SMEs in Nigeria. Research attributed the poor performance of the power sector to government spending on unproductive sectors (Olayemi, 2012). Thus, it is without a doubt that efficient policies and capital investment in the energy sector

will enhance electricity supply and consequently improve the productivity of SMEs in Nigeria.

3.5.2. Legal System

Prior studies show that a strong legal system promotes R&D investment (Seitz and Watzinger, 2017). The legal systems in most developing countries such as Nigeria have a negative impact on the business environment and innovation investment. Research shows that efficient legal systems promote technological progress through the protection of creativity and innovation of firms (Hall and Sena, 2017). More precisely, the intellectual property system fosters economic growth, innovation, and international competitiveness (Gould and Gruben, 1997). Furukawa (2007) find that a well-functioning legal system provides strong protection of patent rights and investment incentives that motivate the investors in R&D activity. Similarly, Jiao, Koo, and Cui (2015) find that local legal system has a significant and positive effect on firms' product innovation, technological innovation, process innovation, and management innovation in China. A recent survey shows that SMEs in European countries investing in intellectual property rights are more likely to achieve higher growth (EUIPO, 2019).

Intellectual property rights and protection in Nigeria include patents, industrial designs, trademarks, and copyright. Table 3.5. shows some of the laws governing intellectual property rights and protection in Nigeria.

Table 3.4: Some Legal Frameworks of IPRs in Nigeria

- Copyright Act (as amended), Cap. C28, Laws of the Federation of Nigeria 2004
- Patents and Designs Act, Cap. P2, Laws of the Federation of Nigeria 2004
- Trade Marks Act, Cap. T13, Laws of the Federation of Nigeria 2004
- Merchandise Marks Act, Cap. M10, Laws of the Federation of Nigeria 2004
- Trade Malpractices (Miscellaneous Offences) Act, Cap. T12, Laws of the Federation of Nigeria 2004

Source: Banwo and Ighodalo, 2019

However, for these tools to be effective, a country needs a well-functioning legal system. As in most of the SSA countries, intellectual property rights and protection are yet to be fully integrated into the institutional arrangements. Edosomwan (2019:6) suggests that "corruption and lack of coordination among the various agencies of government involved in the development and protection of IP rights are also a big challenge". The author also observed that intellectual property theft is high in Nigeria, with the manufacturing, consumer goods, technology, software, biotechnology, and pharmaceuticals as the most hit sectors. More so, Banwo and Ighodalo (2019) highlight the negative impacts of administrative holdups, unqualified personnel, and inadequate penalties for infringements, outdated laws, and inventory systems. Rapp and Rozek (1990:75) argue that:

> If property rights to potential innovation do not reside with an innovator, the incentive to devote resources to innovation is reduced, and society can expect fewer new products and processes. Proper assignment of these property rights brings forth innovations that provide increased productivity and, thus, economic growth and development.

Certainly, more efforts from the government in areas of effective mechanism, awareness, and enforcement of intellectual property rights will boost the innovation activities and productivity of entrepreneurial firms.

3.5.3. Financial System

The recognition of a relationship between financial system, innovation, and productivity growth of SMEs is widely documented in the literature (e.g. Levine, 1997; Robb and Robinson, 2014; Fraser et al., 2015). The financial system of a country plays a pivotal role in economic growth because it facilitates the transfer of financial resources from surplus sectors to deficit sectors (Choe and Moosa, 1999). The quality of financial institution can stimulate the R&D investment by enabling firms to get access to financial resources. For example, a well-organized financial system can promote successful innovation and productivity by providing support such as R&D subsidies, tax reduction on innovation activities to the entrepreneurial firms.

However, the financial markets are underdeveloped and highly imperfect in the SSA region when compared to developed economies (Sacerdoti, 2005; Fowowe, 2017; Quartey et al., 2017). The difficulty of accessing finance stands out as the main factor underlying low productivity of SMEs in the region (Page and Soderbom, 2015). Previous studies reveal that financial challenges faced by firms in the SSA are twice as higher as other developing countries; and only about twenty-three (23) percent of firms use bank loans (Otchere et al., 2017; Ayalew and Xianzhi, 2018). Despite the low percentage of bank loans for entrepreneurial projects, small firms are less likely to secure loans when compared to large firms.

In most cases, traditional providers hesitate to finance the activities of SMEs due to information asymmetry (Greenwald and Stiglitz, 1986). In addition to intangibility and uncertain returns characterizing innovation activities (Silva and Carreira, 2010), the lack of detailed firm information as well as weak institution make it difficult for financial providers to assess the potentials of innovation projects of these firms (Kerr and Nanda, 2015). Hence, in the face of high degree of information asymmetry, the traditional financial providers are either reluctant to finance innovation projects of SMEs or charge high-interest rate to scare them away. What's more, banks face greater liquidity constraints than other lenders; thus, as a result of weak investors' protection and institutional qualities (Winton and Yerramilli, 2008), they find it hard to finance innovation projects of SMEs in this region. Given the high level of financial constraints faced by SMEs in Nigeria, in chapter 5, I shall empirically ascertain whether access to external financial supports enhances both the innovation capabilities and productivity growth of these firms.

3.6. Firm-Level Determinants of Innovation

Having considered the impact of country-specific factors on SMEs' innovation activities and productivity, in section, I will focus on the main firm-level determinants of innovation and productivity. Research shows that firms are heterogeneous in their internal resources (Penrose, 1956). As a result, the amount of resources devoted to innovation by a firm largely depends on some firm-specific characteristics (Klette and Kortum, 2004).

3.6.1. Firm Size

Recall Schumpeter's two patterns of innovation activities presented in chapter 2. Schumpeter Mark (I) posits that entrepreneurs or small firms are the engine of innovation and economic growth and innovations. Whereas Schumpeter Mark (II) suggests that large firms in a concentrated market are the drivers of technological progress. Empirical studies are mixed on the role of firm size on innovation-decision and productivity (Ayalew et al. 2019). For example, Gault (2013) finds that large firms have a higher propensity of conducting R&D activities and innovate than smaller firms. Shefer and Frenkel (2005) suggest that larger firms in Israel tend to undertake more share of industrial R&D than smaller ones. Similarly, Roper and Hewitt-Dundas (2008) reveal find that larger-sized firms are more likely to introduce product and process innovation than smaller firms. Research suggests this trend is linked to several advantages that larger firms have over smaller ones. For example, they have more access to finance, scale economies, advertising power, and scope of economies for R&D (Scherer,1965; Cohen and Klepper, 1996).

Despite the advantages, burgeoning evidence shows that SMEs are not less innovative than large firms (Acs and Audretsch, 1988; Saunila, 2019). For example, Hall, Lotti, and Mairesse (2009) find that both product and process innovation have a positive impact on the productivity of Italian SMEs. Besides, the effect of large-size can hamper innovation activities through the loss of managerial control or excessive bureaucratic power. As well, rigid hierarchies that characterise most of the large firms can disincentivize R&D personnel and, in turn, affect innovation

performance (Cohen 2010). Unlike large firms, SMEs enjoy the advantages of adaptability, less rigid management structures, and entrepreneurial orientation, which allow them to implement innovations (Hewitt-Dundas, 2006; Alshanty, and Emeagwali, 2019). Furthermore, it is argued that the impact of firm size on innovation activities depends on the type of innovation in question. For example, SMEs are more likely to introduce radical innovations; whereas large firms may have an edge regarding innovation types that require huge capital investments (Morck and Yeung 2001).

Evidence from emerging markets shows that small firms are rapidly engaging in innovation activities given that they have to survive and compete with foreign companies (Aksoy, 2017; Afriyie, Du, and Ibn Musah, 2019). For example, Acquaah and Agyapong (2015) find that innovation has a significant positive effect on the performance of micro and small family businesses in Ghana. Similarly, in a study of 1058 manufacturing SMEs from Sub-Saharan LDCs, Abubakar et al. (2019) find that firm size is positively related to innovation. These authors show that R&D activities have a strong impact on both product and process innovation performances of SMEs in Djibouti, Tanzania, Uganda, Zambia, and the Democratic Republic of Congo. Based on these empirical results, I expect SMEs in Nigeria to engage in innovations as it improves competition efficiency and productivity trajectories.

3.6.2. Firm Age

In recent years, research shows that age affects the innovation capabilities and performance of firms (Rothaermel, Hitt, and Jobe, 2006). Generally, it is assumed

that mature firms perform better than young firms. In a study of Spanish firms, Coad et al. (2016) find that age has a negative and significant impact on the performance of young firms. This finding is supported by the learning effect that allows mature firms to innovate more efficiently. Experience comes with age, and in turn, allows firms to build on their existing capabilities and routines. Innovation is often associated with uncertainty, and lack of experience may negatively affect the innovation propensity of young firms. However, as time goes by, they can gain experience and resources that enable them efficiently handle uncertainty and risks linked to innovations (Levitt and March 1988). Also, Coad, Segarra, and Teruel (2016) suggest that market position and reputation accumulated over the years enable firms build relationships, which in turn, can positively influence their innovation outcomes (Tripsas and Gavetti, 2000).

On the other hand, evidence shows that young firms, especially new entrants are more likely to invest in innovations than the incumbents when pursuing a market entry strategy. Young firms have been associated with high degree of riskiness, which consequently, increases the tendency of engaging in radical innovation development. Huergo and Jaumandreu (2004) examined the impact of firm age and process innovation on the growth of productivity and find that young firms exhibit higher rates of productivity growth which tend to converge on average over the years.

In the context of developing countries such as Nigeria, there are more young SMEs than mature ones, mostly located in the manufacturing sector broadly construed. Even though these firms may have high risk-taking propensity and entrepreneurial outlook, they are more exposed to the challenges compared to the mature SMEs and large firms. For example, they are less likely to secure external

supports for innovation activities from financial intermediaries. Besides, young firms have to overcome the liability of smallness, newness, and legitimatization in order to innovate, compete efficiently, and achieve growth (Kraus et al., 2020). As a result, I expect these factors to influence the innovations and productivity gains of SMEs in Nigeria.

3.6.3. Employee Training Programme

Human capital is a central element of technological progress and economic growth as I discussed in the previous chapter (Storper and Scott, 2009). Firms with a substantial share of total stock of human capital are likely to grow faster than their counterparts (Gossling and Rutten, 2007). Van Uden, Knoben, and Vermeulen (2017) observe that the internal mechanisms that stimulate human capital are of particular importance for innovative output of firms in Kenya, Uganda, and Tanzania. As innovation is a process of learning both for individuals and firms, research highlights the need for company training to complement the stock of knowledge, competences, and skills acquired through formal education (Mincer 1996). McGuirk, Lenihan, and Hart, (2015) find that SME managers who participated in company training are more likely to introduce innovations. Gallié and Legros (2012) find that employee training has a strong positive effect on the innovation activities of French firms. Bauernschuster, Falck, and Heblich (2009) reveal that that training has a significant and positive effect on innovation in German firms. Similarly, González, Miles-Touya, and Pazó (2016) find that workforce training has a significant impact on firm innovation performance in Spanish manufacturing firms.

In developing countries, the results of van Uden, Knoben, and Vermeulen's (2017) reveal that the employee's schooling has a negative influence on firm innovation, especially for manufacturing firms that offer employee slack. Abdu and Jibir (2017), find that firms that provide formal training to their employees are likely to engage in product innovation. However, their findings suggest that formal education does not necessarily lead to innovative activities in the absence of appropriate company training in the context of developing countries. On this basis, it is expected that both human capital development in form of formal education and company training will influence innovation achievement and consequently, productivity growth of SMEs in Nigeria.

3.6.4. Cooperation

Innovation is a complex process that requires the combination and utilization of a wide variety of knowledge resources (Muscio 2007). Recent research highlights the shift in innovation activities from a closed to open process embedded in a learning economy (Asheim and Isaksen 1997; Laursen and Salter, 2006). Open innovation model posits that not all good ideas originate from an organization (Chesbrough, 2003). Firms can no longer afford to innovate alone, but rather engage in knowledge search outside their organisational boundaries (Chesbrough and Crowther, 2006). Knowledge is distributed across a wide range of different sources in the international markets, giving SMEs the opportunity of collaborating with external partners such as customers, suppliers, and competitors. Tidd and Bessant (2009) suggest that open innovation is motivated by the desire to reduce the cost

of technology development, risk for market entry, achieve economies of scale for production, and promote shared learning.

In fact, evidence supports a positive impact of external knowledge sources on innovation performance of firms in the context of developing economies (Cheng, and Sheu, 2018). In a study of 11 countries in sub-Saharan Africa, Medase and Abdul-Basit (2020) examine the significance of external knowledge sources as a determinant of firm's innovation performance. These authors find that external information acquired from customers, competitors, consultants, new employees, and workshops has strong impact on the implementation of product, process, marketing, and organizational innovation. There is reason to believe that cooperation with external agents is likely to influence the innovation performance of SMEs, especially in developing countries such as Nigeria. As mentioned earlier, these firms face resource constraints and, in most cases, they do not have a private in-house R&D department. However, cooperation with agents such as research institutions, suppliers, customers, and other firms both in the domestic and international markets can provide them with valuable opportunities for complementing their innovation capabilities and performance. Besides, SMEs are better positioned to take advantage of external knowledge than large firms due to their flexible management practices (Ortega-Argilés et al. 2009).

3.6.5. International Trade

International trade, terms of import and export, has been identified as a main determinant of innovation at the firm-level. From the endogenous growth perspective, firms with export orientations are more likely to innovate for the

following reasons. First, the pressure in the international market spur firms into investing in innovation activities to enhance their products, processes, and secure competitiveness. Second, the international market offers varieties of learning opportunities. Grossman and Helpman (1993) suggest that trade enables a bidirectional exchange of knowledge across borders. The assumption is that firms with exporting activities are exposed to knowledge resources that are not readily available to their peers in the domestic markets. Thus, by operating in foreign markets, firms can gain both technological and market knowledge. Evenson and Westphal (1995) state that:

> A good deal of the information needed to augment basic capabilities has come from the buyers of exports who freely provided product designs and offered technical assistance to improve process technology in the context of their sourcing activities.

With the emergence of new technologies and digitalization, SMEs in developing economies are evolving and rapidly expanding into foreign markets (Tekin and Hancioğlu, 2018). Studies suggest that firms from a weak business environment have a higher likelihood of entering foreign markets where efficient institutions allow for increased learning opportunities and technology sourcing (Dunning, 1998).

The potential of learning by doing and its impact on innovation is not restricted to exporting activities. Arrow (1962: 155) argues that learning is "the product of experience," which occurs only through the attempt to solve a problem and thus only "takes place during activity." This suggests that firms can also learn

by importing (Acharya and Keller, 2007). This would certainly be the case for firms in developing countries operating far from the technological and knowledge frontier in the production process (Andersson et al., 2008). These authors also show that high-quality imports positively affect the introduction of novel export products in the importing regions by helping local firms to exploit the advantages of global specialization. It is expected in this study that engaging in international trade, especially through exporting activities, improves both the innovation performance and productive growth of SMEs in Nigeria.

3.7. Conclusion

In this chapter, I examined the profile of SMEs in Nigeria as well as their contributions to the economy. Given that innovation is a main vital tool of growth and performance, I discussed, on one hand, the impact of country-specific factors, including lack of access to reliable power supply, ill-functioning legal system, lack of access to financial resources, on firm innovation and productivity. I argued that If SMEs are to grow and increase their contribution to the country's economy, the government will have to invest more in improving the institutional arrangement and R&D activities. On the other hand, I examined the impact of firm-characteristics, including firm size, firm age, company training, cooperation, and international trade, on the innovation activities of SMEs in Nigeria. Having considered these issues, I will focus on empirical aspect of this study. In the next chapter, I will discuss the challenges linked to gathering innovation information as well as data used in this study.

References

Abdu, M, and Jibir, A. (2017). Determinants of firms' innovation in Nigeria. Kasetsart Journal of Social Sciences, 1–9.

Abubakar, Y.A., Hand, C. Smallbone, D., and Saridakis, G. (2019). What specific modes of internationalization influence SME innovation in Sub-Saharan least developed countries (LDCs)?Technovation,79,56-70,

Acharya, R. C., and Keller, W. (2007). Technology Transfer through Imports, no 13086, NBER Working Papers, National Bureau of Economic Research, Inc.

Acs, Z., and Audretsch, D. (1988). Innovation in Large and Small Firms: An Empirical Analysis. The American Economic Review, 78(4), 678-690.

Acs, Z.J. and Audretsch, D.B. (1990) Innovation and Small Firms. The MIT Press, Cambridge.

Afriyie, S., Du, J., and Ibn Musah, A. (2019). Innovation and marketing performance of SME in an emerging economy: the moderating effect of transformational leadership. J Glob Entrepr Res 9, 40.

Aghion, P., and Howitt, P. (1992). A Model of Growth through Creative Destruction, Econometrica, 60, issue 2,323-51.

Aksoy, H. (2017). How do innovation culture, marketing innovation, and product innovation affect the market performance of small and medium-sized enterprises (SMEs)? Technology in Society, 51, 133–141.

Alam, A., Uddin, M., and Yazdifar, H. (2019). Institutional determinants of R&D investment: Evidence from emerging markets, Technological Forecasting, and Social Change,34-44.

Alby, P., J.-J. Dethier, and S. Straub (2010). Firms operating under Infrastructure and Credit Constraints in Developing Countries: The Case of Power Generators. Policy Research Working Paper 5497. World Bank.

Allred, B.B., and Steensma, Kevin. (2005). The influence of industry and home country characteristics on firms' pursuit of innovation. Management International Review. 45. 383-412.

Alshanty, A. M., and Emeagwali, O.L. (2019). Market-sensing capability, knowledge creation, and innovation: The moderating role of entrepreneurial-orientation,
Journal of Innovation & Knowledge, 4, Issue 3, 171-178.

Andersson, M., Johansson, S., and Lööf, H. (2008). Productivity and international trade: Firm-level evidence from a small open economy. Review of World Economics/Weltwirtschaftliches Archiv, 144(4), 774–801.

Asheim, B.T., and A. Isaksen, (1997). Localisation, Agglomeration, and Innovation: Towards Regional Innovation Systems in Norway? European Planning Studies 5 (3), 299-330.

Audretsch, D. and Keilbach, M. (2004). Entrepreneurship Capital and Economic Performance, Regional Studies, 38:8, 949-959.

Ayalew, M.M., Xianzhi, Z., and Hailu, D.H. (2019). The finance of innovation in Africa, European Journal of Innovation Management, Vol. 23 No. 3,348-382.

Ayalew, M. M., Xianzhi, Z., Dinberu, Y. D., and Hailu, D. H. (2019). The Determinants of Firm's Innovation in Africa. Journal of Industry, Competition, and Trade. doi:10.1007/s10842-019-00313-4

Banwo-Ighodalo (2016). Strengthening Intellectual Property Rights and Protection in Nigeria, http://www.banwo-ighodalo.com/grey-matter/strengthening-intellectual-property-rights-and-protection-in-nigeria

Bauernschuster, S., Falck, O. and Heblich, S. (2009), Training and Innovation, Journal of Human Capital, 3, issue 4, 323-353.

Beck, T., Demirguc-Kunt, A., and Levine, R. (2005). SMEs, Growth, and Poverty: Cross-Country Evidence. J Econ Growth 10, 199–229.

Cheng, C.C.J.and Sheu, C. (2018). Enhancing radical innovation: the interplays of open innovation activities, firm capabilities, and environmental dynamism, Asian Journal of Technology Innovation, 26:3, 369-397.

Chesbrough, H. (2003). Open Innovation: The New Imperative for Creating and Profiting, from Technology. Harvard Business School Press, Boston.

Chesbrough, H. and Crowther, A.K. (2006), Beyond high tech: early adopters of open innovation in other industries. R&D Management, 36: 229-236.

Choe, C. and Moosa, I. A., (1999). Financial System and Economic Growth: The Korean Experience, World Development, 27, 6, 1069-1082.

Coad, A., Segarra, A., and Teruel, M. (2016). Innovation and firm growth: Does firm age play a role? Research Policy, 45, Issue 2,387-400.

Cohen, W. M. (2010). Fifty Years of Empirical Studies of Innovative Activity and Performance, Handbook of the Economics of Innovation, in: Bronwyn H. Hall and Nathan Rosenberg (ed.), Handbook of the Economics of Innovation, edition 1, volume 1, chapter 0, pages 129-213, Elsevier.

Cohen, W.M., and Klepper, S. (1996). Firm Size and the Nature of Innovation within Industries: The Case of Process and Product R&D. The Review of Economics and Statistics, 78(2), 232-243.

Cravo, T., Gourlay, A., and Becker, B. (2012). SMEs and regional economic growth in Brazil, Small Business Economics, Springer, vol. 38(2) 217-230.

Aifuwa Edosomwan, A. (2019). Protecting intellectual property rights in Nigeria: A review of the activities of the Nigerian Copyright Commission, World Patent Information,58. DOI: https://doi.org/10.1016/j.wpi.2019.101908.

Evenson, R. E., and Westphal, L. E., (1995). Technological change and technology strategy, ch. 37, p. 2209-2299 in Chenery, Hollis and Srinivasan, T.N. eds., Handbook of Development Economics, vol. 3, Part 1, Elsevier.

Fakira, H. (1994). Energy for micro-enterprises. Energy Policy Research and Training Project. Energy and Development Research Centre. University of Cape Town. Paper No. 12: 16-25.

Fowowe, B. (2017). Access to finance and firm performance: Evidence from African countries, Review of Development Finance,7, Issue 1,6-17.

Fraser, S., Bhaumik, S. K., and Wright, M. (2015). What do we know about entrepreneurial finance and its relationship with growth? International Small Business Journal, 33(1), 70–88.

Gallié, E-P., and Legros, D. (2012). Firms' human capital, R&D, and innovation: a study on French firms, Empirical Economics, 43, issue 2,581-596.

Gault, F. (2013). Handbook of Innovation Indicators and Measurement, volume 19, Innovation indicators, and measurement: challenges, pages 441–464. Edward Elgar Publishing.

Goedhuys, M., and L. Sleuwaegen (2010) High-growth entrepreneurial firms in Africa: a quantile regression approach. Small Business Economics 34:31-51.

González, X., Miles-Touya, D. and Pazó, C. (2016) R&D, worker training and innovation: firm-level evidence, Industry and Innovation, 23:8, 694-712

Gossling, T., and Rutten, R. (2007). Innovation in regions European Planning Studies, 15, 253-270.

Greenwald, B. C., and Stiglitz, J. E. (1986). Externalities in Economies with Imperfect Information and Incomplete Markets, The Quarterly Journal of Economics, Volume 101, Issue 2,229–264

Grimma, M., Hartwiga, R., and Layd, J. (2013). Electricity Access and the Performance of Micro and Small Enterprises: Evidence from West Africa, European Journal of Development Research (2013) 25, 815–829.

Grossman, G. M., and Helpman, E. (1993). Innovation and Growth in the Global Economy. Scottish Journal of Political Economy, 40: 231-232

Hall, B., and Sena, V. (2017). Appropriability mechanisms, innovation, and productivity: evidence from the UK, Economics of Innovation and New Technology, 26, issue 1-2,42-62.

Hall, B.H., Lotti, F., and Mairesse, J. (2009). Innovation and productivity in SMEs: empirical evidence for Italy. Small Bus Econ 33, 13–33

Hewitt-Dundas, N. (2006). Resource and Capability Constraints to Innovation in Small and Large Plants, Small Business Economics, 26, issue 3, 257-277.

Huergo, E. and Jaumandreu, J. (2004), Firms' age, process innovation and productivity growth, International Journal of Industrial Organization, 22, issue 4, p. 541-559.

ITC (2018). Business Ecosystems for the Digital Age, the International Trade Centre, Geneva, Switzerland.

Jabbour, L. S., Beatriz, A. Ndubisi, N. O., and Seles, R. P. (2020). Sustainable development in Asian manufacturing SMEs: Progress and directions, International Journal of Production Economics, 225, https://doi.org/10.1016/j.ijpe.2019.107567

Jackson, G., and Deeg, R. (2008). Comparing capitalisms: understanding institutional diversity and its implications for international business. J Int Bus Stud 39, 540–561.

Jiao, H. Koo, C.K., and Cui, Y. (2015). Legal environment, government effectiveness, and firm's innovation in China: examining the moderating influence of government ownership Tech. Forecasting Soc. Chang., 96, 15-24

Klette, T., and Kortum, S. (2004). Innovating Firms and Aggregate Innovation. Journal of Political Economy, 112(5), 986-1018.

Kraus, S., Kailer, N., Dorfer, J., and Jones, P. (2020). Open innovation in (young) SMEs. The International Journal of Entrepreneurship and Innovation, 21(1), 47–59.

Laursen, K., and Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among U.K. manufacturing firms. Strat. Mgmt. J., 27: 131-150.

Lazonick, W. (2005). The Innovative Firm in Jan Fagerberg, David Mowery, and Richard Nelson, eds., The Oxford Handbook of Innovation, Oxford University Press: 29-55.

Lee, R. P., Özsomer, A., and Zhou, K. Z. (2015). Introduction to the special issue on Innovation in and from Emerging Economies. Industrial Marketing Management 50, 16-17.

Leigh, N. G., and Blakely, E. J. 2016. Planning local economic development: Theory and practice, SAGE publications.

Levine, R. (1997). Financial Development and Economic Growth: Views and Agenda, Journal of Economic Literature, Vol. 35, No. 2, pp. 688–726.

Levitt, B., and March, J. G. (1988). Organizational Learning, Annual Review of Sociology, Vol. 14, 319-340.

Lin, B., and Benjamin, I. N. (2018). Causal relationships between energy consumption, foreign direct investment, and economic growth for MINT: Evidence from panel dynamic ordinary least square models. Journal of Cleaner Production, 197, 708–720.

Lorenz, E. (2014). Do Credit Constrained Firms in Africa Innovate Less? A Study Based on Nine African Nations', GREDEG Working Paper Series No. 2014-29.

Medase, S.K., and Abdul-Basit, S. (2020). External knowledge modes and firm-level innovation performance: Empirical evidence from sub-Saharan Africa, Journal of Innovation & Knowledge,5, Issue 2, 81-95.

McGuirk, H., Lenihan, H., and Hart, M. (2015). Measuring the impact of innovative human capital on small firms' propensity to innovate Res. Policy, 44 (4) (2015), 965-976.

Medase, K., and Barasa, L. (2019). Absorptive capacity, marketing capabilities, and innovation commercialisation in Nigeria, European Journal of Innovation Management,22, 5, 790-820.

Mincer, J. (1996). Economic development, growth of human capital, and the dynamics of the wage structure. J Econ Growth 1, 29–48.

Morck, R., and Yeung, B. (2004). Family Control and the Rent-Seeking Society. Entrepreneurship Theory and Practice, 28(4), 391–409.

Muscio, A. (2007). The Impact of Absorptive capacity on SME's Collaboration, Economics of Innovation and New Technology, 16:8, 653-668.

OECD (2018). Strengthening SMEs and entrepreneurship for productivity and inclusive growth, Key Issues paper, SME Ministerial Conference, Mexico.

Olayemi, S-O. O. (2012). Electricity Crisis and Manufacturing Productivity in Nigeria (1980-2008), Developing Country Studies, Vol 2, No.4, 16 - 21.

Olayungbo, D.O. (2019). Effects of oil export revenue on economic growth in Nigeria: A time-varying analysis of resource curse, Resources Policy,64, https://doi.org/10.1016/j.resourpol.2019.101469.

Ortega-Argilés, R., Moreno, R., and Caralt, J.S. (2005). Ownership structure and innovation: is there a real link?. Ann Reg Sci 39, 637–662.

Otchere, I., Senbet, L., and Simbanegavi, W. (2017). Financial sector development in Africa–an overview, Review of Development Finance,7, Issue 1, 1-5.

Page, J., and Söderbom, M. (2015). Is Small Beautiful? Small Enterprise, Aid, and Employment in Africa. African Development Review, 27: 44-55.

Penrose, E.T. (1956), Towards a Theory of Industrial Concentration, Economic Record, 32: 64-77

Plessis, M. D. (2007). The role of knowledge management in innovation. Journal of Knowledge Management 11: 20–29.

Quartey, P., Turkson, E., Abor, J., and Iddrisu, A. (2017). Financing the growth of SMEs in Africa: What are the constraints to SME financing within ECOWAS? Review of Development Finance. 7. 10.1016/j.rdf.2017.03.001.

Rapp, R.T., and Rozek, R.P. (1990). Benefits and Costs of Intellectual Property Protection in Developing Countries. Journal of World Trade, 24, 75-102.

Robb, A. M. and D. T. Robinson (2014), 'The Capital Structure Decisions of New Firms', Review of Financial Studies, Vol. 27, No. 1, pp. 153–79.

Robertson, C., and Chetty, S.K. (2000). A contingency-based approach to understanding export performance, International Business Review, Vol. 9 No. 2, pp. 211-235.

Roper, S., and Hewitt-Dundas, N. (2008). Innovation persistence: Survey and case-study evidence, Research Policy, 37, issue 1, 149-162.

Rosenbusch, N., Brinckmann, J., and Bausch, A. (2011). Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs, Journal of Business Venturing, 26,441-457.

Rothaermel, F.T., Hitt, M.A., and Jobe, L.A. (2006). Balancing vertical integration and strategic outsourcing: effects on product portfolio, product success, and firm performance. Strat. Mgmt. J., 27: 1033-1056.

Sacerdoti, E. (2005). Access to Bank Credit in Sub-Saharan Africa; Key Issues and Reform Strategies, IMF Working Papers 05/166, International Monetary Fund.

Safari, A. and Saleh, A.S. (2020). Key determinants of SMEs' export performance: a resource-based view and contingency theory approach using potential

mediators, Journal of Business and Industrial Marketing, Vol. 35 No. 4, pp. 635-654.

Scherer, F. (1965). Firm Size, Market Structure, Opportunity, and the Output of Patented Inventions. The American Economic Review, 55(5), 1097-1125

Schumpeter, Joseph A., 1934, The Theory of Economic Development, Oxford University Press.

Seitz, M., and Watzinger, M. (2017). Contract enforcement and R&D investment Res. Policy, 46 (1), 182-195.

Shefer, D., and Frenkel, A. (2005). R&D, firm size, and innovation: an empirical analysis, Technovation, 25, Issue 1,25-32.

Silva, F., and Carreira, C. (2010). Measuring firms' financial constraints: Evidence for Portugal through different approaches, no 2010-15, GEMF Working Papers, GEMF, Faculty of Economics, University of Coimbra.

Solow, R. M. (2007). The last 50 years in growth theory and the next 10, Oxford Review of Economic Policy, Oxford University Press,23(1), 3-14.

Srholec, M. (2011). A multilevel analysis of innovation in developing countries Ind. Corp. Chang., 20 (6), 1539-1569

Storey. D.J. (1994). Understanding the Small Business Sector. London: Routledge/ITP.

Storper, M., and Scott, A. (2009). Rethinking human capital, creativity and urban growth, Journal of Economic Geography, 9, 2,147-167.

Tidd, J., and Bessant, J. (2009). Managing innovation: Integrating technological, market, and organizational change. Wiley.

Tripsas, M. and Gavetti, G. (2000), Capabilities, cognition, and inertia: evidence from digital imaging. Strat. Mgmt. J., 21: 1147-1161.

van Uden, A., Knoben, J., and Vermeulen, P. (2017). Human capital and innovation in Sub-Saharan countries: a firm-level study, Innovation, 19:2, 103-124.

Waarden, F.V. (2001). Institutions and innovation: the legal environment of innovating firm Org. Stud., 22 (5) (2001), pp. 765-795.

Wang, C. Yi, J., Kafouros, M. and Yan, Y. (2015). Under what institutional conditions do business groups enhance innovation performance? J. Bus. Res., 68, 694-702.

Winton, A., and Yerramilli, V. (2008). Entrepreneurial finance: Banks versus venture capital, Journal of Financial Economics, 88, issue 1, 51-79.

Wu, J., Wang, C., Hong, J., Piperopoulos, P., and Zhuo, S. (2016).Internationalization and innovation performance of emerging market enterprises: the role of host-country institutional development, J. World Bus., 51, 251-263

Yunusa, L. A. (2020). Exchange rate volatility and Nigeria crude oil export market,
Scientific African,9. DOI://doi.org/10.1016/j.sciaf.2020.e00538.

Yeoh, P.L., and Jeong, I. (1995). Contingency relationships between entrepreneurship, export channel structure, and environment: a proposed conceptual model of export performance, European Journal of Marketing, Vol. 29 No. 8, pp. 95-115.

Chapter Four

Measuring Innovation Outputs

Fundamental to the evaluation of any research program is an ability to measure the output(s) from the research.
Albert N. Link, 1995

4.1. Introduction

The nature and availability of data influence our understanding of the pattern of innovation, innovation output, and productivity of firms. The measurement of innovation activities is not always an easy task. For example, researchers have to decide whether to analyse the innovation performance using the measures of innovation input, intermediate or output indicators. The task is even more daunting in the context of developing country SMEs, where firm-level data are not readily available and comprehensive compared to the developed countries. Besides, the majority of these firms operate in the informal sector, thereby increasing the task of collecting reliable innovation data. Research suggests that collecting appropriate innovation information about SMEs is very important as it not only reveals the innovation pattern of these firms but also helps in evaluation processes and policy decisions (Link, 1995).

The objective of this chapter is to present the data used in the empirical section of this research. The chapter is organised as follows: In Section 4.1, I will outline the two main approaches to collect innovation data. In Section 4.2, I will

discuss the features and challenges of collecting innovation data in developing countries. In Section, 4.3., I will present the innovation survey database used in this study. Finally, in Section 4.4., I will describe the three innovation output variables used in the empirical studies.

4.2. Approaches in the Collection of Innovation Data

4.2.1. Object-based Approach

There are several ways of measuring innovation in the literature (Arundel and Hollanders, 2005; Bogliacino et al., 2012; Hoskens, 2015). These attempts highlight both multidimensional nature of innovation activities as well as the challenge of mapping innovation efforts, especially at the firm level (Young, 1996; Smith, 2005). However, there are two generally accepted methods used in the literature, namely: the object approach and subject approach. The former is "a single, focal, most important innovation, facilitating information retrieval about enablers, features, and outcomes of business innovations" (OECD, 2019). The emphasis of this approach is on the phenomenon itself, that is, individual innovation activities. The object-based innovation data are generally collected from publications such as magazines, technical and trade journals. In the object-based approach, the process consists of identifying the most significant technological innovations and then examining the features of the firms as well as new products and processes in question (Pianta and Sirilli, 1997).

This approach goes back to the work of Edwards and Gordon (1984), who prepared an innovation database for the U.S Small Business Administration (SBA). The database includes 8,074 innovations introduced to the US market in 1982,

including 4,200 manufacturing products. These authors defined innovation as "a process that begins with an invention, proceeds with the development of the invention and results in the introduction of a new product, process or service to the marketplace" (Edwards and Gordon, 1984: 1). This definition covers the three main stages of innovation, especially emphasizing the commercialization component of the innovation. The SBA database has been used by scholars in innovation research (e.g. Kleinknecht and Bain, 1993; Feldman and Florida, 1994). For example, Acs and Audretsch, (1990) find that the total number of innovations is negatively related to concentration but positively related to R&D, skilled labour, and the degree to which large firms comprise the industry. Besides, the results reveal that the effects of innovation determinants vary between large and small firms.

In Europe, a similar database was developed by the Science Policy Research Unit (SPRU), at the University of Sussex. It covers information on sources and types of innovation, industry innovation patterns, and cross-industry innovation linkages in the UK between 1945 and 1983. Using the SPRU's database, Pavitt et al. (1987) find that intersectoral difference in the size distribution of innovating firms associated with R&D-based technological opportunities, and technological ease of entry by user firms with main activities outside the sector. Other empirical studies based on this database include Geroski (1990), Tether et al. (1997), Rothwell, (1984, 1989) among others.

However, the object-based approach may suffer from potential selection bias (Link, 1995). Regarding this Santarelli and Piergiovanni (1996: 692) argue that the:

> Counting of innovations lies in the selection of the relevant journals and the features of the new products section in each of them". The number of

innovations identified will probably be positively correlated with the number of journals selected or, in any case, with the total number of journals reporting this kind of information for the relevant country and the length of the new product section in each of them.

Besides, the fittingness of object-based approach is likely to vary across countries, regions, and industries. For example, this approach would be less appropriate in developing countries, where firms are less likely to officially disclose their products to the public and publication outlets due to the high level of informality.

4.2.2. Subject-Based Approach

In the subject-based approach, the focus is on firms that produce or adopt innovations. In this approach, innovation information is collected from both innovating and non-innovating firms (OECD, 2019). It has the advantage of capturing innovation activities of firms that are not directly reported in official outlets such as journals and magazines. The earlier attempts of the subject-based method conducted in Canada, USA, and Europe, were based on the first Oslo Manual (1992). However, it was criticized because of its narrow focus on innovation indicators. More precisely, it paid more attention to specific outputs of innovation, such as patents, which was only relevant for certain industries; and ignored the key elements of the knowledge accumulation process (Cirera and Muzi, 2020).

With the improvement of the Oslo Manual, more comprehensive innovation databases such as the Community Innovation Survey (CIS), which is part of the European Union Science and Technology Statistics, was launched. The current

version of CIS is based on the Oslo Manual (2005), administrated by the European Commission (EC). As a harmonized survey, CIS contains information on sectoral innovation activities of different types of firms, innovation types, economic activities, and other firm-level characteristics in EU member states and number of ESS member countries. The database has been widely used in enterprise innovation research (e.g. Peneder, 2010; Horbach and Rennings, 2013). For example, using Dutch part of CIS, Brouwer, and Kleinknecht1 (999) find that a firm's propensity to patent is significantly higher among R&D collaborators, and it varies across sectors and by firm size. Using CIS data, Tavassoli and Karlsson (2015) examined the persistence of the innovation behaviour of Swedish firms. They find that among the four types of innovations analyzed that product innovations have the strongest, whereas marketing innovations have less impact on persistence. For UK firms, Audretsch and Belitski (2020) find that R&D plays an important impact on innovation and productivity of firms, while knowledge spillovers are more important on firm productivity than R&D activities.

4.3. Innovation Survey in Developing countries

The availability of an adequate database is vital to understand not only the technology patterns of firms but also the various impacts of innovation activities on productivity growth. While databases such as CIS in Europe, SBA in US have induced substantial body of empirical evidence on firm-level innovations, the majority of developing countries are still lagging behind in this aspect. Regarding this Cirera and Muzi (2020) write that: "Yet less is known about the extent and

impact of firm-level innovation in developing countries, which greatly undermines the ability to design appropriate policies to promote innovation and support economic growth". To date, there are a handful of attempts in developing countries to develop innovation surveys using the tools and guidelines of the Oslo Manual. For example, the Bogota Manual, which is standardized indicators of technological innovation in Latin American and Caribbean countries (RICYT, 2010). The manual was later modified, a set of methodological guidelines was included to capture the features of innovation and technological diffusion in the region (Castellacci and Natera, 2012). The database has been used in several empirical studies (e.g. Crespi and Peirano, 2007; Raffo et al., 2008).

Furthermore, recognizing the pivotal role of innovation information in the development of science and economic growth in Africa, the African Union Ministerial Conference in charge of Science and Technology (AMCOST) initiated a call for an improvement of Science Technology and Innovation (STI) on the continent. One of the outcomes of the initiatives was the development of innovation survey, which is in its third wave. Out of the 55 countries in Africa, the following countries participated in the national innovation survey: Algeria, Angola, Burkina Faso, Cameroon, Egypt, Ethiopia, Gabon, Ghana, Kenya, Lesotho, Malawi, Mali, Mozambique, Namibia, Nigeria, Rwanda, Senegal, Seychelles, South Africa, Tanzania, Togo, Uganda, Zambia and Zimbabwe (AU–NEPAD, 2010, 2019; NPCA, 2014).

Despite these attempts, these innovation surveys in developing countries are still limited in several ways. According to Bogliacino et al. (2014), these surveys focus less on R&D activities and pay more attention to measurements of training activities, technology acquisition, and organizational innovations due to the

distance of technology frontier and underdeveloped absorptive capacity that characterize innovation activities in developing countries (Lugones, 2006; Anlló, 2006). Second, there are problems related to sample designs as well as tendency of focusing more on large firms. As a result, "the lack of significant coverage of small firms—that in developing countries represent the largest part of industry and services—prevents an understanding of the actual process of knowledge generation and diffusion" (Bogliacino et al. 2014: 225).

Third, as we mentioned above, informality influences the collection of innovation data in developing countries. Research shows that the informal sector still constitutes the major share of all the firms and plays a vital role in both the innovation activities and economic growth in the SSA region (Pérez et al. 2018; Ibidunni et al., 2020). However, the survey instrument and extant framework in most of the developing countries are not appropriate for measuring innovation activities in the informal sector (Cozzens and Sutz, 2014). Similarly, Siyanbola et al. (2016) argue that innovation surveys in Africa countries do not sufficiently capture indigenous knowledge and innovation activities, which have potential impacts on the medical and agricultural industries.

Finally, scholars suggest that innovation surveys in developing countries are yet to be fully harmonized, especially in the areas of common definition and languages (Gault, 2011; Cirera and Muzi, 2020). It is argued that a higher degree of harmonization would be beneficial as it allows for cross-country and cross-industry empirical analyses of innovation activities of firms in the region (Castellacci and Natera, 2012).

4.4. Innovation Surveys in Nigeria

Important efforts at improving the STI indicators led to the development of Nigerian National Science and Technology policy in 1986. This policy was updated in 1997; and since then, it is reviewed every 5 years (Olaopa et al., 2011). To reinforce its efforts, the federal government mandated the National Centre for Technology Management (NACETEM) to conduct policy research in the areas of energy and environment, ICT, policy review, innovation, entrepreneurship, indigenous technology, and R&D activities (Siyanbola et al., 2012). Later, the NACETEM's project was integrated into the New Partnership for Africa's Development, Office of Science and Technology (NEPAD OST), African Science, Technology and Innovation Initiatives (ASTII) in 2008 (Siyanbola et al., 2016).

The Nigerian Innovation Survey (NIS) used in this study is part of the STI indicators developed by the NACETEM. It covers data from wave 1 (2005-2007) and wave 2 (2008-2010). The surveys were first carried out in 2008 (including a sample of 1000 firms) and then repeated in 2011 (including a sample of 1500 firms). The second wave was Nigeria's part of the African Science, Technology and Innovation (ASTII) indicators, supported by the NEPAD and Private Enterprise Development in Low-income Programme of the UK's Department for International Development. The NIS follows the implementation and procedures of the "Guidelines for Collecting and Interpreting Innovation Data" of the Oslo Manual (OECD, 2005).

The questionnaire contains 12 sections. The survey contains information both on firm characteristics and innovation activities. More precisely, in collecting the information, firms were asked whether they have engaged in innovation activities during the periods of the survey. It covers different types of innovations, including information on a variety of indicators on inputs, outputs, innovation sources, cooperation, and hampering factors, etc. Table 4.1. shows a summary of the aspects covered in the survey.

Table 4.1: Breakdown of the NIS Sections

- General information: firm location, industry branch, geographical scope of the market, number of employees, personnel qualifications, total turnover, etc.
- Indicators of innovation outputs
- Ongoing and abandoned innovation activities
- Innovation activities and expenditures: R&D expenditures, acquisition of machineries, software, patents and licenses, outsourced R&D, and personnel training.
- Source of information and cooperation for innovation activities
- Effects and objectives of innovation activities
- Factors hampering innovation activities
- Intellectual property rights
- Government supports for innovation

The sampling frame used was based on a directory of enterprises from both the Nigerian Stock Exchange (NSE) and the National Bureau of Statistics (NBS). It is good to mention that NSE's list includes only firms in the formal sector. On the other hand, the list of NBS contains firms in both formal and informal sectors. Besides, a proportional probability sampling tool was used to select firms with a minimum of 10 employees. Consequently, the NSE and NBS lists were cross-referenced and any firm that appeared in both of them was automatically included in the sample.

The survey used a multistage systematic random sampling technique. First, the firms were stratified into manufacturing and service sectors using the Industrial Classification of all Economic Activities (ISIC revision 3.1). Second, the firms were stratified according to geographical locations, covering the six geopolitical zones of Nigeria, namely north-east, north-west, north-central, south-west, south-east, and south-south. Thus, the survey is a fair representation of the innovation activities of firms in Nigeria. Third, the firms were stratified according to employee size.

The survey instruments were hand-delivered by field officers. To increase the response rate, the physical addresses of the firms were confirmed. In the case of firms that are out of business operation or with no traceable addresses, they were replaced with similar firms from the same sector and geographical location. Other actions taken to increase the response rate were telephone calls, follow-up visits, etc. The final sample of the surveys is shown in table 4.2.

Table 4.2: Final sample of the NIS (Wave 1: 2005 – 2007; Wave 2: 2008 – 2010)

Sector	**Year of survey (2008)**	**Year of survey (2011)**	**Total**
Manufacturing	519	371	890
Service	209	260	469
Total	**728**	**631**	**1,359**

Even though the survey questionnaires were not identical in the two surveys, they were very similar in the sections used in this study. The final pooled sample includes 1359 firms, an overall response rate of 54.3 percent. For the purpose of this work, I included a sample of firms in both sectors and eliminated firms with missing information, which reduced the sample to 162 firms (service sector) and 255 firms (manufacturing sector).

4.5. Choice of Innovation Indicators

The choice of innovation output indicators is one of the main challenges of mapping innovation activities and performance of firms. For example, technological innovations have been traditionally measured by patents (Schmookler, 1950, 1953). Scholars suggest that patents are a good proxy for innovation both at the regional level (Acs, Anselin and Varga, 2002) and firm level (Griliches, 1990). Patents as a proxy allow for a cross-country comparison of innovation activities (Connolly, 1997, 1998; Smith, 2005). However, its use as a measurement of innovation has been criticised on several grounds (Mansfield, 1986). First, it is a fraction of innovation, which is more an indirect or intermediate measure, instead of measure of innovation output (Comanor and Scherer, 1969). What's more? Kleinknecht (2016:2) argues that:

> The 'propensity' to patent an invention may differ between industry branches, depending on the relative costs of innovation and imitation: if innovation costs are high and imitation costs are low, the propensity to patent is high; the opposite may hold if imitation costs are relatively high. Moreover, little is known about what firms do with their patents: what is the share of patents that is actually translated into commercially viable products?

One of the main limitations of patents is that it does not capture all aspects of innovation activities. Recall that generated ideas have to be commercialized to be

considered as innovation. However, in reality, not patented inventions are commercialized; and not innovations are patented (Griliches, 1990; Kleinknecht, Poot, and Reijnen, 1991). The latter case is more predominant in the developing countries, where legal systems and patent offices are either not fully developed or inefficient as mentioned above.

As a result of these limitations, scholars argue that "the actual economic significance of new technology can be better understood by means of a direct measure of innovation output" (Santarelli and Piergiovanni, 1996: 690). Both Schumpeter and Oslo Manual's definitions show that innovation is a multifaceted construct, cutting across the technological and non-technological spheres. Technological innovation refers to the use of new technology to produce changes in products or services, and also to how products and services are produced (Damanpour, 1987). As global competition is driving technological innovations, SMEs are commercializing disruptive products at the expense of large firms (Carayannopoulos, 2009). Radicic and Djalilov (2018) show that SMEs investing in technological innovation perform better in the export markets. Similarly, Becker and Egger (2013) find that technological innovation positively affects the performance of German firms. Since product and process innovations are related to the development or application of new technologies, this study understands them as technological innovation (OECD, 2005).

However, although technological innovation drives competitive advantage, it is not sufficient for managing contingency factors in today's global market. Research shows that firms can create and sustain a competitive advantage via non-technological innovation (Mothe and Nguyen, 2012). Gupta and Foroudi (2016)

suggest that the adoption of marketing innovation can lead to changes in product, pricing, and promotion strategy, and consequently, improve firm performance.

4.6. Definition of Innovation Output Indicators

a) Product Innovation

Product innovation is the introduction of goods or services that are new or have had their features and intended uses significantly improved. It includes significant improvements in technical specifications, components, and materials, software in the product, user-friendliness, or other functional characteristics (Oslo Manual, 2005). In the Schumpeterian model of creative destruction, product innovation is pivotal to firm competitiveness and productivity as we saw in the previous chapter. For example, SMEs can create a competitive advantage by introducing technologically advanced products with novel and unique features that meet the market's demands. Through horizontal and vertical product differentiations, SMEs can successfully enter new foreign markets as well as increase shares in existing markets and, in turn, productivity gains (Becker and Egger, 2013). The NIS defined product innovation as "the introduction to market of a new or significantly improved good or service with respect to its capabilities, such as improved user-friendliness, components, software or sub-system".

b) Process Innovation

Process innovation refers to the implementation of a new or significantly improved production or delivery method. It includes a significant change in techniques, equipment, and/or software (Oslo Manual, 2005). The objective of firm pursuing process innovation is to decrease unit costs of production or delivery, to increase quality, or to produce or deliver new or significantly improved products (Ganotakis and Love, 2010). SMEs producing new products at a lower price can increase their efficiency and consequently, perform better in the export market than non-innovating firms (Becker and Egger, 2013). The NIS defined process innovation as "the use or implementation of new or significantly improved process or method for the production or distribution of goods or services or supporting activity". In the cases of product and process innovation, NIS specified that "the innovation (new or improved) must be new to your enterprise, but it does not need to be new to your industry sector or market".

c) Marketing Innovation

Marketing innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion, or pricing (Oslo Manual, 2005). It represents ways through which a firm addresses customers' demands, opens up new markets, and positions products on markets to increase its sales (Gunday et al., 2011). Grimpe et al. (2017) argue that marketing innovation is neither subordinate to nor a mere 'mechanism for exploiting technologically novel products commercially'. This highlights the

fundamental role of marketing innovation as a source of competitive advantage. In other words, the competitiveness of a firm goes beyond mere ownership of technology (Patterson et al., 2003). It also includes a firm's ability to respond to the market environment through the 'knowledge gathered from customers and competitors in the process of market research' (Grimpe et al., 2017: 362). Such knowledge embodied in a new marketing strategy results in superior performance in the export market. This re-echoes Drucker's claim, "that any business enterprise has two–and only two–basic functions: marketing and innovation" (Drucker, 1954: 40). The NIS defined marketing innovation as "significant changes to the aesthetic design or packaging of a good or service (exclude changes that alter the product's functional or user characteristics –these are product innovations)".

4.7. Conclusion

While the significant role of innovation in survival and growth is largely uncontested, its measurement is a challenging task. This has led to several attempts to capture various aspects of innovation activities, especially innovation output at the firm level. In this chapter, I presented the two main approaches used in the collection of innovation data, namely, object-based approach and subject-based approach. I discussed the characteristics and challenges linked to the collection of innovation data in developing countries. Finally, I presented the NIS database as well as described the three innovation output variables used in the empirical analyses in the next two chapters.

References

Acs, Z.J. and Audretsch, D.B. (1990) Innovation and Small Firms. The MIT Press, Cambridge.

Acs, Z., Anselin, L., and Varga, A. (2002). Patents and innovation count as measures of regional production of new knowledge, Research Policy, 31, 7, 1069-1085.

Anlló, G. (2006). An overview of Latin America innovation surveys. In Blankley, W., Scerre, M., Molotja, N., & Saloojee, I. (Eds.). Measuring innovation in OECD and non-OECD countries (Chap. 10, pp. 141–162). Cape Town, South Africa: HSRC Press.

Arundel, A., and Hollanders, H. (2005). EXIS: An exploratory approach to innovation scoreboards. Brussels: European Commission, DG Enterprise.

AU—NEPAD. (2010) African Innovation Outlook 2010. AU—NEPAD: Pretoria, South Africa.

AU—NEPAD. (2019) African Innovation Outlook 2010. AU—NEPAD: Pretoria, South Africa.

Audretsch, D. B., and Belitski, M. (2020), The role of R&D and knowledge spillovers in innovation and productivity, European Economic Review, 123, DOI: https://doi.org/10.1016/j.euroecorev.2020.103391

Becker, S.O., and Egger, P.H. (2013). Endogenous product versus process innovation and a firm's propensity to export, Empirical Economics, Vol. 44 No. 1, pp. 329-354.

Bogliacino, F., Perani, G., Pianta, M., and Supino, S.(2012).Innovation and development. The evidence from innovation surveys, Latin Am. Bus. Rev., 13 (3)219-261.

Brouwer, E., and Kleinknecht, A. (1999). Innovative output, and a firm's propensity to patent.: An exploration of CIS micro data, Research Policy,28, 6, 615-624.

Carayannopoulos, S. (2009). How Technology-Based New Firms Leverage Newness and Smallness to Commercialize Disruptive Technologies. Entrepreneurship Theory and Practice. 33. 419 - 438.

Castellacci, F., and Natera, J. (2013). The dynamics of national innovation systems: A panel cointegration analysis of the coevolution between innovative capability and absorptive capacity, Research Policy, 42,3,579-594.

Cirera, X. and Muzi, S. (2020). Measuring innovation using firm-level surveys: Evidence from developing countries, Research Policy, 49, Issue 3. DOI: https://doi.org/10.1016/j.respol.2019.103912.

Comanor, W. S., and Scherer, F. M. (1969). Patent Statistics as a Measure of Technical Change, Journal of Political Economy, 77,3,392-98.

Connolly, M. (1997). Technology, Trade, and Growth: Some empirical Findings, Federal Reserve Bank of New York: Research paper No. 9727.

Connolly, M. (1998). The Dual Nature of Trade: Measuring its Impact on Imitation
and Growth", Duke University

Cozzens S. and Sutz J. (2014). Innovation in informal settings: Reflections and proposals for a research agenda. Innovation and Development; 4 (1): 5–31.

Crespi, G., and F. Peirano. (2007). Measuring Innovation in Latin America: What We Did, Where We Are and What We Want to Do. Paper presented at the Conference on Micro Evidence on Innovation in Developing Countries UNU-MERIT. Maastricht.

Damanpour, F. (1987). The Adoption of Technological, Administrative, and Ancillary Innovations: Impact of Organizational Factors. Journal of Management, 13(4), 675–688.

Edwards, K.L. and T.J. Gordon, 1984, Characterization of Innovations Introduced on the US Market in 1982, prepared for the US Small Business Administration by The Futures Group under contract #SBA-6050-OA-82, March 1984 (The Futures Group).

Feldman, M., and Florida, R. (1994). The Geographic Sources of Innovation: Technological Infrastructure and Product Innovation in the United States. Annals of the Association of American Geographers, 84(2), 210-229.

Ganotakis, P. and Love, J.H. (2011), R&D, product innovation, and exporting: evidence from UK new technology-based firms, Oxford Economic Papers, Vol. 63 No. 2, pp. 279-306.

Gault, F. (2011). Social impacts of the development of science, technology, and innovation indicators, UNU-MERIT Working Paper 2011-008, Maastricht: UNUMERIT, pp. 15.

Geroski, P. (1990). Innovation, Technological Opportunity, and Market Structure. Oxford Economic Papers, 42(3), new series, 586-602.

Griliches, Z. (1990). Patent Statistics as Economic Indicators: A Survey. Journal of Economic Literature, 28(4), 1661-1707.

Grimpe, C., Sofka, W., Bhargava, M., and Chatterjee, R. (2017). R&D, Marketing Innovation, and New Product Performance: A Mixed Methods Study. J Prod Innov Manag, 34: 360-383.

Gunday, G., Ulusoy, G., Kılıç, K., and Alpkan, L. (2011). Effects of innovation types on firm performance, International Journal of Production Economics, 133(2), 662-676.

Gupta, S., Malhotra, N., Czinkota, M., and Foroudi, P. (2016). Marketing innovation: A consequence of competitiveness. Journal of Business Research. 69. 10.1016/j.jbusres.2016.02.042.

Hoskens, M. (2015). Short vs. Long Form: Method Effects in Measuring Innovation. Paper presented at the OECD NESTI/EUROSTAT scoping workshop on the third revision of the Oslo Manual. Oslo, Norway.

Horbach, J., and Rennings, K. (2013). Environmental innovation and employment dynamics in different technology fields – an analysis based on the German Community Innovation Survey 2009, Journal of Cleaner Production,57, 158-165.

Ibidunni, A. S., Kolawole, A.I., Olokundun, M. A., and Ogbari, M. E. (2020). Knowledge transfer and innovation performance of small and medium enterprises (SMEs): An informal economy analysis, Heliyon,6, Issue 8, https://doi.org/10.1016/j.heliyon.2020.e04740.

Kleinknect, A. (1993). Why do we need new innovation output indicators? An Introduction, in Kleinknecht, A. and Donald B. (eds.), (1993). New Concepts in Innovation Output Measurement, New York: St. Martin's Press.

Kleinknecht, A. and Donald B. (eds.), (1993). New Concepts in Innovation Output Measurement, New York: St. Martin's Press.

Kleinknecht, A., T. P. Poot, and J. O. N. Reijnen (1991). Formal and Informal R&D and Firm Size: Survey Results from The Netherlands, in Z. J. Acs and D. B. Audretsch, Innovation and Technological Change. An International Comparison. (London: Harvester Wheatsheaf),84–108.

Link, A. N. (1995). The Use of Literature-based Innovation Output Indicators for Research Evaluation, Small Business Economics 7: 451-455.

Lugones, G. (2006). The Bogotá Manual: standardising innovation indicators for Latin America and the Caribbean. In Blankley, W., Scerri, M., Molotja, N., & Saloojee, I. (Eds.). Measuring innovation in OECD and NON-OECD countries selected seminar papers (pp. 163–182). South Africa: HSRC Press.

Mansfield, E. (1986). Patents and Innovation: An Empirical Study. Management Science, 32(2), 173-181.

NEPAD. (2005) African Science, Technology and Innovation Indicators (ASTII), Towards African Indicator Manuals. A Discussion Document. http://www. nepadst.org/doclibrary/pdfs/iastii_jun2006.pdf, accessed March 2009.

NEPAD OST. (2006) Africa's Science and Technology Consolidated Plan of Action.NEPAD OST: Pretoria, South Africa.

NEPAD Planning and Coordinating Agency (NPCA). (2014) African Innovation Outlook 2014. NPCA: Pretoria, South Africa.

Mothe, C., and Nguyen, T. (2012). The impact of non-technological on technological innovations: do services differ from manufacturing? An empirical analysis of Luxembourg firms, Post-Print, HAL.

NPCA (2014), African Innovation Outlook II, Pretoria: NEPAD Planning and Coordinating Agency.

OECD. (2005). Guidelines for collecting and interpreting innovation data. Oslo Manuals.

OECD (2019). The object method for innovation measurement, in Oslo Manual 2018: Guidelines for Collecting, Reporting, and Using Data on Innovation, 4th Edition, OECD Publishing, Paris, https://doi.org/10.1787/9789264304604-13-en.

Olaopa O.R., Akindele, S.T., and Hassan O.M. (2011). Science and technology research:
Repositioning the thinking of policymakers in Nigeria. African Journal of Science, Technology, and Innovation Development; 3 (1): 202–225.

Patterson, K., Grimm, C., and Corsi, T. (2003). Adopting New Technologies for Supply Chain Management. Transportation Research Part E: Logistics and Transportation Review. 39. 95-121.

Pavitt, K., Robson, M., and Townsend, J. (1987). The Size Distribution of Innovating Firms in the UK: 1945-1983. The Journal of Industrial Economics, 35(3), 297-316.

Peneder, M. (2010). Technological regimes and the variety of innovation behaviour: Creating integrated taxonomies of firms and sectors, Research Policy,39, Issue 3,323-334.

Pérez, J. A. H., Kunc, M.H., Durst, S., Flores, A., and Geldes, C. (2018). Impact of competition from unregistered firms on R&D investment by industrial sectors in emerging economies, Technological Forecasting and Social Change,133, 179-189.

Pianta, M. and Sirilli, G. The Use of Innovation Surveys for Policy Evaluation, in: OECD, Policy Evaluation in Innovation and Technology, OECD, Paris, 1997.

Radicic, D. and Djalilov, K. (2019), The impact of technological and non-technological innovations on export intensity in SMEs, Journal of Small Business and Enterprise Development, 26, 4,612-638.

Raffo, J., Lhuillery, S., and Miotti, L. (2008). Northern and southern innovativity: a comparison across European and Latin American countries. Eur J Dev Res 20, 219–239.

Rothwell, R. (1984). The role of small firms in the emergence of new technologies, OMEGA 12.1, 19-29.

Rothwell, R. (1989). Small fh-rns, innovation, and industrial change, Small Business Economics 1, 51-64.

Santarelli, E., and Piergiovanni, R. (1996). Analyzing literature-based innovation output indicators: the Italian experience, Research Policy, 25, issue 5, 689-711.

Smith, K. (2005). Measuring innovation. In Fagerberg, J., Mowery, D., and Nelson, R. (Eds.). The Oxford handbook of innovation. Oxford: Oxford University Press.

Siyanbola, W.O., Olaopa, O.R., and Hassan, W.O. (2012). Designing and implementing a Science, Technology, and Innovation (STI) policy in a developing country context: Recent experience from Nigeria. The 10th Triple Helix International Conference. Conference Proceeding, Panghegar, Bandung.

Siyanbola, W., Adeyeye, A., Olaopa, O., and Hassan, O. (2016). Science, technology, and innovation indicators in policy-making: the Nigerian experience. Palgrave Commun 2, 16015.

Tavassoli, S., and Karlsson, C. (2015). Persistence of various types of innovation analyzed and explained, Research Policy,44,10, 1887-1901.

Tether, B.S., Smith, I.J., and Thwaites, A.T.(1997). Smaller enterprises and innovation in the UK: the SPRU innovations database revisited, Research Policy,26, Issue 1, 19-32.

Young A. (1996). Measuring R&D in the Services", STI Working Papers 1996/7, OECD, Paris.

Chapter Five

Innovation efforts, External Supports and Productivity

5.1. Introduction

There is a substantial body of evidence investigating the linkages among R&D, innovation, and productivity of firms using a structural equation modelling approach (e.g. Mairesse and Mohnen, 2002; Griffith et al., 2006; Audretsch, and Belitski, 2020). However, given that the majority of these studies focus on mainly R&D activities of large firms, our understanding of the relationship between innovation efforts and productivity of small firms is still limited (Hall et al., 2009; Audretsch, Kritikos and Schiersch, 2020). Owing to the importance of SMEs as the engine of economic growth as we saw in the previous chapters, it is pertinent to further uncover their ability to generate ideas, and transform innovations (not restricted to R&D activities) into economic values (Bauman and Kritikos, 2016), especially in the context of developing country economies (Younas and Rehman, 2020).

Research is almost unanimous in that the lack of access to finance is the major drawback of the innovative activities of these firms (Wang, 2016; Wellalage and Fernandez, 2019). As a result, the Nigerian government both at the national and state levels has started providing various forms of financial supports to encourage innovative and growth-oriented firms (Adegboye and Iweriebor, 2018). Research suggests that access to external financial support offers small firms greater flexibility and incentives for innovation (OECD, 2018). Public support for

innovation is grounded on market imperfection (Arrow 1962) as well as the link between productivity of firms and national economic growth (Beck, Lu, and Yang, 2015; Page and Soderbom, 2015). However, we know much less about the effect of these financial supports on the innovation success and productivity of SMEs in Nigeria. Given that public financial supports originate from various sources, it is important to examine their heterogeneous effects on innovation stages of these firms. Such an investigation is very pertinent as it helps us to better understand whether (or not) external financial supports stimulate innovation efforts and productivity in the context of developing country economies such as Nigeria. Thus, this chapter fills this research gap by answering the following questions: First, to what extent does external financial supports affect the various innovation stages – knowledge input, innovation output, and productivity of Nigerian SMEs? Second, in addition to R&D investments, what other factors determine the innovation efforts and productivity of these firms? Third, what types of innovation have more significant impact on their productivity?

To answer these questions, an econometric structural model proposed by Crepon, Duguet, and Mairesse (1998) is employed. More precisely, the CDM model explains the productivity of firms in terms of innovation output, and innovation output in terms of knowledge inputs (though not limited to R&D investments). Following Griffith et al. (2006) and Aldieri et al. (2019), I modified the original version of the CDM model to accommodate external financial supports. However, in contrast to prior studies (Raffo et al., 2008), I included external financial supports from the state, federal, and foreign governments in the four equations of CDM model to determine their impacts on the knowledge input stage all the way to productivity. Second, I considered various types of innovation outputs, to ascertain

which one of them has greater impacts on labour productivity of SMEs in Nigeria. Finally, other information contained in the NIS allowed us to estimate the potential impacts of other internal firm-level characteristics and exogenous factors on innovation efforts and productivity.

The structure of this chapter is as follows: In Section 5.2, I will review the literature on the relationship between innovation and productivity based on CDM framework in developed and developing countries. In Section 5.3, I will discuss the role of external financial supports on innovations efforts in the context of developing country firms. In Section 5.4, I will present the CDM model, including the four equations and empirical strategy. Finally, I will report and discuss the main results in Section 5.5.

5.2. Literature Review

a) R&D investments, Innovation, and Productivity in Developed Economies

Studies show that innovation has a positive impact on productivity (e.g. Loof and Heshmati, 2006; Hall and Mairesse, 1995). However, the estimation of the relationship between innovation activities and productivity has been one of the most challenging tasks. One of the earliest attempts is by Pakes and Griliches (1980), who estimated a knowledge production function. In this model, productivity does not depend solely on labour and physical capital inputs, but also production of new knowledge (i.e. current and past R&D investments). Although many scholars followed this model (e.g. Mairesse and Sassenou, 1991; Hall and Mairesse, 1995; Lach, 1995), it has been criticized for measuring knowledge as an

accumulated stock of R&D expenditures as well as directly linking productivity to R&D activity, without considering the channels through which R&D shapes productivity (Mairesse, Mohnen, and Kremp, 2005).

Furthermore, building on Pakes and Griliches' framework, Crepon, Duguet, and Mairesse (1998) propose a structural model. The CDM, as it is also known, is a three-stage model, consisting of four equations: (1) selection equation (2) innovation input equation, (3) innovation output equation, and (4) productivity equation. Using data for French firms, these authors find that productivity positively correlates with higher innovation outputs measured as both patents and share of sales due to innovative product, even when the impact of capital and skills is controlled. The CDM model has since become the workhorse in the innovation-productivity analysis based on innovation surveys (Lööf, Mairesse and Mohnen, 2017). It has been widely applied both in its standard and modified versions across various countries (Norbert, Lööf and Peters, 2003). For example, Lööf and Heshmati (2002) for Norway, Finland and Sweden; and Griffith et al. (2006) for France, Germany, Spain, and the UK, find evidence for a positive relationship between innovation input and innovation output as well as between innovation output and firm's productivity.

Similarly, recent evidence from[5] Hall and Sena (2017), Audretsch and Belitski (2020) for the UK; Alderi et al. (2019) for Italy; van Leeuwen and Mohnen (2017) for the Netherlands; Kijek and Kijek (2019) for Poland; Czarnitzki and Delanote (2017) for Belgium; Jaumandreu and Mairesse (2017) and García-Pozo et

[5] a comprehensive review of literature on application and extension of Hall, Mairesse, and Mohnen (2010), Hall (2011), Mohnen and Hall (2013), and Lööf, Mairesse, and Mohnen (2017).

al. (2018) for Spain; Peters et al. (2018) for Germany, Ireland, and the UK; and Frick, Jantke and Sauer (2018) for Germany, Spain, France, and Italy, show that investment in R&D is correlated with innovation output; and innovation success positively affects productivity, albeit with variations in the size of the coefficients.

b) Innovation Efforts and Productivity in developing economies

The majority of the extant empirical studies focus on large firms from developed or newly industrialized economies. The effects of innovation are very heterogeneous, thereby making it difficult to generalize the results obtained by the developed economies for developing economies. Besides, the extant studies focus on R&D activities as the main determinant of innovation. However, substantial innovation activities in developing countries are based on improvements in existing processes and product designs via the absorption of foreign technologies (Howell, 2017). Firms in these economies innovate far from the technological frontier and often face extremely resource constraints as we saw in the previous chapters (Hobday, 2005). Thus, to understand the drivers of productivity in developing economies, it is important to consider innovation efforts of firms beyond the traditional R&D activities (Raffo et al., 2008; Arza and López, 2010).

Previous studies in developing countries show that innovation determinants of firms are heterogeneous, thus, deviating from the evidence from developed economies (e.g. Chudnovsky, López and Pupato, 2006; Wadho and Chaudhry, 2018; Barros, 2021). For example, in a study of six Latin American countries, Crespi and Zuniga (2012) find that firms investing in knowledge activities, not just R&D, are likely to introduce new technological advances and those that engage in

innovation have greater productivity. These authors show that the acquisition of embodied and disembodied technologies, industrial engineering, tooling-up, and technical training are main drivers of innovations in Argentina, Chile, Colombia, Costa Rica, Panama, and Uruguay. Besides, their findings differ from the OECD countries as only technological innovation, but not technological innovation is positively related to productivity in Argentina and Colombia. Benavente (2006) find that innovation activities are related to firm size, sector, and market power. However, their results reveal that the productivity of Chilean firms is not affected by R&D expenditure in the short run.

For Mexican manufacturing firms, Brown and Guzmán (2014) show that innovation efforts, along with export intensity, foreign direct investment (FDI), access to technology, are the main determinants of innovation, particularly in local firms as compared to foreign firms. More so, Busom and Vélez-Ospina (2017) find that increase in human capital improves productivity in manufacturing and service industries in Colombia. However, innovation output increases productivity below the median of the productivity distribution. For Chilean firms, Álvarez, Bravo-Ortega, and Zahler (2015) find that manufacturing and service industries have similar determinants of technological innovations. Besides, they find a positive effect of technological and nontechnological innovations on labour productivity for both sectors. Wadho and Chaudhry (2018) find that product innovation leads to increased labour productivity in Pakistan. Above all, their results reveal that vertical knowledge flows from foreign clients and suppliers are major determinants of innovation decisions.

c) Innovation Activities and Productivity in Sub-Saharan Africa

Despite a recent surge of studies in the tradition of CDM modelling in developing countries, they overly concentrate on Latin America and Asia (Morsy and Amira El-Shal, 2020). Moreover, empirical evidence from these countries is highly mixed (Crespi, Tacsir, and Vargas, 2016; Aboal, Ezequiel Tacsir, 2018; Shi et al., 2020). There is a paucity of studies empirically investigating innovation efforts and productivity gains in Sub-Saharan Africa. To date, there is a handful of evidence such as Goedhuys, Janz, and Mohnen (2008), who find that technological variables, R&D, product innovation and process innovation, license of technology, and training, negatively affected productivity. They show that only foreign ownership, ISO certification seem to affect productivity.

Cirera, Lage, and Sabetti (2016) estimated the impact of the adoption of information and communications technology (ICT) and innovation on productivity using firm-level data for a sample of six Sub-Saharan African countries. Their findings suggest that ICT is an important determinant of product, process, and organization innovations in the Democratic Republic of Congo, Ghana, Kenya, Tanzania, Uganda, and Zambia. Nevertheless, it is only the degree of novelty that positively affected productivity. For Ghanaian manufacturing firms, Fu, Mohnen, and Zanello (2018) find that acumen and skills of entrepreneurs, instead of R&D activities, as the drivers of innovation activities. These authors reveal that technological innovations have more effect on labour productivity of firms than managerial innovations. In addition, the role of innovation in productivity tends to be greater for formal firms than informal firms. Finally, Morsy and Amira El-Shal (2020) show that access to external knowledge, largely through ICT, R&D, and skills development are determinants of innovation efforts in African firms.

However, it is only product innovation that strongly affects the productivity of these firms.

The results obtained from these studies significantly differ not only from the OECD countries but also from other developing countries. This highlights the importance of reconsidering the factors underlying innovation efforts and productivity in SSA van Uden, Knoben, and Vermeulen, 2017; Abdu and Jibir, 2018). In this region, R&D intensity is generally very low (WIPO, 2019), and firms lag considerably behind in knowledge acquisition, absorptive capacity, managerial and production skills (Goedhuys, 2007; Goedhuys and Sleuwaegen, 2010). Despite these contributions both in the developed and developing countries, there are generally very few empirical studies explicitly exploring the innovation-productivity link in SMEs.

One of the first attempts was from Hall et al. (2009), who find that international competition stimulates R&D intensity, especially for high-tech firms in Italy. Also, firm size, R&D intensity, and investment in equipment increased the probability of implementing process and product innovations. In turn, innovation outputs, especially process innovation, have a positive impact on productivity. Furthermore, for German micro firms, Baumann and Kritikos (2016) find that the R&D intensity is positively correlated with the likelihood of reporting innovation, with a larger effect size for product than for process innovations. Moreover, innovation success of these firms enhanced labour productivity in a comparable way as larger firms. Finally, Audretsch, Kritikos, and Schiersch (2020) observe that highly skilled employees, together with R&D activity, drive the innovation output of micro-firms in the knowledge-intensive service sector.

5.3. Government intervention and innovation

The current study acknowledges the contributions of previous scholarship on SMEs, while also exploring its implications in SSA for the following reasons. SMEs in Nigeria differ from their peers from developed economies, especially in terms of capital market structure. The high cost of innovation hampers the productivity of small entrepreneurial firms lacking internal financial resources (Wellalage and Fernandez, 2019). Under normal circumstances, firms can overcome their internal financial constraints through traditional external providers such as banks, venture capitalists, etc. However, the situation in Nigeria is different as we saw in the previous chapter.

Public support is a useful instrument for mitigating the negative effects of financial constraints on private innovative activities (Hyytinen and Toivanen 2005). Previous studies conducted in several developed economies show that firms receiving government financial supports invest more in innovative activities and grow faster (e.g. Görg and Strobl, 2007; Czarnitzki and Lopes-Bento, 2013). For example, Aerts and Schmidt (2008) find that government R&D subsidies significantly improved the innovation activities of Flemish and German firms. Similarly, Bérubé and Mohnen (2009) show that Canadian plants that benefited from receiving R&D grants and R&D tax credits have more world-first product innovations and were more successful in commercializing their innovations. Government invention in innovation is justified in several ways. First, in face of market failures, government intervention can relax the tension between social returns to R&D and private rate of returns across industries and sectors (Nelson, 1959). The problem of appropriability implies that the private rate of return to R&D

is likely to be below the social return, leading firms to under-invest in R&D activities (Arrow, 1962). Second, successful innovations involve high costs that are often beyond the financial capacity of most private firms, especially SMEs. Thus, firms require assistance from government or external donors due to the difficulties linked to accessing financing from the traditional financiers. Hall (2008:410) argues that

> [...] it may still be difficult or costly to finance R&D using capital from sources external to the firm because there is often a wedge between the rate of return required by an entrepreneur investing his own funds and that required by external investors. By this argument, unless an investor is already wealthy, or firms already profitable, some innovations will fail to be provided purely because the cost of external capital is too high, even when they would pass the private returns hurdle if funds were available at a 'normal' interest rate.

As a result of pervasive market imperfections in Nigeria, it is reasonable to assume that policy instruments can create positive incentives for private-sector innovations (Oyelaran-Oyeyinka, 2014). In other words, efficient governments can stimulate innovation and productivity in SMEs and consequently, enhance long-term national economic growth (Abdu and Jibir, 2017).

Due to the persistent financial challenges facing firms in Nigeria, the government both at the national and state levels are implementing various forms of financial resources, ranging from R&D grants, taxes to subsidies, to stimulate innovation activities in growth-oriented firms (AUC, 2014; OECD, 2019). If these instruments work, it is expected that they will offset the financial constraints and

consequently improve R&D intensity of firms. While previous studies have advanced our understanding of the impacts of government support on private business innovations, the evidence is still inconclusive. In fact, it is still unclear whether such interventions stimulate innovation activities. In Nigerian context, studies examining the impacts of external supports for innovation activities on the productivity of firms are still scarce. The nascent research on the innovative activities of firms in Nigeria is yet to provide sufficient empirical evidence on the following critical questions:

RQ1: To what extent do different sources of external financial supports affect innovation intensity, innovation success, and productivity of Nigerian SMEs?
RQ2: In addition to R&D investments, what other factors determine innovation efforts and productivity of these firms?
RQ3: What types of innovation have more significant impact on their productivity?

5.4. Empirical strategy: Innovation-Productivity Analysis

I rely on the CDM model to analyse the relationship between innovation efforts and productivity. The standard version of CDM model is an empirical structural model consisting of four equations (Hall and Mairesse 2006; Lööf and Heshmati 2006). In the first stage, firms decide whether (or not) to invest in R&D activity (Selection equation); and upon choosing to engage in innovation, firms decide the amount of resources to invest in R&D activities (Intensity equation). The second stage

estimates the knowledge production function in which innovation inputs lead to innovation outputs (Innovation equation). In the final stage, the innovation outputs are linked to economic performance, generally expressed by firm's labour productivity (Production equation). The model accounts for issues arising from innovation surveys as well as corrects for potential simultaneity and endogeneity problems in the various stages.

First, to account for the various sources of external financial supports, I categorize them into state government support, federal government support, and foreign government support. In this study, unlike previous studies, I added these sources of external financial supports in the four equations of the CDM model. The approach allows us to understand their impacts on the different stages of innovation process as well as on productivity of firms.

Second, instead of focusing on only technological innovations (Morris, 2018), I consider three types of innovations: product innovation, process innovation, and marketing innovations. Recent literature shows that firms investing in different types of innovations have higher productivity than their counterparts focusing on a single-innovation strategy (Hashi, and Stojčić, 2013; Wadho and Chaudhry, 2018).

Third, I included a set of firm internal characteristics (age, size, and 2-digit sector) and other exogenous factors (technical training, cooperation, patent, export orientation, and competition) to capture their impacts, alongside R&D activities, on innovation efforts and productivity of Nigerian SMEs.

a) R&D equations

The first stage of the model includes two equations, namely the selection equation and intensity equation. Even though all firms in our sample engage in some sorts of innovation efforts, not all of them report it (Griffith et al.2006). The CDM model addresses the selectivity biases that may arise in this stage of the estimation. Thus, Eqn. (1) is the selection equation, which captures the decision to invest and report R&D, expressed as a standard sample model:

$$R\&D\ INV_i = \begin{cases} 1\ if\ RD\ INV_i^* = \beta x_i + \varepsilon_i > z \\ 0\ if\ RD\ INV_i^* = \beta x_i + \varepsilon_i \leq z \end{cases} \quad (1)$$

where $R\&D\ INV_i$ is an (observable) indicator function that takes 1 if a firm i reports a positive innovation expenditure, and 0 otherwise. R&D INV_i^* a latent innovation variable that takes 1 if firm i decides to engage and report innovation activities when the investment is above a given threshold z. x_i is a vector of explanatory variables (external financial supports, along internal firm-level characteristics and external factors influencing R&D decision), and finally, ε_i is an error term.

Conditional on a firm's decision to invest in innovation, the second equation estimates the R&D intensity as follows:

$$R\&D\ INT_i = \begin{cases} RD\ INT_i^* = \gamma\kappa_i + \epsilon_i & if\ RD\ INV_i = 1 \\ 0 & if\ RD\ INV_i = 0 \end{cases} \quad (2)$$

where R&D INT_i^* is the unobserved latent variable reflecting a firm i investment intensity; and κ_i is a vector of determinants of R&D expenditures. Following prior studies (Baumann and Kritikos, 2016; Aldieri et al.,2019), I estimate selection equation (1) and intensity equation (2) using the Heckman selection model on the assumption that the error terms ε_i and ϵ_i are bivariate normal with zero mean and variance equal to unity.

b) Innovation Function

In the second stage, I consider the determinants of product, process, and marketing innovations using a knowledge production function in Eqn. (3), expressed thus:

$$INNO_i^j = \delta R\&D\ INT_i^* + \theta w_i + u_i \quad j = 1, \dots, 3 \qquad (3)$$

Where $R\&D\ INT_i^*$ is the latent R&D effort proxied by the predicted value of the R&D intensity from Eqn. (2); $INNO_i^j$ i is a dummy variable taking the value of 1 if firm i has done product innovation, process innovation, or marketing innovation and 0 otherwise; wi is a set of covariates influencing the innovation outcomes of firms; and finally, u_i is the error term. I introduce a set of interaction term to examine whether the effect of introducing various types of innovations is greater for firms receiving more external financial supports. I estimated Eqn. (3) as a binary probit model.

c) The Productivity Equation

In the third and final stage, I estimate the effect of product innovation, process innovation, and marketing innovation on labour productivity (sales per employees in logs). I estimate Eqn. (4) with a Stochastic frontier model.

$$y_i = \alpha_i INNO_i^* + \vartheta X_i + v_i \qquad (4)$$

where y_i is labour productivity; $INNO_i^*$ is the predicted probability of innovation outputs from Eqn. (3); and X_i is other potential determinants of productivity. To test whether firms with more access to external financial supports are more productive, I introduce a set of interaction terms between the predicted probability of innovation outputs from equation (3) and state government support, federal government support, and foreign government support respectively.

5.5. Descriptive statistics

Table 5.2 presents the descriptive statistics of the main variables. 59% of the firms in the sample introduced product innovation, 47% process innovation, and 48%

marketing innovation respectively. The high percentage of product innovation over the process innovation and marketing innovation may be due to the differentiation strategy linked to product direction (Friar, 1995). Prior studies show that competitive superiority is determined by the ability of a firm to improve its product performance (Kuncoro and Suriani, 2018; Marshall and Parra, 2019).

On average, 85% of the firms invested in R&D and around 61% sourced for external R&D. In the sample, 60% received external supports for innovation from the state government, 60% from the federal government, and 57% from foreign government. Of the total sample, 19% of the firms reported patent protection; and 52% engaged in collaborative innovation.

Table 5. 2: Data statistical properties

Variables	Mean	Std. Dev.	Min	Max
Productivity	12.694	2.832	4.605	21.95
Product innovation	0.599	0.490	0	1
Process innovation	0.476	0.500	0	1
Marketing innovation	0.486	0.500	0	1
Physical capital	9.578	2.362	2.609	19.58
Human capital	39.237	23.049	2	156
Age	2.680	0.651	0.693	4.38
Size	4.176	0.892	2.303	5.64
Cooperation	0.522	0.500	0	1
Patent	0.193	0.395	0	1
Sector	0.611	0.488	0	1
R&D investment	0.856	0.351	0	1
R&D expenditures	10.965	2.362	3.995	20.97
Competition	0.455	0.498	0	1
Export orientation	0.604	0.489	0	1
External R&D	0.617	0.486	0	1
State government	0.604	0.489	0	1
Federal government	0.595	0.491	0	1
Foreign government	0.578	0.494	0	1
Training	0.282	0.450	0	1

Regarding size, 61% are medium-side enterprises, while 39% are small enterprises. In general terms, Table 5.2 indicates that the firms in the sample have a high level of labour productivity, with 60% export orientation.

5.6. Empirical Results

a) R&D Decision and Investment Intensity equations

Table 5.3 presents the results of Eqn. (1) – selection model, and Eqn. (2) – intensity model. The results in column (1) show that the probability of firms engaging in innovation activities increased with human capital and innovation cooperation. First, these findings are consistent with previous evidence on human capital as a driving force for innovation at the firm-level both in developed economies (e.g. Teixeira and Tavares-Lehmann, 2014) and developing economies (van Uden, Knoben and Vermeulen, 2017; Sun, Li and Ghosal, 2020). Second, firms cooperating with external partners are more likely to conduct innovation activities (Zeng, Xie, and Tam, 2010). In an increasingly global market, timeliness of innovation decision-making is very important to the competitiveness of firms (Ciganek, Haseman, and Ramamurthy, 2014). As SMEs are limited in internal capacity, the availability of potential external partners can influence the timeliness of innovation decisions. Thus, the results reveal that human capital and cooperation are the major determinants of innovation decisions in Nigerian SMEs.

Prior studies suggest that firm characteristics play a vital role in innovation decisions. The results show that both firm size and age reduced the probability of having innovations. More precisely, the findings show that as both size and age of a firm increases (decreases), the less (more) likely it engages in R&D activities.

Evidence suggests that older firms are less innovative (Marin, 2014). Conversely, the findings confirm the so-called Mark I, namely, the hypothesis on the 'creative destructive' role of young and small firms in the implementation of innovations (Pellegrino, Piva, and Vivarelli, 2012). However, the results differ from previous studies of firms in Ethiopia and Ghana, where more mature firms have a greater probability of conducting innovation activities (Gebreeyesus, 2009; Fu et al., 2018). Besides, the negative and significant coefficient for business sector (with service as reference group) indicates that firms in the manufacturing sector are not more likely to engage in innovation activities than their peers in the service sector. This is an interesting result as it is in line with studies on the innovativeness of firms in the service sector (Audretsch, Kritikos, and Schiersch, 2020).

Furthermore, Table 5.3 (column 2) reports the results from the estimations of Eqn. (2). Similar to the findings on innovation-decision (Eqn.1), human capital and innovation cooperation have positive and significant coefficients (0.019132 and 0.014800 respectively), indicating that the amount of resources invested in R&D is, on average, greater in firms with a high level of human capital and innovation cooperation. In addition, the results show that R&D intensity increases with physical capital (investment in machinery per worker in logs). Consistent with previous works, these findings are interpreted as an indication of the role of human and physical capital acquisitions on innovation activities, especially when pursuing growth in developing countries (Kumar, 2003, Van et al., 2010). The results reveal that these firms invested heavily in existing equipment acquisitions. This is not surprising given that a large portion of innovation activities occurring in developing countries is based on enhancement of existing processes and absorption of technologies developed abroad.

Research suggests that external financial supports play a vital role in the innovation decisions and R&D intensity of firms. For example, in a study of Spanish food industry, Acosta, Coronado, and Romero (2015) find that firms receiving local and national funds have a greater probability of engaging in R&D activities. Similarly, Crespi and Zuniga (2011) find that public financial supports for innovation positively affected the innovation investment propensity of firms in six Latin American countries. Contrary to our expectation, external financial supports from both state and federal governments are not significant for R&D intensity. This is in line with Raffo et al. (2008) who find that public funding does not stimulate R&D intensity of firms in Switzerland, Argentina, and Mexico. However, we find that firms receiving financial support from foreign government have a greater probability of increasing their R&D intensity.

Again, the results of Eqn. (2) are consistent with those of Eqn. (1) as they show that sector, firm age, and size have negative and significant impacts on R&D intensity (Kleinknecht, 1991; Hansen, 1992). For example, in a study of German firms, Baumann and Kritikos (2016) find that larger SMEs have a lower R&D intensity than smaller ones. Also, they find that relatively younger firms put more effort into innovation activities than mature firms. Lastly, the negative and significant coefficient for export orientation in our study can be interpreted in several ways. One possible explanation relates to the Schumpeterian hypothesis on a negative relationship between the degree of competition and incentive to innovate (Nicoletti and Scarpetta, 2004). Even though firms with international commitment have a greater probability of innovating (Castellani and Zanfei, 2007), fierce competition in the foreign markets may have reduced the innovation incentives of the firms under study. However, it is good to note that the impact of

competition on the innovation incentive is likely to vary across innovation types. For example, competition in a foreign market may motivate a firm to invest more in a cost-efficiency innovation strategy and less product differentiation strategy or vice versa. The second explanation relates to the presence of innovation activities both among international and domestic firms (since the latter is the reference group in the sample).

Table 5.3: Results of Heckman regression (Stage 1)

Variables	Innovation model	
	Selection equation (1) Coef/se	Intensity equation (2) Coef/se
ln (Size)	-0.217079* (0.128135)	-0.220048*** (0.051032)
ln (Age)	-0.091025** (0.043078)	-0.043050** (0.016866)
Sector	-0.137762** (0.054628)	-0.071046*** (0.021260)
ln (Human capital)	0.074849** (0.037333)	0.019132* (0.014800)
log Physical capital	0.127220 (0.160101)	8.802129*** (0.041843)
Cooperation	0.100666** (0.052719)	0.048533* (0.020617)
Patent	-0.010155 (0.062690)	0.010775 (0.024794)
Export orientation	-0.036960 (0.051043)	-0.033187* (0.019963)
State government	0.017871 (0.051223)	0.014191 (0.020091)
Federal government	-0.049145 (0.051250)	-0.022550 (0.020070)
Foreign government	0.059656 (0.050615)	0.030690* (0.019826)
_cons	0.798195* (0.462737)	-8.354962*** (0.150737)
/athrho		22.35808*** (0.080724)
/lnsigma		-0.744377*** (0.015624)
Log-Likelihood		-1932.485
Chi²/Sigma		0.475030***
Rho		0.971545***
No. of observations		2496

****** p < 0.001; ** p < 0.01; * p < 0.05***

Moreover, there is the possibility that some international firms that could not handle high degree of competition, partly due to resource constraints, exited the foreign markets and instead pursued their innovation strategies in the national markets. Taken together, cooperation, foreign government support, physical and human capitals play a crucial role in the innovation-decision and R&D intensity of SMEs in Nigeria. These findings highlight the roles of absorptive capacity, physical capital, and external partners in the innovation activities of SMEs (Cantabene and Grassi, 2020). More precisely, at the initial stage of innovation, firms in developing economies require intangible resources (human capital) to identify, absorb and assimilate technologies (physical capital) created elsewhere (Capozza and Divella, 2019). Besides, they require external financial supports and innovation cooperation to complement their internal knowledge capacity (Xie and Wang, 2020).

b) Innovation Equations

The predicted value of R&D intensity (Eqn. 2) is used to estimate the knowledge production functions (Eqn.3). I used the predicated value as an instrumental variable, to control potential simultaneity issues between innovation effort and the expectation of innovation outcome (Hall, Lotti and Mairesse, 2009). For the dependent variables, I used binary variables for three types of innovation outputs: product innovation, process innovation, and marketing innovation. Table 5.4 shows the estimates of Eqn. (3) with main effects (columns 1, 3, and 6) and interaction effects (columns 2, 4, and 6) of the variables of interest on the three types of innovation output respectively.

First, the result shows that predicated R&D intensity has a positive and significant effect on the likelihood of introducing product innovation and marketing innovation. These findings are corroborated in several empirical studies both in developed and developing economies (e.g. Aldieri et al., 2019; Morsy and El-Shal, 2020). The positive and significant coefficient for marketing innovation is interesting as only technological innovations are traditionally linked to scientific discovery and R&D investments. One possible explanation for this result is the R&D-spillover effect present in firms investing in multiple innovation strategies. This claim is supported by recent studies on the interplay between R&D and novel marketing strategies (Grimpe et al., 2017). The results get even more interesting as the predicted R&D investment is not statistically significant for process innovation. Acosta et al. (2015) have similar results for Spanish firms. This finding is not surprising given the positive and strong significant coefficient for external R&D investment. In other words, it shows that when introducing process innovation, firms do not invest in internal and external R&D simultaneously. Besides, investment in human capital is positively associated with the successful introduction of process innovation.

Second, the external financial support variables, as expected, are positively related to the innovation output, albeit revealing heterogeneous effects. In the main effect (column 1), state government funds and firm age have a high statistical significance on product innovation. This can be interpreted as a confirmation that larger SMEs are more likely to invest funds received from external sources in product innovation. In the interaction effect (column 2), the significant coefficient of Pred. R&D*Foreign government suggests that the probability of investing external financial support in product innovation is high for larger (size = 0.1389 at

99%) and older (age = 0.1200 at 95%) SMEs receiving foreign government fund, but not state and federal government financial supports. In other words, the positive impact of foreign government supports on predicted R&D intensity increases the probability of these firms having product innovation. However, as a standalone variable (column 1), foreign government supports negatively affects the probability of implementing product innovation. Possibly, this result indicates that firms not receiving greater amount of foreign government supports hesitate (or fail) to invest it in product innovation.

Concerning process innovation, the three sources of external supports have positive and significant coefficients, albeit at different statistical levels. Unlike in the case of product innovation, the results reveal that access to external financial supports is not exclusively tied to older firms. In fact, younger firms are more likely to receive state, federal, and foreign government funds for process innovation.

Table 5.4: Results of Probit regression analysis (Step 2)

Variables	Product innovation		Process innovation		Marketing innovation	
	Coef. /se (1)	**Coef. /se (2)**	**Coef. /se (3)**	**Coef. /se (4)**	**Coef. /se (5)**	**Coef. /se (6)**
Predicted R & D	2.062***	2.037***	0.378	0.369	1.123**	1.147***
	(0.510)	(0.511)	(0.500)	(0.501)	(0.501)	(0.501)
Size	0.107***	0.1389***	-0.022	-0.012	-0.000	0.022
	(0.032)	(0.038)	(0.032)	(0.037)	(0.031)	(0.037)
Age	0.072	0.120*	-0.130**	-0.116*	-0.162***	-0.131**
	(0.058)	(0.065)	(0.058)	(0.064)	(0.057)	(0.064)
Sector	0.001	0.080	-0.052	-0.029	-0.226***	-0.173*
	(0.080)	(0.094)	(0.079)	(0.092)	(0.079)	(0.092)
Patent	0.054	0.059	0.015	0.018	-0.012	-0.008
	(0.065)	(0.065)	(0.064)	(0.064)	(0.064)	(0.064)
Cooperation	-0.134*	-0.189**	-0.097	-0.114*	-0.064	-0.101
	(0.077)	(0.085)	(0.076)	(0.083)	(0.077)	(0.083)
ln (Human capital)	-0.262***	-0.303***	0.085*	0.073	0.073	0.044
	(0.064)	(0.069)	(0.063)	(0.068)	(0.063)	(0.068)
ln (Physical capital)	-0.438***	-0.503***	0.058	0.039	0.538***	0.498***
	(0.166)	(0.171)	(0.163)	(0.167)	(0.163)	(0.168)
Training	-0.139**	-0.1349**	-0.120**	-0.118**	0.037	0.042
	(0.057)	(0.057)	(0.057)	(0.056)	(0.056)	(0.056)
Competition	0.024	0.057	0.112**	0.113**	0.037***	0.217***
	(0.052)	(0.052)	(0.051)	(0.051)	(0.056)	(0.051)
External RD	0.097*	0.098*	0.147***	0.146***	-0.039	-0.038
	(0.054)	(0.053)	(0.053)	(0.053)	(0.053)	(0.053)
Export orientation	0.133**	0.154***	-0.035	-0.029	-0.085*	-0.079
	(0.055)	(0.056)	(0.054)	(0.055)	(0.053)	(0.055)
State government	0.078*	-0.082	0.126**	0.099	-0.083*	-0.618**
	(0.054)	(0.251)	(0.053)	(0.246)	(0.053)	(0.246)
Federal government	0.043	-0.036	0.094*	-0.095	-0.084*	0.047
	(0.055)	(0.243)	(0.055)	(-0.095)	(0.054)	(0.237)
Foreign government	-0.308***	-0.775***	0.168***	0.183	0.056	-0.009
	(0.063)	(0.265)	(0.062)	(0.259)	(0.062)	(0.259)
Pred.R&D*State government		0.208		0.031		0.707**
		(0.324)		(0.318)		(0.317)
Pred.R&D*Federal government		0.142		0.259		-0.149
		(0.325)		(0.316)		(0.315)
Pred.R&D*Foreign government		0.594*		-0.032		0.066
		(0.333)		(0.324)		(0.3243)

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

However, the insignificant results for the interaction effect (column 4) show that a greater amount of these funds does not lead to process innovation. Moreover, firms investing in external R&D and human capital are more like to implement process innovation. Finally, only firms receiving more state government funds have a greater probability of introducing marketing innovation (column 6).

Finally, other explanatory variables in equation (3) influencing the relationship between innovation inputs and innovation success include export orientation and size, with positive and strong significance for product innovation. These findings are consistent with the co-evolution of innovation and internationalization in SMEs (Vuorio, Torkkeli, and Sainio, 2020). Studies show that SMEs with international growth strategy is more likely to introduce product innovation that will open up new market niches (Love and Roper, 2015). Second, competition has a positive and significant effect on process innovation. In the last decade, global competition has intensified, imposing new competitive pressures on SMEs, especially from developing economies. The results are consistent with evidence suggesting that firms operating in more fierce competitive markets are more likely to engage in cost-reducing innovations than their peers in less intense competitive markets (Delbono and Denicolo, 1990). What's more, the positive and significant coefficient for external R&D activities indicates that the firms under study adopted new process technologies as a means of enhancing their competitive advantage (Buffa, 1985). Besides, research increasingly suggests that marketing innovation is key to SMEs' survival and growth (Naidoo, 2010). Thus, the results confirm that competition increases the probability of implementing marketing innovation. Finally, another variable of interest is cooperation, which has a negative impact on product and process innovations. These results call for a further

investigation on the impacts of various types of cooperation on innovation performance. We shall undertake this exercise in the subsequent chapter.

c) Productivity equations

Finally, in Eqn. (4), I estimated the link between innovation outputs on labour productivity, where log of sales per employee is the dependent variable. To control for endogeneity problem, I use the predicated probabilities of product innovation, process innovation, and marketing innovation from Eqn. (3). Table 5.5 reports the main effects (columns 1, 3, and 5). I introduced interaction term to ascertain whether the impact of innovation success on productivity is greater for firms receiving more external financial supports from the state government, the federal government, and foreign government (columns 2, 4, 6). In general terms, the results show that innovation outputs have positive and significant effects on labour productivity in all the regressions. Thus, consistent with prior evidence for both developed and developing. However, when the impact of the various innovation types is considered, firms that implemented marketing innovation have the greatest productivity gains, followed by process innovation and product innovation respectively. Prior evidence suggests that process innovations have more impact on productivity of firms more than product innovation (Waheed, 2011). This finding deviates from the evidence that considered product innovation the main driver of productivity gains (Mairesse et al., 2009).

Furthermore, it is worth highlighting the importance of pursuing a diversified innovation strategy when pursuing growth. The size of the coefficient for marketing innovation (13.752) shows that firms implementing novel marketing strategies are

productive than firms investing in product innovation (2.572) and process innovation (6.951) combined. This finding makes a case for devoting more effort to understanding the dynamics of marketing innovation and its impact on firm performance, especially in developing countries (Quaye and Mensah, 2019). Thus, I will further explore this issue by considering the separate and joint effects of technological innovation and marketing innovation on export growth.

Moreover, external financial supports have varied effects on labour productivity as seen in the models. In the case of product innovation, productivity increases for firms that received supports from federal and foreign governments, but decrease with state government as shown in column (1). However, the impact of product innovation on productivity is insignificant for firms with more access to external funds columns (2). For process innovation, access to external funds from state, federal, and foreign government reduced the productivity of firms (columns 3 and 4). However, the positive and significant coefficients in the case of marketing innovation indicate that the three sources of external funds increase productivity gains only in the main effect. On average, we observe that access to more external funds has heterogeneous effects on innovation outputs and productivity gains (Carvalho and Avellar, 2017). These findings call for efficient policy geared towards stimulating innovation activities and productivity in SMEs (Mohnen and Hall, 2013).

As for the other explanatory variable in equation (4), firm age has positive and significant coefficients in all the regressions, suggesting that older SMEs are more productive than their younger counterparts. However, firm size is significant across the models but negatively related to labour productivity.

Table 5.5: Results of Production Function regression analysis (Step 3)

Variables	ln(Productivity)					
	Product innovation		**Process innovation**		**Marketing innovation**	
	Coef. /se	Coef. /se	Coef. /se	Coef. /se	Coef./se	Coef./se
$\widehat{Inno}$	2.572*** (0.057)	2.522***	6.951***	6.936***	14.310***	13.752***
		(0.074)	(0.155)	(0.155)	(0.344)	(0.395)
Size	-0.083***	-0.083***	-0.091***	-0.091***	-0.443***	-0.420***
	(0.0056)	0.006	(0.005)	(0.005)	(0.012)	(0.014)
Age	0.153***	0.156***	0.306***	0.299***	0.392***	0.369***
	(0.007)	(0.007)	(0.008)	(0.009)	(0.010)	(0.013)
Sector	0.270***	0.277***	0.002	-0.002	0.405***	0.379***
	(0.009)	(0.011)	(0.009)	(0.009)	(0.012)	(0.015)
Patent	-0.063***	-0.064***	-0.083***	-0.081***	-0.024**	-0.023**
	(0.011)	(0.0105)	(0.010)	(0.010)	(0.010)	(0.012)
Cooperation	-0.102***	-0.104***	0.337***	0.328***	0.971***	0.907***
	(0.009)	(0.009)	(0.011)	(0.013)	(0.024)	(0.033)
ln (Human capital)	0.112***	0.115***	-0.148***	-0.145***	0.069***	0.066***
	(0.005)	(0.006)	(0.008)	(0.008)	(0.006)	(0.006)
ln (Physical capital)	0.252***	0.256***	0.058***	0.059***	-2.099***	-1.958***
	(0.014)	(0.015)	(0.017)	(0.017)	(0.067)	(0.083)
Training	0.148***	0.152***	0.338***	0.330***	-0.201***	-0.187***
	(0.009)	(0.010)	(0.011)	(0.013)	(0.011)	(0.011)
Competition	-0.005	-0.006	-0.286***	-0.278***	-1.194***	-1.117***
	(0.008)	(0.008)	(0.010)	(0.012)	(0.030)	(0.040)
External RD	-0.095***	-0.097***	-0.401***	-0.390***	0.219***	0.206***
	(0.009)	(0.009)	(0.012)	(0.014)	(0.010)	(0.011)
Export orientation	-0.051**	-0.053***	0.061***	0.060***	0.257***	0.241***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.010)	(0.012)
State government	-0.110***	-0.174***	-0.325***	-0.329***	0.582***	0.578***
	(0.009)	(0.063)	(0.011)	(0.064)	(0.016)	(0.057)
Federal government	0.052***	-0.002	-0.313***	-0.340***	0.160***	0.255***
	(0.008)	(0.059)	(0.011)	(0.063)	(0.009)	(0.058)
Foreign government	0.177***	0.191***	-0.397***	-0.196***	0.058***	0.203***
	(0.008)	(0.060)	(0.013)	(0.066)	(0.008)	(0.058)
$\widehat{Inno}$ *State government		0.104		0.025		-0.067
		(0.103)		(0.129)		(0.126)
$\widehat{Inno}$ *Federal goverment		0.093		0.077		-0.215*
		(0.098)		(0.128)		(0.121)
$\widehat{Inno}$ *Foreign government		-0.016		-0.405***		-0.306**
		(0.102)		(0.131)		(0.120)

****** p < 0.001; ** p < 0.01; * p < 0.05***

These findings are in line with prior evidence in Latin American countries (Crespi and Zuniga, 2011). Although patenting can mitigate the imitation by rivals, and consequently, increase turnover from innovation (Shapiro, 2001), it involves substantial costs, which the majority of SMEs in developing countries can hardly afford. In other words, unlike prior studies, patent negatively affects the productivity of Nigerian SMEs (Andries and Faems, 2013). Besides, the results show that cooperation, physical capital, training, and export orientation improved the productivity of firms investing in process innovation strategy. Similarly, human capital, physical capital, training, and sector increased the productivity gains of firms investing in product innovation. Finally, sector, cooperation, human capital, and export orientation enhanced the productivity gains of firms pursuing marketing innovation.

References

Aboal, D., and Tacsir, E.(2018). Innovation and productivity in services and manufacturing: the role of ICT, Industrial and Corporate Change, Volume 27, Issue 2, 221–241.

Acosta, M., Coronado, D. & Romero, C. (2015). Linking public support, R&D, innovation, and productivity: New evidence from the Spanish food industry, Food Policy, Elsevier, vol. 57(C) 50-61.

Adegboye, A.C., and Iweriebor, S. (2018). Does Access to Finance Enhance SME Innovation and Productivity in Nigeria? Evidence from the World Bank Enterprise Survey. African Development Review, 30: 449-461.

Aerts, K., and Schmidt, T. (2008). Two for the price of one?: Additionality effects of R&D subsidies: A comparison between Flanders and Germany, Research Policy, 37, 5,806-822.

Aldieri, L., Barra, C., Vinci, C.P. and Zotti, R. (2019): The joint impact of different types of innovation on firm's productivity: evidence from Italy, Economics of Innovation and New Technology, DOI: 10.1080/10438599.2019.1685211.

Álvarez, R., Bravo-Ortega, C., and Zahler, A. (2015). Innovation and Productivity in Services: Evidence from Chile, Emerging Markets Finance, and Trade. 51(3),593-611.

Andries, P., and Faems, D. (2013). Patenting Activities and Firm Performance. J Prod Innov Manag, 30: 1089-1098.

Arza, V., and Lopez, A. (2010). Innovation and Productivity in the Argentine Manufacturing Sector, IDB Working Paper Series, No. IDB-WP-187, Inter-American Development Bank (IDB), Washington, DC.

Arrow, K. (1962). Economic Welfare and the Allocation of Resources for Invention, p. 609-626 in the Rate and Direction of Inventive Activity: Economic and Social Factors, National Bureau of Economic Research, Inc.

Audretsch, D. B., and Belitski, M. (2020), The role of R&D and knowledge spillovers in innovation and productivity, European Economic Review, 123, DOI: https://doi.org/10.1016/j.euroecorev.2020.103391.

Audretsch, D.B., Kritikos, A.S. and Schiersch, A. (2020). Microfirms and innovation in the service sector. Small Bus Econ 55, 997–1018.

Ayalew M.M. and Xianzhi, Z. (2018). Bank competition and access to finance: evidence from African countries. J Ind Compet Trade 19:155–184.

Ayalew, M.M., Xianzhi, Z. and Hailu, D.H. (2019), The finance of innovation in Africa, European Journal of Innovation Management, Vol. 23 No. 3, pp. 348-382.

Barros, H. M. (2021). Neither at the cutting edge nor in a patent-friendly environment: Appropriating the returns from innovation in a less developed economy, Research Policy, Volume 50, Issue 1, https://doi.org/10.1016/j.respol.2020.104097.

Baumann, J., and Kritikos, A. S. (2016). The link between R&D, innovation, and productivity: Are micro firms different? Research Policy, 45, Issue 6, 1263-1274.

Beck, T. Lu, L., and Yang, R. (2015). Finance and Growth for Microenterprises: Evidence from Rural China, World Development, 67, issue C, p. 38-56.

Benavente, J. M. (2006). The role of research and innovation in promoting productivity in chile, Economics of Innovation and New Technology, 15, issue 4-5, p. 301-315.

Bérubé, C. and Mohnen, P. (2009). Are firms that receive R&D subsidies more innovative?. Canadian Journal of Economics/Revue canadienne d'économique, 42: 206-225

Brown, F., and Guzmán Chávez, G. A. (2014). Innovation and Productivity Across Mexican Manufacturing Firms. Journal of Technology Management and Innovation, 9(4), 36-52.

Buffa, E.S. (1985). Meeting the competitive challenge with manufacturing strategy. Natl. Prod. Rev., 4: 155-169

Busom, I. and Vélez-Ospina, J. A. (2017). Innovation, Public Support, and Productivity in Colombia. A Cross-industry Comparison, World Development, 99, issue C, p. 75-94.

Cantabene, C., and Grassi, I. (2020). R&D cooperation in SMEs: the direct effect and the moderating role of human capital, Applied Economics, 52, 28, 3090-3105.

Capozza, C., and Divella, M. (2019). Human capital and firms' innovation: evidence from emerging economies, Economics of Innovation and New Technology, 28, 7, 741-757.

Castellani, D., and Zanfei, A. (2007). Internationalisation, Innovation, and Productivity: How Do Firms Differ in Italy? The World Economy, 30, issue 1, p. 156-176.

Carvalho, L. and de Avellar, A.P.M. (2017). Innovation and productivity: empirical evidence for Brazilian industrial enterprises, Revista de Administração 52 (2017) 134–147

Chudnovsky, D. L. A., and Pupato, G. (2006). Innovation and productivity in developing countries: A study of Argentine manufacturing firms' behavior (1992-2001), Research Policy, 35, 2,266-288.

Ciganek, A.P., Haseman, W. D., and Ramamurthy, K. (2014). Time to decision: the drivers of innovation adoption decisions, Enterprise Information Systems, 8:2, 279-308

Crépon, B., Duguet, E., Mairesse, J. (1998). Research, Innovation, and Productivity: An Econometric Analysis at the Firm Level," Economics of Innovation and New Technology, 7(3): 115-156.

Crespi G., Tacsir E. and Vargas F. (2016). Innovation Dynamics and Productivity: Evidence for Latin America. In: Inter-American Development Bank, Grazzi M., Pietrobelli C. (eds) Firm Innovation and Productivity in Latin America and the Caribbean. Palgrave Macmillan, New York.

Crespi, G., and Zuniga, P. (2012). Innovation and Productivity: Evidence from Six Latin American Countries, World Development, 40, issue 2, p. 273-290.

Cirera, X., Lage, F., and Sabetti, L. (2016). ICT Use, Innovation, and Productivity: Evidence from Sub-Saharan Africa. Policy Research Working Paper; No. 7868. World Bank, Washington, DC.

Czarnitzki, D., and Lopes-Bento, C. (2013). Value for money? New micro econometric evidence on public R&D grants in Flanders, Research Policy, 42, issue 1, p. 76-89.

Czarnitzki, D., and Delanote, J. (2017). Incorporating innovation subsidies in the CDM framework: empirical evidence from Belgium, Economics of Innovation and New Technology, 26:1-2, 78-92.

Delbono, F., and Denicolo, V. (1990). R & D investment in symmetric and homogeneous oligopol: Bertrand vs Cournot, International Journal of Industrial Organization, 8, 2,297-313.

Fowowe, B. (2011). The finance-growth nexus in Sub-Saharan Africa: Panel cointegration and causality tests. J. Int. Dev., 23: 220-239.

Friar, J.H. (1995). Competitive Advantage Through Product Performance Innovation in a Competitive Market. Journal of Product Innovation Management, 12: 33-42.

Frick, F.Jantke, C. and Johannes Sauer, J. (2019). Innovation and productivity in the food vs. the high-tech manufacturing sector, Economics of Innovation and New Technology, 28:7, 674-694.

Fu, X., Mohnen, P. and Zanello, G. (2018). Innovation and productivity in formal and informal firms in Ghana, Technological Forecasting and Social Change, 131? 315-325.

García-Pozo, A., Marchante-Mera, A.J., and Campos-Soria, J. A. (2018). Innovation, environment, and productivity in the Spanish service sector: An implementation of a CDM structural model, Journal of Cleaner Production, 171, 1049-1057.

Gebreeyesus, M. (2009). Innovation and microenterprises growth in Ethiopia, WIDER Research Paper, No. 2009/51, ISBN 978-92-9230-230-6, The United Nations University World Institute for Development Economics Research (UNU-WIDER), Helsinki.

Goedhuys, M. (2007). The impact of innovation activities on productivity and firm growth: evidence from Brazil, No. 2007-002, MERIT Working Papers, United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT).

Goedhuys, M., Janz, N., and Mohnen, P. (2008). What drives productivity in Tanzanian manufacturing firms: technology or business environment?. Eur J Dev Res 20, 199–218.

Goedhuys, M., and Sleuwaegen, L. (2010). High-growth entrepreneurial firms in Africa: a quantile regression approach. Small Bus Econ 34, 31–51.

GoerG, H., and Strobl, E. (2007). The Effect of R&D Subsidies on Private R&D. Economica, 74: 215-234.

Greenwald, B.C., and Stiglitz, J.E. (1986). Externalities in Economies with Imperfect Information and Incomplete Markets, The Quarterly Journal of Economics, Volume 101, 2,229–264,

Griffith, R., Huergo, E., Mairesse, J., and Peters, B. (2006). Innovation and productivity across four European countries. Oxford Review of Economic Policy, 22(4), 483–498.

Griliches, Z., and Pakes, A. (1980). Patents and R&D at the firm level: A first look. NBER working paper no. 0561. Washington, DC, United States: National Bureau of Economic Research

Hall, B. H., & Mairesse, J. (1995). Exploring the relationship between R&D and productivity in French manufacturing firms. Journal of Econometrics, 65(1), 263–293.

Hall, B. H., F. Lotti, and J. Mairesse. (2009). Innovation and Productivity in SMEs: Empirical Evidence for Italy. Small Business Economics 33: 13–33.

Hall, B., and Sena, V. (2017). Appropriability mechanisms, innovation, and productivity: evidence from the UK, Economics of Innovation and New Technology, 26, 1-2, 42-62.

Hashi, I. and Stojcic, N. (2013). The impact of innovation activities on firm performance using a multi-stage model: Evidence from the Community Innovation Survey 4, Research Policy, 42,2, 353-366.

Heckman, J., (1979). Sample Selection Bias as a Specification Error, Econometrica, 47,153–161.

Hobday, M. (2005). Firm-level Innovation Models: Perspectives on Research in Developed and Developing Countries, Technology Analysis & Strategic Management, 17:2, 121-146.

Howell, Anthony (2017). Innovation and firm performance in the People's Republic of China: A structural approach with spillovers, ADBI Working Paper, No. 805, Asian Development Bank Institute (ADBI), Tokyo.

Hyytinen, A., and Toivanen, O. (2005). Do financial constraints hold back innovation and growth?: Evidence on the role of public policy, Research Policy, 34, 9, 1385-1403.

Jaumandreu, J., and Mairesse, J. (2017). Disentangling the effects of process and product innovation on cost and demand, Economics of Innovation and New Technology, 26, 1-2,150-167.

Kerr, W. R., and Nanda, R. (2015). Financing Innovation, Annual Review of Financial Economics, Annual Reviews, vol. 7(1),445-462.

Kijek, T., and Kijek, A. (2019). Is innovation the key to solving the productivity paradox?, Journal of Innovation & Knowledge, 4, Issue 4, 219-225.

Kumar, K.B. (2003). Education and Technology Adoption in a Small Open Economy: Theory and Evidence. Macroeconomic Dynamics, (4)7: 586-617.

Kuncoro, W., and Suriani, W.O. (2018). Achieving sustainable competitive advantage through product innovation and market driving, Asia Pacific Management Review, 23,3,186-192.

Lach, S. (1995). Patents and productivity growth at the industry level: A first look, Economics Letters, Elsevier, vol. 49(1), 101-108.

Love, J. H., and Roper, S. (2015). SME innovation, exporting, and growth: A review of existing evidence. International Small Business Journal, 33(1), 28–48.

Lööf, H., and Heshmati, A. (2002). Knowledge capital and performance heterogeneity: A firm-level innovation study. International Journal of Production Economics, 76(1), 61–85.

Lööf, H., Mairesse, J., & Mohnen, P. (2017). CDM 20 years after. Economics of Innovation and New Technology, 26(1–2), 1–4.

Mairesse, J., Mohnen, P., and Kremp, E. (2005). The importance of R&D and innovation for productivity: A reexamination in light of the 2000 French innovation survey. Annales d'Economie Statistique, 487–527.

Mairesse, J., and Sassenou, M. (1991). R&D Productivity: A Survey of Econometric Studies at the Firm Level, No. 3666, NBER Working Papers, National Bureau of Economic Research, Inc.

Marshall, G. and Parra, Á. (2019). Innovation and competition: The role of the product market, International Journal of Industrial Organization, 65, 221-247.

Mohnen, P., Mairesse, J., and Dagenais, M. (2006). Innovativity: A Comparison across seven European countries. Economics of Innovation and New Technology, 15(4/5), 391–413.

Mohnen, P., and Hall, B. (2013). Innovation and Productivity: An Update, Eurasian Business Review, 3, 1, 47-65.

Morsy, H., and El-Shal, A. (2020). Working Paper 340 - Innovation and Productivity in Developing Economies, Working Paper Series 2466, African Development Bank.

Motta, V. (2020). Lack of access to external finance and SME labor productivity: does project quality matter?, Small Business Economics, Springer, vol. 54(1),119-134.

Morris, D. M. (2018). Innovation and productivity among heterogeneous firms, Research Policy,47(10),1918-1932.

Naidoo, V. (2010). Firm survival through a crisis: The influence of market orientation, marketing innovation, and business strategy, Industrial Marketing Management, 39, Issue 8,1311-1320.

Nelson, R. (1959). The Simple Economics of Basic Scientific Research, Journal of Political Economy, 67.

Nicoletti, G., and Scarpetta, S. (2003). Regulation, productivity, and growth: OECD evidence, Policy Research Working Paper Series 2944, The World Bank.

Norbert, J., Lööf, H/ and Peters, B. (2004). Firm-Level Innovation and Productivity - Is there a Common Story Across Countries?, No 24, Working Paper Series in Economics and Institutions of Innovation, Royal Institute of Technology, CESIS - Centre of Excellence for Science and Innovation Studies.

Oyelaran-Oyeyinka, B. (2014). The state and innovation policy in Africa, African Journal of Science, Technology, Innovation and Development, 6:5, 481-496,

Page, J., and Söderbom, M. (2015). Is Small Beautiful? Small Enterprise, Aid, and Employment in Africa. African Development Review, 27: 44-55.

Pellegrino, G., Piva, M., and Vivarelli, M. (2012). Young firms and innovation: A micro econometric analysis, Structural Change and Economic Dynamics, 23,4,329-340.

Quaye, D. M., and Mensah, I. (2019). Entrepreneurial leadership and performance of female-owned small and medium-sized enterprises in Ghana, International Journal of Entrepreneurship and Small Business, 38, issue 1/2, p. 19-44.

Raffo, J., Lhuillery, S., and Miotti, L. (2008). Northern and southern innovativity: a comparison across European and Latin American countries. Eur J Dev Res 20, 219–239.

Shapiro, C. (2011). Competition and Innovation: Did Arrow Hit the Bull's Eye?, p. 361-404 in, The Rate and Direction of Inventive Activity Revisited, National Bureau of Economic Research, Inc.

Shi, J., Sadowski, B., Li, S., and Nomaler, Ö. (2020). Joint Effects of Ownership and Competition on the Relationship between Innovation and Productivity: Application of the CDM Model to the Chinese Manufacturing Sector. Management and Organization Review, 1-21. doi:10.1017/mor.2020.13.

Silva, F., and Carreira, C. (2010). Measuring firms' financial constraints: Evidence for Portugal through different approaches, No. 2010-15, GEMF Working Papers, GEMF, Faculty of Economics, University of Coimbra.

Sun, X., Li, H., & Ghosal, V. (2020). Firm-level human capital and innovation: evidence from China. China Economic Review, 59, 101388.

Teixeira, A., and Tavares-Lehmann, A. T. (2014). Human capital intensity in technology-based firms located in Portugal: Does foreign ownership matter?, Research Policy, 43, 4,737-748.

van Leeuwen, G., and Mohnen, P. (2017). Revisiting the Porter hypothesis: an empirical analysis of Green innovation for the Netherlands, Economics of Innovation and New Technology, 26:1-2, 63-77.

van Uden, A., Knoben, J., and Vermeulen, P. (2017). Human capital and innovation in Sub-Saharan countries: a firm-level study, Innovation, 19:2, 103-124.

Vuorio, A., Torkkeli, L., and Sainio, L-M. (2020). Service innovation and internationalization in SMEs: antecedents and profitability outcomes, Journal of International Entrepreneurship, 18(1), 92-123.

Waheed, A. (2011). Innovation and firm-level productivity: econometric evidence from Bangladesh and Pakistan, MERIT Working Papers 2011-061, United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT).

Wadho, W., and Chaudhry, A. (2018). Innovation and firm performance in developing countries: The case of Pakistani textile and apparel manufacturers, Research Policy, Elsevier, vol. 47(7),1283-1294.

Wang, Y. (2016). What are the biggest obstacles to the growth of SMEs in developing countries? – An empirical evidence from an enterprise survey, Borsa Istanbul Review, 16, Issue 3, 167-176,

Wellalage, N. H., and Fernandez, V. (2019). Innovation and SME finance: Evidence from developing countries, International Review of Financial Analysis, DOI: https://doi.org/10.1016/j.irfa.2019.06.009.

Winton, A., and Yerramilli, V. (2008). Entrepreneurial finance: Banks versus venture capital, Journal of Financial Economics, 88, 1, 51-79.

Xie, X. and Wang, H. (2020). How can open innovation ecosystem modes push product innovation forward? An fsQCA analysis, Journal of Business Research, 108, issue C, p. 29-41.

Younas, M.Z., and Rehman, F-U., (2020). Exploring the nexus between innovation and firm performance: new evidence from manufacturing innovation survey of Pakistan, Asian Journal of Technology Innovation, DOI: 10.1080/19761597.2020.1778493.

Zeng, S.X., Xie, X.M., and Tam, C.M. (2010). Relationship between Cooperation Networks and Innovation Performance of SMEs. Technovation, 30, 181-194.

Chapter Six

The Effects of Innovation Strategies on Export Growth

6.1. Introduction

In the previous chapter, I estimated the relationship among innovation efforts, external financial support and labour productivity growth. In this chapter, I will focus on examining whether (or not) innovation as well lead to export growth. Despite the surge and magnitude of FDIs globally, many firms, especially SMEs in developing economies rely on exports as their mode of international expansion. International markets allow these firms to explore new resources and capabilities that are absent in their home markets. However, international operations are characterized by a higher degree of competitive pressure than national operations. This competitive demand is reflected both on the demand side, where consumers demand high quality and low prices; and on the supply side, where firms compete with local firms.

Empirical studies that found a positive impact of innovation on export performance (Tavassoli, 2018). However, the extant empirical studies mainly focus on developed economies with high shares of innovative firms. There is a paucity of research in the SSA region. Given the differences in institutional environments as we saw in the previous chapter, I argue that the results obtained from developed economies may be of little relevance in many developing countries (Fernández-Sastre and Montalvo-Quizhpi, 2019). Thus, this chapter fills this research gap by

examining the nature, types, and effects of innovation on the export growth of SME in Nigeria.

This chapter consists of five sections: Section 6.2 provides a theoretical background and develops hypotheses of this study in Section 6.3. Section 6.4 presents the method and model specification. In Section 6.5, the results of the empirical analysis are presented.

6.2. Theoretical Background

Exporting is one of the most common modes of international market entry as it allows for greater strategic flexibility and production efficiency (Sousa, 2004). Exporting is attractive to SMEs in developing economies because of its low level of commitments and investment risks (Lu and Beamish, 2006). Moreover, it is rapidly becoming a vital instrument for firm growth because of the evolution of the competitive business environment (Golovko and Valentini, 2011). However, success in the export market can be very challenging as it is determined by a variety of factors (Venkatraman, 1989). Cavusgil and Zou (1994) argue that export performance depends on a firm's ability to strategically manage the interplay of internal and external forces. This is consistent with the contingency theory, which posits that export performance is dependent on the context in which a firm operates (Robertson and Chetty, 2000). These authors suggest that firms possessing appropriate internal factors (e.g. strategic orientations or resources) can efficiently respond to the external conditions in the export markets (Yeoh and Jeong, 1995). The rapid environmental changes in the global market are making competition more

intense, especially for the SMEs. Given their specific disadvantage when compared to large firms, SMEs must constantly seek strategies that enable them to grow in the export markets (Audretsch and Belitski, 2013). This has even more implications for SME exporters originating from weak institutional environments such as Nigeria (LiPuma et al., 2011). As a result, it is imperative for these firms to adopt strategies that allow them to respond effectively to the contingency factors in the export markets (Cavusgil and Zou, 1994).

SMEs engaging in technological and non-technological innovations are more likely to grow in the export markets. The issue of engaging in complementary innovation strategies has become very important because of the increasing number of external factors in the export markets (Azadegan and Wagner, 2011). One would expect developing country SMEs to adopt well-balanced innovation types to respond to these demands efficiently. They can respond to the 'market-change' by introducing new products or implementing production processes, which allows them to exploit opportunities. In turn, they can respond to the 'technological-change' by implementing a new marketing strategy that creates new distribution channels or enhances the efficiency of existing distribution channels (Abernathy and Clark, 1985).

6.3. Hypotheses Development

a) Technological Innovation and Export Growth

Product and process innovations lead to high productivity and growth (Love and Roper, 2015). Even though they are often considered as technological innovation,

new products and processes can be linked to purely organizational practices (OECD, 1996) or marketing strategies (Grimpe et al., 2017). However, in this study, we conceive them as technological innovation because of their technical specifications and functional characteristics. Prior research shows that firms investing in product and process innovations can achieve a twofold competitive advantage, namely differentiation strategies and cost efficiency (Grant, 1991). Vernon (1966) suggests that productivity is driven by technological innovation induced by product competition. Over time, products are affected by technological changes and short product life cycles. The success of SMEs in export markets largely depends on their ability to develop high-quality and improved products and production processes (Cassiman and Golovko 2010).

Previous empirical studies carried out in the context of developed economies supported a positive relationship between product innovations and exporting. For example, Tavassoli (2018) shows that product innovation has a positive effect on the export intensity of SMEs. Cassiman et al. (2010) show that product innovation not only positively affects SMEs' export performance but also induces non-exporting SMEs to undertake an international strategy through export activities (Cassiman et al., 2010). Caldera (2010) shows for Spanish manufacturing firms that product and process innovations are positively related to export performance. Similarly, Van Beveren and Vandenbussche (2009) show that the combination of product and process innovation, rather than either of the two in isolation, increases export propensity in Belgium.

Nevertheless, empirical evidence on the effect of product and process innovation is mixed (e.g. Landesmann and Pfaffermayr, 1997). The majority of the prior studies conducted in developed economies show that product innovation has

a stronger impact on export performance than process innovation (Nassimbeni, 2001), whereas others, though few, show that process innovation has more impact in determining export performance (López Rodríguez and García Rodríguez, 2005). One possible explanation for this may be due to the context or the country where the studies were conducted. For example, Roper and Love (2002) showed that in the United Kingdom, product innovation is positively related to the propensity to export. However, in Germany, they found a negative relationship. Likewise, in a two-wave study in Estonia, Masso, and Vahter (2008) find that only product innovation increased productivity in the first wave, whereas process innovation positively affected productivity in the second wave.

Given institution-specific challenges facing SMEs in Nigeria, it is important to examine innovation strategies of these firms as well as identify the dimension of technological innovation that has the greatest effect on their export performance. In the context of emerging markets in countries such as South Africa, Brazil, and India, researchers found that firms with a higher rate of exports over total sales are less likely to engage in technological innovation (Cui et al. 2016). However, in a study carried out in Pakistan, Wadho and Chaudhry (2018) found that export is positively associated with innovation performance, and manufacturing firms exporting to developed countries are more likely to participate in innovation. For example, in a study of Brazilian firms, Goedhuys and Veugelers (2008) found that product innovation leads to superior sales growth rates when it is combined with process innovation. They highlighted that process innovation alone leads to low performance. In Bangladesh and Pakistan, Waheed (2011) found that process innovation has more impact on firm productivity than product innovation. However, the effect of product and process innovation on export performance of

SMEs in Nigeria is largely unclear. Given that technological innovation is a source of competitive advantage, I expect SMEs in Nigeria investing in both product and process innovations to increase their ability to meet market demands; and consequently, achieve better export performance (Zahra et al., 2000). Therefore, I propose the following hypotheses:

H1a: There is a positive relationship between product innovation and export growth.

H1b: There is a positive relationship between process innovation and export growth.

b) Marketing Innovation and Export Growth

Marketing innovation has been identified as a significant source of competitive advantage (Cruz-Ros et al. 2017). It constitutes a fundamental factor for assessing the success of exporting firms (Tan and Sousa, 2015). Marketing innovation enables firms to create new, and differentiated products, and a strong brand image that is difficult for competitors to imitate (Murray et al., 2011). Firms involved in marketing innovation can develop a unique customer-value via market research, intelligence dissemination, and responsiveness to the market (Kohli and Jaworski, 1990). Few studies have analyzed the effect of innovations on export performance in the case of SMEs. This paucity of literature is even more evident in the case of marketing innovations (Valle, 2016). The extant studies did not examine the impact of

marketing innovation on firm performance in isolation, but rather in conjunction with other innovation types such as products and processes and organizational innovations (Bodlaj et al., 2018). These studies found that organizational innovations, along with product innovations, stimulate marketing innovations in SMEs, which in turn, have a positive impact on their export. Unlike these studies, we argue that marketing innovation alone can positively affect the export performance of SMEs. This is because marketing innovation provides firms with a unique strategy for reacting to consumers' needs (Keskin, 2006). Leonidou et al. (2002) show that firms use novel export-marketing strategies to manage the interaction of internal and external factors and consequently, realize their export objectives. Gupta et al. (2016) reveal that marketing innovation related to brand image contributes to firm competitiveness. Moreover, Ozkaya et al. (2015) suggest that firms with marketing innovation capabilities can secure profitable positioning and greater performance. A recent study found an inverse U-shaped relationship between innovation in marketing and the level of international expansion (Bortoluzzi et al., 2018). However, what seems to be clear is that regardless of prior empirical evidence, new studies are needed to analyze the relationship between marketing innovation and SME export performance, especially in the context of developing countries such Nigeria. On this basis, I propose that:

H2: There is a positive relationship between marketing innovation and export performance.

c) Joint effects of Technological and Marketing Innovations on Export growth

Technological innovation and marketing innovation are key strategies for growth. Research suggests that export success largely depends on a firm's ability to explore broad innovation strategies. However, firms vary in terms of size, strategic focus, and resource capabilities (Joo et al. 2018). These factors have implications on the firm's innovation activity and export performance. For example, SMEs from developing economies have to decide whether or not, and how much to invest in technology and market domains. That is, they have to make a trade-off between them. This raises the challenge of achieving a balance between the two domains, especially for firms facing additional institutional constraints (Song et al., 2005). Prior research suggests that focusing on an aspect of innovation allows a firm to manage its organizational requirements effectively; and allot its resources properly (Bhoovaraghavan et al., 1996). Studies show that a firm pursuing a single-innovation strategy can create new products, enter new markets, and increase its productivity (Rodil et al. 2016). Nevertheless, firms are increasingly investing in different types of innovations, either simultaneously or complementarily (Karlsson and Tavassoli, 2016). Recent empirical evidence reveals that the combination of innovation types has a positive impact on firm performance (Azar and Ciabuschi, 2017). For example, in a study of Italian firms, Aldieri et al. (2019) find that both process and product innovation have positive effects on a firm's economic productivity, especially when they are jointly conducted. Also, they show that introducing a new product on the market increases productivity if complemented by marketing innovations.

Since no single innovation is universally superior, I expect SME exporters from Nigeria to engage in technological and marketing innovation simultaneously to achieve a better export growth (Evangelista and Vezzani, 2010). For example, a firm producing new products may require a new marketing strategy to introduce these products to the export markets (Wadho and Chaudhry, 2018). In turn, such a firm can generate new products through product designs, packaging, product promotion, or distribution strategies (Grimpe et al., 2017). Lee, Lee, and Garrett (2019) find that the relationship between new products and firm performance is increased with the introduction of marketing innovation. Technological and marketing innovations can reinforce each other leading to cumulative positive effects on firm performance (Geldes et al., 2016). On this basis, I argue that SMEs from Nigeria simultaneously investing in technological and marketing innovations can achieve greater export growth due to their synergistic effects (Hervas-Oliver et al., 2014). Therefore, we propose that:

H3: The joint effect of technological and marketing innovation is positively related to export growth.

d) The Role of Innovation Cooperation on Export Growth

The relationship between innovation and export behavior is *a priori* unclear, because the direction of causality may also run from export to innovation as suggested by the endogenous growth model (Grossmann and Helpman, 1991). The importance of international exposure on growth strategy is likely to be more

profound on SMEs than large firms due to their resource constraints (Ardito et al., 2019). The internationalization strategy represents a vital learning opportunity for SMEs to enhance technological resources and grow in the export markets (Dikova et al., 2016). SME exporters can improve their innovation performance and consequently, achieve higher returns from innovation by expanding into more markets. In a study of Korean mining and manufacturing firms, Hahn and Park (2011) find that exporting positively affects innovation and vice versa, thus leading to greater productivity. One of the possible explanations of this bi-directional effect is linked to the interactions between firms and external agents as posited by innovation networks (Baptista and Swann, 1998) and open innovation (Chesbrough 2003) theorists. These authors suggest that the export market promotes the interaction between firms and their environment. Firms collaborating with external partners in the export markets can improve their technical knowledge. Innovation collaboration is very attractive to SMEs due to their limited resources. Through external relationships, SMEs can counter the liability of smallness, which inhibits internal R&D activities. SMEs collaborating with external agents in the export markets can absorb external ideas relevant to developing technological innovations. Moreover, a firm can develop a novel marketing strategy or open up new markets from the information gathered from external agents.

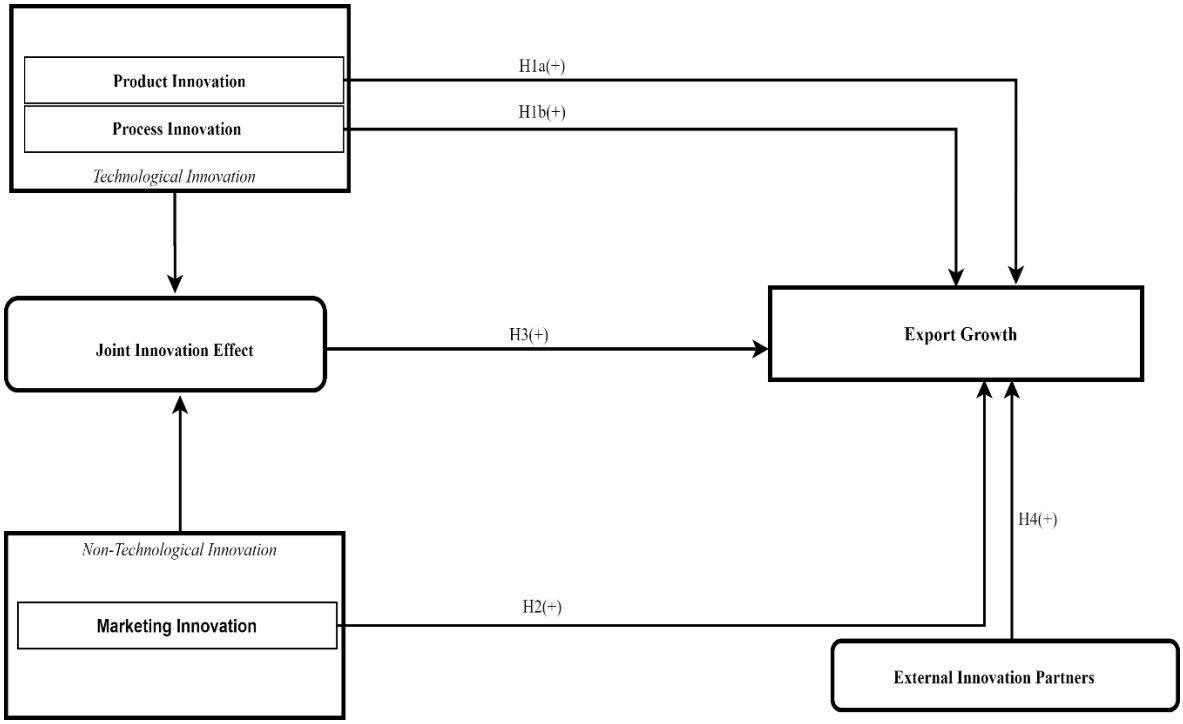
Furthermore, given the aforementioned institutional constraints in Nigeria, there is a sound reason to expect the SMEs from Nigeria to increasingly engage in external innovation collaborations. This is in line with the claim that these firms expand into foreign markets to enhance their innovation performance and export growth objectives (Lou, Xue, and Han, 2010). Such collaborations give them access to facilities and specialist knowledge lacking in their home markets. Also, these

firms can learn about the designs of new products or product packaging and promotion from their external partners. Thus, their international expansion captures the importance of the co-evolution of export activity and collaborative innovation. In a recent study, Moreno-Menendez (2018) reveals that export activities and innovation cooperation follow a two-way path, thus suggesting a mutual influence of the variables on firm growth.

However, despite the extensive literature, there is still a paucity of empirical evidence supporting the co-evolution of exporting and innovation collaboration in developing economies, especially in SSA. Lewandowska et al. (2016) argue that the wide adoption of innovation collaboration strategies among firms in transition and emerging economies highlights its crucial role in international competitiveness. Following this overall positive impact, I argue that SMEs in Nigeria collaborating with external agents with superior knowledge and technologies are likely to be more innovative. Nevertheless, the impact of collaboration on innovation activities depends on the number of external sources (Laursen and Salter, 2006). SMEs with a high level of presence in foreign markets can draw from a wider array of technological resources from external partners (Capaldo and Messeni, 2015). The knowledge accruing from such international exposure can enable SMEs to develop new products, processes, marketing strategies, or upgrade existing ones and consequently respond to changing market environments. As a result, I expect a higher number of external partners to influence the impact of innovations on export performance.

H4: The higher the number of innovation partners, the more positive the innovation-export growth relationship.

Figure 6: Conceptual framework of innovation strategies on export growth



6.4. Model Specification

I adopted the Stock and Watson (1993) Dynamic Ordinary Least Square (DOLS) model. I chose this model because it corrects for possible simultaneity bias present among regressors. Precisely, it proposes a parametric approach for estimating long-run equilibriums in systems possibly integrated of different orders but still cointegrated (Stock and Watson 1993). According to Al-Azzam and Hawdon (2000), the DOLS estimation procedure has certain advantages over alternative approaches like the OLS because it produces more robust estimates. The presence of leads and lags of different variables with integration vectors eliminates the issue of simultaneity bias within the sample. The estimates of DOLS have both better sample properties and provide a superior approximation to normal distribution. Besides,

the inclusion of the leads and lags ensures that the error term is independent of past innovations in stochastic regressors and present in the equation. Following Masih and Masih (1996a), I specify the model thus:

$$Y_t = \alpha_0 + \beta X_t + \sum_{j=-q}^{p} \Phi\, \theta \Delta X_{t-j} + \varepsilon_t \qquad 1$$

Y_t is the dependent variable, X_t is the matrix of explanatory variables;

β is the cointegrating vector representing the long-run cumulative multipliers, while p and q are the lags and leads in the model.

$$\begin{aligned} \mathrm{EXPPERF_t} = \mathrm{X_t M'} + \sum_{\mathrm{i=-m}}^{\mathrm{i=m}} \emptyset_{\mathrm{i}}\, \Delta \mathrm{COOPNIGUNI_{t-i}} \\ + \sum_{\mathrm{i=-n}}^{\mathrm{i=n}} \omega_{\mathrm{i}} \Delta \mathrm{COOPRESINS_{t-i}} + \sum_{\mathrm{i=-j}}^{\mathrm{i=j}} \delta_{\mathrm{i}}\, \Delta \mathrm{MARKINNO_{t-i}} + \sum_{\mathrm{i=-i}}^{\mathrm{i=l}} \theta_{\mathrm{i}}\, \Delta \mathrm{PROCESINNO_{t-i}} \\ + \sum_{\mathrm{i=-i}}^{\mathrm{i=l}} \rho_{\mathrm{i}}\, \Delta \mathrm{PRODUCINNO_{t-i}} + \sum_{\mathrm{i=-i}}^{\mathrm{i=l}} \sigma_{\mathrm{i}}\, \Delta \mathrm{FIRMAGE_{t-i}} \\ + \varepsilon_{\mathrm{t}} \qquad 2 \end{aligned}$$

Where

$M = [C, \alpha, \rho, \beta, \gamma, \tau, \Theta], X$
$= [1,\ LEXPPERF_t\ COOPNIGUNI_t\ MARKINNO_t\ PROCESSINNO_t\ PRODUCTINNO_t\ COOPRESINS_t\ FIRMAGE_t]$

6.5. Empirical Findings

When dealing with time-series data, it is imperative to test for the stationarity of the variables in the model through pre-estimation tests. This is important because non-stationary data may create spurious results for standard OLS regressions. Thus, the result of this test and that of the Stock Watson Dynamic OLS model are presented in this section of the chapter.

a) Stationary and Lag Length Test

I begin the analysis by determining the order of integration of the variables employed in the study. There are several procedures to test for unit roots (Hadri, 2000), I used the Augmented Dickey-Fuller (ADF) test. The result from table 6.2. shows that all the variables in the model are all integrated of order I (1), that is, all the variables became stationary after first differencing, except for firm age which was stationary at its level form. The decision rule for no unit root is that the ADF test statistics must be greater than the Mackinnon critical value for the series to be stationary or have a P-value that is less than the 5% level. Therefore, the results in table 6.2. shows that all series were stationary after the first difference apart from firm age.

Table 6.2: Unit Root Test

Variable	ADF Test Statistic	Mackinnon Critical Value @5%	P-value	Order of Integration	Assessment
EXPPERF	-4.12330	-2.95402	0.0000	I(1)	Stationary
MARKINNO	-5.74456	-2.95402	0.0000	I(1)	Stationary
PRODUCTINNO	-5.41307	-2.95402	0.0001	I(1)	Stationary
FIRMAGE	-4.49659	-2.95112	0.0011	I(0)	Stationary
COOPNIGUNI	-5.93934	-2.95402	0.0000	I(1)	Stationary
PROCESSSINNO	-5.74456	-2.95402	0.0000	I(1)	Stationary
COOPRESINS	-5.56776	-2.95402	0.0001	I(1)	Stationary

b) Cointegration Test

Testing for cointegration allows us to check whether relationships are empirically meaningful. By applying the Johansen test, I find evidence of cointegration among the variables in the model as shown in table 6.3. below. The decision rule for cointegration is based on the trace statistics being greater than the critical value at

the 5% level of significance. This shows that there are at least 1 co-integrating equations present.

Table 6.3: Cointegration Test

Hypothesized No of CE(s)	Eigenvalue	Trace Stat	0.05 Critical val	Prob**
None*	0.825588	168.2481	125.6154	0.0000
At most 1*	0.750836	110.6191	95.75366	0.0032
At most 2	0.550729	64.76079	69.81889	0.1185
At most 3	0.407202	38.35651	47.85613	0.2867
At most 4	0.325271	21.10075	29.79707	0.3514
At most 5	0.197376	8.117092	15.49471	0.4530

c) The Stock-Watson DOLS Long-run Model

Given the presence of cointegration in the model, I established a long-run relationship among the variables. The results of the Stock-Watson dynamic model are shown in table 6.4. The Stock-Watson DOLS parameter estimates were modeled including 1 lag and 1 lead (j=±1) of the equilibrium error without changing the results to any significant degree. According to Newey and West (1987), standard errors in small samples are robust and they allow for valid inferences to be made on coefficients entering as regressors in models both in levels and in log forms.

Table 6.4: Stock-Watson DOLS Long-run Parameter Estimates of Innovation Types and Export Growth

$M = [C, \alpha, \rho, \beta, \gamma, \tau, \Theta], X$
$= [1,\ LEXPPERF_t COOPNIGUNI_t COOPRESINS_t\ MARKINNO_t\ PROCESSINNO_t\ PRODUCTINNO_t\ FIRMAGE_t]$

Variable	Coefficient	t-statistic	Coefficient	t-statistic
	Model 1	**Model 1**	**Model 2**	**Model 2**
Constant	-87.2534	-5.9915	-39.266	-3.61376
PRODUCTINNO	0.144876	0.67394	0.63579	1.92022
COOPNIGUNI	-9.16478	-1.0604		
PROCESSINNO	8.096430	2.36506	13.2427	3.82126
MARKINNO	0.395071	2.79906	-0.07265	-0.45645
COOPRESINS	10.14865	3.48923		
FIRMAGE	0.010585	0.20390		
Sum of square resids	0.95747		0.88355	
R-squared Adjusted	0.88014		0.81001	

Stock-Watson DOLS: Dependent Variable: LEXPPERF

From the regression summary in table 6.4. (Model 1), the finding shows a positive relationship between product innovation and export growth. Since the t-value of 0.67394 is less than the critical t-value at the 5% level of significance, hence (H1a) is rejected. However, the results reveal a statistically significant relationship between process innovation and export growth (H1b). It is significant at a 5% level with t-values of 2.36502. Hence, a 1% increase in process innovation leads to an increase in export growth by 809.6%.

Furthermore, the finding reveals a positive relationship between marketing innovation and export growth at the 5% level of significance with t-values of 2.79906. Moreover, a 1% increase in marketing innovation leads to an increase in export growth by 39.5%. The results support (H2). Regarding (H3), we adopted a second model as shown in Table 6.4. (Model 2) above. I considered the combined effect of technological and marketing innovations on export performance among manufacturing firms in Nigeria. The summary of the results shows that only technological innovation (product innovation significant at the 10% level, while process innovation is significant at the 5% level) had a positive and significant impact on export growth. Marketing innovation, on the other hand, had a negative and insignificant effect. However, their combined effect is above 100%, resulting in 1324% increase in export growth in Nigerian Manufacturing firms.

Finally, in (H4) I analysed two types of cooperation, namely, collaboration with public research institutions (outside Nigeria) and collaboration with universities (within Nigeria). The results from Model 1 show that only collaborations with public research institutes abroad had a positive and significant impact on export growth. These results show that an increase in the number of collaborations with public research institutes positively contributes to export growth. Precisely, a

1% increase in cooperation leads to an increase in export performance by 1014.86% with a t-statistic of 3.489 at the 5% level of significance. Meanwhile, cooperation with Nigerian universities had a negative and insignificant impact on export growth.

References

Abernathy, W. J., and Clark, K. B. (1985). Innovation: Mapping the winds of creative destruction, Research Policy, 14, issue 1, 3-22.

Adams, A. (1982). Barriers to Product Innovation in Small Firms: Policy Implications, European Small Business Journal, Vol. 1 No. 1, 67-86.

Al-Azzam, A., and Hawdon, D. (1999). Estimating the Demand for Energy in Jordan: A Stock-Watson Dynamic OLS (DOLS) Approach, No 97, Surrey Energy Economics Centre (SEEC).

Aldieri, L., Barra, C., Vinci, C., and Zotti, R. (2019). The joint impact of different types of innovation on firm's Productivity: Evidence from Italy. Economics of Innovation and New Technology. 10.1080/10438599.2019.1685211

Allred, B.B., and Steensma, Kevin. (2005). The influence of industry and home country characteristics on firms' pursuit of innovation. Management International Review. 45. 383-412.

Aksoy, H. (2017). How do innovation culture, marketing innovation, and product innovation affect the market performance of small and medium-sized enterprises (SMEs)? Technology in Society. 51. 10.1016/j.techsoc.2017.08.005.

Antonelli, C., and Fassio, C. (2018). The role of external knowledge in the introduction of product and process innovations. In the Evolutionary Complexity of Endogenous Innovation, 109-127.

Ardito, L., Galati, F., Messeni Petruzzelli, A., and Corvino, A. (2019). Improving the financial performance of SMEs: The presence in foreign markets and the moderating role of corporate group and alliance portfolio size. Business Process Management Journal, in press.

Audretsch, D., and Belitski, M. (2013). The missing pillar: the creativity theory of knowledge spillover entrepreneurship, Small Business Economics, 41 4,819-836.

Aw, B. Y., Roberts, M. J., and Winston, T. (2007). Export market participation, investments in R&D and worker training, and the evolution of firm productivity. World Economy, 30(1), 83–104.

Azadegan, A., and Wagner, S. (2011). Industrial Upgrading, Exploitative Innovations, and Explorative Innovations. International Journal of Production Economics. 130. 54-65.

Azar, G., and Ciabuschi, F. (2017). Organizational innovation, technological innovation, and export performance: The effects of innovation radicalness and extensiveness, International Business Review, 26(2).324-336.

Baptista, R., and Swann, G. (1998). Do firms in clusters innovate more? Research Policy, 27, issue 5, 525-540.

Basile, R. (2001). Export behaviour of Italian manufacturing firms over the nineties: the role of innovation, Research Policy, 30, 8, 1185-1201.

Becker, S.O., and Egger, P.H. (2013). Endogenous product versus process innovation and a firm's propensity to export, Empirical Economics, Vol. 44 No. 1, pp. 329-354.

Bhoovaraghavan, S., Vasudevan, A., and Chandran, R. (1996). Resolving the Process vs. Product Innovation Dilemma: A Consumer Choice Theoretic Approach. Management of Science. 42(2), 232-246.

Bodlaj, M., Kadic-Maglajlic, S., and Vida, I. (2018). Disentangling the impact of different innovation types, financial constraints, and geographic diversification on SMEs' export growth. Journal of Business Research.

Bortoluzzi, G., Kadic-Maglajlic, S., Arslanagic-Kalajdzic, M., and Balboni, B. (2018). Innovativeness as a Driver of the International Expansion of Developing Markets' Firms: Evidence of Curvilinear effects. International Marketing Review, 35(2), 215-235.

Buckley, F. (1997). The Canadian Keiretsu. Journal of Applied Corporate Finance, 9: 46-57.

Caldera, A. (2010). Innovation and exporting: evidence from Spanish manufacturing firms, Review of World Economics (Weltwirtschaftliches Archiv), 146, 4, 657-689.

Capaldo, A., and Messeni Petruzzelli, A. (2015). Origins of knowledge and innovation in R&D alliances. A contingency approach. Technology Analysis and Strategic Management, Vol. 27, pp.461-483.

Carayannopoulos, S. (2009). How Technology-Based New Firms Leverage Newness and Smallness to Commercialize Disruptive Technologies. Entrepreneurship Theory and Practice. 33. 419 - 438.

Cassiman, B., and Golovko, E. (2011). Innovation and internationalization through exports, Journal of International Business Studies, Vol. 47 No. 1, pp. 56-75.

Cavusgil, S.T., and Zou, S. (1994). Marketing strategy – performance relationship: an investigation of the empirical link in export market ventures. Journal of Marketing, 58, 1-21.

Chesbrough, H. (2003). Open Innovation: The New Imperative for Creating and Profiting, from Technology. Harvard Business School Press, Boston.

Cruz-Ros, S., Garzon, D., and Mas-Tur, A. (2017). Entrepreneurial competencies and motivations to enhance marketing innovation in Europe. Psychology and

Marketing, 34(11), 1031-1038.

Cuervo-Cazurra, A. (2012). Extending theory by analyzing developing country multinational companies: Solving the Goldilocks debate. Global Strategy Journal, 2: 153-167.

Damanpour, F. (1987). The Adoption of Technological, Administrative, and Ancillary Innovations: Impact of Organizational Factors. Journal of Management, 13(4), 675–688.

Damanpour, F., and Aravind, D. (2012). Managerial Innovation: Conceptions, Processes, and Antecedents. Management and Organization Review, 8(2), 423-454.

Danneels, E. (2008). Organizational antecedents of second-order competences. Strategic Management Journal, 29: 519-543.

Del Giudice, M., Scuotto, V., Garcia-Perez, A., and Messeni Petruzzelli, A. (2019). Shifting Wealth II in Chinese economy. The effect of the horizontal technology spillover for SMEs for international growth. Technological Forecasting and Social Change, 145,307-316.

Dickey, D, and Fuller, W. (1979). Distribution of the Estimators for Autoregressive Time Series with a Unit Root. JASA. Journal of the American Statistical Association. 74. 10.2307/2286348.

Dikova, D., Jaklič, A., Burger, A., and Kunčič, A. (2015). What is beneficial for first-time SME-exporters from a transition economy: A diversified or a focused export-strategy? Journal of World Business. 51, 2, 185-199.

Drucker, P. F. (1954). The practice of management. New York: Harper and Row.

Dunning, J.H. (1998). Location and the multinational enterprise: a neglected factor? Journal of International Business Studies 29(1): 45–67.

Evangelista, R., and Vezzani, A. (2010). The economic impact of technological and organizational innovations. A firm-level analysis, Research Policy, 39, 10, 1253-1263.

Fernández-Sastre, J., and Montalvo-Quizhpi, F. (2019). The effect of developing countries' innovation policies on firms' decisions to invest in R&D, Technological Forecasting, and Social Change,143(C),214-223.

Filipescu, Diana A., Alex Rialp, and Josep Rialp (2009). Internationalization and Technological Innovation: Empirical Evidence on Their Mutual Relationship, in New Challenges to International Marketing: Advances in International Marketing, Vol. 20, R.R.

Foroudi, P., Jin, Z., Gupta, S., Melewar, T.C., and Foroudi, M.M.(2016). Influence of innovation capability and customer experience on reputation and loyalty,

Journal of Business Research,69,11, 4882-4889.

Fritsch, M., and Slavtchev, V. (2007). Universities and innovation in space. Industry and Innovation, 14: 201–218.

Fu, X., Mohnen, P., and Zanello, G. (2018). Innovation and productivity in formal and informal firms in Ghana, Technological Forecasting and Social Change,131(C),315-325.

Ganotakis, P. and Love, J.H. (2011), R&D, product innovation, and exporting: evidence from UK new technology-based firms, Oxford Economic Papers, Vol. 63 No. 2, pp. 279-306.

Geldes, C., Felzensztein, C., and Palacios-Fenech, J. (2016). Technological and non-technological innovations, performance, and propensity to innovate across industries: The case of an emerging economy. Industrial Marketing Management,61,55 – 66.

Goedhuys, M., and Veugelers, R. (2012). Innovation strategies, process, and product innovations, and growth: Firm-level evidence from Brazil, Structural Change and Economic Dynamics, 23, 4,516-529.

Grimpe, C., Sofka, W., Bhargava, M., and Chatterjee, R. (2017). R&D, Marketing Innovation, and New Product Performance: A Mixed Methods Study. J Prod Innov Manag, 34: 360-383.

Gunday, G., Ulusoy, G., Kılıç, K., and Alpkan, L. (2011). Effects of innovation types on firm performance, International Journal of Production Economics, 133(2), 662-676.

Gupta, S., Malhotra, N., Czinkota, M., and Foroudi, P. (2016). Marketing innovation: A consequence of competitiveness. Journal of Business Research. 69. 10.1016/j.jbusres.2016.02.042.

Grossman, G.M., and Helpman, E. (1991). Innovation and Growth in the Global Economy, MIT Press, Cambridge.

Guillén, M. F. (2005). The Rise of Spanish Multinationals: European Business in the Global Economy Cambridge: Cambridge University Press.

Hadri, K. (2000). Testing for stationarity in heterogeneous panel data. The Econometrics Journal, 3: 148-161.

Hall, B., and Lerner, J. (2010). The Financing of R&D and Innovation, ch.14, 609-639, Elsevier.

Hahn, C.H., and Y.-S. Choi (2013). Trade Liberalization and the Wage Skill Premium in Korean Manufacturing Plants: Do Plants' R&D and Investment Matter? In Hahn, C. H. and D. A. Narjoko (eds.), Impact of Globalization on Labor Market. ERIA Research Project Report 2012,4,15-37

Hervas-Oliver, J. L., and Sempere Ripoll, F. and Boronat-Moll, C. (2014). Process innovation strategy in SMEs, organizational innovation, and performance: A misleading debate? Small Business Economics. 43. 873-886.

Higón, D., and Driffield, N. (2011). Exporting and innovation performance: Analysis of the Annual Small Business Survey in the UK. International Small Business Journal. 29. 10.1177/0266242610369742.

Jackson, G., and Deeg, R., (2008). Comparing capitalisms: understanding institutional diversity and its implications for international business, Journal of International Business Studies, 39, issue 4, p. 540-561.

Johansen, S. (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. Econometrica. 59 (6): 1551 1580.

Joo, H. Y., Seo, Y. W., and Min, H. (2018). Examining the effects of government intervention on the firm's environmental and technological innovation capabilities and export performance. International Journal of Production Research, 56(18), 6090-6111.

Karlsson, C., and Tavassoli, S. (2016). Innovation strategies of firms: what strategies and why? The Journal of Technology Transfer, 41, 6,1483-1506.

Keskin, H. (2006). Market orientation, learning orientation, and innovation capabilities in SMEs, European Journal of Innovation Management,9, 4, 396-417.

Kohli, A.K., and Jaworski, B.J. (1990). Market Orientation: The Construct, Research Propositions, and Managerial Implications. Journal of Marketing, 54, 1-18.

Landesmann, M., and Pfaffermayr, M. (1997). Technological competition and trade performance, Applied Economics, 29,2, 179-196.

Laursen, K., and Salter, A. (2006). Open for Innovation: The Role of Openness in Explaining Innovation Performance among UK Manufacturing Firms. Strategic Management Journal, 27, 131-150.

Lee, R., Lee, J-H., and Garrett, T. C. (2019). Synergy effects of innovation on firm performance, Journal of Business Research, 99(C), 507-515.

Lee, R. P., Özsomer, A., and Zhou, K. Z. (2015). Introduction to the special issue on Innovation in and from Emerging Economies. Industrial Marketing Management 50, 16-17.

Leonidou, L. C., Katsikeas, C. S., and Samiee, S. (2002). Marketing strategy determinants of export performance: a meta-analysis, Journal of Business Research, 55, 1, 51-67.

Lewandowska, M. S., Szymura-Tyc, M., and Gołębiowski, T. (2016). Innovation

complementarity, cooperation partners, and new product export: Evidence from Poland. Journal of Business Research, 69(9), 3673-3681.

LiPuma, J., Newbert, S., and Doh, J. (2011). The effect of institutional quality on firm export performance in emerging economies: A contingency model of firm age and size. Small Business Economics. 40, 817 - 841.

López-Rodríguez, J., and García-Rodríguez, R. M. (2005). Technology and export behaviour: A resource-based view approach. International Business Review, 14(5), 539–557.

Love, J. H., and Roper, S. (2015). SME innovation, exporting, and growth: A review of existing evidence. International Small Business Journal, 33(1), 28–48.

Lu, J.W., and Beamish, P.W. (2006). SME Internationalization and Performance: Growth vs. Profitability. Journal of International Entrepreneurship, 4, 27-48.

Luo, Y., Xue, Q. and Han, B., (2010). How emerging market governments promote outward FDI: Experience from China, Journal of World Business, 45,1,68-79.

Mansury, M.A., and Love, J.H. (2008). Innovation, productivity, and growth in US business services: A firm-level analysis, Technovation, 28 (1–2),52-62.

Martínez-Román, J. A., Gamero, J., Delgado-González, M. L., and Tamayo, J. A. (2019). Innovativeness and internationalization in SMEs: An empirical analysis in European countries, Technological Forecasting and Social Change, 148(C). 10.1016/j.techfore.2019.119716

Masso, J., and Vahter, P. (2008). Technological innovation and productivity in late-transition Estonia: econometric evidence from innovation surveys, The European Journal of Development Research, 20, 2,240-261.

Medase, K., and Barasa, L. (2019). Absorptive capacity, marketing capabilities, and innovation commercialisation in Nigeria, European Journal of Innovation Management,22, 5, 790-820.

Mothe, C., and Nguyen, T. (2012). The impact of non-technological on technological innovations: do services differ from manufacturing? An empirical analysis of Luxembourg firms, Post-Print, HAL.

Moreno-Menéndez, A. M. (2018). Co-evolution of innovation cooperation activities and internationalisation through exports. Innovation, 20(4), 353-376.

Murray, J., Gao, G. Y. and Kotabe, M. (2011). Market orientation and performance of export ventures: The process through marketing capabilities and competitive advantages. Journal of the Academy of Marketing Science. 39. 252-269

Nassimbeni, G. (2001). Technology, innovation capacity, and the export attitude of small manufacturing firms: A logit/tobit model. Research Policy. 30. 245-262.

Newey, W., and West, K. (1987). A Simple, Positive Semi-definite, Heteroskedasticity, and Autocorrelation Consistent Covariance Matrix, Econometrica, 55,3,703-08.

Odia, L.O., and Omofonmwan, S.I. (2007). Educational System in Nigeria Problems and Prospects. Journal of Social Science, 14, 81-86.

OECD. (2005). Guidelines for collecting and interpreting innovation data. Oslo Manuals.

Osoro, O., Kirama, S., and Vermeulen, P. (2017). Factors affecting engagement and commercialization of innovation activities of firms in Tanzania, Tanzania Economic Review, 4,1-2,73-90.

Ozkaya, E., Droge, C., Hult, M., and Calantone, R. (2015). Market Orientation, Knowledge Competence, and Innovation, Intern. J. of Research in Marketing. 32 309-318.

Patterson, K., Grimm, C., and Corsi, T. (2003). Adopting New Technologies for Supply Chain Management. Transportation Research Part E: Logistics and Transportation Review. 39. 95-121.

Popadić M. and Černe, M. (2016). Exploratory and exploitative innovation: the moderating role of partner geographic diversity, Economic Research, 29:1, 1165-1181.

Quartey, P., Turkson, E., Abor, J., and Iddrisu, A. (2017). Financing the growth of SMEs in Africa: What are the constraints to SME financing within ECOWAS? Review of Development Finance. 7. 10.1016/j.rdf.2017.03.001.

Radicic, D. and Djalilov, K. (2019), The impact of technological and non-technological innovations on export intensity in SMEs, Journal of Small Business and Enterprise Development, 26, 4,612-638.

Ramadani, V., Hisrich, R.D., Abazi-Alili, H., Dana, L-P., Panthi, L., and Abazi-Bexheti, L. (2019). Product innovation and firm performance in transition economies: A multi-stage estimation approach, Technological Forecasting and Social Change,140, 271-280.

Ramos, E., Acedo, F. and González-Rodríguez, M. (2011). Internationalisation speed and technological patterns: A panel data study on Spanish SMEs. Technovation. 31. 560-572.

Ratten, V. (2015). The Changing Role of the Learning Organization and Knowledge Management in the International Environment. Thunderbird International Business Review, 57: 411-413.

Robertson, C., and Chetty, S. (2000). A Contingency-Based Approach to Understanding Export Performance. International Business Review. 9. 211-235.

Rodil, Ó., Vence, X., and del Carmen Sánchez, M. (2016). The relationship between innovation and export behaviour: The case of Galician firms. Technological Forecasting and Social Change, 113, 248-265.

Rosenbusch, N., Brinckmann, J., and Bausch, A. (2011). Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs, Journal of Business Venturing, 26,441-457.

Rothaermel, F., Hitt, M., Jobe, L. (2006). Balancing Vertical Integration and Strategic Outsourcing: Effects on Product Portfolio, Product Success, and Firm Performance. Strategic Management Journal. 27. 1033 - 1056.

Ruekert, R. W., Walker, O. C., and Roering, K. J. (1985). The organization of marketing activities: A contingency theory of structure and performance. Journal of Marketing, 49(1), 13-25.

Singh, D. (2009). Export performance of emerging market firms. International Business Review. 18. 321-330.

Song, M., Droge, C. Hanvanich, S., and Calantone. R. (2005). Marketing and technology resource complementarity: An analysis of their interaction effect in two environmental contexts. Strategic Management Journal 26 (3): 259–76.

Sousa, C., and Bradley, F. (2008). Antecedents of International Pricing Adaptation and Export Performance. Journal of World Business. 43. 307-320.

Sousa, C. M. P., and Tan, Q. (2015). Exit from a Foreign Market: Do Poor Performance, Strategic Fit, Cultural Distance, and International Experience Matter? Journal of International Marketing, 23(4), 84–104.

Tan, Q. and Sousa, C.M.P. (2015). Leveraging marketing capabilities into competitive advantage and export performance. International Marketing Review, 32(1), 78-102.

Tavassoli, S. (2018). The role of product innovation on export behavior of firms, European Journal of Innovation Management, 21, 2, 294-314.

Tekin, E., and Hancıoğlu, Y. (2017). The effects of innovation on export performance in developing countries. In Bilici, N., Akgül, B., and Pehlivanl, R. (eds.). Global Issues in Social Sciences Different Perspectives–Multidisciplinary Approaches, Peter Lang GmbH.

Van Beveren, I., and Vandenbussche, H. (2009). Product and Process Innovation and the Decision to Export: Firm-level Evidence for Belgium, LICOS Discussion Papers 24709, LICOS - Centre for Institutions and Economic Performance, KU Leuven.

Venkatraman, N. (1989). Strategic Orientation of Business Enterprises: The Construct, Dimensionality, and Measurement. Management Science, 35 (8): 942-962.

Vernon, R. (1966). International Investment and International Trade in the Product Cycle, The Quarterly Journal of Economics,80,2,190–207.

Waheed, A. (2011). Innovation and firm-level productivity: econometric evidence from Bangladesh and Pakistan, MERIT Working Papers 061, United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT).

Valle, R. R. (2016). Human resource productivity, product innovation, and export performance: An empirical investigation. Intangible Capital, 12(2), 619-641.

Wadho, W., and Chaudhry, A. (2018). Innovation and firm performance in developing countries: The case of Pakistani textile and apparel manufacturers. Research Policy, 47(7), 1283-1294.

Wakelin, K., (1998a). Innovation and export behaviour at the firm level. Research Policy 26, 829–841.

Yeoh, P., and Jeong, I. (1995). Contingency relationships between entrepreneurship, export channel structure, and environment, European Journal of Marketing, Vol. 29 No. 8, 95-115.

Young, S. Hamill, J. Wheeler, C., and Davies, J.R. (1989). International Market Entry and Development: Strategies and Management, New York: Harvester Wheatsheaf.

Zahra, S., Ireland, R., and Hitt, M. (2000). International Expansion by New Venture Firms: International Diversity, Mode of Market Entry, Technological Learning, and Performance. Academy of Management Journal, 43(5), 925–950.

Zeithaml, V. A. (1988). Consumer Perceptions of Price, Quality, and Value: A Means-End Model and Synthesis of Evidence. Journal of Marketing, 52(3), 2–22

Chapter Seven

Conclusions, Limitations and Future Research

7.1. Overview of the study

The SMEs have considerable economic significance in developing countries. In Nigeria, they provide a greater share of employment and have the potential of creating new jobs. They contribute immensely to the total value added by enterprises and in the sectoral contribution, the manufacturing firms have the highest proportion of exportable products. However, today's rapidly changing market environment is placing enormous competitive pressure on these firms. This challenge is manifested on the demand side, where consumers are increasingly demanding for high quality and low prices; and on the supply side, where these firms compete with domestic and foreign firms.

As a result, these firms are increasingly recognising the need of pursuing a continuous innovation strategy. Research is almost unanimous on the role of innovation on firm survival and growth. Innovation provides the competitive advantage of product differentiations, which enables firms to successfully enter markets and increase their shares in the existing market. It provides the advantage of cost efficiency, which allows firms to decrease the costs of production and delivery. Also, it enables firms to meet the demands of customers through the creation of novel channels of marketing their products.

However, firms originate and operate within a context, which can either contribute to enhancing their innovation capabilities or hamper them. This work shows that macroeconomic situation, as well as country-specific factors, mitigate against the innovation activities and productivity of SMEs in Nigeria. Other factors discussed are firm-level factors determining the innovation activities of SMEs. In the face of these mounting challenges, it is very important to further understand the innovation activities and performance trajectories of these firms. Thus, this study contributes to the literature by examining, on the one hand, the relationships among access to external financial supports, innovation efforts, and labour productivity growth; and also, the innovation strategies employed by these firms when pursuing growth in the export markets.

In this chapter, I will summarise the key findings and contributions of the two empirical studies: Study I, innovation efforts, external supports, and labour productivity in Sections 7.2; and Study II, innovation strategies on export growth in Section 7.3. In Section 7.4., I will present the limitations and suggest future research directions. Finally, in Section 7.5, I conclude.

7.2. Summaries of the key findings

7.2.1. Study I: Discussions and contributions

The importance of R&D, innovation activities on productivity has been discussed by a great number of scholars and policymakers. However, there is still very little evidence in the context of developing economies, especially SSA. To this end, the first empirical study contributes to the literature by providing an in-depth analysis

of the determinants of innovation efforts and productivity using micro-level data of firms in the manufacturing and service sectors. Building on a structural model proposed by Crépon, Duguet, and Mairesse (1998), this study estimated previously unexplored issues related to the role of external financial supports on the innovation efforts and productivity of SMEs in Nigeria. Unlike previous studies (Crespi and Zuniga, 2011, Acosta et al., 2015), it linked financial supports from the state government, the federal government, and foreign government to the three stages on the CDM model. This study is among the first empirical attempt to investigate the relationship between external financial supports, innovation efforts, and productivity in Nigerian SMEs using the CDM modelling technique.

More precisely, the empirical findings provide support for the relationships between innovation input and innovation output. This means that these firms have the ability to transform their knowledge resources into economic values. These findings are consistent with substantial evidence obtained both in the developed and developing countries (e.g. De Fuentes et al., 2015; Bartelsman et al., 2017; Audretsch and Belitski, 2020). Subsequently, the findings show that innovation success, proxied as product innovation, process innovation, and marketing innovation, positive and significant impact on the labour productivity of SMEs in Nigeria. The study shows that the relationships between R&D, innovation, and productivity in Nigeria is influenced not only by access to external financial supports but also characterized by various internal firm characteristics and exogenous factors. Thus, this evidence complements previous empirical studies in the SSA region uncovering the heterogeneous determinants of innovation activities and productivity of firms (e.g. Goedhuys, Janz and Mohnen, 2008; Fu et al., 2018; Morsy and El-Shal, 2020).

However, unlike previous empirical studies, the findings of this investigation show that cooperation, physical and human capitals play a crucial role in the innovation-decision and R&D intensity of SMEs in Nigeria. Moreover, even though over 57 percent of the firms reported receiving financial supports for innovation activities from the state government, federal government, only 3 percent of support from foreign government contributed to the R&D intensity. In other words, external financial supports have a minimal impact on the initial stage of innovation activities of the firms under study. These findings make a case for the development of more efficient policy instruments. Government, especially at the federal level, should not only offer grants or subsidies for purchasing machineries, equipment (physical capital) but also design and implement programmes that can enhance different forms of technological knowledge embodied in human resources (Capozza and Divella, 2019). In other words, although literature highlights the importance of physical capital as a main determinant of productivity, governments in SSA region must invest in absorptive capacity to facilitate a successful catch-up with firms in developed economies (Cohen and Levinthal, 1990; Goedhuys, Janz, and Mohnen, 2013).

Second, the effect of internal R&D expenditure is statistically significant for introducing product and marketing innovation, but not significant for process innovation. However, the positive and significant coefficient for external R&D suggests that developing country firms have a high probability of outsourcing process innovation. This is consistent with recent evidence from Medda (2020) who found that the share of external R&D has a positive effect on process innovation, but not on product innovation. Also, the innovation equation shows a significant impact of state government support on product innovation. However, older and larger

SMEs with more access to supports from the foreign government have a high likelihood of introducing product innovations. Furthermore, supports from the state, federal, and foreign governments have positive and significant impacts on process innovations. More so, only firms receiving more state government support have a greater probability of introducing marketing innovation. Finally, export orientation and firm size have significant impacts on product innovation; whereas competition is positively associated with both process innovation and marketing innovation.

Third, regarding the impact of innovation output (that is, product, process, and marketing innovation) on labour productivity, the findings show that marketing innovation contributes more to labour productivity than process innovation and product innovation. These findings differ from prior studies emphasizing the role of technological innovation over nontechnological innovation (Schmidt and Rammer, 2007). For example, D'Attoma and Ieva (2020) find that when a firm is engaging in technological innovation, implementing marketing innovation does not play a significant role in innovation success and failure. Conversely, these findings of current study reveal that marketing innovation has a greater effect on productivity gains, thereby supporting increasing evidence on the significance of this type of innovation (e.g. Medrano and Olarte-Pascual, 2016; Adams et al., 2019). Thus, it is necessary for managers to take marketing innovation seriously when pursuing productivity strategies, especially in developing countries.

Moreover, external financial supports have varied effects on labour productivity. This is consistent with other results from other emerging economies (Hong et al., 2016; Wu et al., 2020). On average, supports received from federal and foreign governments has more impact on labour productivity, whereas support from

state government contributed less, suggesting that more grassroot efforts are required in stimulating growth in SMEs. Prior research shows that regional or state governments play a crucial role in promoting entrepreneurship and innovation of SMEs (Doh and Kim, 2014). By investing in these firms, a state government can create more employment opportunities as well as make its region more attractive to both domestic and foreign investors.

Other factors contributing to labour productivity include firm age, cooperation, sector, physical capital, training, human capital, and export orientation have a positive and significant influence on productivity of firms. However, an interesting pattern emerged from patents results, which were not only insignificant both in the knowledge input and innovation output models, but also negatively affected labour productivity. The results highlight the need for improving the policy framework for the protection of intellectual property (IP) in developing countries such as Nigeria. Edosomwan (2019) argues that the current status of IP protection seems to be discouraging entrepreneurs from investing in Nigeria due to a high degree of counterfeit products. In other words, to encourage the innovation activities and productivity of SMEs, government needs to improve the protection of IP and IP rights in Nigeria.

Likewise, improving the capital market means easing the burden of securing financial resources for innovative SMEs in developing economies, especially the SSA countries. In other words, Nigerian government should implement more efficient regulations that can provide better conditions for financing innovation, entrepreneurship, and growth in the private sector.

7.2.2. Study II: Discussions and contributions

The second empirical study investigates the significance of different types of innovation on export growth in Nigeria. Despite the substantial evidence found among firms in the developed economies, it is still unclear whether it can be sufficiently extended to developing economies, especially Africa. The empirical analysis confirmed the role of innovation as an effective tool for achieving growth in export markets (Azar and Ciabuschi, 2016). Generally, the study reveals that technological and non-technological innovations have heterogeneous impacts on the export performance of these firms. However, the details of the findings will be discussed as follows:

First, while research suggests that product innovation increases competitive advantage and market shares of firms (Love and Roper, 2015), this finding shows an insignificant relationship between product innovation and export growth of firms. Possibly, these results could be explained not only by weak institutional factors but also by the paucity of highly technically-skilled personnel and resource constraints prevalent among SMEs (Geldes et al., 2016). This is particularly true for manufacturing firms since the availability of these factors is vital for successful innovation, especially in the early phase of product development (Adam, 1982; Medase and Barasa, 2019). Moreover, the negative results on product innovation suggest that the impact of technological innovation on firm performance is context-based. As SMEs in developing economies tend to behave differently, there is a need for more studies examining the innovation barriers and how these firms use product innovation strategy when pursuing growth in foreign markets.

Second, the findings reveal a statistically significant association between process innovation and export performance. This finding is in line with evidence from both industrialized (Caldera, 2010) and developing (Gunday et al., 2011) economies. Prior evidence shows that process innovation is critical to successful market entry and higher profits in the export markets (Guillen, 2005). However, this finding deviates from large evidence supporting the greater impact of product innovation on performance (Wakelin 1998). It also departs from the prevailing claim that firms engaging in process innovation in isolation run the risk of low performance (Goedhuys and Veugelers, 2012). This means that process innovation can have an exclusive impact on export growth. In this sense, this study contributes to the existing literature by reinforcing the importance of cost-efficiency when pursuing international growth.

Third, scholars are increasingly emphasizing the need for including non-technological innovation in the evaluation of innovation performance of firms (Mothe and Nguyen, 2010). The impact of marketing innovation on SMEs' performance is still underexplored, especially in developing countries. To this end, the impact of this innovation on export growth was estimated. The positive and significant results obtained are consistent with prior evidence both from emerging and developed economies (Ozkaya et al., 2015). Previous research focused mainly on the complementary or indirect effect of marketing innovation. In addition to providing evidence from developing market SMEs, this finding contributes to the literature by supporting a direct impact of marketing innovation on export growth (Mothe and Nguyen Thi, 2010). Besides, it shows that developing market SMEs are increasingly reacting to the changing market environment not only through technological innovations but also through novel marketing initiatives (Grimpe et

al.2017).

Fourth, research suggests that technological and non-technological innovations complement each other, leading to greater performance (Hervas-Oliver et al., 2014). However, there are still limited studies on the individual and joint impacts of product, process, and marketing innovation, especially in the developing countries. This study is among the first studies in Nigeria to estimate the joint effect of product, process, and marketing innovations on export growth. While the overall jointed effect is significant, the results show that technological innovations have a greater impact on export growth than marketing innovation. These findings confirm prior evidence from developed economies, which suggests that firms do not benefit from engaging in a dual-innovation strategy simultaneously (Grimpe et al., 2017). Since such a strategy requires investing in both technology and market domains, firms with limited resources such as SMEs might be better off with a single-innovation strategy. This is particularly true for developing country firms.

Finally, since innovation-export performance is largely contingent on how a firm interacts in its environment, the possible effects of external innovation collaborations were tested. Firms can develop or improve their innovation capabilities by collaborating with external science-based partners both in the home and foreign markets respectively. This study analysed the impact of innovation collaborations with Nigerian universities. The findings show that it is negatively related to export growth. However, the findings show that collaborations with public research institutions abroad have a positive impact on export growth. Thus, while the former collaborations fail to support prior evidence from developed and emerging markets, the latter highlights the importance of science-based partners in the development of business innovations (Antonelli and Fassio 2018). This study

shows that a firm's institutional background shapes its choice of external innovation partners. Nigerian SMEs preferred external innovation collaborations from abroad to local external innovation collaboration. Thus, this study contributes to the literature by showing that firms are selective about their external partners. That is, they do not equally prioritize all types of innovation collaborations. Besides, the strong support for innovation collaboration (outside Nigeria) further uncovers a key internationalization motivation of developing economies firms. Namely, they expand to more efficient institutions where they can collaborate with external partners to enhance their innovation capabilities. Taken together, the second empirical study not only demonstrates that innovation is a vital growth strategy, especially in meeting market demands but also it shows that innovations have heterogeneous effects on export growth of firms.

7.3. Limitations and Future Research Directions

The current research has several limitations, which need to be identified and possibly addressed in future investigations. First, the Oslo Manual (2005) recognized four main types of innovations, namely product innovation, process innovation, marketing innovation, and organizational innovation. Research shows that organizational innovation (which is defined as a new organizational method in business practices, workplace organization, or external relations) plays important role in firm performance. For example, in a study of Spanish firms, Arranz et al. (2019) find that innovation capabilities work through a reciprocal and complementary effect, where technological innovation and organizational innovation reinforce each other. Besides, they find that organizational innovation

has an impact on firm performance. In the context of developing countries, Pino et al. (2016) observe that organizational innovations have more influence on market performance than marketing innovations. Despite the importance of this type of innovation, this current study did not cover it due to the availability of appropriate data. Thus, this study calls for empirical research exploring the direct as well as joint impact of organizational innovation on growth trajectories of SMEs in the SSA region.

Second, the global marketplace is driven by knowledge, and it is shaping how firms innovate and become competitive. The high costs associated with generation of knowledge is forcing firms to search outside their organizational setting (Hernandez-Espallardo et al., 2018). That is, firms are choosing external partners "for mutual development of the innovation, requiring close interaction and collaboration to facilitate the transfer and sharing of tacit knowledge between the parties" (Saebi and Foss, 2015: 21). Literature identified a "wide range of external actors and sources to help firms achieve and sustain innovation" (Laursen and Salter, 2006: 131). This current study focused on collaborations with research institutions both in Nigeria and abroad. Despite this importance of this form of collaboration (Baba, Shichijo and Sedita, 2009; Un and Rodriguez, 2018; Lin, 2019), there is a need for more both theoretical and empirical studies examining the various external collaborators such as suppliers, customer, and other firms and their impacts on the performance of firms in Nigeria (Medase and Abdul-Basit, 2020). For example, it would be interesting to investigate how geographical and cognitive proximities influence the choice of external innovation collaborators as well as their impact on innovation capabilities of SMEs in developing countries.

Third, this research explored the individual and joint impacts of product,

process, and marketing innovation, especially in developing countries. Even though the findings enhanced our understanding of the heterogeneous impacts of technological and non-technological innovation on SME export growth; it opened up the issue of additional competence, namely ambidexterity, which was not considered in this study (Popadić and Černe, 2016). Firms investing in a combination of innovation strategies need to be ambidextrous to achieve high performance. Given that the majority of the extant studies in the SSA region place more emphasis on determinants of innovation and innovation barriers (Osoro et al., 2017), this study calls for more studies focusing on how developing country SMEs develop such second-order competences, especially in the areas of technology and market domains (Danneels, 2008).

7.4. Conclusion

Innovation is widely recognized as a driver of economic growth both at the country and firm levels. Innovation enables entrepreneurial firms such as SMEs to be more competitive and achieve superior productivity gains. This claim is supported by two empirical studies carried out in this research. Despite the limitations of this research, it is among one of the few studies in the SSA region to examine both the linkages among external supports, innovation efforts and labour productivity; and innovation types and export growth. Thus, it is hoped that it will provide a productive area for future research.

References

Adams, A. (1982). Barriers to Product Innovation in Small Firms: Policy Implications, European Small Business Journal, Vol. 1 No. 1, 67-86.

Adams, P., Freitas, I.M.B., and Fontana, R. (2019). Strategic orientation, innovation performance, and the moderating influence of marketing management, Journal of Business Research, 97, 129-140.

Antonelli, C., and Fassio, C. (2018). The role of external knowledge in the introduction of product and process innovations. In the Evolutionary Complexity of Endogenous Innovation, 109-127.

Arranz, N., Arroyabe, M.F., Li, J., and Fernandez de Arroyabe, J.C. (2019). An integrated model of organizational innovation and firm performance: Generation, persistence and complementarity, Journal of Business Research,105,270-282.

Azar, G., and Ciabuschi, F. (2017). Organizational innovation, technological innovation, and export performance: The effects of innovation radicalness and extensiveness, International Business Review, 26(2).324-336.

Baba, Y., Shichijo, N., and Sedita, S.R. (2009). How do collaborations with universities affect firms' innovative performance? The role of "Pasteur scientists" in the advanced materials field, Research Policy,38, Issue 5, 756-764.

Bartelsman, E., van Leeuwen G. and Polder, M (2017); CDM using a cross-country micro moments database, Economics of Innovation and New Technology, 26:1-2, 168-182.

Caldera, A. (2010). Innovation and exporting: evidence from Spanish manufacturing firms, Review of World Economics (Weltwirtschaftliches Archiv), 146, 4, 657-689.

Capozza, C., & Divella, M. (2019). Human capital and firms' innovation: evidence from emerging economies. Economics of Innovation and New Technology, 28(7), 741–757.

Cohen, W., & Levinthal, D. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. Administrative Science Quarterly, 35(1), 128-152.

Danneels, E. (2008). Organizational antecedents of second-order competences. Strategic Management Journal, 29: 519-543.

D'Attoma, I. and Ieva, M. (2020). Determinants of technological innovation success and failure: Does marketing innovation matter? Industrial Marketing Management,91,64-81.

De Fuentes, C., Dutrenit, G., Santiago, F., and Gras, N. (2015). Determinants of Innovation and Productivity in the Service Sector in Mexico, Emerging Markets Finance and Trade, 51:3, 578-592.

Doh, S., and Kim, B. (2014). Government support for SME innovations in the regional industries: The case of government financial support program in South Korea,
Research Policy, 43, 9,1557-1569.

Geldes, C., Felzensztein, C., and Palacios-Fenech, J. (2016). Technological and non-technological innovations, performance, and propensity to innovate across industries: The case of an emerging economy. Industrial Marketing Management,61,55 – 66.

Goedhuys, M., Janz, N., and Mohnen, P. (2008). Knowledge-based productivity in low-tech industries: evidence from firms in developing countries, MERIT Working Papers 2008-007, United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT).

Goedhuys, M., and Veugelers, R. (2012). Innovation strategies, process, and product innovations, and growth: Firm-level evidence from Brazil, Structural Change and Economic Dynamics, 23, 4,516-529.

Grimpe, C., Sofka, W., Bhargava, M., and Chatterjee, R. (2017). R&D, Marketing Innovation, and New Product Performance: A Mixed Methods Study. J Prod Innov Manag, 34: 360-383.

Guillén, M. F. (2005). The Rise of Spanish Multinationals: European Business in the Global Economy Cambridge: Cambridge University Press.

Hernandez-Espallardo, M., Osorio-Tinoco, F., and Rodriguez-Orejuela, A. (2018). Improving firm performance through inter-organizational collaborative innovations: The key mediating role of the employee's job-related attitudes, Management Decision, Vol. 56 No. 6,1167-1182.

Hervas-Oliver, J. L., and Sempere Ripoll, F. and Boronat-Moll, C. (2014). Process innovation strategy in SMEs, organizational innovation, and performance: A misleading debate? Small Business Economics. 43. 873-886.

Hong, J., Feng, B. Wu, Y. and Wang, L.(2016). Do government grants promote innovation efficiency in China's high-tech industries, Technovation, 57–58 4-13.

Laursen, K., and Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms", Strategic Management Journal, Vol. 27 No. 2, 131-150.

Lin, J.-Y. (2019). How does collaboration between universities and R&D firms influence performance? Management Decision, Vol. 57 No. 9, 2436-2476.

Love, J. H., and Roper, S. (2015). SME innovation, exporting, and growth: A review of existing evidence. International Small Business Journal, 33(1), 28–48.

Medase, S.K., and Abdul-Basit, S. (2020). External knowledge modes and firm-level innovation performance: Empirical evidence from sub-Saharan Africa, Journal of Innovation & Knowledge,5,2,81-95.

Medase, K., and Barasa, L. (2019). Absorptive capacity, marketing capabilities, and innovation commercialisation in Nigeria, European Journal of Innovation Management,22, 5, 790-820.

Medda, G. (2020). External R&D, product and process innovation in European manufacturing companies, The Journal of Technology Transfer, Springer, vol. 45(1), 339-369,

Medrano, N., and Olarte-Pascual, C. (2016). The effects of the crisis on marketing innovation: An application for Spain The Journal of Business and Industrial Marketing, 31 (3) 404-417.

Mothe, C., and Nguyen, T. (2012). The impact of non-technological on technological innovations: do services differ from manufacturing? An empirical analysis of Luxembourg firms, Post-Print, HAL.

Osoro, O., Kirama, S., and Vermeulen, P. (2017). Factors affecting engagement and commercialization of innovation activities of firms in Tanzania, Tanzania Economic Review, 4,1-2,73-90.

Ozkaya, E., Droge, C., Hult, M., and Calantone, R. (2015). Market Orientation, Knowledge Competence, and Innovation, Intern. J. of Research in Marketing. 32 309-318.

Pino, Felzensztein, C.C., Zwerg-Villegas,A. M. and Arias-Bolzmann, L. (2016).Non-technological innovations: Market performance of exporting firms in South America,
Journal of Business Research,69, Issue 10, 4385-4393.

Popadić M. and Černe, M. (2016). Exploratory and exploitative innovation: the moderating role of partner geographic diversity, Economic Research, 29:1, 1165-1181.

Saebi, T. and Foss, N.J. (2015). Business models for open innovation: matching heterogeneous open innovation strategies with business model dimensions", European Management Journal, Vol. 33 No. 3, 201-213.

Schmidt, T., and Rammer, C. (2007). Non-technological and technological innovation: strange bedfellows? ZEW discussion paper 07-052.

Un, C.A., and Rodriguez, A. (2018). Local and global knowledge complementarity: R&D collaborations and innovation of foreign and domestic firms, Journal of International Management, Vol. 24 No. 2, 137-152.

Wakelin, K., (1998a). Innovation and export behaviour at the firm level. Research Policy 26, 829–841.

Wu, R., Liu, Z., Ma, C. and Chen, X. (2020). Effect of government R&D subsidies on firms' innovation in China, Asian Journal of Technology Innovation, 28:1, 42-59.

Appendix

Table 5. 1: Definition of the variables

Variables	Definitions
Labour Productivity	Log of sales per employee (Sales per year [in Naira ₦] divided by number of employees)
Product innovation	Dummy variable taking the value of 1 if a firm has carried out only product innovation and 0 otherwise
Process innovation	Dummy variable taking the value of 1 if a firm has carried out only process innovation and 0 otherwise
Marketing innovation	Dummy variable taking the value of 1 if a firm has carried out only marketing innovation and 0 otherwise
Physical capital	Log of investment in machinery per worker (Total investment in Machinery [in Naira ₦] divided by total employees)
Human capital	Percentage of graduates in the workforce (Graduates divided by total employees)
Age	Log of firm age (year established – year of survey)
Size	Log of number of employees
Cooperation	Dummy variable taking the value of 1 if a firm cooperated with external partner in its innovation activities and 0 otherwise
Patent	Dummy variable taking the value of 1 if a firm reported a patent and 0 otherwise
Sector	Dummy based on ISIC classification (1 = Manufacturing, 0 = Services)
R&D Investment	Dummy variable taking the value of 1 if a firm engages in R&D investments and 0 otherwise
R&D expenditures	Log of R&D expenses per worker (Total amount in R&D [in Naira ₦] divided by number of employees)
Competition	Dummy variable taking the value of 1 if a firm exported during the year of the survey, otherwise 0
Export orientation	Dummy variable taking the value of 1 if a firm sells its products and services in African or other international markets and 0 otherwise
External R&D	Dummy variable taking the value of 1 if a firm engages in an extramural R&D during the year of the survey, otherwise 0
State government	Dummy variable taking the value of 1 if a firm receives any financial support for innovation activities from the state/local government and 0 otherwise
Federal government	Dummy variable taking the value of 1 if a firm receives any financial support for innovation activities from the federal government and 0 otherwise
Foreign government	Dummy variable taking the value of 1 if a firm receives any financial support for innovation activities from the foreign government/ foreign sources and 0 otherwise
Training	Dummy variable taking the value of 1 if a firm invests in internal or external training for its personnel, specifically for the development and/or introduction of product and process innovations and 0 otherwise

Table 6.1: Definition of variables: Innovation strategies and Export Growth

Variables	Definitions
Export growth (EXPPERF)	Export sales growth obtained from the World Development Indicator, which is the World Bank's premier compilation of cross-country comparable data.
Product innovation (PRODCUTINNO)	Dummy variable taking the value of 1 if a firm has carried out only product innovation and 0 otherwise
Process innovation (PROCESSINNO)	Dummy variable taking the value of 1 if a firm has carried out only process innovation and 0 otherwise
Marketing innovation (MARKINNO)	Dummy variable taking the value of 1 if a firm has carried out only marketing innovation and 0 otherwise
Collaboration - Nigeria (COOPNIGUNI)	Dummy variable taking the value of 1 if a firm cooperated with universities in Nigeria in its innovation activities and 0 otherwise
Collaboration – abroad (COOPRESINS)	Dummy variable taking the value of 1 if a firm cooperated with research institutions abroad in its innovation activities and 0 otherwise
Firm age (FIRMAGE)	Log of firm age (year established – year of survey)

Table 7: Production Function Results without external financial supports (Step 3)

	ln(Productivity)		
Variables	**Product innovation**	**Process innovation**	**Marketing innovation**
	Coef. /se	Coef. /se	Coef./se
$\widehat{Inno}$	1.937***	2.068***	3.489***
	(0.055)	(0.091)	(0.224)
Size	-0.058	-0.016**	-0.079***
	(0.0059)	(0.006)	(0.009)
Age	0.133***	0.159***	0.167***
	(0.007)	(0.009)	(0.010)
Sector	0.220***	0.064***	0.145***
	(0.010)	(0.010)	(0.012)
Patent	-0.046***	-0.042***	-0.014
	(0.012)	(0.012)	(0.013)
Cooperation	-0.068***	0.102***	0.238***
	(0.009)	(0.011)	(0.018)
ln (Human capital)	0.111***	0.029***	0.108***
	(0.006)	(0.008)	(0.007)
ln (Physical capital)	0.355***	0.458***	0.057
	(0.014)	(0.016)	(0.044)
Training	0.113***	0.119***	-0.028**
	(0.010)	(0.012)	(0.012)
Competition	0.001	-0.062***	-0.268***
	(0.009)	(0.011)	(0.022)
External RD	-0.065***	-0.107***	0.081***
	(0.009)	(0.012)	(0.011)

****** p < 0.001; ** p < 0.01; * p < 0.05***