DETERMINANTS OF TOTAL FACTOR PRODUCTIVITY IN THE RWANDAN SERVICES SECTOR

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DECLARATION

The research paper presented is my original work and it has never been presented in any higher learning institution/university for the award of any degree.

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Signature…… Date ……11/11/2020……

I submit this research paper for examination as a University Supervisor.

Dr. ODHIAMBO SULE

Signature …… Date ……

DEDICATION

To my lovely son, my mother, siblings, and my close friends, for their prayers and being supportive throughout this entire master's journey.

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LIST OF ABBREVIATION

RDB: Rwanda Development Board

AfDB: African Development Bank

AIMS: African Institute of Mathematical Science

CES: Constant Elasticity of Substitution

CMU: Carnegie Mellon University

DEA: Data Envelopment Analysis

GDP: Gross Domestic Product

GMM: Generalized Method of Moments

GoR: Government of Rwanda

ICT: Information and communications technology

IMF: International Monetary Fund

MICE: Meetings, Incentives, Conferences, and Exhibitions

NISR: The National Institute of Statistics of Rwanda

NST: The National Strategy for Transformation

OECD: Organization for Economic Co-operation and Development

R&D: Research and Development

SFA: Stochastic Frontier Analysis

SME(s): Small and Medium Enterprises(s)

SSA: Sab-Saharan Africa

TFP: Total Factor Productivity

Translog: Transcendental Logarithmic

TVET: Technical and Vocational Education Training

UNCTAD: The United Nations Conference on Trade and Development

UNECA: The United Nations Economic Commission for Africa

US: United States

USITC: The United States International Trade Commission

WDI: World Development Indicators

WTO: World Trade Organization

ABSTRACT

It is perceived worldwide that the service sector is important especially in boosting economic growth and generating employment opportunities. More importantly in most developing countries, Rwanda included, the share of the sector towards GDP growth as well as economic transformation is undeniably paramount given that the industry sector has not developed. The study used both the fixed model to calculate service firm's TFP and the pooled OLS regression analysis to analyze the main driving factors for the Rwandese service sector total factor productivity using the firm-level panel data from the census surveys of 2014 and 2017 which covered 165,108 service enterprises. The study findings show that the firm's export status, R&D activities, technology from foreign workers and the formal status are statistically significant and have a positive impact on Rwanda's service sector TFP. Also, being in the small, medium, and large service firm category is related to its productivity. These categories of Rwandan service sector are positive and statistically significant. The domestically owned enterprises have a positive but statistically insignificant association with Rwandan service establishments. Finally, firm location (dummy for urban) is negative but statistically significant associated with TFP.

CHAPTER ONE

INTRODUCTION

1.1 The Background of the Study

There is no clear definition for services rather they are explained by their unique features like being intangible, diverse, inseparable, and others. However, this study cannot exhaust all service characteristics since different services deferrer in their characteristics (Akehurst,1987). Economically, services are intangible activities where the transaction between buyers and sellers takes place without physical good is exchanged (Akehurst,1987). Globally, the service sector significantly contributes to economic growth by increasing employment and boosting the economy (Ghani et al., 2012; Zhou, 2016; and Williams, 1996). The World Trade Organization, (2019) (WTO) points out that the service sector represents a significant share of global trade which is important in determining economic growth, development, and job creation hence boosting the economy. The report also indicates that between the years 2005 and 2017, trade in the sector grew by 5.4 percent accounting for US$ 13.3 trillion in 2017 globally (WTO,2019). Given the increase of trade in services as explained above, Hoekman and Shepherd, (2017) assert that trade in the service sector is positively related to its productivity through technological transfer leading to knowledge spillover. Moreover, the Indian service sector employs a total number of 3.5 million employees annually especially in information and communications technology resulting from the fast growth in business, healthcare, and entertainment (IMF, 2017). The report also points out that service sector productivity leads to productivity in other sectors that use services as their means of production especially the manufacturing sector through the transfer of knowledge. The world bank (2019) report reveals that increasing productivity in this sector serves as a support in the entire economic growth. This is because the sector is not only of importance for trade and industrialization but as it will play a critical role in career and wealth creation (Kim, 2011). Again, the sector also accounts for 61 percent of the global value chain. And this shows that servicification is a vital phenomenon in regards to productivity in the manufacturing sector (Marel, 2018).

Increasing trade in services is likely to encourage structural transformation so as to achieve the 2030 Sustainable Development Agenda. There have emerged promising tradable services activities in developing countries, which include health, finance, energy, transport, and telecommunications among others as some of the services' activities are indispensable to achieving the Sustainable Development Goals (UNCTAD, 2017). Moreover, technology and innovation boost competitiveness and activate the change of resources from less to more productive activities thus enhancing structural transformation for the entire economy (AfDB, 2019). However, there has been little focus given to raise the overall productivity of the factors of production in developing countries compared to their developed counterparts. Yet, productivity growth is not only important in increasing production but also improves the competitiveness of a sector both in the domestic and international markets (Tufail, 2016).

According to Sánchez, (2012), the reason European economies are advanced is that they are service-based economies. He points out that the sector does not only represents a large share of their economies and production system but also plays a role in global market integration and transforming employment structure by generating 70 percent of value-added in employment. He also argues that the sector contributes to the overall productivity growth as seen in the labor productivity indicators.

Africa's service sector plays an important role in international trade since not all African countries can develop through manufacturing. The sector contributes 50 percent to Africa's total trade-in value-added (UNECA, 2015). In sub-Saharan African countries, the service sector growth was 5.6 percent in 2018 (Zerihun & Sennoga, 2018). For most of the individual countries in the sub-Saharan region, the services sector recorded more than 50 percent of the total gross domestic product (GDP) (WTO, 2019).

One can describe total factor productivity as a share of production not explained by the number of inputs thereof formally capital and labor. In other words, it represents output as being a function of the production input (Solow, 1957). However, the above traditional definitions seem inappropriate as far as the service sector is concerned because its measurement is typically associated with creativity and innovative nature. This is because the sector deals with intangibles, which need to increase their quality and consequently leading to its productivity (Nachum, 1999). The firm's performance is essentially determined by its level of productivity

which can be achieved when a firm's predetermined activities are realized and expected results achieved Tzelepis et al., (2006). Rutkauskas, (2005) in his layman's language explains total factor productivity as a combination of efficiency and effectiveness. Rutkauskas also argues that knowledge acquisition is paramount since it leads to critical thinking which also involves a range of other factors that helps in intellectual capital development. This means that the service sector productivity is strongly dependent on technological development and automation.

According to the World Trade Organisation, (2019), developed technology makes the services readily available at all times. The report argues that traditionally the service sector faces a high trade cost because of the need for service dealers to be in physical contact. It further, highlights the importance of digital technologies as a solution since it facilitates cross-border services trade without the physical presence of dealers hence cutting down trade costs. This is because it allows firms to access the global digitized market and reducing barriers to entry into the market hence efficiency and productivity.

1.2 Overview of the service sector in Rwanda

In 2019, Rwanda's economic growth trajectory was 8.6 percent which made it Africa's fastest-growing economy (World Bank, 2019). Despite the Rwandan service sector being the main driver of economic growth and transformation, it has maintained slightly less than 50 percent portion of Rwanda's nominal GDP between the year 2001 and 2018. (GoR, 2018).

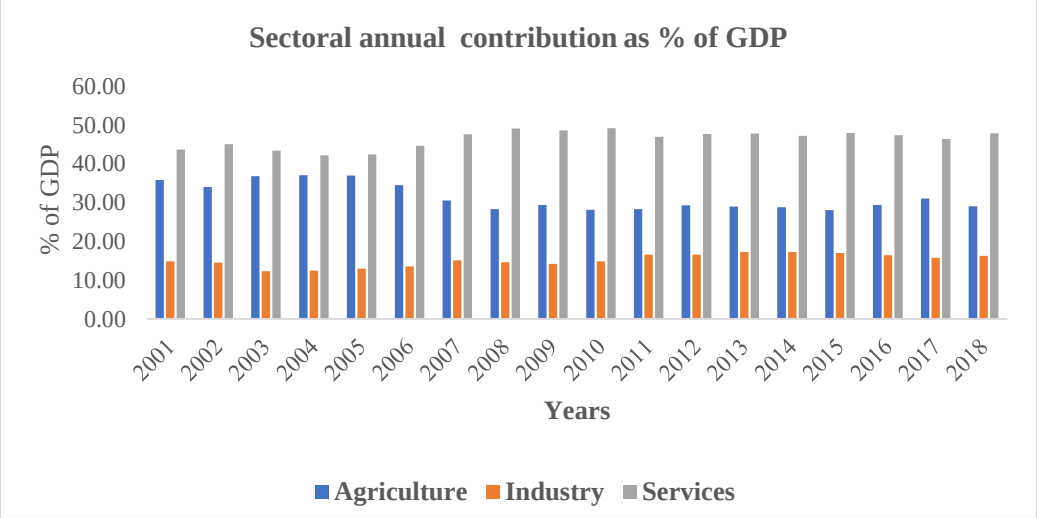
1.3 Performance of the Service Sector in Rwanda

In Rwanda, agricultural and service sectors have been the dominant economic sectors vis a vis the overall production and share to GDP for a long period (Victoire, 2015; AfDB, 2016). To break the bottleneck of her landlockedness, Rwanda's purpose is to make her service sector a hub in the East African region (Uwitonze & Heshmati, 2016). This is evidenced by its performance since it grew by 8.8 percent in 2018 compared to 7.9 in 2017 contributing 47.8 percent to GDP in 2018 (World Bank 2019).

The Rwandan economy will in the future be driven by innovation, integration, agglomeration, and competition (World Bank, 2019). The competitiveness of a firm can be explained in three ways, i.e. when trade in the service sector increases its productivity given the relationship between trade and productivity as earlier explained, when the sector's productivity positively affects the productivity of other sectors especially manufacturing, and when product differentiation raises competitiveness (WTO, 2019). Therefore, increasing total factor productivity in the service industry would be necessary. Despite being the main sector contributing to the country's GDP as shown by Africa Development Bank, 2019, the service sector is constrained by low productivity, which is mainly attributed to limited innovation potential, poor skills, low competitiveness, a weak culture of entrepreneurship, weak infrastructure, and low domestic savings which would otherwise increase output in the sector (UNCTAD, 2015).

Statistics given in Figure 1.1, shows that between the years 2001 and 2018 the share of the service sector to GDP has been maintained at less than 50 percent. The percentage share of Agriculture dropped from 35.74 percent to 29.04 percent between the years 2001 and 2018. There was an improvement in the Industry sector's share to GDP from 12.9 percent in 2001 to 16.23 percent in 2018.

Figure 1: Sectoral comparison in the contribution as a % of Rwanda's GDP since 2001



Source: Author's computation WDI, 2019

Despite improved indicators in the service sector as explained from the above figure, the share of employment as a percentage of the sector's total employment was less than that of agriculture. This is shown in Table 1.1 below using the world bank data**.**

Table 1: Cross-sector comparison in Employment generation as % of Rwanda's Total Employment

Sector	Employment as % of Total Employment
Service	24.84
Agriculture	66.06
Industry	9.10
Total	**100**

Source: Author's computation WDI, 2019

Based on Table 1.1, above, it is observed that the Agriculture sector takes the largest share of employment as % of Rwanda's total Employment with 66.06% followed by the Service sector with 24.84% and the last being the Industry sector with 9.10% (World Bank, 2019).

1.4 Challenges and Policies in the Rwandan Service sector

Rwanda's economy grew at a rate of 9.5 % in 2019 mainly geared by the industry and services sectors whose growth rate was 16 percent for industry and 9 percent for services in 2019. The main service sub-sectors include wholesale and retail trade, and the transport sector mainly Rwandair whose growth stood at 14 percent in 2019. Other services include financial services, real estate, and professional services that grew at the rate of 12 percent combined, scientific and technical activities which grew at 5 percent, and 16 percent respectively (GoR, 2019). However, despite the above achievements and the aim of becoming a service-based economy and the growth in the sector's share to GDP, Rwanda's service sector is still underperforming compared to her counterpart Kenya which is among the leading African countries in service development especially in the financial services (USITC, 2017).

Rwanda is also faced with several challenges on its pathway to development like its landlocked nature, the increase in the service exports costs due to poor infrastructure, lack of skilled

personnel that hinders innovation and managerial capacity, lack of working capital, lack of specialized technology and its usage, limitedness in power supply and its subsequent high costs, high costs of water, mismatch in skills and inadequate access to affordable finance hence achieving modern production technologies becomes a problem. All the challenges highlighted affect the total cost of doing business, productivity and they have escalated the country's debt level to 47.1% in 2018 from 18 % in 2012 which hurts Rwanda's future borrowing capacity (World Bank, 2019; IMF, 2017; NISR, 2019; AfDB, 2016).

Rwanda aspires to have an upper-middle-income and high-income country with a more than 13 percent growth rate which will achieve the income-per-capita of $4,035 and $12,476 by the year 2035 and 2050 respectively under the vision 2050. To realize these targets, Rwanda has put in place several policies that will help to accelerate the total factor productivity of its service sector especially harnessing regional and global market integration thus unlocking the skills gap (World Bank, 2019); GoR, 2016).

Notwithstanding the above-listed challenges, Rwanda has been among the best performer in Sub-Saharan African countries especially in providing a favorable business environment (USITC, 2017). To boost the service sector productivity, Rwanda has formulated many policies including;

Made in Rwanda (2017), articulated under five pillars with one of the aims being to reduce the cost of doing business (*GoR*, 2017) and the Vision 2020 program, which had intensions to increase investments in ICT services to achieve a knowledge-based economy and using the ICT infrastructure to attract foreign direct investment that would lead to high-value services-related employment opportunities.

There is also, the National Strategy for Transformation (2017-2024) whose aims for Rwanda is to become a competitive knowledge-based economy through the acceleration of a private sector-led economy that aims at generating 214,000 annual jobs. To address the energy bottleneck, the government through the National Investment Policy and the Public-Private Partnerships is financing the Kivuwatt Methane Gas project and the Solar energy generation through matching power generation with its transmission to the customer though this is still a challenge. The National Investment Policy has also led to infrastructure development especially the Bugesera airport construction, and the development of Meetings, Incentives, Conferences, and Exhibitions (MICE) initiatives which have attracted huge foreign direct investments to construct

international standard hotels like Marriot, Convention center and others (IMF, 2017; World Bank, 2019).

Furthermore, there is the privatization, investment facilitation, and trade liberalization policy which mainly promotes foreign direct investment and ultimately flow of incomes and technologies (UNCTAD, 2015) and the small and medium enterprises (SME) Development Policy (2010) whose main intention was to promote innovation and technological progress among Rwandan enterprises (AfDB, 2016).

To address the skills gap the government has increased training by encouraging international colleges like AIMS (African Institute of Mathematical Science), CMU (Carnegie Mellon University), and TVET (Technical and Vocational Education Training) known for providing quality education although this takes some times to produce the results. Also, since it is seen that despite Rwandan secondary school enrollments having achieved 39.6 percent in 2017, it is still lower than that of Kenya and Mauritius (IMF, 2017).

1.5 Statement of the problem

The government of Rwanda's (GoR) ambition according to World Bank, (2019), is to transform the economy into a service led-economy by promoting the service's exports through huge infrastructure investment and increasing external connectivity. Rwanda's main service exports are tourism and transport but financial and ICT have started to improve. Also, the world Bank report indicates that services have been and remains to be the main driver of the entire country's GDP since 2001. Despite the sector being important, its share of the GDP decreased from 49.10 % in 2008 to 47.8% in 2018 (See figure 1.1). Also, this is revealed in the statistics provided in the World Bank report which shows that the Rwandan services exports dropped by 1.8 percent, from US$930 million in the years 2017 to US$913 million in 2018 though the tourism earnings grew somewhat, by 1.6 percent in the same period. Also, based on Rwanda's National Strategy for Transformation (NST1) of 2017, the service sector was presumed to grow at a rate of 13.5 percent between the years 2013 and 2020. Therefore, if the above-mentioned declining trends persist, the sector's growth target and Rwanda's aspiration of becoming an upper-middle-income and high-income country by the year 2035 and 2050 respectively will not be achieved (World Bank, 2019; GoR,2017). Therefore, the country may face a challenge of raising income revenues from US$374 million in 2016 to US$800 million in 2024 and creating 240,000 annual jobs by the same period. This could affect Rwanda's target of achieving high-quality standards of living and poverty reduction given the low productivity in the service sector (Government of Rwanda(GoR), 2017).

More so, Rwanda intends to transform her economy by moving labor from subsistence agriculture into the productive service sector. Also, the World Bank, (2019) indicates that Rwanda's service sector total factor productivity (TFP) appears to have reduced in recent years with only the accumulation of capital being the major ingredient for her growth. The only study to my point of view in regards to Rwandan services was conducted by Heshimati and Uwitonze (2016). However, their primary focus was on the entire development of the sector while productivity being the driving factor of development on its own was not looked at. Hence, the study aimed at highlighting its main driving factors in the Rwandan service sector to bridge the existing knowledge gap. Ultimately, helping policymakers to make informed decisions thereof.

1.6 Research questions

This study's main research question is, what are the determinants of total factor productivity in the Rwandan service sector? More specifically, this study aimed at providing answers to these questions below:

(i) What are the drivers of total factor productivity in the Rwandan service sector?

(ii) What are the related policy recommendations that boost total factor productivity in the Rwandan service sector?

1.7 Objectives of the Study

The study's main objective was to analyze the determinants of total factor productivity in the Rwandan service sector

Specifically, this study aimed at:

(i) To determine the driving factors of total factor productivity in the Rwandan service sector.

(ii) To suggest policy implications regarding total factor productivity in the Rwandan service sectors grounded on the study's findings.

1.8 Significance of the study

Based on the importance of the service sector to Rwanda's economy which is reflected in its share of the GDP and the country's ambition of building a competitive service-led economy as earlier stressed, this study adds empirical knowledge to the prevailing literature on the levels of total factor productivity in the Rwandan service sector since this is the first study of its kind. The study provides a detailed perspective on the main factors affecting total factor productivity among the Rwandan service sectors.

Finally, the study results inform policymakers on the areas that require improvements to enhance the government policy of economic transformation by reversing the underperforming sector by increasing total factor productivity in the sector. This will ultimately help in the realization of the targeted GDP growth rate of more than 13 percent by 2050 and the attainment of sustainable development goals as envisaged by the government of Rwanda where the service sector is expected to be the leading sector (GoR, 2016).

1.9 Organization of the study

The remaining chapters of this study are organized as follows. Chapter two critically assesses both the theoretical and empirical literature. Chapter three presents the methodological approach that was be adopted, variables and data description, its source, and the diagnostic tests. Chapter four presents the results of the study while chapter five provides a summary of the main results, conclusion, and policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Since this study intended to analyze the determinants of the Rwandese service sector's total factor productivity, both theoretical and empirical literature was reviewed in sections 2.1 and 2.2 respectively. The overview of the literature is provided in the last section which explains the identified gaps in research.

2.1 Theoretical literature review

Total factor productivity (TFP) can be explained using different theoretical underpinnings. Among them are the following; the growth accounting by Solow (1956 &1957; the Hicks-Moorsteen, the Tornqvist, and the Malmquist Total factor productivity indices by Diewert, 1992; Caves, Christensen and Diewert,1982). The growth accounting theory (Solow residue) defines total factor productivity change as the growth of output that is not statistically associated with the growth measured by the conventional inputs (capital & labor). Also, it is presumed that TFP is a measure of the variation of aggregated real production output that is not accounted for by variations in the real production inputs.

Most of the studies use a Cobb-Douglas production function initiated by Cobb with Douglas which assumes two production inputs, capital, and labor and their elasticities of substitution being equivalent to one (Cobb &Douglas,1928). De Jorge & Suárez, (2014) explain total factor productivity as the ratio of output to input indices especially capital and labor. This is important because it reflects the technology available at the firm's disposal. However, they argue that measuring the service sector's productivity is challenging compared to that of the manufacturing sector since services are created and used simultaneously and there is an interaction between the provider and consumer.

Van Biesebroeck, (2004), explains that the non-parametric approaches used in estimating productivity (i.e. index numbers and data envelopment analysis) are very flexible in specifying technology, but they do not allow for unobservable, making the results of the measurement error

entirely unpredictable. Therefore, to avoid the measurement errors productivity levels estimates are obtained using parametric methods calculated from a production function. Van Beveren (2012) provides a comprehensive survey of different methodologies applied to calculate and analyze total factor productivity on a micro-level. The author explains the advantages and throwbacks of using such approaches to estimate total factor productivity levels and the expected results.

According to Romer, (1990), increased research and development (R&D) is highly correlated to a firm's labor input and output because it raises the stock of knowledge in an economy. More so, at the firm level in an endogenous theory by Young (1998) and Howitt (1999), growth in productivity is presumed to be related to R&D intensity. Also, the neoclassical exogenous models assert that the long-term growth of an economy is determined by conscious investment in technological development despite the technology being an exogenous variable in the endogenous growth theory. This means that countries or regions that invest highly in R&D are believed to be creative and innovative in technological activities that hence increase their productivity (Shen et al., 2019).

According to Liu and Song, (2004), total factor productivity (TFP) is that proportion used to estimate how efficiently every production input is utilized. This is because, with TFP indicators, it is possible to track and analyze the changes in sectoral and industry productivity. Also, Diewert, (1976) integrated several theories (i.e. the theories of the firm, the national accounts, and index number) into a theoretical production method to estimate productivity. This was achieved by adopting a set of formulae of the TFP concept with the assumptions of a perfect competitive input market and constant returns to scale in the production process.

Coelli et al., (2005) explain TFP using the production frontier whereby technical change represent outward shifts of technology on the production possibility frontier curve while technical efficiency leads to the movement alongside the same curve. The approaches explained thereof are grounded in the theory of production and they can be estimated using, econometric methods like the translog, the quadratic, the constant elasticity of substitution (CES), etc. The author also recommends using stochastic frontier analysis (SFA) and Data envelopment analysis (DEA) techniques to analyze TFP.

Due to several nonprice and organizational factors especially in the service sector, the change in total factor productivity is affected by two elements i.e. technical efficiency and technical change since the stochastic frontier model assumes that the prevailing technology is not fully used by enterprises (Kim, 2011). Besides, Durdyev et al., (2014) explain productivity as a combination of both efficiency and effectiveness. Whereas effectiveness is the way enterprise achieves self-motivated desires and expectations of customers, efficiency is the way with which those needs are produced and supplied to their end-users. Furthermore, service sector productivity can be reflected by the service provider's ability to acquire resources and transform them to match the demand for a given service (Sahay, 2005).

2.2 Empirical literature review

Kim (2011), used a parametric stochastic frontier technique to identify the factors that affect TFP on hotels in Malaysian. By decomposing the growth in total factor productivity into technical progress and technical efficiency change using data from 2002 to 2004, the study found out that Malaysian hotels operated averagely at 41 percent efficiency. The estimated coefficients of TFP growth on the variation in technical efficiency and technical progress were -.057, .127, and .070, respectively. Therefore, TFP was determined primarily by technical progress and was overwhelmed by technical inefficiency. Technical efficiency was mainly determined by training, employing graduates from the university, foreign ownership, and outsourcing whereas technical progress was determined by the stock of capital and employing a graduate worker.

Voutsinas and Tsamadias (2014) estimated the association between R&D capital and TFP in Greece from the year 1981 to 2007. They employed the Johansen estimation technique and the vector error correction models to study the causality and short-term change between R&D and TFP. The result revealed a long-run relationship between the public R&D capital and. However, their results showed that the R&D done privately was insignificantly related to TFP. Also, a percentage increase in R&D increased TFP by 0.038%, while a 1% increase in R&D done publicly raised TFP by 0.075%. They proposed that jointly increasing expenditure on R&D and structural reforms improve the efficiency thus the Greek economy's productivity (Voutsinas & Tsamadias, 2014). Additionally, Heshimati and Uwitonze (2016), assessed the effect of

innovation and R&D on the Rwandan service sector's development. By using simple linear regression analysis on Rwanda and the world bank's 2011 enterprise survey, they assert that increasing innovation capacity by one (1) percent, raises the firm's total sales by 0.1124 percent.

In studying whether a firm's location determines its TFP in the Italian manufacturing firm-level, Aiello et al., (2014) employed a multilevel approach on firm surveys from 2004-2006. Their result confirmed the importance of location on its TFP provided there are other settings like infrastructure, an efficient local administration, and investments in R&D.

Verma, (2012), examined the factors determining a service-led economy in India from 1980 to 2005. The study employed sectoral TFP growth rates on three-sector, agriculture, industry, and services, and the result showed that the service's TFP growth was the fastest. The increase in TFP was substantial towards the sector's value-addition. The model performed accounted for the evolution of value-added shares and their rates but did not capture the share employment trends at the sectoral level. The results also indicated that value-added share improved increasing TFP growth in the service sector following the inauguration of marked based liberalization reforms. The results also reveal that trade liberalization increased TFP growth in the service sector whereby it grew from 2.68 to 3.85 percent during the study period.

In an attempt to analyze the factors affecting total factor productivity (TFP) growth in Malaysia from 1971 – 2004 Jajri, (2007), used the Data envelopment analysis (DEA) method to assess the production frontier changes. To decompose TFP into technological change and technical efficiency change, the Malmquist productivity index was used. Results indicated that the TFP growth of the Malaysian economy in the study period was not encouraging since technical efficiency had a negative influence on TFP. Again, results revealed innovation, trade openness, economic restructuring through shifting resources among sectors, and the existence of foreign companies to be the main contributing factors of TFP growth in Malaysia. The study also pointed out the significance of human capital, sophisticated technology, and the adoption of the new technology towards TFP growth.

By adopting a stochastic production frontier approach Coelli et al., (2003), estimated TFP growth for 31 observations in the year 1961 to 1992, of crop agriculture in Bangladesh by breaking down TFP into technical efficiency change and technical change. The results of the study showed a U-shaped pattern for technical change, increasing by the early 1970s because the green

revolution was adopted which gave a technical progress rate of 0.27 percent annually. However, the results revealed that technical efficiency deteriorated at a percentage rate of 0.47 per year. The combination effect of slow technical progress and technical efficiency caused a decrease in total factor productivity (TFP) at 0.23 percent annually. The TFP change was seen to be dependent on the green revolution technology and increase research expenditures on agriculture.

Seo and Lee, (2006) attempted to find the association between Information Communication Technology (ICT) investment and the rise of TFP. They employed the Kaldor–Verdoorn effect on both time-series and cross-sectional datasets of 38 nations from 1992 to 1996. The results indicated that global digitalization had a mixture of both positive and negative impacts on TFP. On one hand, it was evidenced that the digital divide widened the growth gap amongst nations, and on the other hand, it showed that its diffusion generated positive externalities through knowledge spillovers thus rising TFP, especially among low developed nations. This means that developed nations are more advantaged compared to their developing counterparts concerning the development of ICT. Also, the study points out that whereas ICT intensity in the US was 8.3 percent in 1997 it was 1.5 percent in Turkey in the same year, showing 2.2 times higher high ICT strength in OECD countries than non-OECD ones because of differences in investment them. This implies that for nations to maximize the positive externality of ICT on productivity, they require proper coordinated and cooperative plans in ICT investment amongst themselves including its standardization and investment plans.

According to Vagionis and Sfakianakis, (1997), the firm size exhibits two characteristics i.e. On one hand, large firms can improve their competitiveness leading to productivity, and can absorb more employees. Small/micro-firms on the other hand, are outcompeted out of the market due to limitedness in their production capacity. However, Bartelsman and Dhrymes (1998), explains that the literature does not clearly show the relationship between firm size and its total factor productivity. This means that productivity is seemed to increase with size up-to a point and then starts to decline.

In a study aimed at understanding the significance of ownership on firm total factor productivity in Japan, Fukao and Murakami,(2005) found out that enterprises owned by foreigners are believed to be more productive than those owned domestically. The study results show that foreign firms registered 10 percent more TFP plus higher earnings and revenues on capital.

More so, foreign enterprises exhibited high capital-labor proportion and more R&D intensity indicating a higher TFP and labor-saving production forms, labor productivity consequently high wage rates. The study also indicated that in general, foreign-owned companies realized advanced sales and real assets. However, despite labor-saving production techniques, there was a significant reduction in employment among foreign-owned firms compared to their local counterparts because they started having higher productivity and incomes and received strong increases in plant and equipment investment and sales support.

Bigsten and Gebreeyesus, (2009), used a generalized method of moments (GMM) technique to examine the causality relationship between exports and productivity in Ethiopian manufacturing. The results on plant-level panel data show that on average exporters had three more extra workers, and they pay 1.6 times higher wages than those not exporting. In a similar study Esaku, (2019), analyzed the relationships between exports and firm productivity growth in sab-Saharan African countries. The study employed matching and diff erence-in-diff erences methods. It was found that exports create productivity growth amongst exporters, meaning that firms exporting to multiple markets are more productive than those that do not do so. The results also indicate that variations in export markets improved firm-level TFP because the more firms trade to extra market the more productive, they become through spillover effect. The study calls for policymakers to embark on export promotion strategies by availing information to exporters on the possibilities of entering the African export markets and credit facilities to exporting firms so that they can boost their sales through extra export markets.

Mensah, (2016), used the quasi-experimental method on the firm's panel data for 15 Sub-Saharan African nations to understand the effect of power outages on the productivity of firms. To estimate an augmented Cobb-Douglas production, the author applied the Instrumental Variable approach. The results proved that energy deficiencies had a significant inverse relationship on the productivity of a firm, its size, and labor employment. Also, the results revealed that increasing power outage intensity by 1%, reduced the firm's level of productivity from 0.6 percent and 1.1 percent, but had an insignificant effect on the firm income. The results from the study on the impact of bribery and electricity outages on the performance of firm from six geo-political regions in Nigeria by Personal and Archive, (2019) confirms that power outage had an inverse relationship with firm's performance. The result also indicated that firms in the

North-West, South-West, and South-South regions that rely on the public power supply do not entirely depend on self-generated power to improve on their firm performances.

2.3 Overview of the literature

Total factor productivity measures a firm's performance by showing the growth of the production output not only explained by capital and labor. From the surveyed literature above, different studies used both parametric and non-parametric approaches for the estimation of total factor productivity in various sectors like manufacturing, agriculture, and services and among them including; Serot, (1993); Lundvall, Ochuru, and Hjalmarsson, (1999); Coelli et al., (2003 &2005); Heshmati, (2003); Kong and Tongzon, (2006); Ikhsan, (2007); Kim, (2011); Van Beveren (2012) and others. Van Beveren provides detailed information on the distinction of the results of TFP estimates thereof. Despite most of these studies pointing out that the non-parametric approach especially DEA being simple and not subjective to specification errors, making statistical inference may be a problem because it is likely to produce overestimated results. On the contrary, the parametric approach especially the fixed effect as pointed by Van Beveren (2012) does not encounter measurement errors. The technique is assumed to overcome the simultaneity problems resulting from estimating TFP using OLS. In the studies reviewed also, various factors are affecting TFP and they include; R&D activities, the size of the firm, location, Technology, trade openness, ownership, and formal status. However, the contribution of each factor towards TFP varies from one study to another and from one sector to another. This means that some factors are statistically significant and others are not depending on the sector under consideration. To my knowledge, no study in Rwanda has been done as far as the services sector TFP is concerned. Therefore, this study sought to extend the literature in an attempt to understand the levels and factors driving total factor productivity in the Rwandan context. The study used a fixed effect approach given its advantages like overcoming endogeneity and selection bias. This study is entirely anchored on the theory of production.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

The adopted methodology that helped to achieve the study objectives is presented in this chapter. Specifically, the chapter explains the theoretical framework, specification of the empirical model, description, and measurement of identified variables used to undertake the estimation strategy and the data types. Finally, we discussed the diagnostic tests carried out and how they are addressed.

3.1 Theoretical framework

Following van Beveren,(2012); and Tocco Claudio (2015), and based on the dataset this study assumes a standard Cobb–Douglas production function to evaluate total factor productivity. And this takes the following form;

$$Y_{it} = A_{it} K_{it}^{\beta k} L_{it}^{\beta l} \qquad (1)$$

Where $\mathbf{Y_{it}}$ represents the output for the service firm i in period t (t=1,2….., n) and (i=1, 2.....,10)

K_{it}, and L_{it} are respectively the production inputs capital and labor; the subscripts β_k is the capital share while β_l is the of shares of labor; A_{it} stands for the Hicksian neutral efficiency level of i^{th} service firm in t^{th} period. Despite $K_{it,}$ L_{it} being usually observed as values rather than quantities by econometricians, Ait is hardly observable to the researcher (van Beveren,2012). Applying the natural logarithm equation (1) is transformed into a linear production function as;

$$yit = \beta_o + \beta_k k_{it} + \beta_l l_{it} + \varepsilon_{it} \qquad (2)$$

Where the letters presented in the lower-case are the natural logarithms of the input factors explained above and

$$\ln\left(A_{it}\right) = \beta_0 + \varepsilon_{it} \qquad (3)$$

Where β_0 measures the mean efficiency levels for all the service firms in a given period; ε_{it} represents the producer and time-specific deviation from the mean that can further be decomposed into at least a predictable and unobservable component. Consider an equation below (Van Beveren, 2012; & Tocco Claudio, 2015).

$$y_{it} = \beta_o + \beta_k k_{it} + \beta_l l_{it} + v_{it} + u_{it}^q \qquad (4)$$

Where $\omega_{it} = \beta_o + v_{it}$ is the service firm's level of total factor productivity while u_{it}^q represents an independently and identically distributed random variable that accounts for the measurement error. However, following (Pavcnik, 2002; Levinsohn & Petrin, 2003), when we assume ω_{it} to be a firm-specific, but time-invariant, equation (4) can be estimated in using a fixed-effects estimator. The equation to be estimated then becomes;

$$y_{it} = \beta_o + \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + u_{it}^q \qquad (5)$$

3.3 Empirical model specification

According to Van Beveren, (2012); and Tocco Claudio (2015) TFP estimates can be obtained from equation (5) above as follows;

$$\widehat{\omega}_{it} = \hat{v}_{it} + \hat{\beta}_o = y_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_l l_{it} + u_{it}^q \qquad (6)$$

The total productivity obtained from equation (6) can be used to estimate the drivers of TFP using an OLS estimator. Given the factors identified from both the literature and the datasets, we regressed TFP as a dependent variable on the independent variable to find out their impact. The factors include; trade openness, technology capture as a foreign worker, labor captured as the total number of the enterprise workers, capital which is capture as the currently employed capital, ownership, location showing whether the service firm is either located in the rural or urban areas, the service firm's size of which is based on the amount of employed workforce, R&D activities, and formal status captured in form of registered and unregistered firms.

Therefore, the model that was estimated is as follows;

$$TFP_{it} = \beta_o + \beta_1(O)_{it} + \beta_2(R)_{it} + \beta_3(L)_{it} + \beta_4(E)_{it} + \beta_5(T)_{it} + \beta_6(F)_{it} + \beta_6(S)_{it} + U_{it} \quad (7)$$

Where $\mathbf{TFP_{it}}$ is total factor productivity of i^{th} Rwandan service firm in t^{th} period; $\mathbf{O_{it}}$, represents firm ownership. Foreign-owned firms were predicted to be more productive than those that are locally owned.

$\mathbf{E_{it}}$, stands for the firm export status which according to Bigsten, (2009) positively affects total factor productivity.

$\mathbf{L_{it}}$, is the firm location and it was presumed to influence TFP depending on the availability of other endowments like infrastructure, efficient local administration, and investment in R&D (Aiello et al., 2014).

$\mathbf{R_{it}}$, represents firm R&D which was predicted to be positively associated with total factor productivity (Voutsinas & Tsamadias, 2014; Heshimati &Uwitonze 2016).

$\mathbf{S_{it}}$, is the service firm's size and in the dataset, it is captured as the number of workers which is in the categorical form that is Micro, Small Medium, and Large. The size of the firm can either positively or negatively influence TFP. That is to say, large firms were assumed productive than small firms (Vagionis & Sfakianakis, 1997; Bartelsman & Dhrymes 1998).

$\mathbf{F_{it}}$ is the service enterprise's formal status captured as registered formally to the respective local authority. It was predicted that service enterprises formally registered are productive than informal one Lundvall et al., (2000),

$\mathbf{T_{it}}$ is the firm adopted foreign technology captured as the foreign worker in the dataset and based on Seo and Lee, (2006), it was predicted to be positively correlated with total factor productivity.

$\mathbf{U_{it}}$ is the classical error term.

Additionally, $\boldsymbol{\beta}$**'s** represents the estimated coefficients indicating the shares of the above-explained independent variables.

Table 2: Variable description and measurement

Variables	**Their description and Measurement**
The dependent variable	
Total factor productivity	This will be the estimates obtained from the fixed-effect model.
Explanatory variables	
Ownership (**O**)	Captured as a dummy variable taking the value of 1 when the firm is owned by foreigners, and 0 otherwise
Export status (**E**)	Measured as a dummy variable taking the value of 1 if the service firm carried a foreign transaction and 0 otherwise.
Location of the firm (**L**)	Dummy variable taking the value of 1 if the firm is located in the urban area and 0 otherwise.
Firm R&D activities (**R**)	Measured as dummies which takes a value 1 when the firm spends on formal R&D activities through the Rwandan Development Board (RDB) and 0 otherwise.
Size of the firm (**S)**	Which is captured as the enterprise's size. It is captured in four categories: Micro employing 1to 3 workers, small employs 4 to 30 workers, Medium with 31 to 100 workers and Large which has workers ranging from 100 and above.
Foreign technology (**T**)	This is captured as foreign technology resulting from employing foreign employees
Formal status (**F**)	It is measured as a dummy variable taking the value 1 if the service firm is formally registered and 0 otherwise.

3.5 Data source

This study used unbalance pooled panel firm-level datasets sourced from the Rwanda Enterprise Census surveys for 2014 and 2017. The Enterprise Survey was carried out by the Rwandan National Institute of Statistics for the period 2013/2014 and 2016/2017. The surveys captured the entire Rwanda enterprises but we only chose service firms given that the study was only interested in the service sector and covered 165,108 of these firms.

3.6 Diagnostic tests

We performed the Brush-Pegan / Cook-Weisberg tests to test the learner forms of Heteroskedasticity. This arises when the residuals/error term's variance varies across observations which causes the standard error hence difficult in making statistical inference. It is normally due to misspecification, we used robust standard errors as an alternative (Wooldridge, 2009).

Also, the variance inflation factor (VIF) and pairwise correlation matrix test for Multicollinearity was performed. For the VIF test was intended to verify whether all the explanatory variables did not exceed 10. This is because in its presence, the variance of the parameter estimates is inflated which provides wrong magnitudes of the coefficient estimates hence leading to making poor and incorrect inferences (Belsley, Kuh, & Welsch, 1980; Thompson, 2017).

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF THE RESULTS

4.0 Introduction

This chapter presents and discusses the study results. Therefore, the study's main objective was to analyze the determinants of total factor productivity in the Rwandan service sector. To achieve this, the study employed the fixed effect model to calculate TFP and then run an OLS regression analysis. The descriptive statistics of the variables are presented in section 4.1, the correlation analysis is in section 4.2, and the econometric results are in section 4.3.

4.1 Descriptive Statistics

This section is important in that it analyzes the characteristics of the data on the response variable and the predictor variables of interest. The sample size comprised of 163,108 service firms that covered 23 Rwandan districts. The features for the outcome and the predictor variables ranging from the number of observations (sample size), standard deviation, mean, plus their respective minimum and maximum values are presented in table 3.

Therefore, table 3 shows the summary statistics of all the outcome and predictor variables. It is observed that 8.9% of the service firms in Rwanda invested in research and development (R&D) activities or are registered with the Rwanda Development Board (RDB) while only 3.4% of the service enterprises adopted foreign technology through by employing foreign workers. Furthermore, on average a service enterprise in Rwanda earned 2,417,662 Rwanda francs as a turnover when they invested 2,845,748 francs as their capital and approximately employed two workers in the study period.

More so, only 1% of the Rwandan service sector transacted with a foreign nation in selling or buying (either exported or imported). Whereas 1.2% of Rwandan service firms are foreign-owned, while 98.8% of these firms are domestically owned.

Table 3: Summary Statistics of firms in the Service Sector in Rwanda

Variable	Observation	Mean	Std.Dev.	Min	Max
Turnover	165,108	2,417,662	5,832,155	0	50,000,000
Capital	165,108	2,845,748	8,037,841	250,001	75,000,000
Labor	165,108	1.980	24.842	1	6781
R&D	165,108	0.085	0.279	0	1
Technology	165,108	0.034	0.662	0	148
Export-status	165,108	0.010	0.098	0	1
Location	165,108	0.610	0.488	0	1
Formal-status	165,108	0.071	0.257	0	1
Ownership	165,108	0.988	0.109	0	1
***Size**					
Micro_enterprises (1-3)	165,108	0.951	0.215	0	1
Small-enterprises (4-30)	165,108	0.046	0.209	0	1
Medium-enterprises (31-100)	165,108	0.002	0.046	0	1
Large-enterprises (100+)	165,108	0.001	0.027	0	1
*The summary statistics of the production function estimates in their logarithmic form					
ln (Turnover)	80,277	13.723	1.953	11.918	17.728
ln (Capital)	165,108	13.249	1.529	12.429	18.133
ln (Labor)	165,108	0.277	0.539	0.000	8.822

Source: ***Author's computation from NISR Data, 2014 & 2017***

Referring to the location of the service sector in Rwanda, 61% of these firms are located in the urban area meaning that 39% of them are located in a rural area. All Rwandan enterprises are required to have local authority and administrative registration like the Rwanda Development Board (RDB), the Governance Board, the Rwanda Revenue Authority among others. However, only 7.1% of the Rwandan service firms were formally registered between 2014 and 2017.

About the firm size, the service enterprises within Rwanda are categorized into four categories i.e. micro, small, medium, also known as SME(s), and large enterprises. This is in line with the Rwandan SMEs development policy developed in 2010. Thus, about 95.1% of these Rwandan service enterprises are micro in size with a range of employees between one and three. Contrary,

only 4.6%, 0.2% and 0.1% represent small, medium and large-sized enterprises respectively. And they employ between 4 to 30, 31-100 and 100 and above workers respectively.

Furthermore, in table 3, about 95.14% of the service firms in Rwanda are micro-sized but only 2.52% of these firms employ about 4 and above employees. In comparing the firm's formal status in the Rwandan service, 97.48% are informal and they are micro while 64.44% are formal. In addition, 32.11% of Rwandan small services firms are in the formal status while about 2.47% of them are informal. Overall, 3.45% of formal service enterprises employ about 31 and more workers, while only 0.5% of the informal firms have more than 30 employees.

Table 4: The Distribution of the Service Enterprises into the formal status by their Size

Firm-Size	Count			Percentage		
	Total	Formal	Informal	Total	Formal	Informal
Micro (1-3)	157,087	7538	149,549	95.14	64.44	97.48
Small (4-30)	7,544	3756	3,788	4.57	32.11	2.47
Medium (31-100)	356	299	57	0.22	2.56	0.04
Large (100+)	121	104	17	0.07	0.89	0.01
Total	165,108	11697	153,411	100	100	100

Source: ***Author's computation from NISR Data, 2014 & 2017***

4.2 Correlation Analysis

The table below (5), represents a pairwise correlation matrix. And the correlation coefficients show that correlation between all the independent variables is low, meaning that multicollinearity was not inherently a problem in these variables

Table 5: Pairwise Correlation Matrix

Variables	Capital	Labor	Technology	Ownership	R&D	Trade-openness	Location	Formal-status	Micro-enterprises	Small-enterprises	Medium-enterprises	e
Capital	1											
Labor	0.131	1										
Technology	0.152	0.370	1									
Ownership	0.123	0.018	0.239	1								
R&D	0.361	0.058	0.063	0.082	1							
Export-status	0.276	0.029	0.058	0.126	0.182	1						
Location	-0.180	-0.021	-0.023	-0.007	-0.163	-0.084	1					
Formal-status	0.472	0.077	0.088	0.087	0.395	0.215	-0.212	1				
Micro-enterprises	-0.406	-0.117	-0.133	-0.087	-0.272	-0.117	0.152	-0.389	1			
Small-enterprises	0.346	0.046	0.065	0.073	0.249	0.097	-0.146	0.359	-0.969	1		
Medium-enterprises	0.226	0.085	0.170	0.052	0.100	0.072	-0.034	0.140	-0.203	-0.011	1	
Large-enterprises	0.171	0.424	0.256	0.036	0.070	0.062	-0.023	0.085	-0.121	-0.007	-0.001	

Source: ***Author's computation from NISR Data, 2014 & 2017***

4.3 Empirical Results

To calculate total factor productivity the study employed the fixed effect regression model and then predicted the residuals of the model. The within R-squared indicate that only 42% of Rwandese service output is explained by the input factors (capital and labor). This implies that 58% of these service firm's output is explained by the conventional input factors and this concurs with what Solow, (1956&1957) asserted to be TFP. While in analyzing the main factors determining total factor productivity in Rwanda's service sector, we used an ordinary least square regression model as proposed by Van Beveren (2012); and Tocco Claudio (2015). This was done by regressing the obtained TFP on these identified variables from the literature to be influencing service total factor productivity. Also, as indicated in equation 6 in the methodology.

Table 6: The Fixed Effect Regression Analysis

The Fixed-effects regression					
Variable	**Coeff**	**Std.Error**	**Z**	**P-value**	**Sign**
ln (Capital)	0.721	0.003	234.860	0.000	***
ln (Labor)	0.247	0.008	29.780	0.000	***
Constant	3.910	0.040	98.610	0.000	***
sigma_u	0.000		Robust standard errors:		
sigma_e	1.473		***<0.01, **p<0.05, *p<0.1		
Within R-squared	0.422				
Number of observations	97974				
Wald chi2(2)	71921.110				
Prob>chi2	0.000				

Source: ***Author's computation from NISR Data, 2014 & 2017***

4.5 Determinants of total factor productivity in the Rwandan service sector

The main objective of the study was to analyze the determinants of total factor productivity of the service sector in Rwanda. Thus, the estimated parameters of the ordinary least squire model arising from equation (6) are presented and discussed in this section. However, while table 7 shows the results of the model before testing for heteroskedasticity, table 9 presents the robust standard error regression analysis correcting for the presence of heteroskedasticity (Wooldridge, 2009).

Table 7: Results of the ordinary least square regression analysis

OLS regression					
Variables	**Coef.**	**Std. Error**	**t-statistics**	**P-Value**	**Sign**
Ownership	0.025	0.023	1.100	0.271	
R&D	0.444	0.009	48.170	0.000	***
Location	-0.298	0.005	-59.220	0.000	***
Export-status	0.770	0.025	30.550	0.000	***
Technology	0.020	0.004	5.180	0.000	***
Formal-status	1.246	0.011	115.770	0.000	***
***Size**					
Small (4-30)	1.166	0.012	93.720	0.000	***
Medium (31-100)	2.000	0.053	37.780	0.000	***
Large (100+)	2.397	0.092	26.110	0.000	***
Constant	17.473	0.023	758.540	0.000	***
Number of observations	165,108		Robust standard errors:		
R-squared	0.291		***<0.01, **p<0.05, *p<0.1		
Prob>F	0.000				

Source: ***Author's computation from NISR Data, 2014 & 2017***

Table 8: The Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance	
Hi: Variables fitted values of TFP	
Chi2(1)	2416.69
Prob > chi2	0.000

Source: ***Author's computation from NISR Data, 2014 & 2017***

In Table 8 above, following Wooldridge, (2009), after a regression analysis, the study tested whether the model fitted the values of total factor productivity/ whether there was a constant variance of the residuals or they vary. This was done by testing the null hypothesis was the presence of constant variance in the residuals the and the alternative was that the variance of the residuals was not constant. The interpretation, therefore is that when the probability value is less than 0.05, we reject the null hypothesis confirming the presence of heteroskedasticity which calls for the application of the robust standard error to account for it. And the results are shown in table 8 as earlier mentioned.

Table 9: Results of the Robust standard error regression analysis

Variables	Coef.	Robust Std. Error	t-statistics	P-Value	Sign
Ownership	0.025	0.021	1.200	0.232	
R&D	0.444	0.011	41.120	0.000	***
Location	-0.298	0.005	-55.680	0.000	***
Export-status	0.770	0.027	28.130	0.000	***
Technology	0.020	0.006	3.390	0.001	***
Formal-status	1.246	0.013	92.910	0.000	***
***Size**					
Small (4-30)	1.166	0.016	75.060	0.000	***
Medium (31-100)	2.000	0.056	36.030	0.000	***
Large (100+)	2.397	0.099	24.100	0.000	***
Constant	17.473	0.021	816.050	0.000	***
Number of observations	165,108		Robust standard errors:		
R-squared	0.291		***<0.01, **p<0.05, *p<0.1		
Prob>F	0.000				

Source: ***Author's computation from NISR Data, 2014 & 2017***

Overall, the estimated model is fit as shown by the results in table 8 with the evidence of a strong statistically and significant probability value (p-value) of 0.000. From an ordinary least square estimation also, it is observed that apart from the ownership variable, all other variables have positive and statistically significant at 1% levels while the location is negative but significant.

About the determinants of TFP from the robust standard regression in table 8, the result reveals that the coefficient of the dummy for domestic ownership is positively and statistically insignificant related to TFP compared to that of the foreign ownership. This study results concur with the empirical study by Lundvall, Ochuru, and, Hjalmarsson (1999) who argued that foreign ownership does not explain the variation of the manufacturing firm productivity in Kenya. However, the results are in contrast with the study by Weche (2013) who found that service enterprises in German, owned by foreigners are on average superior than those locally owned because they are bigger with high skilled personnel.

The coefficient of the activities of research and development (R&D) is positively and statistically significant associated with total factor productivity in the Rwandan service enterprises. The theory predicted that enterprises which spends worth in R&D are likely to be more productive than those whose expenditure is not entirely on research and development. These results are consistent with those presented by Heshimati and Uwitonze (2016), on the development of the entire Rwandan service sector. Also, Voutsinas and Tsamadias (2014), found the presence a positive relationship between Greece firm TFP and research and development especially the one done by the government. Also, Adetutu and Ajayi (2020), confirms that both foreign and domestic expenditure on R&D is highly related to total factor productivity of sab-Saharan African agriculture firms while Kreuser and Newman (2018), asserted that research and development were related to TFP of South African manufacturing firms.

With regard to the location of the firm, the coefficient of a dummy representing rural is negatively and significantly. Meaning that being in the urban area is negative but significantly related to service total factor productivity. These findings are in line with those by Tang (2017) on the financial sector in Taiwan; Aiello et al., (2014) on the manufacturing firms in Italy; and Arnold (2008) for services in sab-Saharan African countries.

More so, the coefficient of the service enterprise's export-status is positive and statistically significant correlated with total factor productivity for the estimated model. This implies that the firm's exports i.e. both direct and indirect positively affects total factor productivity of the service sector in Rwanda through learning by exporting. The results concur with those of Bigsten, (2009), who found out exports to be positively affecting Ethiopian manufacturing firm's productivity. the manufacturing industry through technological transfer.

On the coefficient of technology obtained from employing foreign workers is positively and statistically significant. This study, therefore, reveals that technology brought about by these employed foreign employees has a positive impact on the Rwandan service's total factor productivity. These study findings are in line with those by Harmse and Abuka (2005) who pointed out that technology was positively related to TFP in south African manufacturing enterprises by enhances industrial innovation through knowledge spillover. However, Seo and Lee, (2006), also explain that the influence of technology on TFP in OECD countries proved to have both positive and negative effects.

The formal status's coefficient is also positive and statistically significant. This indicate that the dummy representing firms in the Rwandan service sector which are formally registered are highly likely to be correlated with TFP more than their unregistered (informal) counterparts. Lundvall et al., (2000), established that generally formal manufacturing firms in Africa, especially in Kenya, are more productive than informal firms.

Regarding the service firm's size, which is estimated based on the employed number of workers per establishment; the coefficient for categories of the small, medium, and large sizes are all positive and statistically significant from the model estimates. Meaning that service establishments in these sized categories are associated with service total factor productivity than micro-sized ones. Van Biesebroeck, (2005), found that manufacturing firms in sub-African categorized in the same size were more productive than micro-sized enterprises and the performance was due to the fact that these firms operate with hardly any capital.

Table 10: VIF test

Variable	VIF	1/VIF
Ownership	1.080	0.922
R&D	1.160	0.861
Location	1.060	0.946
Export-status	1.070	0.933
Technology	1.180	0.851
Formal-status	1.380	0.746
***Size**		
Small (4-30)	1.190	0.843
Medium (31-100)	1.060	0.943
Large (100+)	1.080	0.922
Mean VIF	1.140	

Source: ***Author's computation from NISR Data, 2014 & 2017***

Table 10 above shows the Variance inflation Factor (VIF) for the multicollinearity test. Basically, the VIF tells us the multiple by which the coefficient variance is increased due to multicollinearity among independent variables. Therefore, for all the estimated predictor variables, the VIF is less than 10 indicating that multicollinearity was not a problem in the independent variables (Belsley, Kuh, & Welsch, 1980; Thompson, 2017).

CHAPTER FIVE

SUMMARY, CONCLUSION AND POLICY RECOMMENDATION

5.0 Introduction

Given that mainly this study sought to analyze the determinants of TFP, in this chapter we present the summary of the study findings, conclusions, and the policy implication as well as the future areas by which the study can be extended. In section 5.1 we present the study summary, section 5.2 provides the conclusion while the policy implications and the areas for future research are presented in sections 5.3 and 5.4 respectively.

5.1 Summary

As earlier pointed out, Rwanda intends to transform her economy into a knowledge service led-economy by becoming a service hub in the region. This is also in line with the country's target of having an upper-middle-income and high-income country by the year 2035 and 2050 respectively. However, the service share of the Rwandan GDP has slightly contracted since 2009. The study investigated total factor productivity levels and the main determinants thereof in the Rwandan service sector. The study employed the fixed effect model to calculate TFP and ordinary least square to analyze the factors determining TFP.

Regarding the determinants of Rwandan service TFP, the results indicate that apart from the firm's location coefficient, all other variable's coefficients are positive and statistically significant. This implies that expenditure on R&D activities, the dummy representing locally owned firms, dummy and the one that represent firms that are formally registered, technology brought about by the total number of foreign workers and the dummy variable that stands for the service firm's export status are important in determining total factor productivity of service sector in Rwanda. Also, about the enterprise's size, coefficients for the firm categorized as small, medium, and large are positive and statistically significant meaning that establishments under these categories are productive than micro firms. Furthermore, the location coefficient is negative and statistically insignificant meaning that this factor is less important in determining the service firm's productivity in Rwanda.

5.2 Conclusion

Given the importance of the service sector towards Rwanda's GDP growth, understanding the determinants of total factor productivity on a sectoral level is of great advantage. Also, beyond being the driving factor for national long-run economic growth as well as higher living standards, total factor productivity is equally important in generating benefits both within firms as well as increasing efficiency and technological change. The sector in Rwanda, however, still experiences different constraints as mentioned in chapter one and main one including enterprise underperformance, inadequate infrastructure hindering the cost of service transactions both in and away from the country. Furthermore, there is inaccessible to affordable finance and operating capital, unspecialized technology, and its usage and an unskilled labor force.

From the findings, therefore, it is observed that the location of service establishments (that is being located in the urban) in Rwanda is less likely to be related to its productivity. More so, the results indicate that firms that spend reasonably on formal R&D activities are likely to be more productive than those that do not spend worth on research and development activities in the service enterprises of Rwanda. In addition, while service firms that are domestically owned and those that have access to a foreign market (through export status) are definitely believed to be more productive than those owned by foreigners as well as those that do not carry out foreign transactions. It is also observed that technology resulting from employing foreigners is highly correlated to service firm total factor productivity through knowledge spillover. Finally, the findings show that formally registered Rwandan services and firm sized as small, medium, and large are more productive than the unregistered and micro firms. However, the domestic ownership statistically insignificant though positive.

5.3 Policy Implications

The study's second objective was to provide policy recommendations given the findings. Since the Rwandan government opted for the service sector driven economy to realize an upper-middle-income in 2035 as well as a high-income in 2050. We recommend the government to put more emphasis on formulating policies favoring entrepreneurs operating in this sector. Moreover, the study established positive and statistically significant coefficients for enterprise's R&D activities, export status (only firms that access foreign market exports and imports),

technology through employing foreign employees, formal status, and the firm size (for the small, medium, and large category). Therefore, these variables are key in explaining Rwanda's service sector total factor productivity. However, the location (but those located in urban), is negatively but statistically insignificant. Hence, the government should encourage and provide investment support to firms that adopt R&D activities because they lead to innovation thus improving technical skills. Also, Rwanda in partnership with the private sector should invest in infrastructural development across the country to increase service total factor productivity. Again, Rwanda needs to put in place foreign trade policies that facilitate and encourages all forms of service export to benefit from prevailing economic integration. There is also a need to increase and expand ICT application by hiring foreign workers and human capital development through training and improving the quality of education. This will enable digitizing of the services sector to become mobile-based by targeting countryside consumers. About the formal status, the GoR in partnership with other stakeholders are required to encourage and sensitize service enterprises on the advantages of becoming formal establishments. This is because the results postulate that formally registered service firms are more productive than informal ones. In addition, the government should put in incentives for firms to graduate from micro to small, medium, and large since they are highly correlated with TFP.

Finally, the study findings indicated that there is a positive and insignificant coefficient for the ownership variable (the dummy for domestically owned firms). This perhaps because state-owned firms have high operating capital invested by the government as evidenced by the world bank report of 2019 which postulates that the country's growth is brought about an accumulation of capital instead of total factor productivity thus foreign-owned services are less productive compared to locally owned ones.

5.4 Areas for potential future research

In this study, we analyzed the determinants of the Rwandan service sector's total factor productivity. This study can be extended by decomposing TFP into technical efficiency and technological progress to understand whether TFP is brought about by efficiency or technical change. The study also can be extended in determining the levels of TFP and consider other economic sector's productivity like in manufacturing and agriculture.

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