Analysis of Factors Affecting Firm-Level Innovation Activity in Ethiopian firm

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Abstract

Many countries use, apply, and emphasize innovation policies to promote long-term development by building a knowledge economy focused on a skilled and well-paid workforce. Ethiopian firms have to learn to engage effectively in innovation activities to be able to create innovative products, processes, and services to make the SME ecosystem very active, capable, and efficient. The firm's engagement in innovative activities must become mandatory. Firms must not lose their market share and customers in the future as a result of a shift in demand from existing customers for new technology. As a result, research was conducted to identify the fundamental factors influencing the success of innovations and to discover, provide, and forward workable solutions to Ethiopia's evolving firms. The data sources for firm-level innovation used in this paper are based on the Enterprise Survey conducted by the World Bank (WBES, 2011 and 2015). The WBES currently covers over 644 firms in 2011 and 862 in 2015. 372 firms have been used in the panel data survey. The factors affecting Ethiopian firms' innovativeness are then investigated using a panel regression model. Panel data regression can assist to control dependent variables on an in the dependent variable. The factors affecting Ethiopian firms' innovativeness are then investigated using a panel regression model. The paper explored Ethiopian firms' innovation by examining both the positive and negative factors that influence the variables such as training, R&D participation, education, and certification of a quality product that influence the innovation value chain. The paper suggests that firm owners and the government invest more in R & D involvement, training for workers who create new ideas, and the development of a firm website to boost innovation.

1. Introduction

1.1 Background Information

Innovation is the process of creating a product or service solution that delivers significant new customer value. The process begins with the selection of the customer and market, including the identification, prioritization of opportunities, and ends with the creation of an innovative product or service. In developing countries, business is one of the most prevalent concepts of our time. Innovation plays an important role in the growth of a company's efficiency, competitiveness, and market share, all of which increase profit. A large number of countries have stressed innovation policies as a means to promote long-term growth and to build a knowledge economy based on a qualified and well-qualified workforce (Mason, Bishop and Robinson, 2009).

In contrast to China and other European countries, African countries' involvement in innovation activities is very poor. Only 10.2 percent of Africa's firm's ongoing innovation activities were abandoned in favor of participation in all forms of development, including product, method, marketing, and organizational innovation (STIC, 2015). Ethiopia scored poorly in terms of innovation, as measured by gross R&D expenditure, innovative goods exports, university or industry R&D collaboration, regulatory efficiency index, domestic credit to the private sector, amount of scientific and technical journal papers, and ICT usage index. Sub-Saharan Africa (including Ethiopia) ranks lower in the Global Innovation Index (GII) ranking of countries by country. The average of the following factors was used to calculate the rating figure: Institutions, human resources, and science, infrastructure, consumer maturity, and business sophistication (Dutta, 2011).

Ethiopia is ranked 109th out of 140 countries in the World Economic Forum's Global Competitiveness Index (GCI, 2009), with a score of 3.7 out of 7.0 in the 2015-16 survey. In the last six years, the average score of innovation measures has increased by 0.5 points (3.2 in 2015-16, from 2.7 in 2009-10). Ethiopia continues to lag behind the rest of the world in terms of key innovation indicators, and there is still room for improvement. In comparison to participation in all types
of innovations (product, process, marketing, and organizational), only 8.2 percent of Ethiopian innovation activities were ongoing or abandoned (STI, 2018). Low innovation leads to foreclosed properties. Ethiopia's economy is still primarily agricultural and mineral-based, with raw materials and agriculture accounting for the majority of exports. It is located at the beginning of the global value chain. It must either catch up along the global value chain or breakthrough by developing an integrated, sustainable, smart, and innovative path through the use of a networked, united, integrated and sustainable new development path. Therefore, this study aims to determine what factors influence innovation in Ethiopian firms.

1.2 Statement of the problem

Ethiopia's manufacturing and service sectors improved innovation, which is one of the most important ways to compete, drive quality, grow competitiveness, increase productivity, and gain market share, which will eventually increase profits and export, particularly in the current knowledge economy. Ethiopia has begun to implement some of the World Bank and OECD recommendations for encouraging innovation and entrepreneurship. Ethiopia's ambitious Science, Technology, and Innovation Policy has been announced, recognizing the need to improve the country's technical capabilities and infrastructure in order to promote innovation, entrepreneurship, and firm growth. (Science, Technology, and Innovation Policy, 2012).

However, according to the Global Innovation Index (2017) survey, Ethiopia continues to have one of the lowest rates of innovation activity in Sub-Saharan Africa. With a ranking of 24.16 out of 100, Ethiopia is ranked 110th out of 127 countries. Ethiopia continues to lag behind the rest of the world in key innovation metrics, but there is still room for improvement. Furthermore, according to GEM (2012), Ethiopia had one of the lowest rates of entrepreneurial activity in the Sub-Saharan African region, with just 12% of the adult population (18 to 64) in the process of starting a new business or operating businesses that were 3.5 years old or less (average of 28 percent for countries in the region). Approximately 8% of adults owned a well-established business (the regional average is 15%).

As a result of innovation problems in Ethiopia, Mulu (2015), Tesfaye (2014), and STC (2015) conducted qualitative research on the role of innovation at the firm level in Ethiopia. All of the results point to the fact that entrepreneurship and innovation are the engines of Ethiopian firms' and economic growth. Moreover, others study Ethiopian firms' engagement effectively in innovation activities. Inevitably, they are going to be dependent on other countries' innovative products, imported with hard currency from developed and other developing countries (Mulu, 2015). But firms' engagement in such activities is becoming mandatory unless they lose their market share and customers in the future as a result of a shift in demand from existing customers for new technology.

Therefore this study, the scope of theories that explain the causes of inventiveness has likewise grown throughout time. Until recently, the importance of firm features has been the focus. However, subsequent research has shown that external factors like market structure and the quality of the institutions in which the business operates are as important. Although several studies have been conducted on the subject, external variables have received less attention. Because not all innovation drivers are equally essential for nations at different stages of development, it's critical to assess the importance of both internal and external variables in the context of a developing country. Therefore, the aim of this paper was to conduct quantitative research to understand the factors that influence innovation at the firm level by using pane data, which means the same cross-section or individual units throughout multiple time periods. This type of data analysis has the benefit of being more reliable for finding factors that affect innovation at the firm level. For these and other reasons, innovation has for many decades been subject to thorough analysis and research.

2. Literature Review
2.1 Firm-Level Innovation

Schumpeterian (1943), firm innovation is the accumulation of knowledge and implementation of new ideas. Innovation is the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations innovation is the implementation of a new or significantly improved product (good or service) or process. Firm-level innovation is defined as the renewal, modification, or creation of more effective or beneficial processes, products, or methods of doing things in a company's day-to-day operations. This could include implementing new ideas, developing dynamic goods, or improving existing services (Mytelka, 2000). This could include implementing new ideas, developing dynamic goods, or improving existing services for businesses. If successfully managed, innovation is the generation of value from the knowledge and a driver of economic progress (Haskel, Goodridge and Wallis, 2012). From this point of view, in the world of firm innovation, can be defined as a change that is executed by a firm and then exposed to the market. This suggests that a company can innovate at several stages of its development, such as creation, R&D transfer, organization, and marketing. In turn, innovation becomes a catalyst for higher productivity and rapid economic growth.

Innovation is synonymous with confusion since it seeks to boost the firm's competitive position. As a consequence, there is no mention of technology in either the broad definition or the current definition. As a consequence, there is no mention of technology in either the broad definition or the current definition. It specifically considers "non-technological" aspects of innovation (marketing and organizational) that were not previously considered, thus encompassing a wider range of information sources and types besides scientific knowledge (OECD 2005). Therefore, the following four key subtypes of firm-level inventions are described in the Oslo Manual.

**Product innovation:** the launch of a new or substantially improved good or service in terms of its characteristics or intended uses. Major changes in technological requirements, components, and materials, embedded software, user-friendliness, or other functional characteristics are examples. Traditional surveys have used three metrics to assess the complexity or novelty of an invention in this context: new products for the firm, new products for the business, and new products for the foreign market (OECD 2005).

**Process innovation:** The introduction of a new or substantially enhanced manufacturing or distribution system is referred to as process innovation. Innovative methods for manufacturing goods or delivering services, Innovative logistics, shipping, or distribution methods for inputs, products, or services, and Innovative supporting behavior for processes, such as maintenance systems or operations for buying, accounting, or computing are all examples of major improvements in techniques, equipment, and/or software (OECD 2005).

**Marketing innovation:** The introduction of a new marketing strategy involving major improvements in product design or packaging, product placement, product promotion, or pricing is referred to as marketing innovation. They are intended to improve marketing efficacy and productivity in order to achieve a competitive advantage (OECD 2005).

**Organizational innovation:** The introduction of a new organizational approach in the firm's corporate processes, workplace structure, or external relations is referred to as organizational innovation. Structured developments that affect roles, accountability, command lines, and knowledge flows, as well as the number of hierarchical levels; the divisional structure of functions (R&D, development, human resources, financing, and so on) or the distinction between line and support functions; and procedural innovations. As a result, these technologies, such as simultaneous engineering or zero buffer rules, alter or introduce new procedures and processes within the organization (OECD 2005).

In general, According to the Organization for International Cooperation and Development (OECD, 2018), all science, technical, organizational, financial, and commercial measures that lead to the implementation of innovations, or are
intended to lead to the implementation of innovations, are described as innovation activities. Some innovation practices are novel in and of themselves, while others are not but are needed for the implementation of innovations. R&D that is not explicitly linked to the creation of a particular innovation is often included in innovation activities. As a result, intangible assets like as R&D, data, software, patents, designs, unique organizational methods, and firm-specific talents are becoming increasingly valuable in today's economy. Knowledge-based capital consists of a mix of non-physical assets.

Lazonick, an economist, proposed Firm Innovation Theory to justify superior success in the face of imperfect markets. According to the theory, a firm's function is to convert productive resources into commercially viable goods and services. This can be accomplished by a company engaged in innovation. As a result, creative businesses produce higher-quality goods at lower costs, resulting in superior economic efficiency. Innovative businesses have the potential to turn productive capital into higher-quality, lower-cost goods and services, which benefits consumers and other economic participants (Lazonick, 2013).

As a result of an evolutionary (continuous) process of innovation (diversity generation) and market selection, firms' innovative behaviors, industry dynamics, and economic outcomes are all affected (Nelson and Winter, 1982). Endogenous growth theories, which are based on R&D activities, externalities, and the AK models, the most basic version of the endogenous growth model, established techniques in which technological spillover, R&D efforts, and international technology transfer are the major growth contributors (Cohen and Levinthal, 1990). "R&D is a fundamental source of information that constitutes a firm's absorptive capacity, meaning, its ability to recognize, assimilate, and exploit new knowledge from the environment," according to the author. These theories are used to investigate the relationship between knowledge input and knowledge output, as well as the output of innovation (firm performance). Evidence shows that companies that invest heavily in knowledge are more likely to create innovation. There is a virtuous circle in which R&D, innovation, and productivity all reinforce one another, ensuring long-term growth (Guloglu and Tekin, 2012).

The knowledge and skills needed by businesses to select, install, operate, maintain, adapt, improve, and develop technologies are referred to as technological capacity. The firm's ability to develop technological capacity, which is dependent on the firm's current knowledge, is a major determinant in innovation. Learning, obtaining, and transferring knowledge, as well as adjusting company behavior to reflect new knowledge and insights, are all required to acquire this competence. Informal and incremental problem solving and experimentation inside the firm, which are closely related to production, organization, and marketing, may make up a significant portion of the learning in small firms, rather than well-defined R&D programs and other formalized 'technological endeavor (Mungila Hillemane, 2012).

Technological innovation has the potential to boost individual business growth at the micro level while also giving industry growth a new dimension at the macro level. They provide a significant reason for why growth rates differ at the firm, regional, and national levels. As a result, technological advancement is at the center of economic transformation. The ultimate source of productivity and growth is technological innovation. It is the only proven method for economies to continue to grow. (Solow, 1987). They are the driving forces of modern economies because of their diversified contributions in terms of employment, exports, and technical developments. Its ability to innovate is notable among its accomplishments, as current economic theory assigns a significant significance to innovation in the evolution of industries. Technological innovation is an essential component of a company's competitiveness, and it's inescapable for businesses looking to gain and maintain a competitive advantage or enter new markets (Becheikh, Landry and Amara, 2006).

Firm-level innovation management requires models that enable prioritization of innovation activities and resource allocation in the context of current and future competitive needs. The importance of external actors in the conception,
development, and commercialization of innovation has expanded in the age of the World Wide Web and globalization. Strategists are debating the best ways to take advantage of, and protect against, the challenges posed by the "democratization of innovation" thanks to the concept of "open innovation." (Palangkaraya, Spurling and Webster, 2016).

In different contexts, technological innovation has been described in various ways. It is defined as the process by which enterprises master and implement the design and manufacture of goods and services that are new to them, regardless of whether they are new to their competitors, consumers, or the rest of the world, in the context of a developing country. It's a process or product that's brand new to the economy of a developing country, regardless of whether it's been utilized before. The OECD definition, however, is the most commonly quoted: "implemented technologically novel products and processes, as well as significant technological advancements in products and processes?" However, all definitions emphasize the importance of providing a new or improved product or technique that can provide a firm, industry, or economy a new direction (Mytelka, 2000).

Innovation has been identified as a stimulus for industrial progress in several studies. Firms require innovations in order to enter new markets, obtain a competitive advantage, expand market share, and achieve significant economic growth. Firms in Hong Kong, Singapore, South Korea, and Taiwan (the Asian Tigers), for example, have used innovation to achieve industrial growth and long-term competitiveness. Because of the quick pace of change in sectors, as well as the tough difficulties provided by competition and globalization, businesses must innovate to be competitive. Innovation is undoubtedly a fundamental driver of disparities in productivity, income variations, business growth, and industrial competitiveness catch-up in emerging nations. (Baek, Yongchun, & Randall 2005).

2.1.4 Role of Innovation in the Firm Level

Innovation on growth have been analyzed at different levels of aggregation and using different types of growth variables: revenues, value-added, employment, competition. Our focus is on labour growth at the firm level. As more aggregated levels are considered, it becomes harder to disentangle growth stemming from innovation and growth due to industrial restructuring, entry, exits, and businesses cycle effects, to mention a few

The importance of innovation for the survival of market-competing enterprises was highlighted by Schumpeter (1942). The introduction of new combinations triggers a process of competition with a decisive cost or quality advantage, striking not at the margins of incumbent enterprises' earnings and outputs, but their fundamental foundations and life. "under capitalism, the innovative activity becomes necessary, a life-and-death matter for the firm and innovation has replaced pricing as the name of the game in many major industries" (Baumol, 2002) has reinforced the importance of innovation as a critical activity of a firm.

"The effects of innovation for employment are of special importance, yet the relationship between innovation and employment is not well-known," according to (Harrison et al., 2014) Long-term, innovation is unquestionably good for growth and prosperity. In the short and medium run, however, the aggregate consequences of innovation on employment growth might go either way: one firm's success may lead to the demise of another due to business-stealing effects, or the innovative firm may reduce sections of its previous production. Hence, it seems critically important to comprehend the effects at the micro-level to design an appropriate long-term innovation policy. The link between innovation and employment can thus, and should, be studied at different levels. Apart from creating employment, new and growing firms introduce products, processes, and business model innovations, develop new markets, and change the rules of the game of their industries (Bhide, 2000).
(Herstad, Sandven and Ebersberger, 2015) innovation output may affect firm growth in basically two ways. First, the direct market response as a specific innovation is launched, which will influence the firm's incentive to adjust capacity to profit-maximizing levels. Second, indirect effects imply learning and the accumulation of knowledge, which may translate into other types of innovations that can either reinforce or dampen the direct market response. And new ventures are more prone to develop, use, and introduce radical, market-making products that give the firm a competitive edge over incumbents.

Moreover Accord to (ERTÜRK, 2009), In science and technology, technological innovation is the most essential element affecting firm competitiveness. In today's society, innovation has become a crucial notion. Every industry and segment of Western culture is concerned about product innovations, production methods, and organizational changes in their surroundings. International commerce, industrial structure, the establishment and development of new enterprises and industries, and the expansion and survival of existing firms and industries have all been influenced by technological innovation. This broad spectrum of consequences has piqued people's interest and sparked debate. One of the most fundamental and strong forces affecting both the economy and society is technological innovation. National goals and public demands continue to provide obstacles for science and technology, especially as these goals and demands shift. Firms that engage in R&D boost their competitiveness and profit potential. R&D is commonly thought to have a substantial impact on a company's sales, productivity, and profit. Demonstrate that a company's sales success is determined by the stochastic outcome of its R&D, physical capital, human capital, marketing, and competitive pressure from within and outside the industry. Individual firms benefit from higher returns on their innovation investments, the mobilization of resources to invest in innovation, and the likelihood of greater revenues from innovation as a result of their performance. As a result, the success of a firm has a positive impact on innovation (Heshmati and Lööf, 2008).

According to the literature, the primary goal of innovation is to improve people's lives. When it comes to running a business, innovation is the key. Firm-level innovation enhances your ability to adapt to change and discover new opportunities. It can also give you a competitive advantage by allowing you to offer better products and services to your customers. Additionally, at this firm level to expand market share and maintain a competitive edge, one of the most important tools in a company's growth strategy is innovation. Firms in developed countries have grasped the importance of innovation, which rapidly changes the value-added of products and services, as the global market becomes more competitive. Firms can use innovations to gain a strategic perspective on how to solve problems and maintain a competitive advantage in the long run. Firms with the ability to innovate are better able to respond to environmental concerns than non-innovative firms.

Firms innovate in order to create value and preserve or improve their market position. Firm-level innovation is a means to attaining business success and higher market value, which is reliant on: A market with appropriate size or growth. Firms can use innovation to:-introduce more product and service variations, allowing for better market segmentation and penetration, improve existing products and services to provide better utility to customers, improve production processes, allow for faster and better delivery of products, and services. Furthermore, firm-level innovation refers to the commercialization of an idea and its effective implementation. Introducing a new product or service into your firm. Not only will innovation help your firm survive, but it will also help it expand and generate more revenues. There are several practical ways to determine whether your ideas have profit potential, including increasing productivity, lowering expenses, becoming more competitive, increasing brand value, forming new alliances and relationships, and increasing turnover and profitability.

2.3 Empirical Review of Selected Cases on Factors Affect Firm-Level Innovation
The function of formal institutions at the regional level innovation, according to Qu (2014). It is proposed that regional formal institutions and FDI influence Chinese firm innovation as well as regional innovation. The WBES2012, China Statistical Yearbook, and the NERI Index of Marketization of China were used in the study. The main findings were reached: FDI has no spillover effects on innovation, and regional formal institutions promote Chinese firms to innovate, while the study has found no such effect from legal institutions, and regional formal institutions encourage regional innovation. The study examined the factors that influence a firm's innovation in Nigeria (Abdu and Jibir, 2018). The study employed data from the World Bank's enterprise survey, which was evaluated using probit and Tobit regression models. The findings revealed that investing in R&D, formal training, a business's size, exporting status, rivals, location, type, industry, or firm activities all positively influence a firm's tendency to innovate.

NGWADLEKA (2017), investigates the relationship between innovation and firm-level export intensity using pooled ordinary least squares (OLS) and a Tobit regression on a cross-sectional dataset from 2016. By focused on the relationship in three southern African countries, the study contributes to the body of knowledge. The findings show that simultaneously implementing product and process innovations has a positive influence on direct firm-level export intensity. Meanwhile, R&D has a significant and positive influence on the indirect export intensity at the firm level.

Kiveu et al. (2019), the purpose of this study was to see how innovation influences firm competitiveness in manufacturing SMEs in Kenya's Nairobi County. Data was collected from a sample of 284 firms from 2012 to 2014. Multiple linear regression was used to investigate the influence of innovation on competitiveness. According to the data, 97 percent of manufacturing SMEs were evolving with different ideas, with the majority of them making minor changes. Innovations have a significant positive effect on competitiveness.

Bigsten et al., (1998), Between 2002 and 2011, the World Bank, Kenya National Bureau of Statistics, Central Bank of Kenya, United Nations Industrial Development Organization, and Institute of Policy Analysis and Research collected secondary data for 30 manufacturing businesses. The panel fixed effects model was used to examine the data. The study discovered a favorable relationship between capital stock and manufacturing company growth in Kenya. However, the study found a significant and negative relationship between leverage, salary bill, power cost, and fuel cost, and manufacturing firm growth in Kenya. According to Ndemezo & Kayitana (2020), also The data utilized comes from the World Bank's 2006 enterprise survey in Rwanda, which is referred to as "ID RWA 2006 ES v01 M WB." This impacts resulting three key findings: Product innovation is closely associated to process innovation, which means that firms that participate in process innovation deliver new or better goods to the market; however, innovation output, such as 'international quality-recognition,' is unrelated to firm innovation. It is connected to the use of technology licensed from foreign firms, and the main determinant of a firm's financial performance is its "international quality-recognition."

Feldman & Kogler (2010), Firms are located in regions, and regions differ in terms of the supply of fostering factors that help firm innovation, such as favorable institutions, infrastructure, and the amount of R&D stock accumulated in the region. Region-specific variables are essential for regional-based companies' innovation because they can promote externalities and knowledge spillovers between firms within a region. Attempt to identify the major determinants of innovation in manufacturing and non-manufacturing firms in South Africa via Oerlemans and Pretoriu (2006). The findings are based on data collected during in the 2001 South African Innovation Survey. The amount to which firms have internal knowledge resources and use internal and external knowledge and information sources affect innovative outcomes, according to this theory-based exploratory, empirical research. Sub-samples, on the other hand, yield different findings. Imitators are incremental and non-manufacturing innovators, whereas radical and manufacturing innovators exclusively profit from their resources. Seenaiah & Rath (2018), use selected manufacturing firms in India to examine the determinants of innovation. The study is based on a survey of 190 manufacturing firms in the India cities of Bengaluru and Hyderabad. The findings of the panel probit model show that in the manufacturing sector, exports
and R&D investment have a positive and significant impact on innovation. Other important factors, such as import intensity, the experience of managers, and holding employee training sessions at the firm level, have a favorable impact on innovative activities.

Lynskey (2004), investigated the factors of innovation in Japanese technology-based start-up firms as measured by patent applications and new products using original firm-level data. Examine these factors in terms of both firm and management traits. According to the findings, technological capacity, internal funds, venture capital funding, and university-industry relationships are all important firm-level determinants of innovation. Determinants of innovation in low- and high-tech sectors (Jang, 2017). The data for this study comes from the South Korean Survey of Business Activities for the years 2014 and 2015. To deal with the over-dispersed dependent variable, a negative binomial model is used. Export, foreign ownership, and inter-firm collaboration all exhibited substantial positive effects on innovation output in the whole sample, but profit had no such effect.*

3. Research Methodology

This section dealt with the detailed steps and procedures to conduct the analysis of innovation activated at a firm. It includes the research approach adopted to examine the main determinants of innovation, the type of data used and the techniques for data collection, the sampling method, including sample size, sampling frame, the methods utilized to manage and analyze the data, and the process of constructing an empirical model with identification and measurement of its components, measurement, and selection of variables, and expected relations between the dependent and independent variables.

3.1 Data source

The data regarding the innovation model in this paper is based on enterprise surveys conducted by the World Bank (WBES, 2011 and 2015) in Ethiopia between April, 20011 and February 2015. Enterprise Surveys currently cover over 644 firms in 2011 and 862 in 2015. A total of 372-panel firms have been surveyed, and data was collected on each firm's experience and enterprise perception of the environment (including innovative activities) in which they operate.

This dataset covers both manufacturing and business service firms. The WBES dataset provides interesting and new information on firm-level innovation activities, both in terms of measuring innovation itself (propensity and intensity) and also providing explanatory variables for innovation. The survey asked the participant firms about their innovation-related activities during 2011 and 2015. In terms of the former, the survey provides a direct measure of innovation. WBES provides interesting explanatory variables such as whether a given firm collaborated in its innovation activities or not, and also whether the innovation activities have been persistently pursued or not.

3.2 DATA ANALYSIS AND MODEL SPECIFICATION

Panel data, which contains both time series and cross-sectional data, is a particularly essential sort of data in quantitative innovation activities. A data panel will contain information that covers both time and space. A panel data study design that combines the attributes of cross-sectional (inter-firm) and time-series data (inter-period) was used. Panel data consists of observations of the same cross-section or individual units over several time periods. The advantage of this method of data analysis is that it is more reliable.

The firm-based survey provides useful explanatory variables for analyzing factors affecting innovation at the firm level, such as whether a firm is participating in its innovative efforts or not, and whether those activities are pursued persistently or not. To realize the principal objectives of the study, quantitative techniques were applied using panel binary logit regression. Panel Binary Logit Regression is employed to estimate product, process, marketing, and
organizational innovations gave that the variables are binary dummies. Thus, the panel binary logistic regression model can be specified as in Equation 1. The dependent variable is an innovation dummy that indicates whether a firm is innovative or not in 2011 and 2015.

3.3. MODEL SPECIFICATION

This research studies panel logit model was constructed as per preceding similar empirical investigation depicted below;

\[ \text{Innovation} = \beta_0 + \beta_1 \text{Firm Age it} + \beta_2 \text{Sex it} + \beta_3 \text{R&D it} + \beta_4 \text{Ownership it} + \beta_5 \text{Education it} + \beta_6 \text{Credit it} + \beta_7 \text{own website it} + \beta_8 \text{training it} + \beta_9 \text{size firm it} + \beta_{10} \text{Location it} + \beta_{11} \text{Certification-quality it} + \beta_{12} \text{direct exports it} + \epsilon \]

Where: Innovation = dummy (yes/no) production innovation, process innovation, marketing innovation and organization innovation, \( \beta_0 = \) Beta note (intercept regression function), \( \beta_1 \ldots \beta_8 = \) Coefficient of independent variables, \( \epsilon = \) Error term (2011 and 2015 years).

Consider the logistic panel data model given by

\[ P(y_{it} = 1 | x_{it}, c_i) = \frac{e^{x_{it} \beta + c_i}}{1 + e^{x_{it} \beta + c_i}} \] .............................. (1)

Where \( x_{it} \) is the vector of covariates. In the presence of missing observation in the vector \( x_{it} \) we express it as a sum of two vectors \( x_{its} \) and \( x_{it1} \) for the sample – present covariate values and the missing covariate value respectively. Therefore, the model (1) above is written as

\[ P(y_{it} = 1 | x_{it}, c_i) = \frac{e^{[x_{its} + x_{it1}] \beta + c_i}}{1 + e^{[x_{its} + x_{it1}] \beta + c_i}} \] .............................. (2a)

and

\[ P(y_{it} = 0 | x_{it}, c_i) = \frac{1}{1 + e^{[x_{its} + x_{it1}] \beta + c_i}} \] .............................. (2b)

For a panel data set with only two time periods we have \( t = 1, 2 \) and we consider the conditional Probabilities:

\[ \Pr(y_{i1} = 0, y_{i2} = 1 | x_{i1}, x_{i2}, c_i, y_{i1} + y_{i2} = 1) \] .............................. (3a)

And

\[ \Pr(y_{i1} = 1, y_{i2} = 0 | x_{i1}, x_{i2}, c_i, y_{i1} + y_{i2} = 1) \] .............................. (3b)

The conditioning is done on \( y_{i1} + y_{i2} = 1 \) as this sum is a sufficient statistic for the individual

Effect, ci. For the logistic functional form, we have \( pr(y_{i1} + y_{i2} = 1 | x_{i1}, x_{i2}, c_i) = \)

\[ \frac{e^{[x_{1i} + x_{12}] \beta + c_i}}{1 + e^{[x_{1i} + x_{12}] \beta + c_i}} \]

Which yield, up on simplification
The conditional log likelihood function can thus be obtained using equation (8) and (9) as

\[
Pr(y_1 = y_2 = 1 | x_1, x_2, c) = \frac{e^{x_i s + x_i I} \beta + c_1}{1 + e^{x_i s + x_i I} \beta + c_1} \cdot \frac{e^{x_i s + x_i I} \beta + c_1}{1 + e^{x_i s + x_i I} \beta + c_1} \tag{4}
\]

The conditional probabilities on \( y_{i1} + y_{i2} = 1 \) are thus expressed as,

\[
Pr(y_{i1} = 0, y_{i2} = 1 | x_{i1}, x_{i2}, c, y_{i1} + y_{i2} = 1) = \frac{e^{x_i s + x_i I} \beta + c_1}{1 + e^{x_i s + x_i I} \beta + c_1} \tag{5}
\]

\[
Pr(y_{i1} = 0, y_{i2} = 1 | x_{i1}, x_{i2}, c, y_{i1} + y_{i2} = 1) = \frac{e^{(x_i s + x_i I) + (x_i s + x_i I)} \beta}{1 + e^{(x_i s + x_i I) + (x_i s + x_i I)} \beta} \tag{6}
\]

Notice that the individual fixed effects, \( c \), are eliminated through the conditioning on \( y_{i1} + y_{i2} = 1 \). It also follows that

\[
Pr(y_{i1} = 0, y_{i2} = 0 | x_{i1}, x_{i2}, c, y_{i1} + y_{i2} = 1) = \frac{1}{1 + e^{(x_i s + x_i I) + (x_i s + x_i I)}} \tag{7}
\]

Equation (4.6) and (4.7) can be expressed as

\[
Pr(y_{i1} = 0, y_{i2} = 0 | x_{i1}, x_{i2}, y_{i1} + y_{i2} = 1) = \frac{e^{-\Delta x_i I \beta}}{e^{-\Delta x_i s \beta + e^{\Delta x_i I \beta}}} \tag{8}
\]

and

\[
Pr(y_{i1} = 1, y_{i2} = 0 | x_{i1}, x_{i2}, y_{i1} + y_{i2} = 1) = \frac{e^{-\Delta x_i s \beta}}{e^{-\Delta x_i s \beta + e^{\Delta x_i I \beta}}} \tag{9}
\]

Respectively, where \( \Delta x_{i1} = (x_{i2I} - x_{i1}) \) and \( \Delta x_{i2} = (x_{i2s} - x_{i1}) \).

The conditional log likelihood function can thus be obtained using equation (8) and (9) as

\[
\ln L = \sum_{i=1}^{N} \left[ d_{01i} \ln \left( \frac{e^{\Delta x_i I \beta}}{e^{-\Delta x_i s \beta + e^{\Delta x_i I \beta}}} \right) + d_{10i} \ln \left( \frac{e^{-\Delta x_i s \beta}}{e^{-\Delta x_i s \beta + e^{\Delta x_i I \beta}}} \right) \right] \tag{10}
\]

Where \( d_{01i} \) selects the individuals for which the dependent variable changed from 0 to 1 while \( d_{10i} \) selects the cases for which the dependent variable changed from 1 to 0.

The score vector and observed information matrix are respectively.

\[
S(\beta) = \frac{\partial \ln L}{\partial \beta} = \sum_{i=1}^{N} d_{01i} \Delta x_{i1} \cdot \frac{-\Delta x_{i1} s e^{-\Delta x_i s \beta + \Delta x_i I \beta} e^{\Delta x_i I \beta}}{e^{-\Delta x_i s \beta + e^{\Delta x_i I \beta}}} + \frac{-\Delta x_{i1} s e^{-\Delta x_i s \beta + \Delta x_i I \beta} e^{\Delta x_i I \beta}}{e^{-\Delta x_i s \beta + e^{\Delta x_i I \beta}}} \tag{11}
\]

\[
l(\beta) = \frac{\partial \ln L}{\partial \beta} = \sum_{i=1}^{N} \left[ d_{01i} \Delta x_{i1} \left( \frac{\Delta x_{i1} s e^{-\Delta x_i s \beta + \Delta x_i I \beta} e^{\Delta x_i I \beta}}{e^{-\Delta x_i s \beta + e^{\Delta x_i I \beta}}} - \Delta x_{i1} \right) + d_{10i} \left( \frac{\Delta x_{i1} s e^{-\Delta x_i s \beta + \Delta x_i I \beta} e^{\Delta x_i I \beta}}{e^{-\Delta x_i s \beta + e^{\Delta x_i I \beta}}} - \Delta x_{i1} \right) \right] \tag{12}
\]
3.4 variable definition

Dependent variables

In a survey-based measure of innovation, each firm was given the standard question: “Did your firm implement a new or considerably enhanced method or product in the recent [defined] period?” The binary data from the survey was then used to determine whether or not the firm was engaged in innovation efforts. This measurement of innovation, on the other hand, has been criticized for capturing just a broad attempt to innovate (how many firms innovate), rather than the quality of those initiatives (how many firms innovate) (Palangkaraya, Spurling and Webster, 2016)

Therefore the WBES From 2011 to 2015, the ES questionnaire contained an innovation section, which was intended to gather data on firm-level innovation activities in selected developing countries. At its most fundamental level, the Oslo Manual's standard defines innovation (OECD, 2005). The following four parameters are used to determine whether or not innovation activities have occurred.

i. **Product innovation**, as measured by the survey question "Has this institution launched new or substantially enhanced goods or services over the last three years?"

ii. **Process innovation** is focused on the following survey question: “Has this establishment adopted some new or substantially improved methods of producing goods or providing services in the last three years?”

iii. **Marketing innovation** is focused on the following survey question: “Has this establishment of a new marketing method involving significant changes in product design or packaging, product placement, product promotion and pricing that is the use of new pricing strategies to market whereas in the last three years?

iv. **Organization innovation** is focused on the following survey question: “Has this of a new organizational method in the firm’s business practices, workplace organization or external relations in the last three years?”
Table 1
Summary of explanatory variables and their expected effect on the dependent variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variables Proxies and Definition</th>
<th>Expected effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
<td>innovation</td>
<td>NA`</td>
</tr>
<tr>
<td>Innovation</td>
<td>Yes/no</td>
<td></td>
</tr>
<tr>
<td>Independent Variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top Management's Experience</td>
<td>Numbers</td>
<td>Positive</td>
</tr>
<tr>
<td>Access to Credit</td>
<td>Yes/no</td>
<td>Positive</td>
</tr>
<tr>
<td>Education</td>
<td>Means of employment education</td>
<td>Positive</td>
</tr>
<tr>
<td>Ownership type</td>
<td>categorical variables</td>
<td>Negative</td>
</tr>
<tr>
<td>Participation of R&amp;D</td>
<td>Yes/no</td>
<td>Positive</td>
</tr>
<tr>
<td>Sex of managers</td>
<td>Female/male</td>
<td>Negative</td>
</tr>
<tr>
<td>Tanning</td>
<td>Yes/no</td>
<td>Positive</td>
</tr>
<tr>
<td>size firm</td>
<td>categorical variables</td>
<td>Positive</td>
</tr>
<tr>
<td>Location</td>
<td>Yes/no</td>
<td>Positive</td>
</tr>
<tr>
<td>Certification-quality</td>
<td>Yes/no</td>
<td>Positive</td>
</tr>
<tr>
<td>Electrical available</td>
<td>Yes/no</td>
<td>Positive</td>
</tr>
<tr>
<td>own website</td>
<td>Yes/no</td>
<td>Positive</td>
</tr>
<tr>
<td>direct exports</td>
<td>Numbers</td>
<td>Positive</td>
</tr>
<tr>
<td>national sales</td>
<td>Numbers</td>
<td>Positive</td>
</tr>
</tbody>
</table>

4. Result And Discussion

4.1 Firm-Level Innovation in Ethiopia

This chapter examines current businesses' creative activities using data from the World Bank's Enterprise Surveys. Identifying the sorts of factors that influence firm-level innovation, as well as how much they innovate, and explaining the source of innovation in Ethiopian firms between 2011 and 2015.

The World Bank conducted Ethiopian enterprise surveys in 2011 and 2015, surveying a total of 644 firms in 2011 and 848 firms in 2015. The survey was conducted in the country's four most populous regions, Oromia, Amhara, Southern Nations Nationalities and People (SNNP), and Tigray, as well as Addis Ababa, the administrative city. The following is a list of the firms that were used in the survey: In 2011, Addis Ababa accounted for more than half of the companies (468), with Oromia accounting for 12.7 percent (82 firms), Tigray for 6% (40 firms), Amhara for 6% (43 firms), and SNNP for 5% (34 firms). And also, Ethiopia's most recent enterprise survey, which covered 848 firms, was completed in 2015. The survey was conducted in Oromia, Amhara, Southern Nations Nationalities and People (SNNP), and Tigray, as well as two administrative cities: Dire Dawa and Addis Ababa. The sample firms are broken down as follows: More than half (451 enterprises) are from Addis Ababa, with 16% (138 businesses) from Oromia, 13% (109 businesses) from Tigray, 8% (70 businesses) from Amhara, 6% (53 businesses) from SNNP, and 3% (27 businesses) from Dire Dawa.
Table 2: Sample firm in the Regional

<table>
<thead>
<tr>
<th>Regional</th>
<th>Numbers enterprise surveys survey in 2011 and 2015 year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2011</td>
</tr>
<tr>
<td>Addis Ababa</td>
<td>468</td>
</tr>
<tr>
<td>Oromia</td>
<td>82</td>
</tr>
<tr>
<td>Amhara</td>
<td>43</td>
</tr>
<tr>
<td>Southern National Nationalities</td>
<td>34</td>
</tr>
<tr>
<td>Tigray</td>
<td>40</td>
</tr>
<tr>
<td>Dire Dawa</td>
<td>-</td>
</tr>
</tbody>
</table>

Sources: World Bank survey 2011 and 2015

4.2 Innovation activity’s in Ethiopian firms

The firms in the sample show a lot of variety between the various categories of innovations and the year. Product innovation was pursued by 42.5 percent of surveyed firms in 2011 and 37.2 percent in 2015. Marketing innovation was pursued by 47.3 percent in 2011 and 27.2 percent in 2015. Process innovation was pursued by 43.3 percent in 2011 and 20.6 percent in 2015. Organizational innovation was pursued by 42.5 percent of surveyed firms in 2011 and 23.3 percent in 2015.

According to the survey results, innovation decreased between 2011 and 2015, indicating that Ethiopian innovation activity is low. The global innovation index and the digital quality of life index both support this result. Ethiopia is rated 110th out of 110 nations in the third annual edition of the Digital Quality of Life Index (DQL) and 127th out of 131 economies in the GII 2020, according to the world innovation index and the Digital Quality of Life Index.

Table 3

<table>
<thead>
<tr>
<th>Year</th>
<th>Percent of innovation activity’s and numbers of firms participation in innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Product</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Ethiopian</td>
<td>274(42.5)</td>
</tr>
<tr>
<td>2011</td>
<td></td>
</tr>
<tr>
<td>Ethiopian</td>
<td>314(37.2)</td>
</tr>
<tr>
<td>2015</td>
<td></td>
</tr>
</tbody>
</table>

Sources: World Bank survey 2011 and 2015

4.3 Firm’s participation in innovation indictor
According to Dutta (2011), indicators of innovation include gross R&D expenditure, innovative goods exports, university or industry R&D collaboration, regulatory efficiency index, domestic credit to the private sector, number of scientific and technical journal papers, generating new ideas, and ICT usage index.

Firm by innovation indicates that 125 firms (34%) participated in research and development in 2011 and 212 firms (36%) participated in R & D in 2015. By university or industry R & D collaboration, 123 (45%) firms created new ideas in 2011 and 123 (45%) in 2015, compared to 10 (7%) firms in 2011 and 14 (8%) in 2015. With an indicator of innovation that is very low, the rate of innovation may seem unexpectedly high. This is mainly because of the definition used for innovation in the World Bank’s Enterprise Survey, which is based on the Oslo Manual, which broadly defines innovation.

<table>
<thead>
<tr>
<th>Innovation Indicator</th>
<th>2011</th>
<th>2015</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation in research and development</td>
<td>125</td>
<td>212</td>
<td></td>
</tr>
<tr>
<td>R&amp;D expenditure</td>
<td>-</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>Creating new ideas</td>
<td>123</td>
<td>234</td>
<td></td>
</tr>
<tr>
<td>Innovative goods exports</td>
<td>-</td>
<td>-</td>
<td>Not collect data</td>
</tr>
<tr>
<td>University or industry R&amp;D collaboration</td>
<td>-</td>
<td>-</td>
<td>Not collect data</td>
</tr>
<tr>
<td>Domestic credit to the private sector</td>
<td>154</td>
<td>256</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author’s calculations using Enterprise Survey

4.4 Econometrics Result on Factor Affecting innovation in firm-level 2011-2015 in Ethiopian

As per annex 1-4, the Hausman test table indicated that the appropriate estimation model from fixed effect and random effect is The Prob > chi2 was greater than 5%, which means rejecting the alternative hypothesis and accepting the null hypothesis, or not rejecting the Ho. Therefore, the random effect estimation model was more appropriate than the fixed effect estimation model. Therefore, the best-chosen model was the random effect model regression.

For the regression model, seven variables such as research and development involvement, own website, credit, ownership, training, and electrical availability are affected by product innovation and firm size, own website, research and development involvement, and training. Those variables are also affected by process innovation. In addition to this, marketing and organizational innovation are also influenced by experience management, own website, education, training, and research and development engagement.
Table 5
Factor Affecting innovation in rm-level 2011-2015 in Ethiopian

<table>
<thead>
<tr>
<th>Variables</th>
<th>Product innovation</th>
<th>Process innovation</th>
<th>Marketing innovation</th>
<th>Organization innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coef. p-value</td>
<td>Coef. p-value</td>
<td>Coef. p-value</td>
<td>Coef. p-value</td>
</tr>
<tr>
<td>Location</td>
<td>-.045 .837</td>
<td>-.161 .437</td>
<td>.175 .457</td>
<td>-.035 .856</td>
</tr>
<tr>
<td>size firm</td>
<td>-.121 .391</td>
<td>-.042 .495</td>
<td>.069 .306</td>
<td>.167 .186</td>
</tr>
<tr>
<td>Ownership</td>
<td>.104 .098*</td>
<td>-.042 .495</td>
<td>.069 .306</td>
<td>.035 .557</td>
</tr>
<tr>
<td>Experience-mgt</td>
<td>.008 .410</td>
<td>-.008 .381</td>
<td>-.022 .039*</td>
<td>-.005 .545</td>
</tr>
<tr>
<td>Sex-mgt</td>
<td>.016 .960</td>
<td>-.324 .308</td>
<td>-.447 .218</td>
<td>-.561 .073*</td>
</tr>
<tr>
<td>Certification-quality</td>
<td>.564 .017*</td>
<td>.24 .257</td>
<td>.359 .14</td>
<td>.378 .065*</td>
</tr>
<tr>
<td>Electrical available</td>
<td>.633 .017*</td>
<td>.135 .583</td>
<td>.275 .328</td>
<td>-3 .223</td>
</tr>
<tr>
<td>own website</td>
<td>.669 .001*</td>
<td>.605 .002*</td>
<td>.94 .000*</td>
<td>.747 .000*</td>
</tr>
<tr>
<td>national sales</td>
<td>.002 .602</td>
<td>.001 .851</td>
<td>-.002 .706</td>
<td>.002 .659</td>
</tr>
<tr>
<td>direct exports</td>
<td>-.006 .216</td>
<td>.002 .726</td>
<td>-.004 .382</td>
<td>-.005 .246</td>
</tr>
<tr>
<td>Research&amp;development</td>
<td>1.249 .000*</td>
<td>1.084 .000*</td>
<td>2.234 .000*</td>
<td>1.333 .000*</td>
</tr>
<tr>
<td>Credit</td>
<td>.37 .079*</td>
<td>-.221 .261</td>
<td>.004 .984</td>
<td>.102 .593</td>
</tr>
<tr>
<td>Education</td>
<td>.003 .408</td>
<td>.004 .184</td>
<td>.006 .097*</td>
<td>.007 .017*</td>
</tr>
<tr>
<td>Training</td>
<td>1.012 .000*</td>
<td>.704 .001*</td>
<td>1.179 .000*</td>
<td>.985 .000*</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.636 .001*</td>
<td>-2.17 .002*</td>
<td>-1.912 .018*</td>
<td>-2.961 .000*</td>
</tr>
</tbody>
</table>

Sources: - stata 15 results, World Bank survey 2011 and 2015

4.5 Interpretation of the significant variables

Research and development participation: - is a significant factor influencing Ethiopian firms' innovation. The results of the random effect model in table 4.4 show that participation in R&D has a positive and statistically significant influence on all types of firm innovation. The results show a (marginal effect of 1.248 and a p-value of 0.000 at 1% significance level production innovation, a marginal effect of 2.234 and a p-value of 0.000 at 1% significance level process innovation, a marginal effect of 1.08, and a p-value of 0.000 at 1% significance level marketing innovation, and a marginal effect of 1.333 and a p-value of 0.000 at 1% significance level organizational innovation). Taking other independent factors into account, the coefficient of research and development involvement revealed that a one percent change in research and development participation resulted in 1.248 times more product innovation, 2.234 times more process innovation, 1.08 times more marketing innovation, and 1.333 times more marketing innovation by research and development participation. Because of R & D is critical for firm innovation because it delivers valuable information and insights, as well as enhancements to current processes that boost efficiency while lowering costs. It also enables firms to produce new goods and services in order to survive and prosper in a competitive market. The investigative actions that a person or firm decides to conduct with the goal of making a discovery that will either produce a completely new product, product line or service are referred to as research and development.
this result is also supported by different scholars. According to Bowen et al (2013), the ability to educate, invent, and construct is critical to our country’s economic prosperity. Long-term national investments in fundamental and applied research and development (R & D) are critical in the flow of market-based innovations through a complex system that combines the capabilities of scientists and engineers, entrepreneurs, business executives, and industrialists. These funds have fueled everything from tiny business start-ups to the expansion of high-tech sectors, resulting in the employment of millions of people. Innovation has a major influence on employment, not just in high-tech companies, but also in other businesses that benefit from improved capabilities and productivity. Both the private and governmental sectors participate in R&D in a mutually reinforcing and complementary manner to assist in the creation, manufacturing, and commercialization of innovative goods and processes.

**Training**

- is another important element that influences innovation in Ethiopian firms. The findings of the random effect model in table 4.4 show that innovation has a positive and statistically significant influence on training. The results show that (marginal effect of 1.178 and p-value of 0.000 at 1 percent significance level production innovation, marginal effect of 0.704 and p-value of 0.000 at 1 percent significance level process innovation, marginal effect of 0.984 and p-value of 0.000 at 1 percent significance level marketing innovation, marginal effect of 1.01 and p-value of 0.000 at 1 percent significance level organization innovation). Taking other independent variables constant, the coefficient of training participation revealed that a one percent change in training resulted in a 1.178-time increase in product innovation, a 0.704-time increase in process innovation, a 0.984-time increase in marketing innovation, and a 1.01-time increase in marketing innovation. Because of Human capital is crucial for innovation since it necessitates a wide range of worker abilities. Formal education is essential for human capital development, and it should be provided by national education systems. However, training (especially on-the-job training) is critical in delivering the wide range of skills required to improve total innovation capacity.

Bauernschuster et al (2009), provide the most solid evidence of firm-sponsored training’s beneficial influence on creativity. Over the years 1997–2001, these authors discovered that such training has a favorable and statistically significant influence on innovation in German firms. Their findings show that a ten-percentage-point increase in training intensity corresponds to a ten-percentage-point rise in the tendency to innovate. They discover that training only influences the form when they distinguish between routine and radical innovation. They believe that radical innovation is more difficult to execute since it relies on the workforce’s inherent talents, such as creativity, inventiveness, and a willingness to collaborate. Furthermore, because radical innovation is seen as too dangerous, businesses may prefer to train for regular innovation in order to stay current with technological advancements. Additionally, Miles-touya (2012) explains the effects of R & D and worker training on innovation performance in a sample of Spanish manufacturing businesses examined in this article, with a distinction made between large and small firms. The findings show that R&D is a critical factor in explaining firm innovation success and that worker training investment has a considerable, albeit smaller, impact. The findings support a complementary relationship: training boosts the impact of R & D on innovation.

**Own website:** - is another important element affecting Ethiopian firm innovation. Table 4.4 shows that innovation has a positive and statistically significant influence on own websites based on the results of the random effect model. The results showed (marginal effect of 0.604 and p-value of 0.001 at 1% significance level production innovation, the marginal effect of 0.746 and p-value of 0.002 at 1% significance level process innovation, the marginal effect of 0.668 and p-value of 0.001 at 1% significance level marketing innovation, the marginal effect of 0.940 and p-value of 0.000 at 1% significance level organization innovation). Taking all other independent variables constant, the coefficient of their own website revealed that a one percent change in their own website resulted in a 60% change in product
innovation, a 7% change in process innovation, a 66.8% change in marketing innovation, and a 94% change in organizational innovation. Because of The internet is regarded as one of the most promising areas and the next big thing for businesses in the future, and it is attracting increasing interest from businesses and research. A website is a digital depiction of a company's services and products. As a result, going through the process of developing a new innovative marketing and organizational strategy provides the best chance for a firm to evaluate everything it is doing. When we go through a change effort.

**Education**

- another significant factor that influences innovation in Ethiopian firms is education. Table 4.4 shows that innovation has a positive and statistically significant influence on education, according to the results of the random effect model. As a result (marginal effect of 0.002 and p-value 0.001 at 1% significance level of product innovation; marginal effect of 0.0059 and p-value 0.001 at 1% significance level of process innovation). Taking other independent factors into account, the coefficient of education indicated that a one percent change in education resulted in a 2 percent change in product innovation and a 5.9 percent change in process innovation. Individuals gain information, knowledge, understanding, and skills through involvement in informal (for example, at educational institutes) or formal (for example, competency development ('learning-by-doing') in the workplace) education and training. Individual competency development, unlike R & D, primarily consists of disseminating existing capabilities, even if they are new to the individual in question. Individual competency development leads to a higher stock of human capital, and human capital is the engine of innovation. Another studies support that According to Varsakelis (2006), According to research, nations that invest in the quality of mathematics and science education at all levels (primary, secondary, and tertiary) do better in terms of innovation. Other studies suggest that educational achievement has risen steadily over the last few decades. For developing countries, education is critical. Newly industrializing countries have made significant investments in education as a method of spurring economic growth and innovation. From the perspective of the innovation system, one of the key issues is the extent to which the entire educational system is capable of producing the type of knowledge, skills, and competence that innovative firms require (Toner, 2011).

**Size firm**

- Another major factor that influences Ethiopian firm innovation is the size of the firm. Table 4.4 shows the results of the random effect model, which illustrate that innovation has a positive and statistically significant influence on firm size. The result reveals that (a marginal effect of -0.289 and a p-value of 0.017 at 1 percent significance level product innovation; a marginal effect of 0.167 and a p-value of 0.058 at 1 percent significance level process innovation). Keeping all other independent variables constant, the coefficient of firm size revealed that a one percent change in firm size resulted in a 28 percent change in product innovation from large to small and a 5.8 percent change in process innovation from small to large. Even if there has long been a debate around the extent to which scale influences the innovative behavior of firms, One of the first and most influential contributions came from Schumpeter, who hypothesized that large firms innovate more because they have the resources and financial freedom needed to invest in innovation, and because their market power provides them with a higher capacity to reap the returns from innovation. In contrast, the propensity of small firms to innovate is also lower, since they lack financial resources and face greater obstacles to accessing external financial resources. In contrast to small firms, large businesses can also take advantage of economies of scale and scope in R&D and spread risks over a portfolio of projects. Moreover, the conventional wisdom that small is better for innovation has been challenged by authors like Mandel (2011), who argue that scale is becoming increasingly important for innovation in a globalized world. Also, large firms can more easily attract highly skilled specialists and support the establishment of large R & D laboratories. In addition, large firms can defend their patents more efficiently and can employ specialists to access government funding schemes. But there are
also reasons why large firms might be less innovative. As firms grow larger, they may lose the entrepreneurial dynamism, internal flexibility, and responsiveness to changing circumstances that stand at the core of innovation. An increase in bureaucracy, a higher degree of risk aversion, and a lack of appropriate incentives prevalent in large firms can make them less innovative than smaller, more agile companies. When firms become larger, they may develop more layers of corporate hierarchy; their decision-making processes become longer, leading to slower reaction times; decisions are often controlled by risk-averse accountants, and managers become bureaucrats that lack the necessary dynamism to innovate. In such contexts, it will be difficult to generate radically new ideas and turn them into business opportunities.

5. Conclusions And Policy Implication

This study aimed to look into the conditions under which innovation is conducted in Ethiopian firms. It was primarily concerned with demonstrating how various factors influence the conduct of innovation in Ethiopian firms in greater depth. What factors drive innovation in Ethiopian firms? Results from the pane model show that participation in research and development, as well as training, are factors that influence all types of innovation, including production, process, marketing, and organizational innovation. In addition, education has an impact on process and marketing innovation. in order to improve innovation at the firm level. Firm owners and the government spend more on research and development in areas like joint projects with higher education and the creation of a research and development department within the company to boost firm-level innovation and rewording for workers who generate new ideas to promote training for workers. and also the development of their own website that has a high level of participation in innovation, research, and development.

Declarations

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Competing Interests

Mr. Abebaw is a Ph.D. student, and they have no financial common interests. He's concerned about the graduate school profile. Abebaw is advised by several authors. but all the authors have no relevant financial interests.

Author Contributions

Mr. Abebaw Abibo developed the working concept and design. The author performed material preparation, data collection, analysis, and writing the initial draft of the publication. Mammo Muchie (professor), Dr. Zerayehu Sime (associate professor), and Dr. Wondumhunegn Ezezew (associate professor) all provided feedback on earlier drafts as well as the final product. All of the authors read and approved the final manuscript.

Availability of data and materials

The World Bank's enterprise survey provided data.

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Above all, I want to thank God for his unfailing love and support throughout my life. I'd like to extend an invitation to AfricaLics to review and comment on the paper.

References


Annex

Annex 1 to 4 are available in supplementary section

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Annex14.docx