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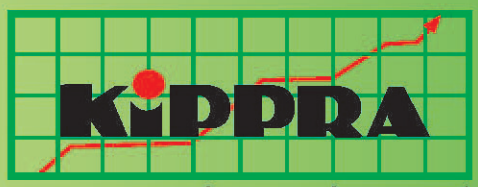

The KENYA INSTITUTE for PUBLIC POLICY RESEARCH and ANALYSIS

The Nexus Between Innovation Gap and Firm Ownership in Kenya: A Gender Approach

Beatrice Kinyua
Miriam Mwiti

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THE KENYA INSTITUTE FOR PUBLIC POLICY RESEARCH AND ANALYSIS (KIPPRA)

YOUNG PROFESSIONALS (YPs) TRAINING PROGRAMME

The Nexus Between Innovation Gap and Firm Ownership in Kenya: A Gender Approach

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Kenya Institute for Public Policy
Research and Analysis

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This paper is produced under the KIPPRA Young Professionals (YPs) programme. The programme targets young scholars from the public and private sector, who undertake an intensive one-year course on public policy research and analysis, and during which they write a research paper on a selected public policy issue, with supervision from senior researchers at the Institute.

Abstract

This paper sought to explore the gender gap in innovation among firms in Kenya. The study's objective was to determine the extent of the gender innovation gap for male-owned and female-owned firms, and the factors contributing to this gap. Subsequently, the study incorporated the Blinder Oaxaca decomposition technique adopting the extended non-linear regression version by Fairlie. Cross-sectional data used was sourced from the World Bank Enterprise Survey 2018. The findings highlighted that the probability of female owned-firms to innovate was lower than that of male-owned firms, an indication that there was an innovation gap. Further, it was established that male-owned enterprises had better innovation outcomes as they possessed resources that female-owned firms did not have. These resources include hiring of an experienced top manager who may require large compensation, thus hindering female-owned firms from recruiting due to the associated financial resource constraints. Additionally, there were unobservable factors that formed a larger portion of the innovation gap, indicating that there were structural biases that favoured male-owned firms to be innovative over female-owned firms. These structural biases are often associated with discrimination. These findings therefore shed light on gender inequalities that exist in the context of innovation. There is need for policy makers to promote gender equality by advocating and formulating policies that address structural biases, thus creating a level playing field in terms of promoting impartiality in innovation among male-owned and female-owned firms in Kenya. Reducing the unobservable structural biases that accounted for a higher share in gender innovation gap would significantly reduce the innovation gap in Kenya.

Abbreviations and Acronyms

AGPO	Access to Government Procurement Opportunities
ARIPO	African Regional Intellectual Property Organization
AU	African Union
AUC	African Union Commission
BEEPS	Business Environment and Enterprise Performance Survey
CUE	Commission on University Education
GGI	Gender Gap Index
GII	Gender Inequality Index
GoK	Government of Kenya
GPI	Gender Parity Index
ICT	Information Communication Technology
ITC	International Trade Centre
KENIA	Kenya National Innovation Agency
KNBS	Kenya National Bureau of Statistics
NACOSTI	National Commission for Science, Technology and Innovation
NGAAF	National Government Affirmative Action Fund
NRF	National Research Fund
OAPI	Organization Africaine de la Propriété Intellectuelle or African Intellectual Property Organization
OECD	Organization of Economic Cooperation and Development
SDGs	Sustainable Development Goals
STEM	Science, Technology, Engineering and Mathematics
ST&I	Science, Technology and Innovation
STISA	Science, Technology and Innovation Strategy for Africa-2024
TVET	Technical Vocational Education Training
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
WEF	World Economic Forum
WEI	Women Empowerment Index

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1. Introduction

Innovation is a key economic development factor that affects productivity and competitive advantages at both the firm and national level. According to the Oslo Manual, innovation is the introduction of new products and processes by a firm or organization (Organization for Economic Co-operation and Development-OECD, 2018). Globalization has propelled economic systems around the world into innovation as industries seek to remain competitive and enhance their productivity (Muigai and Gitau, 2018). However, due to the capital-intensive nature of innovation, many firms miss out on this requisite activity and do not fully participate in this evolving competitive space. This results into an innovation gap, which refers to a situation in which there is disparity between a firm's goal of creating new products or processes and the actual performance of doing so in the business (Dalziel, 2010; Gittelman and Kogut, 2003; Dasgupta and David, 1994).

The Sustainable Development Goals (SDGs) have mandated the adoption of a gender lens assessment in analyzing key economic and social issues that have been assumed to be gender neutral. Taking cognizance of the importance of gender equality, it is essential for societies to empower both male and female to contribute fully to economic development (OECD, 2018). This will in return contribute to the elimination of the gender gap, which is a measure of gender equality subject to the relative gaps between male and female in key aspects such as education, policy and the economy among others (World Economic Forum-WEF, 2021). Therefore, there is need to eliminate all kinds of discrimination against women, hence empowering them by providing equal opportunities (UN, 2015). In developed countries, the presence of gender diversity has led to a positive impact on innovation (Ritter-Hayashi, Vermeulen and Knoben, 2019). However, developing countries have been characterized by lower levels of gender equality, thus it is yet to be established whether there are any positive outcomes of gender diversity on innovation.

The contribution of innovation to businesses is crucial as firms that adopt technologies in their operations can navigate against the dynamic challenges (OECD, 2010). Globally, female entrepreneurs have been operating in firms that utilize minimal innovation in that they are mostly in the retail sector, while male entrepreneurs are more likely to be in manufacturing where innovation is rampant (World Bank, 2019).

In Africa, Science, Technology and Innovation have been identified as vital tools and enablers to propel the continent to sustainable development (African Union Commission- AUC, 2014). Similarly, the African Union (AU) adopted a protocol for women's rights championing for equality and women empowerment. The

AU Agenda 2063 proposed the formulation of a 10-year strategy to guide the realization of an inclusive and sustainable growth through Science, Technology and Innovation (ST&I). In this regard, the Science, Technology, and Innovation Strategy for Africa (STISA - 2024) was developed as the continental long-term strategy seeking to transform Africa into a knowledge-based and innovation-led economy (AUC, 2014). So far, the Strategy has enabled the realization of key deliverables, such as the development of infrastructure and enhancement of technical capabilities across Africa. Most notably, there has been the establishment of research funds aimed at mobilizing financial resources for innovation, rather than depending on external funds. An example is the Kenya National Research Fund (NRF).

Narrowing down to Kenya's Vision 2030, the national development blueprint, Science Technology and Innovation (STI) has been outlined as a foundation to its three pillars. In alignment to the AU Agenda 2063, the Vision seeks to rapidly transform Kenya into a knowledge-based economy, thus elevating its global status to a middle-income country. The Kenya Vision 2030 also emphasizes mainstreaming gender into all socio-economic strategies. Historically, women compared to men have had less access to resources. Consequently, there has been disparity in innovation among male-owned firms and female-owned firms, thus portraying a gender gap (UN Women, 2019).

Innovation has immense benefits to society, but inadequate participation by women neutralizes the full realization of the same. When innovation is viewed with a gender lens, the untapped potential is discovered and this aids in transforming both men's and women's lives. However, society has ignored that all socio-economic systems are deeply gendered. As a matter of fact, all societal aspects are characterized by not only differences between men and women but also inequalities. Focusing on innovation, there has been a gender gap that arises from systemic barriers that have impeded women's participation in the same (UN Women, 2019).

The gender innovation gap has constrained efforts to achieve gender equality and women empowerment. A Women Empowerment Index (WEI) that was recently developed for the first time in Kenya to statistically gauge the level at which women have been economically enabled indicates that only 29 per cent of women are empowered. Those in urban areas having twice as much likelihood of being empowered at 40 per cent than those in rural areas at 22 per cent (Government of Kenya, 2020). With the level of women empowerment nationally yet to reach a substantial 50 per cent, this has prevented them from becoming developers and consumers of technology that would have addressed their needs. The key reasons as to why women-owned firms have had minimal attempts to access and

use innovation include inadequacy of resources such as technical skills, property ownership, financial challenges and socio-cultural discrimination. These factors are essential for active participation in innovation.

Under property ownership, African women rarely get to own their own pieces of land (Mutume, 2005). Subsequently, the total number of land titles issued between 2013 and 2017 shows that only 10.3 per cent of the titles were issued to women, while 85.6 percent of the titles were issued to men (Kenya Land Alliance, 2018). Additionally, these lands owned by females are relatively smaller and less fertile compared to those of males (Mutume, 2005). As a result, women tend to have inadequate collateral for taking up loans (Ravazzini and Chesters, 2018), which is required to boost capital, hence their contribution to innovation within the entrepreneurial sector is minimal. Moreover, women in Kenya have poor access to finances, a phenomenon clearly outlined by gender disparity in financial inclusion where males have 85.6 per cent access to finances compared to women with only 80.6 percent (KIPPRA, 2020).

Similarly, there are only 15 per cent of women participating in STEM courses at the higher education level in Kenya (CUE, 2019). This poor enrollment in STEM has biased women from utilizing the scientific knowledge required for active participation in innovation (World Bank, 2017). The overall effect is that there is limited adoption of innovation by female-owned enterprises, as they are biased from utilizing such scientific literature for innovative ideas.

In addition, cultural factors have also played a part in impeding women's participation in innovation. These include outright denial to access education due to early marriages and teenage pregnancies, perceptions that educating the girlchild does not have economic benefits, and that working in some sectors is viewed as a taboo. Social responsibilities such as unpaid care work, inflexible work schedules have hindered women's efficient participation in innovation. In Kenya, both the paid and unpaid work by women account for 1.4 hours for every hour worked by men (Action Aid, 2013). Women work 5 hours longer than men, which is an average of 13 hours compared to 8 hours by men (Ellis, 2007), yet they are paid less at Ksh 62 for every Ksh 100 earned by a male for similar work (World Economic Forum, 2015).

Under Article 10 of the Constitution of Kenya (2010) on National Values and Principles of Governance, the concepts of equality, equity, inclusiveness and non-discrimination all point to the core target of SDG 5 on gender equality. Attaining equality will eliminate the gender innovation gap, allowing for better innovations that meet the needs and wants of all beneficiaries. Understanding and addressing the dynamics of the innovation gap between male- and female-owned firms will be responsive to the specific needs by the two groups. Therefore, the study aims to

determine the extent of gender innovation gap for male-owned and female-owned firms in Kenya, and to evaluate the factors contributing to the gender innovation gap.

The remainder of the paper is organized as follows: Section 2 provides the stylized facts on the key resources required for innovation, gender stereotypes and cultural norms, and a review of the existing policies. Section 3 outlines the theoretical and empirical literature review. Subsequently, section 4 presents the methodology while section 5 outlines the findings and discussions. Section 6 of this paper highlights the conclusions and recommendations of the study.

2. Innovation Resources, Gender Stereotypes and Cultural Norms and Policy

2.1 Key resources required for innovation

Innovation in a firm is dependent on various factors. However, several barriers have affected the ability of women to navigate technology and innovation, among them being the insufficient education and training and inadequate ownership of resources such as capital, land and access to finances (Gichungi et al., 2020). Biscione, Boccanfuso, Caruso and de Felice (2021) highlights that the acquisition of knowledge and skills through education and training has had a significant effect on innovation. Gender Parity Index (GPI) has been used as a proxy for measuring the level of acquisition of information and technology uptake, and is measured as the ratio of female to male students enrolled at different levels of education (UNESCO, 2005). A GPI equal to one indicates equality in enrolment between male and female learners. If the GPI is lower than 1, it signifies that males are favoured over females in enrolment while if GPI is more than 1, females are favoured over males.

In Kenya, data from 2019 indicates that there was equality in secondary school enrolment as the GPI was equal to 1 (Kenya National Bureau of Statistics -KNBS, 2020). This indicates that both boys and girls were fairly enrolled within secondary schools. However, at the tertiary level, there has been disparity in enrolment of male and female students over the years. Table 1 highlights the enrolment by gender at the Technical and Vocational Education and Training (TVET) institutions in Kenya.

Table 1: Enrolment and Gender Parity Index for TVET institutions in Kenya

Year	TVET Enrolment		TVET Enrolment Gender Parity Index
	Male	Female	Total
2015	79,846	52,927	0.660
2016	91,209	74,432	0.820
2017	125,291	101,356	0.810
2018	157,971	126,535	0.800
2019	186,252	142,268	0.760

Data Source: Kenya National Bureau of Statistics (2020)

TVET enrolment signifies that male are favoured over female as GPI has been less than 1 in the period between 2015 and 2019 (KNBS, 2020). Similarly, in Kenyan universities, enrolment has been in favour of male students compared to that of their female counterparts, as GPI has been less than 1 over the period 2015 to 2019

(KNBS, 2020). Further, a report by the Commission for University Education-CUE (2019) indicated that enrolment in both public and private universities by gender was 58 per cent male and 42 per cent female. This disparity in enrolment at the tertiary level indicates lower acquisition of technical skills by female, which are essential in spurring innovation.

This can further be illustrated by the dismal female to male enrolment in Science, Technology, Engineering and Mathematics (STEM) courses at the higher education level. STEM courses are categorized as the fields of Natural Science, Mathematics and Statistics, Information and Communication Technologies and Engineering, Manufacturing and Construction (OECD, 2017). The overall STEM enrolment Gender Parity Index (GPI) was 0.43, indicating that universities favour male enrolment to female as shown in Table 2 (CUE, 2019). In Engineering, Manufacturing and Construction, the GPI was lowest at 0.28, showing that there are more male enrolled in the course over female. Opportunities in engineering and natural sciences have been found to equip the entrepreneurs with technical know-how needed for innovation. However, female are less likely to complete degrees in natural sciences and engineering (Marvel et al., 2015). The total number of females enrolled in all STEM courses in Kenya is only 15 per cent (CUE, 2019). This figure is much lower than that of the global number of female students participating in STEM courses at 30 per cent (UNESCO, 2017).

Table 2: Enrolment in STEM courses at public and private universities in all field of study (PhD, Masters, Postgraduate, Bachelors, Diploma)

Cluster	Male	Female	STEM Enrolment Gender Parity Index
Engineering, Manufacturing and Construction	23,672	6,642	0.280
Information and Communication Technology	25,784	10,668	0.410
Natural Science, Mathematics and Statistics	31,574	18,097	0.570
Total STEM Enrolment	81,030	35,407	0.430

Data Source: Commission for University Education - CUE (2019)

Generally, this is an indication that males are favoured in acquiring the requisite skills and technical know-how at the tertiary level than the female. The overall effect is that there is limited uptake of technical knowledge by females compared to males, and this limits their ability to utilize complex technologies.

Other determinants of innovation include the choice of the sector male-owned and female-owned firms operate in. A report by the International Centre for Research

on Women (ICRW) established that in 2019, the number of women formally employed in Kenya's manufacturing sector was 17 per cent compared to men at 83 per cent (Mugyenyi et al., 2020). This phenomenon highlights the disparity of employment within the sector. Additionally, an assessment of self-employed business persons portrays a similar finding. There are more men entrepreneurs within the manufacturing sector where innovation is rampant, whereas female entrepreneurs are more likely to be found within the retail sector where minimal innovation is required (World Bank, 2019). Moreover, studies have purported that female entrepreneurs are more likely to start up a business and innovate in the service sector rather than the manufacturing sector (Blake and Hanson, 2005).

A Business Impact Survey was carried out on 4,964 businesses globally in 136 countries to gauge the differences in outcomes for male and female-owned businesses amidst COVID-19. The findings indicated that the impact was higher in female-owned firms at 64 per cent in comparison to their counterparts at 52 per cent (International Trade Centre - ITC, 2020).

Figure 1: Impact of COVID-19 on female-led and male-led firms

Data Source: International Trade Centre (2020)

This is an indication that female-owned firms were highly sensitive to disturbances such as the pandemic than male-owned ones and that they had little cushion to support them during such adversities. The same study was able to highlight that women-owned firms had inadequate capital and finances to mitigate against external shocks such as COVID-19 (ITC, 2020).

The choice of the sector in which one operates was found to be linked to inequality of opportunities (Marvel et al., 2015; Sabarwal et al., 2009). Therefore, female

entrepreneurs are likely to be found in industries that require low innovation due to shortage of technical skills required to innovate. In this regard, as studies have indicated, female-owned firms in Kenya are therefore confined to specific stereotypical roles such as hairdressing industry, hotelier business and caregiving, among others.

Innovation has also been linked to the willingness to take on risk. This is because entrepreneurial innovation involves a lot of risk and uncertainty on the invested returns. Female entrepreneurs have been associated with minimal risk as they tend to be risk averse, unlike their counterparts who are risk takers in nature (Hillesland, 2019; Klapper and Parker, 2011; Sabarwal et al., 2009). Additionally, men have been found to have a higher risk-taking propensity to women, and thus a significant gap between male and female (Muller, 2004).

The top leadership of a firm has also been linked to the innovative stance that the business would take. There have been contradicting findings over the years by researchers on the implication of having either a male or female top manager in firms. Some studies have purported that firms that are led by transformative male managers are more prominent to have the workforce inspired to be innovative (Reuvers et al., 2008). In contrast, however, other studies show that female top managers positively influence a firm's innovative decisions (Ritter-Hayashi, Vermeulen and Knoben, 2019).

Most profoundly, access to resources is also deemed to be crucial in supporting a firm's capacity to innovate. One important dimension to the innovative capability of a firm is access to financial resources, which may hamper innovation by firms (Idris, 2009). Women entrepreneurs have been on the tail end of accessing finances, thus impeding their participation in technological innovation due to the capital-intensive nature required to innovate (Honohan and Beck, 2007). Historically, female entrepreneurs have faced cumbersome challenges in accessing financial credit (Buvinic and Berger, 1990). In addition, inadequate resources in terms of land ownership have played a crucial part in limiting women's access to finance as they do not have collateral against the credit applied for (Ravazzini and Chesters, 2018).

The situation is dire in Sub-Saharan Africa, where only one in five households have access to formal financing options (Honohan and Beck, 2007) and the rate of financial literacy among women is very low (Lusardi and Tufano, 2009). Narrowing down to Kenya, the rate of financial inclusion highlights that there is a gender disparity where 85.6 per cent of male have access to finances while only 80.3 per cent of females have access to finances (KIPPRA, 2020). This phenomenon explains the gender gap in access to finances that is translated to a gender gap in innovation.

2.2 Gender Stereotypes and Cultural Norms

Gender perspective is crucial in defining the role that male and female play in societies. These gender perceptions impact the choices made by society towards men and women. There exists gender stereotypes and cultural barriers that pose impediments on how opportunities are extended to both male and female, and hence affecting their participation in technology and innovation. Traditionally, women-owners have faced numerous disadvantages that are more rampant to their firms compared to male-owned firms. These disadvantages include inadequate flexible work policies, poor wages, low job tenure and absence of training (Castellano and Rocca, 2020; Smeaton et al., 2014; Kahn et al., 2014). Additionally, sexism in some countries has manifested, whereby parents invest less in a girl's education as there are no perceived benefits in doing so (United Nations - UN, 2003). This is mainly because jobs are economically beneficial to men compared to women in terms of pay, and that once a woman is married, these returns will be enjoyed by the husband's family (UN, 2003).

Insufficient mentorship for the girls and women by role models in the technical fields has also contributed to the gap in their enrolment to STEM courses. In Sub-Saharan Africa, the tech industry comprises of less than 30 per cent of women professionals (UN, 2003). This has resulted in a fragmented approach to holistically establish a support system for mentorship and networking. In addition, some social and cultural norms have been found to bar females from ownership of productive assets such as land, which has further widened the gender asset and wealth gaps (Doss et al., 2014; Deere and Doss, 2006; Mutume, 2005).

On the other hand, men have been perceived to be the dominant decision-makers within the society. Therefore, ideas by women are rarely given an ear (Cooper, 2012), notwithstanding that there is discrimination against women who own or manage businesses as they are viewed to be domineering by being assertive since such practices are reserved for males.

Further, social responsibilities may also hinder the entrepreneurial creativity and innovation of women due to the time they are engaged in unpaid domestic duties such as cleaning, food preparation, childcare and care for the elderly among other duties (Sabarwal et al., 2009). Additionally, inadequate flexible work policies have also hindered the efficient participation of women within the entrepreneurial sector. This is because they have devoted their time to unpaid domestic work. Similarly, the different sectors in which male and female entrepreneurs venture into are also culturally stratified, as there are jobs that are termed as a taboo for women to be working in (UN Women, 2015). In turn, these adversely impact the operations within their businesses and their ability to be innovative amidst such challenges.

2.3 Policy Review

Table 3: Policy Review

Policy	Objectives	Focus on Gender and Science, Technology and Innovation (ST&I) Policies	What has been done	Gaps
Global Policies				
Sustainable Development Goals (SDG 5) on Achieving Gender Equality and Empowering all Women and Girls[1]	To terminate any kind of discrimination against women and girls and enhance the involvement of women at decision-making levels through provision of equal opportunities	• Among the targets, there will be the establishment of reforms within the national laws to ensure equal rights by women in accessing economic resources, land and financial services • Another target is to strengthen the usage of Information, Communication and Technology (ICT) to augment and reinforce the empowerment aspect among women	There has been the administration of legislative frameworks to proactively advance gender equality	• According to the United Nations Economic and Social Council (2017), women around the globe are yet to make progress in attaining equality as they occupy very marginal and minimal positions in top management, which is less than a third • Due to COVID-19 the gender inequalities have been exacerbated as the pandemic effects are different for men and women (UNFPA, 2020) • Discriminatory social norms are still being practiced

1 United Nations. Sustainable Development Goals. https://www.un.org/sustainabledevelopment/gender-equality/

Policy	Objectives	Focus on Gender and Science, Technology and Innovation (ST&I) Policies	What has been done	Gaps
Beijing Declaration and Platform for Action (BPfA) on Women's Rights[2]	The 1995 agenda for the global advancement of equal rights and human dignity of women and men and women empowerment initiative through gender equality in law and in practice	Among the 12 critical areas: • Education and training was outlined as a critical sector to bridge the gap between women and men in the acquisition of knowledge and change the stereotypes while eradicating the women's illiteracy • Additionally, women and the economy was another sector aimed at ending gender discrimination (low earnings, insure jobs and poor representation in managerial posts) in businesses, firms and any employment • Boost women's access to economic resources such as credit, land, science and technology, ICT, markets and vocational training (UN, 1995)	• 5-year reviews have been conducted to ensure progressive implementation of the Declarations • Revision of the school curricula and policies to have inclusive educational programmes • Promotion of STEM interest among girls to minimize the digital divide among men and women[3] • Programmes created to ensure gender mainstreaming of policies such as the promotion of decent jobs for women and their ability to accumulate resources such as land, among other assets • Training businesswomen on business management and entrepreneurship skills, introducing them to micro-finance credit to ensure their empowerment and self-reliance	• Wage disparity where women still earn 10 to 30 per cent less than men • Only 30 per cent of the global researchers in science are female due to gender discrimination biased pedagogy and limiting education materials[4] • Gender disparity at secondary and tertiary levels widen especially in Sub-Saharan Africa (UN Women, 2015) • There are at least 51 per cent women who are illiterate in Least Developed Nations (UN Women, 2015)

2 UN Women. World Conferences on Women. https://www.unwomen.org/en/how-we-work/intergovernmental-support/world-conferences-on-women.

3 UN Women. 12 Critical Areas. https://www.unwomen.org/en/news/in-focus/csw59/feature-stories.

4 UN Women, 2015. The Beijing Platform for Action turns 20: Education and Training for Women https://beijing20.unwomen.org/en/in-focus/education-and-training.

Policy	Objectives	Focus on Gender and Science, Technology and Innovation (ST&I) Policies	What has been done	Gaps
Regional Policies				
Africa Union (AU) Agenda 2063	Science, Technology and Innovation identified as an enabler to continental development through sustained growth (AUC, 2014)	• Adoption of a Protocol for Women's Rights • Member States to allocate at least one percent of their Gross Domestic Product (GDP) to Research and Development (R&D)	• Establishment of national funds for research by some African countries to mobilize financial resources rather than depend on external sources of funds, e.g. the Kenya National Research Fund (NRF) • Existence of regional Intellectual Property Rights Protocols in Africa including OAPI (Organization Africaine de la Propriété Intellectuelle or African Intellectual Property Organization) and ARIPO (African Regional Intellectual Property Organization) that has facilitated the streamlining of the continent's intellectual property regimes (AUC, 2014) • Research collaborations such as bilateral STIs that call for research proposals (AUC, 2014)	• There is no African country that has attained the target of allocating 1 percent of GDP to R&D e.g. Botswana's R&D expenditure to GDP was at 0.4 per cent in 2005 while South Africa's was at 0.9 per cent in 2005 • Limited opportunities for females in trade, healthcare and industry compared to males • Poor access to land ownership and credit by women • Women who eventually own land end up having smaller and less fertile pieces of land (Mutume, 2005)

Policy	Objectives	Focus on Gender and Science, Technology and Innovation (ST&I) Policies	What has been done	Gaps
Science, Technology, and Innovation Strategy for Africa (STISA) 2024	The 10-year Strategy targets to transform African nations into Knowledge-based and innovation-led economies, hence attaining equal access to nutrition, health, education and training, peace and security among others	• The Strategy outlined various priority areas including efficient communication via intellectual potency. In this regard, the Strategy seeks to promote ICT uptake, access and use. • The Strategy highlights Science, Technology and Innovation (ST&I) as one of the objectives that ought to be attained to address the priority areas identified • Elevation of technical capabilities and institutional capacity to develop ST&I • Further knowledge creation through fortifying Intellectual Property Rights (IPRs) • Forging synergies in innovation and entrepreneurship to strengthen economic gains	• Development of various pillars such as revamping infrastructure to facilitate research and innovation. This includes the launch of living labs and innovation hubs, such as iHub in Kenya and CcHub in Nigeria	• Insufficient technical skills and capabilities, especially in ICT thus constrained human capital (Bartels et al., 2016)

Policy	Objectives	Focus on Gender and Science, Technology and Innovation (ST&I) Policies	What has been done	Gaps
National Policies				
Kenya Vision 2030	Aims at transforming the country into an industrializing middle-income country dispensing a high quality of life to all citizens based on ST&I to elevate the country's global position through rapid technological transformation, hence making Kenya a knowledge-based economy	• Strategies to boost ST&I include strengthening technical capabilities by competent training of personnel, especially post-graduate studies in science and technology • Promote research-industry linkages with actors in productive sectors, hence boosting competitiveness. • Intensification of research in priority areas • Gender is under the Social Pillar of the Kenya Vision 2030, which seeks to mainstream gender aspects in all socio-economic aspects and to promote equity in power and resource distribution between male and female. • The Vision sought to improve access to business opportunities and education for women. • Promote financial support to the female, thus reduction in wage differentials	• Establishment of various institutions such as the National Research Fund (NRF), Kenya National Innovation Agency (KENIA) and National Commission for Science, Technology and Innovation (NACOSTI), among others, thus enhanced coordination of national technology and innovation activities. • Establishment of Centres of Excellence in 3 universities. • Disbursement of funds through the National Government Affirmative Action Fund (NGAAF) geared towards supporting affirmative action activities. • Women Enterprise Fund and Uwezo Fund institutionalized to provide finances in the form of credit to women and equipping them with entrepreneurial skills through training (Government of Kenya, 2018). • Access to Government Procurement Opportunities (AGPO) to offer technical training to empower women in accessing 30 per cent minimum preference on Government procurement	• Funding challenges given that the R&D expenditure to GDP is still below the targeted one per cent. • Mismatch in skills acquired at the university level to that demanded in the industry sector, especially for the extractives sectors

Policy	Objectives	Focus on Gender and Science, Technology and Innovation (ST&I) Policies	What has been done	Gaps
The Kenya Gender Sector Statistics Plan (GSSP) 2019/20–2022/23	To provide a framework of best practice in statistical production and dissemination of gender disaggregated statistics	• Support the monitoring of SDGs through efficient generation and implementation of gender statistics. • To conduct a needs assessment that supports data generation, accessibility and hence an enabling environment via evidence-based policies	• Gender Inequality Index (GII) has narrowed from 0.7 in 1995 to 0.55 in 2018 (Government of Kenya, 2020). • For the first time in Kenya there is a Women Empowerment Index developed that aids in gauging the level of women empowerment in Kenya	• Gender is at the tail end of budgetary allocation by law makers in Kenya due to inadequate awareness on the importance of gender disaggregated statistics for gender equality (Government of Kenya, 2020). • Kenya's Gender Inequality Index (GII) is highest within EAC at 0.55 in 2018 while countries such as Rwanda have a GII of 0.41 in 2018 (Government of Kenya, 2020). • County Integrated Development Plans (CIDPs) are not using data that has gender aspects thus questions on whether policies generated are able to mainstream gender perspectives

Policy	Objectives	Focus on Gender and Science, Technology and Innovation (ST&I) Policies	What has been done	Gaps
Sessional Paper No. 2 of 2019 on National Policy on Gender and Development	The transformation of the Kenyan society from gender-based discrimination in all life aspects	• To attain gender equality and women' empowerment in labour and employment and in education. • The paper targets training of women on how they could access the AGPO opportunities and Affirmative Action Funds enabling them access resources and eradicate poverty. • Targets to secure land rights for women, which could serve as collateral to access financial credit. • Sensitization of the society on cultural attitudes to allow increased participation of women in science and technology and accessing ICT and STEM courses. • Eradicating gender bias in educational materials and the school curriculum, and incorporating role modelling structure within the education programmes	• The Gender Gap Index (GGI), which measures the progress towards parity on a scale of 0 (disparity) to 1 (parity) has improved in Kenya from 0.694 in 2017/18 to 0.7 in 2018/19 (Government of Kenya, 2020). • The Development of a National Gender Sector Statistics Plan (GSSP) has enabled the radical shift on how gender statistics are generated and used to provide evidence-based policies that allow for gender mainstreaming across key policies, plans and legislation at the National and County levels	• There is low uptake of Affirmative Action Funds by women-owned enterprises as only 0.4 per cent of females access these funds (MSME Survey, 2016)

Source: Authors' (2021)

3. Literature Review

3.1 Theoretical Foundation

There are two main theories underpinning this study, which include the preference-driven gap theory and the constraint-driven gaps theory.

3.1.1 Preference-driven gap theory

The preference-driven gaps theory recognizes that there exists differences in male and female entrepreneurship. Specifically, there is an inherent difference in innovation by both male and female entrepreneurs, which occurs due to the choice of industry one prefers to invest in or the willingness to take risk of investing in new products or services. Generally, females are more risk averse than males (Dohmen et al., 2011; Dohmen and Falk, 2011; Croson and Gneezy, 2009) and as a result they are less likely to take risky actions such as producing new products and using new technologies (Carter et al., 2003). However, Marvel et al. (2015) and Sabarwal et al. (2009) contend that the choice of industry may be linked to inequality of opportunities. Additionally, Marvel et al. (2015) argue that female entrepreneurs engaging in innovation activities are likely to encounter industry-specific skills gaps and skills shortages. Therefore, many female entrepreneurs are more likely to be found in industries with low innovation potential, while male entrepreneurs have dominated high technology industries in which technological innovation typically occurs. Literature further indicates that female entrepreneurs are more likely to start up a business and innovate in the services sector, rather than the manufacturing sector (Blake and Hanson, 2005). Considering that entrepreneurial innovation involves significant risks and uncertainty, the gender innovation gap may exist since women are less likely to take risks than men (Hillesland, 2019; Klapper and Parker, 2011; Sabarwal et al., 2009).

3.1.2 Constraints-driven gap theory

The constraints-driven gaps framework theorizes that there are various gender-based constraints that undermine the performances of female-owned firms. Female entrepreneurs have difficulties in accessing financial resources and information that may hamper innovation in their firms (Idris, 2009). Buvinic and Berger (1990) find that female entrepreneurs struggle more with loan applications, while Lusardi and Tufano (2009) finds lower overall financial literacy among women. In addition, some social and cultural norms have been found to bar female ownership of productive assets such as land that has further widened the gender wealth gap (Ravazzini and Chesters, 2018; Doss et al., 2014; Deere and Doss, 2006). Further,

there also exists gender stereotypes and organizational practices that perceive men as dominant decision-makers. Therefore, ideas proposed by women may not be encouraged (Cooper, 2012). More so, if these ideas are heard, they are less likely to be acted upon (Foss et al., 2013). Female participation in innovation may also be hindered by limitation of time spent in running an enterprise and limited mobility due to social responsibilities. As a result, these challenges pose serious impediments to innovation and the overall firm growth for female owned enterprises (Sabarwal et al., 2009).

3.2 Empirical Literature Review

Biscione, Boccanfuso, Caruso and de Felice (2021), using the Blinder-Oaxaca decomposition, investigated the effect of gender ownership on technological innovation at the firm level and highlighted the factors that explain the gender ownership gap in innovativeness for selected transition countries. The study found that human capital and job training activities contribute positively to this innovation gap between the two groups, while tertiary education contributed negative effects. Additionally, sources of knowledge, R&D and external knowledge contributed positively to the innovation difference. Access to financial resources, in form of subsidies, widened the gap while availability of a credit line reduced it. Studies have shown that when smaller firms invest in worker's skills through training, the training was found to boost innovation even in the absence of R&D (González, Miles-Touya and Pazó, 2016). Contrary to this, Rogers (2004) reveals that training in Australian firms did not have a significant effect on innovation.

Na and Shin (2019) in their study focused on the role of gender diversity in promoting a firm's innovation in the Emerging Economies. Using the Business Environment and Enterprise Performance Survey (BEEPS) 2013 data from the World Bank, they applied the Heckman two-stage model to measure the effect of female shareholder percentage, female CEOs, and a female majority of employees on overall firm innovation. The study found that female ownership percentage positively affected firm's individual innovation measures, which included products-related innovations, organizational innovation, marketing innovation and R&D investments except for process innovation.

In a study to investigate the effect of gender diversity and gender equality on firm innovativeness, Ritter-Hayashi, Vermeulen and Knoben (2019) used a binary logistic regression model, with clustered standard errors and incorporated interaction effects in the analysis to account for the moderating effect of gender equality. The study further employed firm size, firm type, R&D and education as control variables given the positive impact they have on innovation. The findings

indicated that gender diversity among firm's owners and workforce, and having a female top manager, benefits innovation in developing countries. However, gender equality did not significantly moderate the relationship. Similarly, Bessant et al. (2002) postulated that smaller enterprises were more likely to adapt technological innovation as they were more agile in terms of adapting to market changes and stay ahead over their competitors.

Dohse, Goel and Nelson (2018) using a logistic regression model and the World Bank Enterprise Surveys data of 2010 and 2016 examined whether firms with female managers or female owners were better at bringing innovations to the market than males in the emerging and developing countries. The study found that female managers were more likely to introduce innovations compared to female owners. Moreover, larger and older firms and those investing in R&D were likely to introduce innovations. Kor (2003) also found that the top manager's experience was critical in seizing new growth opportunities such as innovation. The study further articulated that the managerial experience was attributed to possessing skills and knowledge and, therefore, competence in the top management of a firm (Carpenter et al., 2001; Castanias and Helfat, 2001).

Gender biases in the acquisition of formal education have an indirect effect on innovation activities. Several studies have found a positive association between formal education and generation of innovative products or services (Marvel and Lumpkin, 2007; Fischer et al., 1993). Additionally, formal education was also found to equip the business owners and managers with technical skills to assess and sieve potential innovation opportunities, especially for those in engineering or natural sciences (Marvel et al., 2015). However, despite these benefits, research has found that female entrepreneurs are less likely to complete degrees in natural science or engineering than their male counterparts (Strohmeyer et al., 2017; Marvel et al., 2015). Moreover, women have further been found to face challenges in accessing education, training, and employment (Carrasco, 2014).

Gichungi et al. (2020) posited that the use of technology in farm production exacerbated the challenges faced by women as it led to male dominance in the productive value chains displacing women from the sector. The study used a quasi-experimental approach where the research was conducted both before and after analyzing production, with and without the incorporation of technology. A panel household survey was carried out for the years 2013 to 2014 in Machakos County to find out the effect of adopting a technological strategy on gender roles in production. The findings were that, with the introduction of technology, women's participation and decision-making was reduced as men took over from women because there was an increase in productivity and income. Further, the study also pointed out that women's reduced role in taking up new technologies

was attributed to their inadequate access to land, education, training, financial support and extension services These findings resonate with those of Fisher and Qaim (2012), Njuki et al. (2011), Team and Doss (2011) and Kumar (1994).

3.3 Summary of Literature Review

The two main theories anchoring this study, the Preference-driven gap theory and the Constraints-driven gap theory, are aligned to this study's objectives. From literature, it has been proven that there is a gender innovation gap due to constraints such as access to finances, land ownership and education. Similarly, the gender innovation gap exists due to preferences by male-owned firms to invest in sectors that are more innovation intensive, and risky in nature while female-owned firms invest in the stereotypical feminine sectors that are risk averse and require minimal innovation. Additionally, most studies on the gender innovation gap were focused on the developed economies, and very few on the developing countries, especially Kenya. Correspondingly, the variables chosen to evaluate the gender innovation gap vary across the empirical works, with majority focusing on human capital, job training activities, and formal education, which were found to be positively significant in contributing to innovation. Policy review highlights that there are various gaps at the global level that include gender inequality and discriminatory social practices. Regionally, there is gender disparity in access to education at the tertiary level, mainly in Sub-Saharan African, thus constrained technical skills required for innovation. In Kenya, mainstreaming of gender policies, funding for R&D and gender activities are at the tail end of the law makers' agenda and focus. This study seeks to contribute to the gap in literature by shedding light on the extent to which gender innovation gap in Kenya has been embedded in male-owned and female-owned firms.

4. Methodology

This section discusses the model adopted by the study, the variables and their measurements and the data sources and the descriptives.

4.1 Decomposing Gender Innovation Gap

This study employed the Blinder-Oaxaca decomposition technique (Blinder, 1973; Oaxaca, 1973) to analyze the gender innovation gap for male-owned and female-owned firms in Kenya. Over time, the linear Blinder–Oaxaca decomposition has been reviewed and applied to non-linear estimation models (Fairlie, 1999; 2005; Yun, 2000; 2004; 2005). In this regard, the non-linear decomposition technique by Fairlie (2005) was adopted, since this study's dependent variable was innovation, and it was measured as a binary variable. The technique allows for the decomposition of outcome variables between two groups into a part that is explained by differences in observed characteristics, and a part attributable to differences in the estimated coefficients. The innovation of a firm is measured as a categorical variable observed when the firm reports that it has introduced new or significantly improved products or processes. The binary aspect is demonstrated where 1 is recorded when a firm has introduced new products or processes, and 0 if otherwise. Additionally, an assumption of the Blinder-Oaxaca decomposition technique is that in the absence of an innovation gap, the estimated effects of the male-owned firms and female-owned firms would be equal.

This paper explores the innovation gap, which is measured as a function of human capital, managerial characteristics, firm characteristics and ownership of resources across female-owned firms and male-owned firms. The equation estimated takes the form of:

$$Y_i = \beta X_i + \gamma G_i + \varepsilon_i \qquad (1)$$

Where Y_i represents the outcome variable, which is innovation; X_i is the vector of predictor variables, including human capital (training programmes and number of employees), managerial characteristics (female top manager and top managers years of experience), firm characteristics (industry of operations and number of establishments in the firm) and ownership of resources (access to financial credit and ownership of building); G_i is the binary variable that shows the male-owned firms and female-owned firms; β is the coefficient of the covariates, while γ is the coefficient of the control gender variable.

The first step in the Blinder-Oaxaca decomposition technique by Fairlie (2005) involves the estimation of innovation for the pooled sample and the different

gender groups with the determinants of innovation being human capital, managerial characteristics, firm characteristics and ownership of resources. The equation of the probit regression of the pooled sample is represented as:

$$Y = \propto_k^* + \sum_{k=1}^{k} \beta_k^* X_k + \varepsilon \qquad (2)$$

Where Y represents the dependent variable, innovation; X_k is the vector of covariates for the pooled sample; β^*_k is the coefficient of the covariates of the pooled sample; $\propto^*_k$ is the constant, while ε is the idiosyncratic error term. Further, the separate probit regressions to predict the likelihood of innovation in male-owned firms and female-owned firms are given in equations 3 and 4.

$$E(Y_M) = \propto_M^* + \sum_{k=1}^{K} \beta_{MK} X_{MK} \qquad (3)$$

$$E(Y_F) = \propto_F^* + \sum_{k=1}^{K} \beta_{FK} X_{FK} \qquad (4)$$

Where E stands for Expectation. The second stage of the decomposition involves determining the innovation gap, which has two components, namely: the endowment effect and the coefficient effect. The endowment effect is the portion of the innovation gap, which is usually given when male-owned firms and female-owned firms differ in terms of the attributes. It is attributed to the mean differences of the covariates between the two gender groups, which represents the "observed" component of the study that arises when there is variance in resource endowments such as human capital, managerial characteristics, firm characteristics and ownership of resources.

The coefficient effect is the other portion of the innovation gap caused by the difference between the estimated group coefficients from the average return of the pooled sample. It represents the "unexplained" portion, given as the residual not accounted for by the determinants of innovation. It outlines the difference in returns to the resources invested for innovation to occur in a firm. Therefore, the gender innovation gap "Z" is given as the mean difference of the dependent variable between male-owned firms and female-owned firms:

$$Z = E(Y_M) - E(Y_F) \qquad (5)$$

Substituting equation (3) and (4) to equation (5):

$$Z = \propto_M^* + \sum_{k=1}^{K} \beta_{MK} X_{MK} - \propto_F^* - \sum_{k=1}^{K} \beta_{FK} X_{FK} \qquad (6)$$

The innovation gap between the mean outcomes of innovation for male-owned firms and female-owned firms in equation (6) can be rearranged as equation (7), where the innovation gap is decomposed into endowment effect and coefficient effect, which is further broken down to the male coefficient effect and female coefficient effect.

$$Z = \sum_{k=1}^{K} \beta_k^*[X_{MK} - X_{FK}] + (\propto_M - \propto_k^*) + \sum_{k=1}^{K} [\beta_k^* - \beta_{MK}]\, X_{MK} + (\propto_F - \propto_k^*) + \sum_{k=1}^{K} [\beta_{MK} - \beta_k^*] X_{FK} \qquad (7)$$

The first component of the decomposition represents the endowment effect, explaining the innovation gap portion that arises due to differences in endowments. The second component represents the coefficient effect explaining the innovation gap portion that arises from the "unobserved" portion, given as the residual not accounted for by the innovation determinants. The gap in coefficients is attributed to the fact that, theoretically, female-owned enterprises have worse coefficients than male-owned enterprises. The coefficient effect measures the changes in female-owned firms' outcome as a result of innovation if they possessed similar coefficients to those of male-owned firms. This component measures the unobserved characteristics that may be directly linked to the aspects of discrimination of women by the society. Various forms of discrimination include part-time work, social responsibilities, limited promotions and poor wages (Castellano and Rocca, 2020; Smeaton et al., 2014; Kahn et al., 2014).

4.2 Data and Data Sources

The main data source for this study was the World Bank Enterprise Survey of 2018. The data was cross-sectional in nature as it was collected in the period from May 2018 to January 2019. The World Bank Enterprise Survey data was collected using stratified random sampling focusing on ten counties, namely: Nairobi, Kisumu, Mombasa, Kiambu, Kirinyaga, Kilifi, Machakos, Trans Nzoia, Uasin Gishu and Nakuru. The surveys cover a broad range of business environment topics, including innovation production, access to finance, infrastructure, competition, and performance measures. This study's sample was mainly constituted of firms' innovation uptake based on ownership by gender. The unit of analysis is an establishment, which is defined as the location in which businesses carry out their operation or industrial activities. A firm is comprised of one or several establishments. The sizes of the firms within the study comprised of a varying number of employees, including the small firms with 5 to 19 employees, medium firms with 20 to 99 employees and large firms with over 100 employees. The study consisted of 1,001 observations. However, since the study targeted firms solely owned by males and firms solely owned by females, a sample size of

631 observations was generated. This is because, according to literature, a firm comprised of both male and female owners would pose a challenge in decomposing the gender innovation gap (Blinder, 1973; Oaxca, 1973).

The dependent variable of interest for this study was innovation, which was measured as the introduction of new products and processes based on the definition by Oslo Manual (OECD, 2018). Innovation of a firm is measured as a categorical variable, which is taken to be 1 if a firm has introduced new or significantly improved products or processes and 0 if otherwise. The study's explanatory independent variables are gender, human capital (training for innovation programmes and number of employees), managerial characteristics (female top manager and top manager's years of experience), firm characteristics (industry/sector of operation and number of establishments in a firm) and ownership of resources (share of building owned and occupied by establishment and access to financial credit). A description of these independent variables and how they were measured is discussed below.

Table 4: Study variables, their components and measurement

Variable	Component	Measurement
Innovation (Dependent Variable)	• Product innovation • Process innovation	• Categorical binary (1 innovation, 0 otherwise)
Gender	• Female • Male	• Categorical binary (1 female, 0 male)
Human Capital	• Training for innovation programmes • Number of employees	• Categorical binary • Continuous
Managerial Characteristics	• Female top manager • Top manager's years of experience	• Categorical binary • Continuous
Firm Characteristics	• Industry/sector operation • Number of establishments in the firm (multiple establishments)	• Categorical at level • Continuous
Ownership of Resources	• Share of building occupied and owned by establishment (%) • Access to financial credit	• Continuous • Categorical binary

Source: Authors' computation (2021)

Gender was used to distinguish between male-owned and female-owned firms. The constraints-driven gap framework postulates that gender-based constraints such as access to finance impede the performance of female-owned firms compared to male-owned firms (Idris, 2009). Gender is measured as a dummy variable where respondents that are female take on the value of 1 while male take on the value of 0.

Other variables of interest include training for innovation programmes. From the literature reviewed, it was found that job training activities contributed positively to the innovation gap (Biscione, Boccanfuso, Caruso and de Felice, 2021). Similarly, it was found that investing in workers' skills through training would boost innovation (González, Miles-Touya and Pazó, 2016). Training programmes that were geared towards innovation were measured as a dummy variable, where the responses take the value of 1 if there was training and 0 if no training took place.

Further, another key variable of interest was the number of employees, which is important in determining the human capital aspects of a firm. Biscione, Boccanfuso, Caruso and de Felice (2021) found that human capital contributed positively to the innovation gap. The number of employees is, therefore, measured as a continuous variable. The study also looked at how managerial characteristics affected innovation by firms where the components analyzed were the female top manager and the top manager's experience. Studies have found that having a female top manager would benefit a firm in terms of innovation, especially in developing countries (Ritter-Hayashi, Vermeulen and Knoben, 2019). The female top manager was measured as a dummy variable where the value of 1 was assigned if the firm had a female top manager and 0 if otherwise. The top manager's experience was found to be a crucial factor in seizing new growth opportunities such as innovation (Kor, 2003). In this regard, top manager's experience was measured as the number of years of experience and was captured as a continuous variable.

Additionally, the industry or sector a firm was operating in was another variable that the study adopted to explore the gender innovation gap for firms in Kenya. According to the Preference-driven gap theory, the differences in innovation between male-owned and female-owned firms was due to the choice of industry one prefers to invest in. Generally, it was found that many female entrepreneurs are more likely to be found in industries with low innovation compared to male (Marvel et al., 2015). The industry or sector of a firm's operation was measured as a categorical variable at level. Similarly, the number of establishments in a firm was adopted to highlight the firm's characteristics. Multiple establishments variable was used as a proxy for size of the firm. In this regard, the larger the firm, the more the establishments operating under it and vice versa. Bessant et al. (2002) argued that smaller enterprises were more likely to innovate as they easily adapt to market changes to gain competitive advantage. This study measured whether a firm had multiple establishments and was taken to be a continuous variable.

The study also looked at the ownership of resources as another explanatory variable, which was mainly comprised of access to finances and share of buildings occupied and owned by the establishment. According to the Constraints-driven gap framework, it is postulated that gender-based constraints such as access to

finance impede the performances of firms (Idris, 2009). Lusardi and Tufano (2009) also alluded that the low financial literacy among women hindered them from accessing finances. In this regard, access to financial credit in the study was measured as dummy variable, with firms who had access to financial credit being allocated the value 1 while firms who did not have access to financial credit being assigned the value 0. The ownership of assets from literature was found to be a key factor in innovation as the inadequacy of these productive assets owned by females such as land was found to widen the gender asset and wealth gap (Ravazzini and Chesters, 2018; Doss et al., 2014). The study measured the share of building occupied and owned by an establishment as a continuous variable. This was done by considering what percentage of the building occupied by the firm was actually owned by the firm. In this regard, the ownership of assets was considered as a percentage, measuring what share of the buildings occupied were actually owned by an establishment.

Table 5: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Innovation	631	.494	.500	0	1
Training for innovation	631	1.575	.495	1	2
Number of employees	544	24.884	77.708	1	1000
Female manager	630	1.860	.347	1	2
Top manager experience	624	15.819	11.749	1	65
Industry/ sector	631	4.452	1.885	1	7
Multiple establishments	631	1.819	.385	1	2
Building ownership	626	52.385	49.355	0	100
Credit line	614	1.653	.476	1	2

Source: Authors' computation, 2021

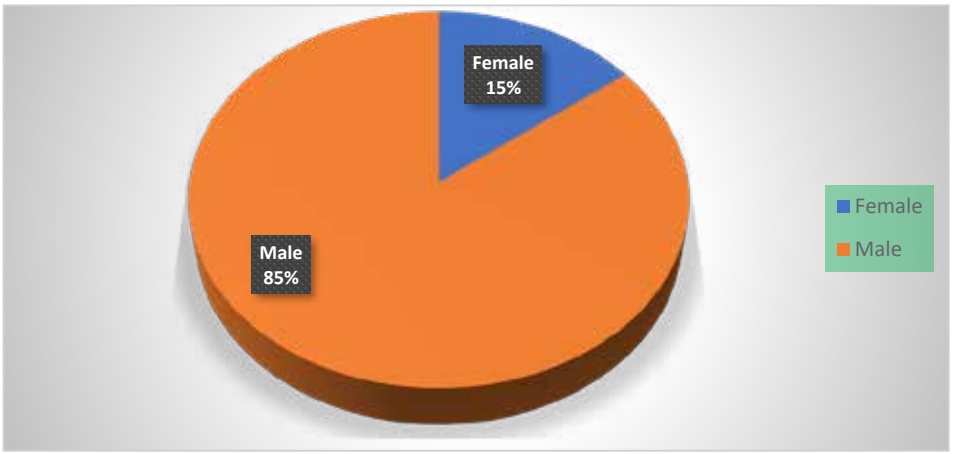
From the descriptive statistics, the average number of employees that firms employed since establishment was an average of 25. Additionally, the average number of years of experience for the top manager was at least 16 years. On average, firms had at least 50 per cent ownership of the buildings where the business was located.

5. Findings and Discussions

Ownership of firm was restricted to firms solely owned by males and those solely owned by females. This was to control for the challenge that may be faced while decomposing the gender innovation gap if there were firms that had both male and female owners (Blinder, 1973; Oaxaca; 1973). In this regard, the total number of observations reduced from 1,001 to 631.

5.1 Descriptive Statistics

Figure 2: Ownership of firms by gender

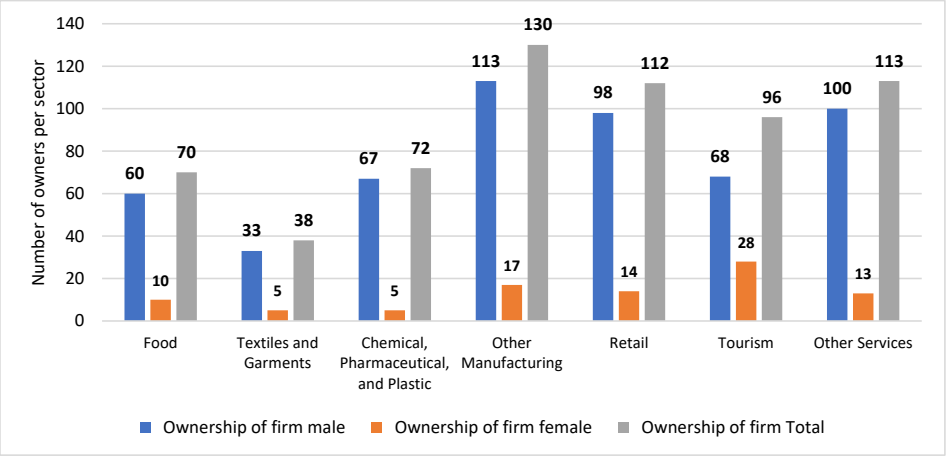


Data Source: World Bank Enterprise Survey (2018)

Out of the 631 firms, only 92 (15%) were solely owned by female while 539 (85%) were solely owned by males. The low level of female representation in businesses is consistent with literature (Ritter-Hayashi, Vermeulen and Knoben, 2019).

There are various sectors in which male-owned and female-owned firms operate. These include food, textile and garment, chemical, pharmaceuticals and plastics, other manufacturing, retail, tourism and other services. The top three industry sectors that had a higher representation of the total firms were other manufacturing, other services followed by retail with 130, 113 and 112 firms, respectively. All sectors were predominantly dominated by male-owned firms with the female-owned firms barely well represented. The above findings are in line with the Preference-driven gap theory, which outlines that differences in innovation between male-owned and female-owned firms are a factor of the choice of industry one prefers to invest in. Similar to empirical literature, these findings denote that many female entrepreneurs are more likely to be found in industries with low innovation potential compared to male (Marvel et al., 2015).

Figure 3: Industry sector by gender



Data Source: World Bank (2018) Enterprise Survey

However, in the tourism sector, there was a higher representation of female-owned firms, which totaled 28 compared to male-owned, which were around 68. These findings align to those of Klapper and Parker (2010), who presented that female-owned firms are mostly constituted within industries that are labour-intensive, such as the tourism sector while male-owned firms are mostly represented in capital intensive sectors such as manufacturing.

Table 6: Pairwise correlation matrix for pooled sample

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Innovation	1.000									
Ownership	0.049	1.000								
Training for innovation	-0.337***	0.001	1.000							
Number of employees	0.066	-0.061	-0.105**	1.000						
Female manger	-0.033	-0.339***	0.007	0.070	1.000					
Top manager experience	0.120***	-0.102**	-0.069*	0.109**	0.196***	1.000				
Industry/ sector	-0.055	0.054	-0.022	-0.163***	-0.078*	-0.112***	1.000			
Multiple establishments	-0.112***	-0.039	0.072*	-0.015	0.013	-0.070*	-0.054	1.000		
Building ownership	0.060	-0.039	-0.035	0.151***	0.049	0.220***	-0.143***	0.028	1.000	
Credit line	-0.043	-0.050	0.137***	-0.073*	-0.038	-0.080**	0.066	0.061	-0.078*	1.000

**** statistically significant at 1%, ** statistically significant at 5%, * statistically significant at 10%*

From the pairwise correlation matrix, training for innovation, the top manager's experience and multiple establishments in a firm were all statistically significant at 1 per cent, indicating that they are correlated with innovation. Correlation ranges from -1 for a perfect negative linear relationship to +1 for a perfect positive linear relationship (Freedman et al., 2007).

The training for innovation is moderately significant at -0.34 but negatively correlated with innovation. The findings suggest that if a firm trains its employees on the development of new products or processes, the firm is less likely to innovate. This is a contradiction of the empirical literature as Biscione, Boccanfuso, Caruso and de Felice (2021) postulated that the acquisition of knowledge and skills through education and training have a significant effect on innovation. However, the findings concur with Rogers (2004) as he found out that training did not have a significant effect on innovation. His argument was that a single observation of training would be a poor proxy for human capital.

The top manager's years of experience was found to be significant and positively correlated to innovation, implying that the more experienced the managers are, the more the innovation developed by a firm. The multiple establishments within a firm were also found to be significant and negatively correlated with innovation. This signifies that a firm that has more establishments does not necessarily mean that they are going to have more innovations. These findings also contravene empirical studies that state otherwise in that the number of establishments contribute significantly to innovation (Ritter-Hayashi, Vermeulen and Knoben, 2019).

Table 7: Difference in mean

Variable	Pooled	Male	Female	Mean Difference
Innovation	0.480	0.550	0.490	-0.070
Training for innovation	1.570	1.570	1.570	0.000***
No. of employees	26.960	13.950	24.880	13.010
Female manager	1.580	1.910	1.860	-0.330***
Top manager experience	16.320	12.930	15.820	3.380**
Industry/ sector	4.410	4.700	4.450	-0.290
Multiple establishments	1.780	1.830	1.820	-0.040
Building ownership	53.170	47.770	52.380	5.410
Credit line	1.660	1.600	1.650	0.070

**** statistically significant at 1%, ** statistically significant at 5%, * statistically significant at 10%*

This study is pegged on the Preference-driven theory and the Constraints-driven gap theory, which allude that there are substantial differences in the operation of male-owned and female-owned firms. These differences arise from the choices made on which industry sector a firm will operate in. Similarly, the difference in the two groups also stem from the limitations faced by a firm regarding endowment of resources such as managerial characteristics, firm characteristics, human capital and ownership of land or capital.

The top manager's years of experience is statistically significant at 5 per cent significance level. The years of experience of a top manager is higher in female-owned firms at around 16 years compared to at least 13 years in male-owned firms. Therefore, this is well expressed by the mean difference, which is an average of at least 3 years.

The mean difference for a female manager is significant at 1 per cent significance level but is negative at 0.33. This is because female managers are employed in larger numbers within male-owned firms than within the female-owned firms. It is equally important to recognize the parity in the training for innovation. This is because the mean difference is statistically significant at 1 per cent, and the value 0 indicates that there are no differences in male-owned firm and female-owned firms when it comes to training for innovation.

5.2 Regression Results

Table 8: Probit regression and non-linear decomposition results

Column 1	Column 2			Column 3
Variables	**Probit Regression Results (Marginal Effects)**			**Non-Linear Decomposition Results**
Innovation (Dependent Variable)	**Male**	**Female**	**Pooled**	**Decomposition Coefficients**
Training for Innovation	-0.854***	-0.754*	-0.689***	-0.004* (0.002)
No. of employees	0.000	0.006	0.0005	0.001 (0.004)
Female manager	-0.071	-0.164	0.210	-0.010 (0.033)
Top manager experience	0.013*	0.005	0.013*	0.012** (0.006)
Industry/ Sector	-0.036	-0.02	0.012	0.003 (0.004)
Multiple establishments	-0.319	-0.105	-0.007	-0.009* (0.006)

Column 1	Column 2			Column 3
Variables	**Probit Regression Results (Marginal Effects)**			**Non-Linear Decomposition Results**
Innovation (Dependent Variable)	**Male**	**Female**	**Pooled**	**Decomposition Coefficients**
Building ownership	0.001	-0.001	0.001	0.002 (0.003)
Credit line	0.085	-0.078	0.183	0.002 (0.004)
Constant	1.767**	1.833		
N	443	84	527	527
Probability of Female Innovation Pr (Y!=0 G=1)				0.467
Probability of Male Innovation Pr (Y!=0 G=0)				0.536
Innovation Gap (Difference)				0.068
Total explained portion of Innovation Gap				0.0068
Total unexplained portion of Innovation Gap				0.062

** p<0.05, ** p<0.01, *** p<0.001*

Three separate probit regressions were estimated to predict the likelihood of innovation in male-owned firms, female-owned firms and the pooled sample. The parameters were estimated using the maximum likelihood method and the marginal effects are as shown in Column 2 of Table 8. The results from the regression depict that the top manager's experience is significant for the pooled sample at 10 per cent significance level. Similarly, the top manager's experience for male-owned firms was also significant at 5 per cent significance level. In this regard, this is a reflection that the managerial characteristics are significant in determining the innovation of a firm for both pooled and male-owned firms. The coefficients are both 0.013 for the pooled sample and male-owned firms, respectively, implying that for every additional year of experience by the top manager, it is more likely for firms to innovate. Most profoundly, both the pooled sample firms and the male-owned firms would innovate at 1.3 percent. This signifies that male-owned firms and the firms within the pooled sample are more likely to access innovation than female-owned firms due to the top manager's experience within the industry's sector. This study's findings are in line with the findings of Kor (2003), who postulated that a top manager's experience was pivotal in contributing to a firm's growth prospects, such as innovation. These findings are also in line with the empirical works of Carpenter et al. (2001) and Castanias and Helfat (2001), who posited that the top managers with vast experience were associated with greater performance within the firms.

Female top manager was insignificant in this study, which is contrary to other studies' findings that have demonstrated how female top managers positively impacted the innovative decisions by a firm (Ritter-Hayashi, Vermeulen and Knoben, 2019). However, the findings that a female top manager was insignificant to influence innovation supports the findings by Na and Shin (2019). Their study conducted on 30 emerging countries found the female ownership percentage to have a positive effect on marketing innovation while the female top manager had a negative impact on process innovation.

Further, training for innovation was also found to be highly significant at one per cent significance level for the pooled sample and male-owned firms. Similarly, training for female-owned firms was found to be significant but at five per cent significance level. The coefficients for the male-owned, female-owned, and pooled sample firms were, however, all negative. This indicates that for a firm to have new products or new processes in their operations, there was less likelihood that training took place. For there to be innovation in male-owned and female-owned firms, there is a less likelihood that there was any training, which is contrary to the study's expectation and other empirical study findings.

Contrary to these findings, González, Miles-Touya and Pazó (2016) and Marvel and Lumpkin (2007) found that there was a positive association between formal training and generation of innovative products or processes. In concurrence to this study's findings, Rogers (2004) found out in his investigation on Australian firms that training did not have a significant effect on innovation. He argues that the training variable was not significant in determining innovation because a single observation of training would be a poor proxy for human capital. Further, he also expounds that the data collected to investigate innovation was for a single year, and that may have affected the observation. Similar to the findings by Rogers (2004), firms in Kenya may have invested in training but due to a short window of observation caused by the cross-sectional data timeframe, the firms may not have registered any innovation.

Following the probit regression, the Fairlie decomposition technique was applied to distinctly identify the differences between male-owned firms and female-owned firms in terms of their individual characteristics and their behavioural effects. The Fairlie technique determines the difference in predicted probability of innovation to occur between male-owned and female-owned firms. Further, the decomposition then evaluates the group differences in the explanatory variable to the outcome variable (Vuluku, Wambugu and Moyi, 2013). The reference group that was considered during the decomposition was the male-owned firms, which implies that female-owned firms were given the characteristics of the males to determine what the gender innovation gap would be.

Column 3 of Table 8 highlights the modified Blinder-Oaxaca decomposition by Fairlie of the innovation gap between male-owned and female-owned firms. The decomposition involves splitting the innovation gap into explained and unexplained coefficients, which elaborates the differences between male-owned firms and female-owned firms due to differences in resource endowment and structural biases. The total number of observations in the decomposition model were 527. Additionally, the probability by female owned firms to innovate was lower at 0.47 than that of male-owned firms at 0.54. These findings converge with the Preference-driven gap theory, which stipulates that there is an inherit difference in innovation by both male and female entrepreneurs. This also supports the empirical literature that contends that female entrepreneurs are more likely to be found in industries with low innovation potential compared to male entrepreneurs (Blake and Hanson, 2005).

The decomposition further highlighted that the gap in innovation between male-owned and female-owned firms was given by the difference in probabilities to innovate as 0.068, resulting from both explained and unexplained factors. The coefficient on total explained factors was 0.0068, which accounts for 10 per cent of the gender innovation gap. Subsequently, the difference between the total gender innovation gap and the total explained factors gives the unexplained value, which is 0.0612. The unexplained value accounts for 90 per cent of the gender innovation gap. This is an indication that the larger proportion of the innovation gap between male-owned and female-owned firms is largely attributed to the unexplained factors. These findings support the hypotheses of this study and are similar to the findings of other scholars such as Barasa (2020).

The explained portion of the gender innovation gap accounted for 10 per cent, implying that the observable characteristics of these study contributed minimally to explaining the innovation gap. The observable characteristics were attributable to the endowment in resources that male-owned firms had over female-owned firms. In this regard, the male-owned enterprises had better innovation outcomes as they possessed some resources that female-owned firms did not have. From the decomposition, these resources include the top manager's years of experience and the multiple establishments of a firm, which were found to be significant in the study.

The top manager's years of experience gave male-owned firms an upper hand in innovation as it was found to be significant in the regression. This is in line with the findings of Kor (2003) that also postulated that a firm with an experienced top manager had higher prospects in innovation. Similarly, Carpenter et al. (2001) found that top managers with more experience drove the firm to better performance due to innovation. In this regard, the findings of this study imply that if female-owned

firms had a top manager with similar or higher years of experience, then there would have been no innovation gap. There is also concurrence with the Constraints-driven gap theory that narrates that various gender-based constraints undermine the performances of female-owned firms. This may be associated with financial resource constraints that hinder female-owned firms from recruiting top managers with higher experience as they would require larger compensation (Barasa, 2020). Additionally, female owned firms are less attractive to skilled managers with higher years of experience because they are largely informal and may not meet the remuneration threshold of such experienced personnel (Barasa, 2020).

Nevertheless, multiple establishments in a firm were found to be significant but had a negative coefficient. Multiple establishments variable was used as a proxy for size of the firm. In this regard, the larger the firm, the more the establishments operating under it. The decomposition results, therefore, reveal that for a firm to have new products or new processes in their operations, there was less likelihood that it had multiple enterprises. Smaller firms had better chances to innovate than larger firms. This study is concurrent with the findings of Bessant et al. (2002), who stipulated that small enterprises are likely to be more innovative due to their agility and ability to adapt to market shifts, thus gaining competitive advantage. Therefore, female-owned firms would have had higher innovation if they had similar coefficients in resource endowments or firm characteristics to the male-owned firms. Closing the gap in factor endowment would reduce the gender innovation gap but not to a large extent.

The unexplained factors, however, showed that there were other structural biases that favoured male-owned firms to be more innovative over female-owned firms. These unexplained factors are determined by the differences in coefficients of the characteristics (Vuluku, Wambugu and Moyi, 2013). The study findings highlight that the unexplained portion of the innovation gap between male-owned firms and female-owned firms totalled 90 per cent, which constituted the largest part of the gender innovation gap. These unexplained portions of the innovation gap as revealed by the decomposition results can, therefore, be termed as the unobservable characteristics (Barasa, 2020). The unexplained contribution or structural effect has been termed as difficult to measure and is often associated with discrimination (Castellano and Rocca, 2020). These forms of discrimination include some structural and institutional factors, part-time work, caring responsibilities, insufficient flexible work policies, limited opportunities for promotions and poor compensation and benefits, among others (Castellano and Rocca, 2020; Smeaton et al., 2014; Kahn et al., 2014). Therefore, it is evident that unobservable characteristics defined by gender perspectives and social norms play a significant role in defining how innovation takes place within male-owned and female-owned firms.

Historically, there has been denial of equality and suppression of basic forms of gender rights contributing to gender discrimination (Shastri, 2014). These forms of discrimination include outright denial to access education, restriction from operating in certain industries or sectors viewed as a taboo and insufficient mentorship and networks from the role models in technical fields (World Bank, 2020; UN Women, 2015). Additionally, women have also faced challenges such as limited access to productive assets, including land (Doss et al., 2014; Deere and Doss, 2006; Mutume, 2005). The social responsibilities undertaken by females, such as unpaid domestic work and inadequacy of flexible work policies hinders their ability in entrepreneurial innovation (Sabarwal et al., 2009). Reducing these structural biases, which constitute about 90 per cent of the gender innovation gap, would significantly reduce the gender innovation gap between male-owned firms and female-owned firms in Kenya.

6. Conclusion and Recommendations

The aim of this paper was to examine the extent of the gender innovation gap for male-owned and female-owned firms in Kenya, and evaluate the factors contributing to this gap. Empirical literature has shown that there has been little empirical evidence on the gender innovation gap for firms in Kenya. This paper has been able to make a significant contribution to explain this gender gap in innovation for male-owned firms and female-owned firms within the Kenyan context. Using cross sectional data from the World Bank Enterprise Survey of 2018, a modified version of the Blinder Oaxaca decomposition technique for non-linear regression by Fairlie was adopted to expound on these concepts. Subsequently, three separate probit regressions were estimated to predict the likelihood of innovation in male-owned firms, female-owned firms and the pooled sample. The probit regression results reveal that the top manager's years of experience and the training for innovation are significant correlates for innovation. Additionally, the findings reveal that the probability by female-owned firms to innovate was lower than that of male-owned firms. These results concur with the Preference-driven gap theory that argues that there is an inherent difference in innovation by both male and female entrepreneurs. Similarly, female entrepreneurs are more likely to be found in industries with low innovation potential compared to male entrepreneurs (Blake and Hanson, 2005).

The low participation of female-owned firms in innovation may be attributed to the results that showed that male-owned enterprises had better innovation outcomes as they possessed resources that female owned firms did not have. These resources include the hiring of an experienced top manager, who may require large compensation, thus hindering female-owned firms from recruiting due to the associated financial resource constraints. Therefore, there is need for inclusive policies that allow female owned firms to access resources such as financial credit that would then translate to the ability to hire qualified human capital and hence narrow the gender innovation gap.

Another central policy question then is what part after decomposition is the gender innovation gap, what extent of this gap is attributable to female-male differences in observable characteristics, and what is the effect of the same? In this regard, the Fairlie decomposition technique was applied to distinctly identify the differences between the male-owned firms and female-owned firms in terms of explained factors and the unexplained factors. The findings highlighted that the overall decomposition defines the innovation gap between male-owned and female-owned firms as 0.068 resulting from both explained and unexplained factors. The explained factors accounted for 10 per cent of the gender innovation gap, while the unexplained factors accounted for 90 per cent of the gender innovation

gap. This highlights that female-owned firms had less probability to innovate compared to male-owned firms, as a larger portion of the gender innovation gap was attributable to unexplained factors.

The unexplained portion of the innovation gap, which are the unobservable characteristics, could be associated with discrimination (Castellano and Rocca, 2020). Social and cultural norms have been found to bar female from ownership of productive assets such as land and that has further widened the gender asset and wealth gaps (Doss et al., 2014; Deere and Doss, 2006; Mutume, 2005). These findings align with the Constraints-driven gap theory that articulates that gender-based constraints such as access to finances, information, land and education may impede the performance of female-owned firms compared to male-owned firms (Idris, 2009; Ravazzini and Chesters, 2018; Biscione, Boccanfuso, Caruso and de Felice, 2021). The findings, therefore, shed light on the gender inequalities that exist in the context of innovation. Policies that promote gender equality may therefore level the playing field in terms of promoting impartiality, and hence empowering women. Additionally, gender-sensitive innovation policies will ensure that Kenyan women are more innovative, hence empowered in their business operations and addressing their needs. Overall, there is need for continuous sensitization of the society on cultural attitudes to allow increased participation of women in innovation, science and technology particularly in accessing education, financial resources and enterprise. The State Department for Gender implementing Sessional Paper No. 2 of 2019 on National Policy on Gender and Development to consider conducting rigorous sensitization campaigns, particularly within the counties to counter the structural biases and hence attain equality in innovation for male-owned firms and female-owned firms in Kenya.

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