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The impact of female entrepreneurship on a country's innovative performance

Supervisor: Daniel Ljungberg

Course Coordinator: Ethan Gifford

Students: Laura Lechner & Lina Hartmann

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Abstract

Purpose – As entrepreneurship is still a traditionally male-dominated field, more research and political initiative is needed to create a level-playing field between women and men in this industry. The purpose of this research, therefore, is to first understand how female entrepreneurship (FE) influences innovation performance (IP) now, and how this effect has changed over time. Moreover, different factors that might have an influence on the relationship are analyzed.

Research Problem – Whereas the interest in and research on FE has been growing over the past years, not many studies have looked at the relationship between FE and IP in particular, especially not on a global scale. As innovation is a key driver of economic growth, it is crucial to understand the impact of women on innovation, as they do make up half of the earth's population, after all, and can therefore meaningfully contribute to a country's economic growth.

Methodology – The research method applied in this paper was an Ordinary Least Squares Analysis (OLS) with two control variables and two moderator variables. The dependent variable was IP, measured by the Global Innovation Index (GII) and the independent variable was FE, measured by the Global Entrepreneurship Monitor (GEM). The control variables were years and countries, and the moderator variables were development stage (DS) of a country and opportunity-driven entrepreneurship (ODE) as a motivational factor. The sample size was 57 countries, observed over a period of 10 years.

Results – It was found that FE has a negative effect on IP overall. Moreover, the negative effect has slightly decreased over time. One explanation of these results is the manifold barriers women are facing when trying to follow an entrepreneurship career. However, both moderator variables – ODE and the DS of a country - have a negative effect on the main relationship, which means that the negative relationship between FE and IP is strengthened even more, indicating that e.g., economies with female entrepreneurs who are highly opportunity-driven have a stronger negative effect on the IP. Moreover, the 'developed' stage of a country was found to be statistically insignificant. The 'developing' stage of a country and the opportunity-driven motive for entrepreneurship were statistically significant.

Significance – The significance of this study is to give a deeper understanding into the impact females make on IP and possible factors that could influence that impact. Its novelty lies in the analysis of a relatively large sample size over time, and in that other studies usually consider economic growth or development instead of IP. The choice of indices allows a very holistic investigation, helping politicians and managers in understanding the impact of women and why this topic contains so many complexities, which makes it a challenge that is not easily mastered.

Limitations – Some of this study's biggest limitations are the choice of indicators (i.e., the GEM and GII indices) that were extremely broad and have their own limitations which makes pinpointing specific factors that influence FE hard. Additionally, not every country in the world could be included, and some data had to be transformed and imputed, which could have affected the analysis.

Keywords – female entrepreneurship, innovation performance, country-level analysis, OLS, opportunity-driven entrepreneurship, innovation, developed countries, developing countries

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List of Abbreviations

ABBREVIATION	DEFINITION
ANOVA	Analysis of Variance
DS	Development Stage
FE	Female Entrepreneurship
IMF	International Monetary Fund
IP	Innovation Performance
GEM	Global Entrepreneurship Monitor
GII	Global Innovation Index
ODE	Opportunity-driven Entrepreneurship
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
SEM	Standard Error of the Mean
TEA	Total early-stage Entrepreneurial Activity
UNCTAD	United Nations Conference on Trade and Development
VIF	Variance Inflation Factor
WIPO	World Intellectual Property

1 Introduction

In today's rapidly changing world, entrepreneurship and innovation have emerged as crucial concepts that hold the potential to drive growth and success in various fields. Due to the complexities of modern society and increasing competition, there has been a notable shift towards developing innovative business ideas among both men and women.

However, it is important to consider gender dynamics when discussing entrepreneurship as traditionally, this field has been male-dominated due to certain societal norms limiting female participation. Despite these challenges, there has been a surge in the number of female entrepreneurs, leading to a growing interest in the impact of female entrepreneurship (FE) on innovation (Global Entrepreneurship Monitor [GEM], 2022a). In the theoretical field, the topic has therefore gained more attention. Literature is now increasingly focusing on FE since many researchers desire to underline its essential contribution to the larger entrepreneurship phenomenon and economic development (Alves et al., 2017; Nissan et al.; Sarfaraz et al., 2014). Also in the economic world the topic has gained interest. It is particularly relevant in light of the current global economic climate, which places a premium on innovation as a key driver of economic growth and development (Rafi, 2022). By now, FE has become a key constituent of the business industry globally. In 2012, approximately 47% of all entrepreneurs were female entrepreneurs (GEM, 2013). However, it is shown that female start-up rates have decreased by approximately 15% between 2019 and 2020 worldwide (GEM, 2022). One significant factor contributing to this trend could be the unfavorable assessment of the enabling environment for female entrepreneurs by national economic experts participating in the Global Entrepreneurship Monitor (GEM) survey across various countries (GEM, 2022). Consequently, it is not surprising that women's participation in entrepreneurship is comparatively lower than men's on a global scale (GEM, 2022). Specifically, while an average of 13.6% of men engage in startup activities, only 10.4% of women do so and generally, more men than women manage or own limited liability companies (GEM, 2022a; Meunier et al., 2022).

Consequently, the motivation to investigate FE has arisen due to the exponentially growing awareness that prior research places on FE (Poggesi et al., 2016). Therefore, it is seemingly alluring to examine the progress of FE as well as its potential future directions. Additionally, it may be interesting and fruitful to analyze its impact on countries' innovation performance (IP). Innovation, as mentioned, is a key driver for economic growth. This is because economic growth can only be achieved by an increase in productivity or population (Rafi, 2022) and an increase in productivity can be achieved by fostering innovation. New, innovative products or services have the ability to create jobs or make existing jobs easier for the workers, therefore increasing overall productivity (Lambrechts & Stacy, 2020). Therefore, it seems crucial for governments to foster innovation in their country if they want to grow economically or keep their economic standard stable. In this paper, the term IP is used when referring to the levels of innovation of a specific country.

Previous studies have explored the link between entrepreneurship and innovation (e.g. Schumpeter, 2000). Also, the connection between FE and innovation has been explored before, however this research is often limited to a review of one country or a country group, like for example developing countries (e.g. Ojong et al., 2021). Moreover, studies have considered the

impact of FE on economic development or growth (Brush & Cooper, 2012; Crane, 2022; Sajjad et al., 2020). They propose that women are crucial for economic development, but that the magnitude of the impact of FE depends on the development stage (DS), cultural norms and infrastructure of a country. As entrepreneurship, innovation and economic development are all closely connected, it is interesting to analyze the relationship between entrepreneurship and innovation, and FE and innovation in particular. Studies have not yet investigated the relationship between FE and innovation on a global scale, limiting our understanding of the complex interactions between entrepreneurship, innovation, and gender in this regard.

1.1 Problem discussion and research question

Despite the growing recognition of the importance of entrepreneurship and innovation for economic growth and development, there is still a substantial gender gap in entrepreneurship. Women entrepreneurs must overcome numerous barriers such as institutional and social obstacles, individual doubts or insecurities, and business-related impediments. These barriers hinder their entrepreneurial activities. Moreover, despite a growing recognition of the importance of entrepreneurship for innovation, and of FE in general, the connection between FE and IP remains a topic that is understudied as mentioned (Nissan et al., 2012). Therefore, comparatively little is known about FE compared to male entrepreneurship even though women do contribute to the gross national product and societal welfare, and they create jobs and innovations (Brush et al., 2010). The importance of understanding the relationship between FE and innovation cannot be overstated, as it can inform policies and programs that aim to promote both gender equality and economic growth. Through this thesis, we seek to examine this vital link by investigating how FE contributes to IP. In addition to that, an examination of the factors that facilitate or hinder women's capacity to innovate is going to be conducted. Our approach will involve a quantitative analysis of existing data through which we will try to proof the influence of FE on innovation. We aspire to bring clarity and depth to this important field of study by means of our research findings.

Therefore, this study aims to address this problem by proposing the following research question:

How does the degree of female entrepreneurship of countries impact innovation performance on a global scale?

This study will explore the relationship between FE and innovation and examine how FE impacts IP. The study at hand is intended to examine whether or not FE has an influence on a country's IP. Moreover, the goal of this research is to determine how the effect of FE has altered over time and if this particular impact varies depending on a country's level of development (i.e., developed or developing) and the motivation behind FE.

To answer this research question, we use a quantitative approach. We will gather data mainly from the GEM, the Global Innovation Index (GII), and the World Intellectual Property Organization (WIPO), to analyze the relationship between FE and innovation. Our objective is to analyze as many cases as possible - ranging from diverse countries - so that our findings can contribute to insights on a worldwide basis. Then, an Ordinary Least Squares (OLS) analysis will be conducted to understand how these two variables interact with each other based on 570

observations. The DS of countries as well as the motivational factors for female entrepreneurs will act as moderators, to explore how these two factors might influence our findings.

In conclusion, this study will contribute to the growing body of literature on entrepreneurship, innovation, and gender by investigating the role of FE in innovation on a global scale. This study seeks to explore the intricate connections between entrepreneurship, innovation, and gender. Its objectives are twofold: to depict the historical influence between 2012 and 2021 of female entrepreneurs on global IP and to offer insights for policies and programs that foster gender equality, economic growth, and innovation in the present and future.

1.2 Structural outline

The paper will be structured as follows: First, the theoretical background will build some general understanding of the topic and help putting the research into context. At the end of the theoretical background, the hypotheses that were developed to test the research question will be formulated. This point is followed by the method, which will go into detail on why we chose a quantitative approach and how we conducted our analysis. After that, the analysis will be conducted, where descriptive statistics will be performed on our variables and the assumptions for an OLS analysis will be tested. Then, each hypothesis will be analyzed in more detail, they will be answered, and our results discussed. The paper ends with our conclusions, where the research question is being answered and implications for future research, limitations and managerial implications will be presented.

2 Theoretical background and hypotheses

In this section of the paper, the theoretical background to the research is described. Therefore, a foundation to the research will be created. To address our research question, we derive hypotheses based on the existing literature on FE and innovation. These hypotheses are formed based on conclusions reached by analyzing the following topics. First, a broad introduction to innovation will be given including the most widely used definitions, its importance, industries that are particularly innovative, government policies to foster innovation, how to measure it and factors that can influence the occurrence of innovation. Thereafter, entrepreneurship in general will be defined and drivers and barriers to entrepreneurship in a broad context are being displayed. Subsequently, the topic of entrepreneurship is narrowed down to FE, as the research question is concentrating on women entrepreneurs specifically. Here, the most common drivers and barriers to FE are being presented. Next, the connection between FE and innovation is being made and discussed. Then the contextual factors influencing FE are being described, followed by the formulation of the hypotheses tested in this paper.

2.1 Innovation

The concepts of entrepreneurship and innovation are closely connected, as entrepreneurial individuals are usually seen as the main drivers for innovation – may it be in the corporate or individual context (Schumpeter, 2000) and because innovativeness is a crucial factor for a business to be entrepreneurial.

Joseph Schumpeter was one of the first economists to highlight the importance of innovation in the 1930ies. He defined innovation by giving five different types: the “introduction of a new product or a qualitative change in an existing product; process innovation new to an industry;

the opening of a new market; development of new sources of supply for raw materials or other inputs; changes in industrial organization" (OECD, 1997, p. 16). An aspect that stands out in these types of innovation is that each of them contains the feature of newness. This is a crucial element when trying to define innovation, which can be seen when looking at later definitions of the term. Thompson (1965) defines innovation as the "generation, acceptance and implementation of new ideas, processes, products or services" (Thompson, 1965, p. 2). Similar definitions to this one have been made in 1986 by van de Ven and in 1996 by West and Anderson. Baregheh et al. (2009) have conducted a literature review including all the common definitions on innovation across disciplines to derive a definition that includes all aspects of innovation: "Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace" (Baregheh et al., 2009, p. 1334). Other than the concept of newness, the aspect of competitiveness is to be highlighted here.

Therefore, the importance of innovation becomes clear; not only is innovation a big driver for companies to stay competitive, through companies staying relevant in the competitive landscape, but it also generates completely new, entrepreneurial businesses. Therefore, new jobs are being created or wages are rising, which leads to increased productivity (European Central Bank, 2017). This highlights the importance of innovation. Economic growth can only be realized either through an increase in population or higher productivity (Rafi, 2022). It is crucial to foster economic growth as a country to come out of recessions and to improve or hold living standards. The International Monetary Fund found a positive relationship between innovation and economic growth (Ulku, 2004). Innovations in the digital and technological fields can have impacts on and spillover effects to many sectors, like infrastructure, health, education and manufacturing (Rafi, 2022). One of the reasons the biggest economies of the world have continuously performed so well is also innovation. 50% of the U.S.'s annual GDP growth can be attributed to innovation (U.S. Chamber of Commerce Foundation, 2015). To get these numbers, it is extremely important for the government and other institutions to promote innovation, for example by increasing its spending on research and development, investing in education and enabling entrepreneurs to start businesses more easily (European Central Bank, 2017). This is another aspect that shows how closely related the concepts of entrepreneurship and innovation are.

There are specific industries that have more innovation potential than others. Therefore, countries that are specializing in these specific industries and spend their money on improving their competitive positions in them have an advantage considering economic growth and living standards. Most broadly, any industry that has to do with technology has extreme innovation potential. Governments often provide essential support to the high-tech industry, which encompasses fields such as medicine, manufacturing, energy, information and professional, scientific and technological services (Low & Isserman, 2015; U.S. Chamber of Commerce Foundation, 2015). Especially high innovation potential was found in the computer and electronic manufacturing, the miscellaneous professional, scientific, and technical services, information and communication technologies, the administrative and support services industries and creative industries (Audretsch & Belitski, 2020; Low & Isserman, 2015). These industries possess the potential to generate high-income jobs not just within their organization, but also in related sectors. A significant reason why these companies prove beneficial for a

region's economy is because of their involvement in business ventures beyond their own state (U.S. Chamber of Commerce Foundation, 2015). The surge and continuing development of internet technology and transportation availability have enabled these corporations to set up shops practically anywhere they desire (U.S. Chamber of Commerce Foundation, 2015). This working procedure results in their fundamental contribution towards promoting an environment of competitiveness, while propelling future economic growth thereby augmenting overall prosperity. To foster innovation in tech-based companies, certain key building blocks are necessary, including a research base that generates new knowledge, mechanisms for knowledge transfer, access to risk capital, a technically skilled workforce, and an entrepreneurial culture (U.S. Chamber of Commerce Foundation, 2015). Here, the focus on entrepreneurship as a crucial factor in driving innovation becomes clear. Johansson et al. (2007) go as far as saying that innovation cannot exist without entrepreneurship. Countries that lack entrepreneurs are less likely to innovate and ergo experience higher productivity and economic growth (Rafi, 2022). Therefore, it is essential for governments to facilitate and enable the creation of innovations in society by promoting these building blocks.

When considering how governments can help foster innovation, government policies are a crucial tool (Johansson et al., 2007). Lundvall and Borrás (1997) propose that it is important to implement policies in such a way that they are vertically integrated, harmonizing trans-national, national and regional instruments and strategies. The policies should complement and support each other to bring about the highest level of innovativeness. Also horizontally, it is important that different policy areas are coordinated, therefore bringing positive synergies to enhance the learning ability in the system (Lundvall & Borrás, 1997). Johansson et al. (2007) have conducted an extensive and holistic research about the possible policies governments can use. Even though their focus was on the policies the EU should apply, their propositions can be applied to non-EU countries as well. Some of the measures they are mentioning are:

- Develop intellectual property rights.
- Provide platforms for university-industry R&D interaction.
- Improve and expand infrastructure to enhance knowledge production, productivity growth, and network benefits.
- Invest in ICT and promote its use.
- Invest in higher education because it provides higher payoffs than primary and secondary education.
- Promote on-the-job training and lifelong learning.
- Increase labor mobility.
- Enhance competition in the financial sector.
- Improve alternative financial aid, such as "business angels", for venture capital.
- Reduce bureaucratic barriers to founding start-ups.
- Support cluster formation.
- Support R&D cooperation between firms, universities, and the public sector.
- Create incentives for university researchers to commercialize their innovations.
- Promote public-private relationships (Johansson et al., 2007).

When implementing some of these many ways on how governments can foster innovation in a country, it is important to also measure the success of these policy tools. Otherwise, governments could potentially invest in the wrong tools or condemn specific tools altogether if they produce no results. Therefore, it is important to look at ways on how to measure innovation on a country-level. Multiple innovation indices exist that try to measure the innovativeness of a country, like for example the GII or the European Innovation Scoreboard. To derive their scores, they each look at specific factors that can help to determine the innovativeness of a country. In its measurement of innovation, the metrics in the GII – which is applied to measure IP in this study - are divided into input and output factors.

Input factors are institutions, human capital and research, infrastructure, market sophistication, and business sophistication. Institutions here covers the institutional framework of an economy, including political and regulatory environments and the business environment. Human capital and research measure the level and standard of education and research activity in an economy. Infrastructure includes sub-pillars for information and communication technologies (ICTs), general infrastructure, and ecological sustainability. The fourth pillar is market sophistication, which focuses on the availability of credit and an environment that supports investment, access to the international market, competition, and market scale (World Intellectual Property Organization [WIPO], 2020).

The output factors are knowledge and technology outputs and creative outputs. The knowledge and technology outputs pillar covers variables typically associated with inventions and innovations. It includes patent applications filed by residents at the national patent office and at the international level, scientific and technical published articles, an economy's number of articles that have received high citations, statistics on the impact of innovation activities at the micro and macroeconomic level, such as labor productivity increases and spending on computer software and statistics on intellectual property receipts, high-tech net exports, exports of ICT services, and net outflows of foreign direct investment. The creative outputs pillar measures the role of creativity for innovation and includes statistics on trademark applications by residents and the most valuable brands, proxies for creativity and creative outputs, such as national feature films produced and creative goods exports and indicators on generic and country-code top-level domains, Wikipedia edits, mobile app creation, and downloads of apps by headquarters origin (WIPO, 2020).

The European Scoreboard uses less indicators than the GII does, the indicators they use to measure innovation are, however, similar to the ones used in the GII. The indicators used in the European Scoreboard cover areas such as education, lifelong learning, scientific publications, broadband penetration, innovation, and patent applications, among others. The indicators are broken down into different categories such as science, technology, and innovation, and are used to track progress towards specific goals and targets (Hollanders & Es-Sadki, 2022).

The importance of measuring innovation becomes clear, especially with regards to government tools. When understanding which indicators contribute most to innovation in a specific country, the government can adjust their innovation policy tools accordingly. However, not only public policy, but also multiple other factors influence how much a country innovates. The OECD has determined spatial, locational, markets and the social environment to be important factors.

Spatial and locational factors can be considered as important, as they consider the company's closeness to labor and product markets and therefore determine the costs and awareness of consumer demand (Krugman, 1991).

Similar to this factor, markets can also be important for a country's innovativeness. The OECD proposes that multiple factors can affect innovation in the market. For example, the demand of customers or users for products can drive different innovations. Firms that research and identify customer wants and needs and therefore innovate towards fulfilling those needs will be more competitive. This would eventually lead to higher innovation levels across the country, as each firm strives to stay competitive. In general, competition is another factor that can drive innovation. If a market is subjected to intense competition and high levels of technological change, this can result in short product life cycles. When having short product life cycles, firms have to update their products often, which results in more innovation. Another market factor influencing innovation is the availability of labor. Certain individuals within the firm are accountable for developing and upholding the internal competencies necessary for innovation. As a result of the crucial connection between human capital and innovation capabilities, it is crucial to focus on the labor market for skilled and highly qualified workers (Cohen & Levinthal, 1990; Grimshaw & Jones, 2012). Additionally, the traits of suppliers who provide goods and services to the firm and finance markets are important factors that not only influence the innovativeness of one firm, but of a whole industry and ultimately can impact the innovativeness of the whole country (OECD).

Moreover, the OECD has found that innovation can be affected by the social context and natural environment in which it exists. The acceptance of citizens towards entrepreneurship and new technologies in general also effects the occurrence of innovation, as there cannot be innovation without people wanting to follow an entrepreneurship career or having an interest in new technologies. The natural environment includes many factors, such as flooding, natural disasters, climate change, water, air, and soil pollution, as well as pandemics. These environmental elements could impact innovation in different ways. They can either drive innovation forward by inspiring firms to address environmental issues through innovative approaches, or they can act as barriers if companies allow these problems to hinder their progress (OECD).

Concluding, the concept of entrepreneurship and innovation are clearly closely connected and affect an economy's productivity and growth. Therefore, it is important to facilitate innovation as much as possible and to consider the factors that influence innovation closely. The next section is going more into depth on the concept of entrepreneurship and will ultimately connect innovation to FE specifically.

2.2 Entrepreneurship

Since various definitions exist throughout society and there is not always consent among these definitions as to what is considered entrepreneurship and what is not (Z. J. Ács et al., 2014), the most influential of these definitions are elaborated on in the following:

First, Schumpeter (1974) mentioned alternative combinations that could lead to entrepreneurial action, like new products or services, new methods of production, new markets, new sources of supply and new forms of organization. Therefore, he perceives an entrepreneur as an

innovative individual whose main intention is defined as carrying out new combinations of means of production (Schumpeter, 1974). Second, Knight (1982) characterizes an entrepreneur as a person making decisions within uncertain environments and conditions, and as a person that needs to inhabit managerial competence. Penrose (2011) and Schumpeter (1974) both identify creative opportunism as another characteristic of an entrepreneur. Therefore, these three characteristics traditionally seem to define an entrepreneur; the ability to deal with uncertainty and risk, managerial competence and creative opportunism. Third, another commonly applied definition, which is also used by the Harvard Business School, was fathered by Stevenson (1983), who defined entrepreneurship as "the pursuit of opportunity without regard to resources currently controlled" (Stevenson, 1983, p. 3). Pursuit in this context means a strong focus over a short period of time, opportunity describes a possibility to introduce an innovative offering that is neither common nor already available in the market and resources currently controlled can be seen as a different term for resource constraints (Eisenmann, 2013). Building on this, Estrin et al. (2013) define entrepreneurs as individuals who aim for creating a new business, with the intention to work independently.

However, even though many researchers argue that the concept of entrepreneurship is yet rather ill-defined and relatively multi-dimensional, many agree on two major stages of entrepreneurship. These two stages are namely 'new entry' and 'innovativeness'. As a consequence, later literature has developed a three-stage-model of entrepreneurship: (1) the entrepreneurial awareness, meaning whether or not an entrepreneur perceives an opportunity to start a venture; (2) sector choice, which discusses the sector an entrepreneur has chosen to operate in due to some industries being more innovative and 'entrepreneurial' compared to others (Marques, 2017; Wennekers & Thurik, 1999); and (3) an entrepreneur's growth aspirations (Estrin & Mickiewicz, 2011).

Compared to the individual entrepreneur's perspective, from a company perspective, definitions for entrepreneurship are manifold but most commonly include the start or creation of a new company, innovation of or new combinations of resources, pursuing opportunities, acquiring essential resources, taking risks, seeking profits, and generating value (Morris et al., 2011). van Praag and Versloot (2007) define an entrepreneurial firm as a firm that fulfills one of the following conditions: (i) having a workforce of less than 100 employees, (ii) being established for less than 7 years, or (iii) being a new player in the market. They include small firms in their definition of entrepreneurship as this is a common practice among entrepreneurship researchers, even though the size of a business does not necessarily define its degree of entrepreneurship (van Praag & Versloot, 2007). This definition therefore excludes corporate entrepreneurship in big companies, which is defined by entrepreneurial activities in an incumbent as opposed to a startup or newly founded business (Morris et al., 2011). For this analysis, the definition of the GEM for defining entrepreneurs is being used, as we are using their index to measure FE. They define entrepreneurship as the act of starting and operating a new business, where entrepreneurial activities in a corporate context are also being excluded (GEM, 2023).

Generally, entrepreneurship is perceived as a fundamental influencer for an economy's growth and its generation of jobs in the present competitive business environment (Apergēs & Pekka-Economou, 2010).

Drivers and barriers to entrepreneurship

To create an environment conducive to entrepreneurship, research has shown the importance of various factors. A liberal market structure and dynamics have been found to be favorable for entrepreneurship, according to a study by van Stel et al. (2007). Additionally, easy access to financing has been identified as a key factor in promoting entrepreneurship (Sandhu et al., 2011; Welsh, 2014). Government policy can also play a crucial role in fostering entrepreneurship. Ahmad and Xavier (2011) and Goby and Erogul (2011) have found that favorable government policies in terms of taxation, funding programs, and a reduction in bureaucratic procedures related to starting a business can help create an environment that is more supportive of entrepreneurship. Furthermore, political and economic stability has been found to be important for promoting entrepreneurship (Lerner, 2010). Conversely, a lack of stability in these areas can create uncertainty, which can discourage entrepreneurs from starting new ventures.

Ergo, a lack of these supportive elements may create barriers for the development of entrepreneurship. Additionally, various cultural and societal aspects can also impact entrepreneurial activities. Research conducted by Davidson et al. (2010) and Shinnar et al. (2012) indicate that there is a substantial correlation between perceptions about entrepreneurship, including the benefits and risks it entails, and actual entrepreneurship activity rates. According to these scholars, people's beliefs can either enhance or discourage their engagement in entrepreneurial endeavors.

Therefore, in order to create an environment that supports entrepreneurship, it is important to consider not only economic and political factors but also cultural and societal factors that can impact the development of entrepreneurship.

2.3 Female entrepreneurship

In the following section, the concept of FE will be analyzed more in detail. The focus of this study is on FE and how it impacts a country´s IP. FE is subject to specific conditions that differ greatly from male entrepreneurship, especially considering the different barriers to entrepreneurship specifically females encounter. Therefore, the drivers and barriers to entrepreneurship for females, are described below. These drivers and barriers can be applied to the institutional environment, the social environment, individual prerequisites, and the business environment. Additionally, the connection between FE and innovation will be made, contextual factors will be regarded, and the hypotheses will be derived.

2.3.1 Drivers and barriers

Despite progress in recent years, entrepreneurship has traditionally been viewed as a domain dominated by men, which has resulted in comparatively limited opportunities and support for women. During the past 30 years, increasingly, literature focuses on FE because many researchers desire to underline its essential contribution to the larger entrepreneurship phenomenon and economic development (Alves et al., 2017; Nissan et al., 2012; Sarfaraz et al., 2014). Still, the question remains whether FE is only a current media craze that will soon fade again, or if FE will reshape the business environment. 47% of all entrepreneurs are female, forming a valid reason for researchers, businesses, and policy makers to be explored (GEM,

2013). GEM (2012) found 126 million female entrepreneurs starting and/or running businesses, while 98 million women are working in already established businesses, which accounts for 224 million women contributing to today's global economy. However, as Meunier et al. (2022) mention, across 81 economies in the period from 2014-2020, there were more men than women who would manage or own limited liability companies. In fact, men made up three out of four new business owners or directors. While the numbers look a little different for sole proprietors, where men make up two thirds and women make up one third, these businesses are usually small scale, low-risk and low profit businesses (Meunier et al., 2022) and still men dominate the field. Therefore, even though changes to the mindset of a male-dominated entrepreneurial world have started to occur, women entrepreneurs still face major challenges and barriers to success. In the following, these differences in numbers are tried to break down to understand where they could stem from.

2.3.1.1 Institutional environment

The institutional environment in which a person is born has a great impact on how their life is shaped in general, and this also holds true for the concept of entrepreneurship. Therefore, looking at the institutional environment is a starting point to understand the differences between female and male entrepreneurship. Factors such as government measures, access to education, technology, and capital, play a crucial rule when considering FE development (Aidis & Weeks, 2016; Aidis et al., 2013). A summary of the institutional factors influencing women are displayed in Table 1 and will be elaborated upon in the following.

Government measures

The institutional environment can be influenced by the government of each country in different ways. As Verheul et al. (2002) mention, the government has the power to impact the quantity and availability of entrepreneurial opportunities through various means such as investments in research and development, privatization, income and competition policies, regulation or deregulation, fiscal incentives, labor market regulations, establishment and bankruptcy policies. Additionally, the government can facilitate the development of individual capabilities and preferences for self-employment through measures such as access to finance, social security, and information provision, as well as by introducing entrepreneurship education in the educational system. By highlighting entrepreneurship in the media, the government can also foster a more entrepreneurial mindset in society (Verheul et al., 2002). Whereas most of these institutional factors have the same impact on men and women, some differences in execution can create gender-specific drivers and barriers. According to Estrin and Mickiewicz (2011) who applied the GEM dataset (2001-2006) for 55 countries, the size of a state sector (i.e., the proportion of the economy that is controlled by the government) considerably negatively influences the effect on high-aspiration female entrepreneurs (i.e., formal gender discrimination). To be more specific, larger state sectors may be associated with lower rates of FE. Thus, the authors suggest that this may be due to higher tax regulations that are characteristic of large state sectors, which could make it more difficult for women to start and grow businesses. To exemplify, an elemental cause is, amongst others, higher tax regulations which characterize large state sectors. Overall, this suggests that while many institutional factors may impact both men and women equally, some factors may have gender-specific effects that create additional drivers or barriers for female entrepreneurs.

Education

Barriers for women entrepreneurs already become apparent early on. Especially, but not only, in developing countries, women receive less education than men, or they have a harder time accessing education in general, but also particularly entrepreneurship education (Ghouse et al., 2017; Huarng et al., 2012). This can lead to women not being aware of the possibility to become entrepreneurs. In this regard, men usually have higher secondary education completion rates than women do, for example in South Asia, where 60% of men have some secondary education, compared to only 40% of women (Meunier et al., 2022). It has been shown that the years of education relate with the number of entrepreneurs, where more years of education result in more entrepreneurs (Meunier et al., 2022). Conversely, an opportunity to promote entrepreneurship among women arises in the education sector by providing a supportive education system, as this can shift the appeal of entrepreneurial activities towards a more positive perception and can encourage women to take the step into entrepreneurship as a career (Dutta & Mallick, 2018; Mehtap et al., 2017).

Technology

Another aspect is the access to technology. 327 million fewer women than men have access to the mobile internet and a smartphone worldwide (Meunier et al., 2022). Especially since the Covid-19 pandemic, multiple people have started to conduct business from their homes, so not providing women with the digital literacy and better connectivity can be detrimental to their entrepreneurial performance (Meunier et al., 2022).

Capital

Additionally, in multiple countries, gender-blind business support measures have still been found to exist, which clearly do not support women's enterprise development to such a degree that they support male's business development (Aidis & Weeks, 2016). For instance, even though there is clear evidence that women are working as efficiently as men when given the same access to inputs and resources (World Bank, 2012), there is a relatively high gender gap due to female entrepreneurs obtaining difficulties in accessing productive resources (e.g., start-capital) and thus, productivity differences as well as formal gender discrimination exist (Estrin & Mickiewicz, 2011). The difficulty in accessing finance is especially prevalent in developing countries (Aidis & Weeks, 2016; Dutta & Mallick, 2018; Førde, 2013; Ghouse et al., 2017; Mehtap et al., 2017; Murad et al., 2019), where the difference in performance between male and female entrepreneurs is also highest (Crane, 2022).

More specifically, the difficulty in obtaining finance is related to start-up capital, which women are less likely to seek (Fay & Williams, 1993), but also to support from angel investors (Becker-Blease & Sohl, 2007) and venture capital. Especially venture capital financing is a male-dominated field. There exists an extreme gap between funding to male funded companies and female funded companies in institutional investors. 80,2% of all venture capital went to all-male founded companies in 2021, whereas only 2% went to all-female founded companies (Stengel, 2021b). Because of the assumption that women do not bear similar technical capabilities as men do, it can be hard for solo female business leaders to obtain funds from VCs for their businesses (Ferk et al., 2013; Furstenthal et al., 2022). However, a partly solution for this problem for women can be to focus on women investors. It has been shown that women

investors are more likely to fund women entrepreneurs, and there are 144 million active, informal women investors available worldwide (Stengel, 2021a). This represents 5% of women worldwide and over 40% of informal investors in the world (Stengel, 2021a), which paints a promising picture.

To this barrier, government support can present a useful tool to lessen the impact and strengthen FE (Murad et al., 2019). Funding support, women-funding-women, impact investment and gender-lens investing are in this relationship all tools government or policymakers can use to promote entrepreneurship (Stengel, 2021a). Additionally, private institutions can promote FE by providing funding support (Førde, 2013).

Table 1: Institutional factors influencing FE.

Institutional environmental factors	
Government measures	Tax regulations that hinder FE.
Access to education	Especially in developing countries: • On average less years of education than men. ➔ Direct relationship with entrepreneurship.
Access to technology	Especially in developing countries: • Limited access to smartphones and the internet.
Access to capital	Gender-blind financing: ▪ Less likely to seek start-up capital than men. ▪ Less likely to seek angel investor funding than men. ▪ Less likely to receive venture capital funding than men.

2.3.1.2 Social environment

Furthermore, social norms, values, and expectations of women play a key role when considering drivers barriers for FE (Aidis & Weeks, 2016). Especially when looking at gendered perceptions, a gender gap in the entrepreneurial environment becomes clear. Hereby, individual perceptions of one's own skills and capabilities, general stereotypes and the availability of role models play crucial roles. The general perception that society holds about entrepreneurship can also prove important to the decision of women as well as men if to become an entrepreneur. Table 2 displays the different social factors that influence FE in a summarized manner, but they will also be explained in more detail in the following paragraphs.

Individual perception

Minniti (2010) and Welter and Smallbone (2003) found that how one's own skills are perceived, the likelihood of failure, as well as existence of opportunities play an important role in determining if females will follow an entrepreneurship career. In this regard, the traditional female roles, images, and stereotypes seem to be especially compelling since they appear to weaken female self-efficacy and potential (Bird & Brush, 2006; Brush et al., 2004; Gatewood et al., 2009; World Bank, 2012). Due to these inherent ideas, women may unconsciously

internalize certain behaviors, thoughts, and attitudes from their early age onwards (Babcock et al., 2003), thereby eventually influencing their personal ambitions in the business environment (Brush et al., 2009). In 2020, 40% of both men and women believed that men are better business executives and have greater entitlement to employment opportunities when jobs are scarce (United Nations Development Programme [UNDP], 2020). This shows the strong effects of internalized stereotypes that women face in the entrepreneurship world. Another example of these internalized stereotypes becomes apparent in the education sector. If women believe entrepreneurship to be a male domain, they might not participate in seminars about entrepreneurship the same, which can lessen the effectiveness of entrepreneurship education towards women in general (Farooq et al., 2021). Nevertheless, traditional female roles and stereotypes do not only get internalized by women themselves, but a country forming its 'entrepreneurial culture' with regards to how a society views entrepreneurship overall, but also females operating in entrepreneurship, taking risks, and owning businesses plays a fundamental role.

Stereotypes

Stereotypes about women in general and in entrepreneurship and male dominance in the field may hinder FE powerfully (Aidis & Weeks, 2016; Farooq et al., 2021; Mehtap et al., 2017; Murad et al., 2019; Özsungur, 2019; Sajjad et al., 2020). The UNDP (2020) found that about 90 percent of men and women hold biases against women, which shows how deeply embedded in society stereotypes about women are.

Women are expected to stay at home with the family, which makes it difficult for them to balance their work and home life (Aidis & Weeks, 2016; Ghouse et al., 2017; Mehtap et al., 2017; Sajjad et al., 2020). However, this stereotype and barrier can also generate a driver for women. Women can be driven by push and pull factors to follow an entrepreneurship career. Pull factors can be recognition, self-esteem, to become one´s own boss, working on own rules and regulations, becoming independent and earning more money. Push factors can be job dissatisfaction, the family's financial condition, child's education and care, and husband's sickness or death (Agarwal & Lenka, 2015). Social media and other low-level technologies enable women entrepreneurs to work and build their business from home (Ghouse et al., 2017), which not only enables them to follow an entrepreneurship career path in general but might even act as a push or pull factor for these women, as they can reconcile family and work life. However, women, especially in developing countries, often face issues of access to these technologies, family support and acceptance towards them following an entrepreneurship career (Ghouse et al., 2017; Murad et al., 2019; Özsungur, 2019; Sajjad et al., 2020). This alone can act as a great barrier but will hinder entrepreneurship completely if it is combined with other, non-social barriers such as constrained mobility (Mahajan & Bandyopadhyay, 2021; Özsungur, 2019) or less access to an entrepreneurial network (Guelich, 2022; Murad et al., 2019), which is the case in some developing countries. Conversely, Neneh and Welsh (2022) find that family support can also be a strong driver for FE.

Women must overcome strong stereotypes related to their gender and support is needed for them to ultimately decide to follow an entrepreneurship career even with strong pull and push factors, as becoming a female entrepreneur may entail "breaking out of the norms" of

traditionally acceptable female behavior (Agarwal & Lenka, 2015; Welter & Smallbone, 2012; Welter & Smith, 2010).

General perception of entrepreneurship

In contrast, there are also some social factors that do not differ greatly between the two genders. Generally, how a society perceives entrepreneurship as a career opportunity can hinder or promote the occurrence thereof. Men and women both generally perceive new business ownership as a high-status job, they have the same perceptions about the ease of starting a business, they think being an entrepreneur is a good career and they perceive media coverage to be favorable for new companies (Stengel, 2021a). These factors can act as drivers for men as well as women to pursue an entrepreneurship career.

Role models

The report by Furstenthal et al. (2022) shows the importance of FE role models in the social environment of the potential entrepreneur. They highlight that inspiration and motivation for other female colleagues is essential, especially in such underrepresented fields like STEM fields, mirroring the barrier found by Guelich (2022) and Murad et al. (2019) that women entrepreneurs have less access to an entrepreneurial network. This also emphasizes again that perceived personal opportunities and capabilities are critical when aiming to shape entrepreneurial activities, as women might perceive themselves as more capable if they can relate to another women that is an entrepreneur already. However, prior literature pointed out that in the US and Developed European countries still 18% of women are less likely to believe in their entrepreneurial capabilities (VanderBrug, 2013). Even though this perception challenges women in the entrepreneurial contexts, it can particularly create an enormous opportunity for an enabling environment, boosting entrepreneurial activity rates.

Not surprisingly, following this, it was found that men are more likely than women to have the intention of starting a business in the first place (Delmar & Davidsson, 2000), which could result from these social environmental factors. Therefore, naturally, more men would be involved in entrepreneurship than women.

Table 2: Social factors influencing FE.

Social environmental factors	
Individual perception	Individual perception of one's own capabilities and skills (or lack thereof) can hinder entrepreneurship.
Stereotypes	Can act as barriers: • Work-life balance • Family support • Acceptance of career choice Can act as drivers: • Family support

Perception of entrepreneurship	Society's perception of a specific career influences decision to follow that career: • Entrepreneurship generally regarded as a 'good' career choice.
Role models	Lack of strong role models and an entrepreneurship network that are needed to promote FE.

2.3.1.3 Individual prerequisites

Besides institutional and social environmental factors, an entrepreneur's individual prerequisites mold their entrepreneurial (or non-entrepreneurial) activities. Clear differences exist in this regard between women and men, especially with regards to their personality traits. The summary to these individual factors can be found in Table 3.

Personality traits

If entrepreneurs possess specific personality traits in comparison to the general population has been researched extensively. It was found that, when comparing the personality traits of entrepreneurs and managers, entrepreneurs generally are more open to new experiences, and have high achievement motivation (Kerr et al., 2018). They were also found to be slightly less agreeable and neurotic than managers (Kerr et al., 2018). Not only are there differences in personality traits between entrepreneurs and non-entrepreneurs, sex differences also do exist. Women tend to be more creative and emotionally aware, while men are generally task-oriented and have a visual perceptual sense. Women have a broader perspective on things, whereas men tend to focus on narrow issues (Ferk et al., 2013). Women are more neurotic and agreeable than men (Schmitt et al., 2009), which could indicate that they are less likely to follow an entrepreneurship career by default, but instead are more fit to be managers. However, the effect of agreeableness and neuroticism on entrepreneurs was only small. It was also found that women exhibit more consciousness than men (Schmitt et al., 2009). Consciousness is composited of achievement motivation and dependability (Kerr et al., 2018), and achievement motivation is an important personality trait for entrepreneurs. The findings on gender differences in openness to new experiences were mixed; in 67% of the cultures considered by Schmitt et al. (2009) men were found to be more open to experience, whereas 33% of the cultures reported a higher openness to experience of women than men. However, men dare to take risks more often than women do, and confidence in men is higher than in women (Smith et al., 2020). Previous research suggests that men are more risk-taking than females, which is an important prerequisite to become an entrepreneur (Heilman et al., 2004).

Consequently, creating a safe, encouraging, and supporting environment for innovation seems to be crucial to get the greatness out of everyone, which ultimately drives innovation and economic growth. Moreover, one should take into consideration that there are always exceptions to the rule, meaning that not every woman or man has the same personality traits and works the same.

Table 3: Individual factors influencing FE.

Individual factors	
Personality traits	Women possess different specific 'entrepreneurial personality traits' from men.

2.3.1.4 Business environment

Women entrepreneurs, as male entrepreneurs, heavily rely on the overall business environment (Aidis & Weeks, 2016). Even though an increasing number of female entrepreneurs with innovative and growth-oriented business ideas would generate greater economic profits and benefits by creating new products or services, as well as jobs, entrepreneurship remains a gender-specific phenomenon (Aidis & Weeks, 2016; Jennings & Brush, 2013). Thus, globally, there are relatively fewer female entrepreneurs starting a company, along with females growing their firms (Kelley et al., 2013). To understand the potential of FE, one can compare it with male-owned and -led businesses. Firm performance, success and operating sectors are compared below and summarized in Table 4. Firm performance hereby describes the economic performance of a company, whereas firm success means the probability of a company surviving or having to be closed.

Firm performance

A study conducted by Crane (2022) compared the economic growth of female-owned and male-owned entrepreneurial firms. According to the results, there was similar performance between female-owned and male-owned firms in developed countries. However, in developing countries, male-owned firms outperformed their female counterparts notably. Despite these findings, the number of female-owned companies remained significantly lower than that of male-owned ones in all countries. These results suggest a noteworthy lack of female entrepreneurs in developed nations where women's performance is similar to that of male entrepreneurs. Support programs and policies have helped women close performance gaps, but there are still barriers that prevent them from entering innovation-related fields or that result in women "leaking" through the talent pipeline. In developing countries, there still are both performance barriers and cultural barriers that hinder women's engagement in entrepreneurship.

Firm success

When considering high-impact entrepreneurs in the US, the success rate of female-owned companies accomplishing a high-impact status is similar to the one of male-owned firms (Tracy, 2011). High-impact businesses are commonly defined as ventures where entrepreneurs leverage market opportunities through innovation as a key driver (Amorós et al., 2013). Here, on the whole, male and female opportunity entrepreneurs have the same probability of introducing new products or services to either all or some customers, thereby creating notable positive effects that have the potential to transform into the world's largest companies (Stengel, 2021a). Nevertheless, the crucial to-be-examined dissimilarity lies seemingly within the overall percentage of firm ownership. Overall, female firm ownership is lower compared to male firm ownership, whilst also women's firm ownership has a negative relation with firm size,

regardless of growth (Stengel, 2021a). This means that the percentage of women's firm ownership decreases if their firm size increases. Firstly, though, it has to be said that companies that are led by women are also generally smaller than companies owned and led by men, which makes them more vulnerable to economic and market disruptions, like for example the Covid-19 pandemic (Stengel, 2021a). The effects of the pandemic were that women in Europe and North America were 50% more likely than men to close their businesses (Stengel, 2021a).

Sectors

Likewise, sectoral differences appear to be fundamental to be taken into account as well to understand gender differences in the business world. Even though some researchers argue that gender differences are rather exaggerated (Nelson & Duffy, 2010), many researchers argue the underlying issue is that the male entrepreneur is taken as the normative ideal and thus, there are sectoral differences and access to resources that influence gendered outcomes (Aidis & Weeks, 2016). Female entrepreneurs are generally expected to engage in the service sector, as well as areas that 'conform' to their roles, such as beauty parlors, the food industry, and sewing (Bates, 1995; Verheul et al., 2006). So, in summary, women tend to work in industries with a lower average (labor) productivity, which, eventually, contributes to the gender gap in earnings (World Bank, 2012). Interestingly, female entrepreneurs who are engaged in male-dominated sectors tend to make similar incomes, however, commonly, male entrepreneurs generate three times more income than female entrepreneurs, operating in female-dominated sectors (Campos et al., 2012).

Correspondingly, even though generally female-owned and -led companies have the same success- and performance-rates as male-owned and -led businesses, women cope with severe barriers to even arrive at this point. The lack of women in leadership positions to growing companies, making decisions in the private sector seriously affect opportunities for female entrepreneurs (Aidis & Weeks, 2016).

Table 4: Business factors influencing FE.

Business factors	
Firm performance	• Same performance of women- and men-led businesses in developed countries • Men-led businesses outperform women-led businesses in developing countries
Firm success	Women's and men's high-impact companies are similarly successful. However: • Women ownership decreases with firm size. • Women own smaller firms in the first place.
Sectors	• Women are expected to operate in sectors that 'conform to their role'. • These sectors generally generate less earnings

2.3.2 Female entrepreneurship and innovation

Indeed, female entrepreneurs often encounter various obstacles on their entrepreneurial journey. However, when they choose to pursue a career in entrepreneurship, it brings about positive outcomes for society as a whole (Alves et al., 2017). This occurs with respect to an improvement in income distribution in an economy (Gupta et al., 2014; Verheul et al., 2006) due to, for instance, the generation of new jobs and positions. Female entrepreneurs crucially serve as a factor to decrease gender inequality to foster local development (Guillén, 2013; Nieva, 2015). Since that women tend to obtain relatively high degrees of creativity and capacities for innovation (Danilda & Thorslund, 2011; Idris, 2009; Kobeissi, 2010; Nunes & Casaca, 2015), female entrepreneurs are expected to generate strong outcomes in the innovation environment. In fact, attaining high degrees of IP as an entrepreneur is one of the crucial factors for an economy's growth (Nissan et al., 2012). Therefore, by researching, analyzing, and eventually realizing for over 50 years that female entrepreneurs have been confronted by a relatively evident inequality in the business environment, barriers to FE started to stand out (Joshi et al., 2015). Herewith, many researchers point out that women act as influential players in the entrepreneurship phenomenon and economic development (Sarfaraz et al., 2014).

However, some researchers attempt to argue that there are no gender differences related to innovation strategies, and thereby declare that gender differences are not relevant when it comes to innovation capacities (Kushnirovich & Heilbrunn, 2013).

Contrary, some literature also proposes women's underperformance in entrepreneurship (Marlow & McAdam, 2013) due to the expectation that innovation and technology are generally related to masculinity (Alsos et al., 2013). This assumption may stem from the fact that the number of female operating firms is relatively low, especially concerning companies that entail a knowledge base as well as a technological base (Carrington, 2006). The underlying reasons are defined as women's concerns with regards to their professional credibility, credentials, confidence, know-how, social capital, and networking opportunities (Orser et al., 2007). Furthermore, especially when it comes to innovative sectors, being shaped by scientific and technological developments, women are undeniably underrepresented (Fountain, 2000). Women entrepreneurs tend to start businesses in Wholesale/Retail sector (50% of women worldwide), a few in Government (20%), Health, Education, and Social Service sector (18.5%) and only a few in ICT businesses (2.7%) (GEM, 2022a). Therefore, the industry which encounters the most innovation worldwide, namely ICT, is mainly dominated by male entrepreneurs.

2.4 Contextual factors

Different contextual factors can influence the impact of entrepreneurship on a country's innovativeness in different ways. The general characteristics of a country matter to understand the impact of entrepreneurship better. Therefore, especially two contextual factors are important in this research. One of them is the DS of a country, meaning whether it is a developing or a developed country, and the other factor is the motivation to become an entrepreneur, where a difference is made between opportunity-driven entrepreneurs and

necessity-driven entrepreneurs. It is proposed that both factors will have notable effects on the relationship between FE and IP.

2.4.1 Development stage of a country

The DS of a country has a considerable influence on this country's IP. To determine if a country is developed or developing, multiple factors are taken into account. Commonly, the GDP per capita and/or income per capita is used to determine the DS of a country (Business Development Bank of Canada [BDC], 2023). It can also be determined by the level of industrialization and by looking at the human development index, which covers literacy rates, gender unbiasedness, mortality rates and others (Das et al., 2016). It has been shown that developed countries are able to seize innovation opportunities better than developing countries (United Nations, 2023). Therefore, these developed countries can gain first-mover advantages in specific industries that are hard for developing countries to catch up with (United Nations, 2023). Developing countries often do not have the means to take advantage of high-technology innovations and are therefore missing out. They tend to lack scientific and technical skills, as well as necessary policies, regulations and infrastructure to capture the economic gains of new technologies (United Nations, 2023). This, however, does not mean that developing countries are not innovating. It was found that low-income countries actively engage in subtle, gradual innovations that often go unnoticed. These innovations are introduced through a combination of international technology transfer and locally-driven creative endeavors (Fu & Shi, 2022). Therefore, they do not create as much impact on IP as the innovations of developed countries. Moreover, these innovations are often generated out of necessity (OECD, 2012), which leads to the second important contextual factor considered in this study.

To determine if a country is developed or developing, different factors are taken into account. A country's GDP per capita is one common determinator of the DS of a country (Majaski, 2022). The higher the income, i.e. the GDP per capita, the higher is also the demand for innovative goods and services (Hollanders & Es-Sadki, 2022). This phenomenon could also be connected to Maslow's hierarchy of needs, where the need for self-actualization only becomes important once needs such as physiological needs, safety and security needs, love and belonging needs and self-esteem needs, in this order, have been fulfilled (Maslow, 1943).

2.4.2 Opportunity-driven entrepreneurship

This is where the second contextual factor comes into play as well. The fulfillment of basic needs such as the need for food, shelter, employment and prosperity is crucial and entrepreneurship can be the outcome of a desire to fulfill them. However, if a person decides to become an entrepreneur based on the fulfillment of these needs, this development is probable to be rather necessity- than opportunity-driven. Therefore, we propose that the level of innovativeness will also be rather low in these instances, as the goal of the entrepreneur is fulfilling basic needs rather than growth needs such as the need for creativity, meaning and inner potential (Maslow, 1943). Hence, the focus is not on innovating but surviving.

Another assumption that is being made here is that ODE is connected to the DS of a country. This assumption is being made because it can be expected that developed countries with a higher GDP have a population with higher income, which results in the population not needing to follow an entrepreneurship career out of necessity, where they do not have any other

possibility than becoming entrepreneurs. People in countries with high incomes and economic growth do not only have an increased demand for new products and services, and therefore for entrepreneurs and innovation (Hollanders & Es-Sadki, 2022), they also have the opportunity to follow an entrepreneurship career because they want to express themselves and fulfill needs of self-actualization.

2.5 Hypotheses formulation

The hypotheses are now being derived based on a review of the literature review above. In conclusion, it can be said that women do face extreme barriers in entrepreneurship and there is no doubt that entrepreneurship continues to be a male domain. Even though a lot of research and support towards female entrepreneurs has started to occur, the field still remains challenging for women. However, albeit females face more barriers than drivers to entrepreneurship, they still make an important contribution to entrepreneurship and the entrepreneurial landscape of a country. Moreover, there has been mixed evidence on the effects FE has on IP of a country. Contrary to some researchers that propose no effect or an underperformance of female entrepreneurs (Kushnirovich & Heilbrunn, 2013; Marlow & McAdam, 2013; Orser et al., 2007), many researchers propose a positive impact of FE on the innovativeness of a country (Alves et al., 2017; Sarfaraz et al., 2014; Verheul et al., 2006), as described in more detail in 2.3.2 Female entrepreneurship and innovation. Therefore, this thesis supports and strengthens the already conducted research on the topic by testing the impact of FE on a country´s IP. Considering the manifold barriers women are facing and need to overcome with regards to the institutional and social environment, individual prerequisites and the business environment, it is proposed that the relationship between FE and IP will generally be negative. Therefore, the first hypothesis is proposed as follows:

H1: Female entrepreneurship is negatively associated with a country`s innovation performance.

The next hypothesis deals with the development of the impact over time. As mentioned earlier, FE has gained and is still gaining attention. This can help support more and more women in following a career in entrepreneurship with the ultimate goal of having equal amounts of women and men becoming entrepreneurs. With these promising developments in mind, we propose that the impact of FE has increased on IP over the past. Therefore, the next hypothesis is stated as follows:

H2: Over time, the impact of female entrepreneurship of countries on innovation performance has increased.

The last two hypotheses of this research paper take contextual factors into account. As stated above, the DS of a country can have an impact on its IP. Moreover, the DS of a country can be connected to the entrepreneur's motivation for choosing this career path. In developed countries, it is probable that the entrepreneurs are opportunity- rather than necessity-driven. In these instances, it is also presumed that the levels of innovation are higher, as explained more in detail in 2.4 Contextual factors. Considering both of these factors, it is expected that the impact of FE is higher in developed countries, as these countries should also be more innovative and have more demand for entrepreneurs. Moreover, environmental barriers are presumably lower in developed countries, which could result in female entrepreneurs

performing similar to male entrepreneurs. Moreover, it is expected that women that are more opportunity-driven have a higher impact on IP, compared to when they are necessity-driven, which is also explained in more detail in 2.4 Contextual factors. Therefore, the last two hypotheses are stated as follows:

H3: Female entrepreneurship has a more positive influence on developed countries' innovation performance than developing countries' innovation performance.

H4: Female entrepreneurship has a positive influence on innovation performance when their entrepreneurs´ motivation is mainly opportunity-driven.

3 Method

FE and a country's innovativeness are two areas of interest that are intricately linked. So, in this chapter, the method used in this thesis is described. This research paper has been designed to analyze the impact of FE on IP around the globe. More specifically, this chapter describes the applied research design, data collection methods, data analysis techniques, and any other procedures used to investigate the research question and hypotheses. The purpose of this chapter is to provide a detailed account of how the study was conducted and to ensure that the findings are credible, reliable, and valid.

Additionally, the methods section should provide enough information to allow other researchers to replicate the study and assess the quality of the research. It should, thus, also address any potential sources of bias and/or limitations that may affect the validity of the results. To answer the hypotheses and therefore the investigated research question, the selected research strategy, design and method are explained.

3.1 Research strategy and design

To determine which research strategy and design would be the most suitable for this kind of research question and to answer our hypotheses, similar research papers have been reviewed. The most similar paper to the present research is the one by Crane (2022). She analyzed if the entrepreneur´s gender matters in economic growth of a country, uses an OLS regression model and a deductive approach. Moreover, she has decided to conduct a panel study, with observations ranging over multiple years. The paper by Sajjad et al. (2020) reviewed the impact of FE on economic development worldwide and used a multiple regression analysis to answer their hypotheses. Apart from women entrepreneurship, they used globalization and gender inequality as independent variables. Moreover, they did use more different indexes, but no moderator variables, which is where our research differs from theirs. Another difference is that they are looking at one specific year, whereas our study is a panel analysis. Nevertheless, these papers show that following the general method of an explorative but deductive approach with an OLS analysis to test the hypotheses is suitable for our sort of research question Also Brush and Cooper (2012) look at the connection between FE and economic development, however they do so by collecting and sorting through different papers to end up with the ones they deem most influential, and base their results on these papers.

3.1.1 Explorative and deductive approach

While there is already a lot of research on FE and on innovativeness of different countries, not many researchers have focused on the effects FE has on IP on a global scale, especially not at the slow change of this impact over the years. Following other researchers, we decided to perform research that is quantitative in nature and therefore set up testable hypotheses. Accordingly, we are trying to prove a theory, resulting in our research approach being deductive. Deductive research allows for precise testing, which leads to accurate and reliable findings (Bhandari, 2022a). Hence, it would be expected that this thesis has an explanatory research approach. However, given that our problem is still relatively under-researched, our research can be described as exploratory rather than explanatory, even though specific hypotheses are being tested (George, 2023). We are trying to understand the connections between FE and innovativeness better, rather than test or explain a specific phenomenon. Moreover, we are trying to shed light on underlying mechanisms and concluding the causes for the results found. However, due to the choice of using a deductive research approach, this thesis is still structured and focused, where the lack thereof is often a disadvantage of exploratory research (George, 2023). This allows for a balanced approach, weighing out the advantages and disadvantages of each concept.

3.1.2 Panel study

Additionally, the panel research design, also longitudinal study design, is appropriate in the present case as it allows for the analysis of changes in the relationship between FE and IP over time. The panel approach to research follows a group of individuals, in our case specific countries, over a longer period of time (Thomas, 2022). Compared to a cross-sectional study that only looks at a single point in time, a panel study allows for the observation of change over time and the tracking of effects of specific events. It is assumed that, for example, the Covid-19 crisis had effects on innovation and entrepreneurship, hence a panel analysis can give a holistic picture, not one that might be distorted by a singular crisis. Moreover, we are particularly interested in analyzing the development of FE over the years, and if its relative effect on IP has grown, declined or stayed constant. Generally, FE is still a seemingly new phenomenon, and thus, it remains unclear of how it may (or may not) impact IP over time. By exploring the relationship of FE, with regards to gender equality and empowering women, and countries' IP, there is hardly a way around a panel study to explore their development to account for potential changes over time. Additionally, this paper's aim also lays within a temporal sequence of events with regards to a potential causality of FE and IP. And lastly, a relatively suitable sample representativeness can be generated since nations are observed over time with regards to FE and IP. Eventually, this allows researchers to study changes in behavior or outcomes in the entrepreneurial population (here, female entrepreneurs), and determine how such changes may relate to IP.

The research will be examining data from a period of 10 years, from 2012 to 2021. By examining data from a period of ten years, this study can capture trends and changes that may occur over time, providing a more nuanced understanding of the relationship between FE and innovation. The investigation is designed as a retrospective analysis, and the data was not collected by individual researchers but by organizations, which will be discussed further under 3.2 Research Method. Furthermore, the panel design grants the control of confounding

variables that may vary over time, such as economic conditions, which may affect the relationship between FE and innovation.

3.1.3 Quantitative research

As mentioned, this study was conducted as a quantitative study rather than qualitative. The reasoning behind this is that we wanted to shed light on the impact of FE across multiple years and countries. Therefore, for instance, interviews would not have been able to capture the full scope of our research question and would have probably given us a distorted result. Quantitative research allows us a more generalizable result and can show patterns in the data or relationships between the different variables. Moreover, quantitative data is in general easier to replicate and more objective, which adds to the reliability of our study (Bhandari, 2022b). A mixed method approach would have also made sense for this research, albeit ultimately not being chosen. Adding a qualitative element would have allowed a closer inspection of one specific country and the manifestation of the numbers in this country. Interviews or surveys in an example country could have added a more specific perspective and put the numbers into context. However, the focus of this investigation is to generalize findings. Analyzing a single country in greater detail would not have uncovered outcomes that are universally applicable since the countries examined in different indices can be significantly different from one another or even opposites.

3.1.4 Descriptive statistics

After collecting our data, (the process of data collection is explained in more detail in 3.2.1 Data selection) it is amalgamated, therefore the data on all the years is combined into one data set. Then, the datasets were cleaned of missing values and some values were imputed in the dataset of the independent variable to obtain the final number of observations (in more detail in 4.1.2). Afterwards, descriptive statistics are performed to gain a better understanding and insight into the data set and to determine if the data is normally distributed, which makes an OLS analysis more robust.

Measures of general tendency

First, measures of general tendency, like the mean, median and mode were analyzed. The *arithmetic mean* describes the sum of the values over the years and throughout the countries divided by the number of cases. Contrary, the *median* shows the middle value of the variable which represents the point where half of the data is above, and half is below (Manikandan, 2011). The third measure of central tendency is defined as the *mode*, which indicates the most frequent value of the variable (Manikandan, 2011).

Measures of dispersion

The measures that assess the level of variation or diversity in the current dataset include the standard deviation, variance, minimum, maximum, range and standard error of the mean (SEM) (IBM, 2021). As explained by the IBM (2021), the *standard deviation* measures the dispersion around the mean, and the higher the standard deviation, the larger the data is spread, whereas a lower standard deviation shows a relatively smaller spread of the data. Next, the *variance* is the average of the squared differences from the mean, measuring the spread of the data. Hereby, a higher variance, again, indicates a larger spread of the data around the mean.

While variance is commonly used for calculating dispersion, its squared units may not be as intuitive as other metrics such as standard deviation. Consequently, this study employs standard deviation due to its direct correlation with normal distribution theory. As well as considering minimum and maximum values of the numeric variable for measuring data spread; analyzing the *range* – obtained from taking their difference (i.e. the difference between minimum and maximum) - provides valuable insights too. In addition, the *SEM* indicates the extent to which the mean value can differ between samples drawn from the same population. The smaller the SEM, the more likely it is that the sample is an accurate representation of the true population mean (IBM, 2021).

Measures of distribution

To perform a robust OLS analysis, the dataset should be normally distributed. If they are not, the data needs to be adjusted to become usable. Thus, the measures of distribution are analyzed in the following. Skewness and kurtosis are statistical measures that describe the symmetry and shape of a distribution and are often accompanied by their respective standard errors (Blanca et al., 2013).

If the *skewness* has a value of 0, the normal distribution of the respective variable is normally distributed (IBM, 2021). Generally, if the standard error or skewness ratio equals less than –2 or greater than 2, it additionally indicates that the respective dataset is relatively normally distributed. A right-sided tail occurs when a distribution has substantial positive skewness, whereas a distribution with a meaningful negative skewness has a left-sided tail. Another commonly used criterion to identify a departure from symmetry is when the skewness value is greater than twice its standard error (IBM, 2021). This is confirmed by the median displaying higher or lower numbers than the mean for each year (Gawali, 2021). Lastly, to confirm the normal distribution, the dataset can be plotted in a histogram and a distribution curve can be added to see if the data is visibly skewed.

The *kurtosis* (i.e., measure of the extent of present outliers) value indicates if a dataset contains many outliers (IBM, 2021). The kurtosis can be platykurtic (i.e., lighter-tailed than normally distributed data therefore with less outliers than a normal distribution), mesokurtic (i.e., normal-tailed and distributed) or leptokurtic (i.e., heavier-tailed than normally distributed data therefore with more outliers than a normal distribution). For a normal distribution, the kurtosis value must equal 0, while the range of –1 and +1 is generally accepted for normal distribution (IBM, 2021). Moreover, IBM (2023) suggests that kurtosis is platykurtic if the ratio of kurtosis to standard error of kurtosis is less than –2 and leptokurtic if it is higher than +2. Also here, the data can be plotted in a histogram with a distribution curve and boxplots to see the distribution pattern and the existence of outliers, respectively.

3.1.5 Ordinary least squares analysis

The secondary data is analyzed using an OLS analysis to examine the relationship between FE and countries' IP.

According to prior research papers, an OLS analysis is one of the most commonly used statistical techniques used to explore the relationship between an independent variables (plus control variables) and a dependent variable (Groß, 2003). The use of an OLS analysis is suitable for this study because it (1) fits the nature of the dependent variable (i.e., continuous variable)

(Frost, 2023), and (2) it enables the examination of the relationship at hand, while controlling for other relevant factors that may affect this relationship. By including the moderator variables DS of a country and the motivations for starting a new venture (i.e., necessity-driven entrepreneurs and opportunity-driven entrepreneurs), the analysis may isolate the effect of FE on innovative performance while accounting for potential statistically significant influences on the relationship. Furthermore, an OLS analysis can provide information on the strength and direction of the relationship between FE and IP, as well as the magnitude of this studied relationship. This information can help policy makers and stakeholders to understand the potential benefits (and/or drawbacks) of promoting FE as a means of driving innovation and economic growth. As a consequence, we include an OLS analysis as the statistical method since it is the most conceptionally and computationally straightforward and thus, most common estimator in quantitative research (Groß, 2003). Before conducting an OLS analysis, the assumptions of linearity, absence of outliers, independence of observations, homoscedasticity, and normality need to be tested (Groß, 2003; Laerd Statistics, 2018a, 2023). In addition, multicollinearity is investigated to ensure that all predictor variables are not highly correlated with each other since this might affect the reliability of the regression coefficients (Groß, 2003; Laerd Statistics, 2018a, 2023).

3.1.5.1 Scale & linearity, absence of outliers, multicollinearity, independence of observations, homoscedasticity, and normality

In the following, the mentioned OLS assumptions will be tested.

The *first* assumption requires linearity between the independent and dependent variable. Both, the independent and dependent variable are measured on a continuous scale, meaning they are both characterized as an interval (Laerd Statistics, 2018b). Then, linearity can be tested by plotting scatterplots or by checking linearity via SPSS. For this assumption it is important that there is a linear relationship between the dependent variable and each of the independent variables, as well as between the dependent variable and the independent variables collectively (Laerd Statistics, 2023). Once a scatterplot has been created, one can visually check for linearity. When checking for linearity via SPSS, the created table will give the result on linearity and its statistical significance.

The *second assumption* requires the absence of significant outliers present in the data, which may, otherwise, distort the analysis process.

The *third assumption* states that the data must not show multicollinearity. Multicollinearity is given when two or more independent variables are highly correlated with each other, which may lead to problems in understanding which independent variable is responsible for the variance in the dependent variable, as well as technical issues in calculating a regression model (Statology, 2020). So, first, a correlation matrix is created to compute the matrix of Pearson's bivariate correlation among all the independent variables, while all correlation coefficients need to be smaller than 1. In case of ambiguous outcomes, the Variance Inflation Factor (VIF) test can be applied, too, to determine the strength of the potential correlation issue. Hereby, an indication of a multicollinearity issue is if the VIF > 5. Furthermore, if multicollinearity is indeed found in the data, centering the data might solve the problem (Statology, 2020).

The *fourth* assumption is to test for the independence of observations. The independence of observations describes the assumption that the values of each observation are independent. In other words, this assumption requires the absence of autocorrelation, measuring the relationship of a variable with lagged values of itself (Box et al., 2008). Typically, autocorrelation problems may occur in linear regression analyses using time series models which is why we decided to test this assumption. To test this, a Durbin-Watson statistic can be run (Laerd Statistics, 2018b). Hereby, a rule of thumb is that the test statistic values within the range of 1.5 and 2.5, being relatively normal. Field (2011) suggests that values below 1 and/or more than three are a serious cause of concern with respect to autocorrelation.

The *fifth assumption* of homoscedasticity is that the amount of error in the observations is similar at each point of the model. To find out if homoscedasticity exists, the standardized observations should be plotted against the predicted values to understand if the points are distributed fairly across all the values of independent variables. This assumption can also be tested by using a scatterplot (Glen, 2021).

The last step, so the *sixth assumption*, before performing the OLS analysis is to test whether residuals (i.e., errors) are approximately normally distributed (Bewick et al., 2003). This can be done by plotting a histogram with a superimposed normal curve and a Normal P-P Plot or a Normal Q-Q Plot of the studentized observations. These tests will determine if the data is normally distributed.

3.2 Research method

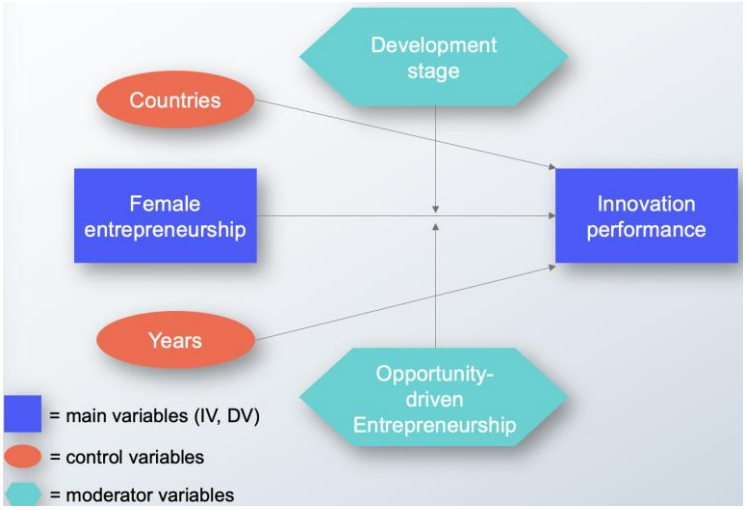
This section describes the research method used in this thesis. The first part will inform about the choices made in data selection for this research, including how many countries were analyzed and the time scope of the thesis. Next, the selection of the dependent variable, IP measured by the GII, is explained. Afterwards, the independent variable, FE measured by the GEM, and why we chose it is illustrated. Finally, the last step is the delineation of the moderator variables applied in this thesis, namely the DS of a country and the opportunity-driven motive for entrepreneurship.

3.2.1 Data selection

Generally, to outline the two major variables in this study, namely FE and IP, only secondary data has been used. In particular, two databases, the GEM and the GII are being employed. In summary, the GEM provides data on the prevalence, nature, and potential of entrepreneurship in various countries, whilst the GII ranks various countries based on their IP. The use of secondary data is particularly cost-effective and time-efficient for this study because much data is already available through reliable sources (i.e., GEM and GII). Thus, the use of secondary data allows for the analysis of data from a larger sample of countries and over a longer period of time, providing a more comprehensive view on the relationship between FE and IP. So, overall, extensive secondary data was gathered, resulting in a sample size of 570 over 10 years, specifically 2012 until 2021, to make this study as expansive as possible. Additionally, longitudinal and international analysis of information is often complex and time-intensive to collect oneself due to scale which approves the choice of secondary data collection.

The sample for this research paper are countries that have data available on both FE and innovation in the GEM and GII reports over the years, respectively. Thus, a total sample size of 57 countries, meaning 570 observations, is selected for analysis. This sample size was chosen to ensure adequate representation from different regions of the world and to provide enough observations for the analysis. In addition, this sample size is large enough to capture a diverse range of economic and cultural contexts, providing a more comprehensive view of the relationship between FE and IP. The summarized model can be seen in Figure 1.

Figure 1: The model applied – all variables included.



3.2.2 Dependent variable – innovation performance

The dependent variable of this research is IP, which is measured by the GII. This index measures the IP of different countries. Determining the innovativeness of a country is not an easy endeavor, as it is affected by multiple different variables. Utilizing a single indicator, like the number of patents filed, for example, may not provide a comprehensive understanding of innovation, which is why the GII was selected to provide a more nuanced view. The GII enables an extensive evaluation of the innovativeness of countries, as it includes over 80 indicators (WIPO, 2023), containing measures on the political environment, education, infrastructure, and knowledge creation of each economy. The index includes innovation input as well as output variables. The input variables to innovation are institutions, human capital and research, infrastructure, market sophistication and business sophistication, whereas the output variables are knowledge and technology outputs and creative outputs (WIPO, 2020). The countries analyzed by the GII slightly differ each year. Therefore, since 2012, it ranks the innovativeness of between 126 and 143 economies yearly. To be more specific, the dependent variable, IP, is constructed by the actual ranking (i.e., index score reaching between 1 and 100) for the sampled countries from the GII over the years, which is applied and considered in this paper, too. We chose to use the GII in our research as it is extremely extensive with its 80 indicators across around 130 countries and because it has existed since 2007, impacting even governments in the innovation agenda of their countries (WIPO, 2023). Therefore, the GII is an influential, comprehensive, and vastly accepted index (Oturakci, 2021).

3.2.3 Independent variable – female entrepreneurship

The independent variable, FE, is being measured by the GEM. This index is knowingly the world's longest running and largest study on entrepreneurs and their perceptions of entrepreneurship. The GEM research program includes annual assessments of roughly 66 countries, covering more than 80% of the world population, thereby including almost all economies which are perceived as globally meaningful (Zoltán J. Ács & Szerb, 2009). More specifically, the GEM approach comprises two surveys: the Adult Population Survey (APS) and the National Expert Survey (NES). On the one hand, the APS targets the attitudes and activities related to entrepreneurship among a random sample of at least 2,000 adults aged 18 to 64 per economy out of the previously mentioned approximately 66 countries, which are covered yearly (GEM, 2022b). On the other hand, the NES concentrates on the contextual factors that influence an individual to initiate a new venture, as well as the subsequent decisions made to sustain and expand the venture (GEM, 2022c). In addition, the GEM evaluation is subject to scrutiny by national experts to ensure its quality and accuracy. Therefore, the APS and NES provide a comprehensive and up-to-date representation of entrepreneurship in each country on an annual basis, which is the primary reason for incorporating GEM as a measurement for the independent variable.

Furthermore, according to the GEM, entrepreneurship is defined as the act of starting and operating a new business. It measures entrepreneurship by looking at the percentage of the population of a country that is between 18-64 years old and either a nascent entrepreneur or the owner-manager of a new firm (GEM, 2023). Overall, the GEM report aims to collect data to analyze the relationship between entrepreneurship and national economic development (Acs & Audretsch, 2003; Bosma, 2013; Carree & Thurik, 2003). The GEM reports are created yearly by research teams, for instance 46 national teams for the 2020/2021 edition, who collect data consistently and coherently, enabling comparisons between different economies in the same year and the same economy over different years. Since the data is accumulated over the years, the consistency of the data sets adds increasing value. Additionally, the GEM has continued collecting data throughout the COVID-19 pandemic, measuring the world pandemic's impacts on global levels of entrepreneurship activity, attitudes, as well as perceptions. Thus, the GEM represents a realistic national entrepreneurship analysis and examination.

3.2.4 Control variables

Control variables, also known as covariates, are additional variables that are included in a quantitative analysis to foster that the relationship between the independent and dependent variable is accurately analyzed and controlled for other factors which may have an impact on the relationship. More specifically, Gordon (1968) argues that including control variables is a major authentication of sophisticated research, while Spector and Brannick (2011) underline the widespread routine in nonexperimental research. Thus, by including control variables in the present analysis, the effect of the main independent variable on the dependent variable can be properly isolated which may advance the quality of the findings. In addition, adding control variables may help to identify potential moderators of the relationship between the main independent variable and the dependent variable, providing more detailed insights into the underlying mechanisms at play (Spector & Brannick, 2011).

Generally, control variables are considered extraneous variables that are not directly linked to the hypotheses being tested (Spector & Brannick, 2011). Still, they are assumed to play a confounding role by producing distortions in observed relationships. Typically, researchers delineate certain variables as being purely for control purposes to understand their crucial role in determining the effects of the independent variable on the dependent variable. The reason why control variables are so important to include lays in their potentially distortive nature on the resulting conclusions (Spector & Brannick, 2011).

Therefore, the following control variables are contained in the present study: countries and years. In the following, both of these control variables are elaborated on.

3.2.4.1 Countries

Including control variables when measuring the relationship between FE on IP is essential to ensure a more accurate estimation of the relationship (Spector & Brannick, 2011). The first important control variable to include is 'country'. Since countries may greatly vary in terms of their economic, political, and social structures, it is important to incorporate this control variable (Verheul et al., 2006). Precisely, a country's attitude and other factors, such as government policies, towards FE might have a great impact on the results. For instance, different policy measures may be utilized by policymakers depending on their target goals. In this case, innovation may depend on a country's absolute amount of diversity. Hence, it may be crucial to examine FE as a share of the total number of entrepreneurs. So, also the granted access to resources in a country can impact the relationship between FE and the country's IP. Moreover, there might be a correlation between a country´s development status and entrepreneurship in general, but especially FE. The reasoning behind this is that there is probably a connection between this status and the reason for why people pursue a career in entrepreneurship. Entrepreneurs in developing countries might become entrepreneurs out of necessity, and therefore not start businesses that are particularly new and innovative, but just pursue this career to sustain their way of living (GEM, 2022a). We have included ODE as a moderator variable to further shed light on this phenomenon. Thus, by including 'country' as a control variable, a proper isolation of the effect of FE on IP might follow, while controlling for the effects of the factor 'country'. In total, 57 countries are included in this study to examine the different countries' effects on the present relationship. This control variable is held constant throughout the study, which essentially means that even though the two indices (i.e., GEM and GII) applied in this study change their sampled economies over time, we constantly only included the 57 countries which are depicted in every year in both indices. Thus, the effects and consequences of the main variables – FE and IP – are controlled by those specific countries. Furthermore, to perform an OLS analysis, the control variable must be a numeric variable as a predictor variable in SPSS which is why it is transformed into numeric codes to fulfill this criterion.

3.2.4.2 Year

Furthermore, we decided to incorporate ten years, and more specifically 2012-2021, in this study to be able to perform a panel study. In other words, data is collected on the same variables (e.g., FE) over multiple time points, which allows to examine changes and trends during varying periods in time. This can be particularly useful for exploring the relationship between FE and IP, as both variables may change over time. Again, we control for this variable in order

to see specific trends and changes only during those specific ten years with respect to the main variables included.

In the regression model, the years as well as the countries variables, actually being characterized as categorical variables, might be transformed, again, into numeric codes in order to capture any potential effects of time on the dependent variable across different countries (StataCorp, 2023). Thus, in this context, the development of FE can be explained and analyzed over each specific year.

3.2.5 Moderator variables

Furthermore, two moderator variables are included in this paper. Overall, a moderator variable can be defined as one which systematically modifies either the form and/or strength of the relationship between a predictor and a criterion variable (Sharma et al., 1981). Thus, both moderator variables included in this study are defined and described in the following.

3.2.5.1 Development stage of a country

As already argued in the theoretical background, there is a reason to believe that the DS of a country obtains a moderating impact on the relationship between FE and IP. Moreover, previous studies have found that, generally, there might be a variation in the share of female entrepreneurs of an economy depending on how developed a country is (GEM, 2019; Verheul et al., 2006). Since the level of (female) entrepreneurship is seemingly higher in economically wealthier countries, and therefore these countries' IP might be superior, the DS of a country is applied as a moderator variable. However, in this study, we apply a two-sample approach, instead of a traditional moderator analysis. The underlying reason behind analyzing the data separately for developed and developing countries is to explore potential differences in the relationship, which would, otherwise not have been possible. To implement this approach, the DS of all countries in our dataset is identified first.

As mentioned in the theoretical background, the DS of a country can be measured by GDP per capita, income per capita, level of industrialization and by looking t the human development index (BDC, 2023; Das et al., 2016). The United Nations (2022) have developed a list that sorts countries into developed economies, economies in transition, and developing economies. Over the course of several years, they have undertaken this task by considering numerous sources. These sources include data from the five regional commissions of the United Nations, the United Nations Conference on Trade and Development (UNCTAD), the International Monetary Fund (IMF), the World Bank, the Organisation for Economic Co-operation and Development (OECD), Eurostat, and national sources. By incorporating information from these diverse channels, they have compiled the list. When sorting the 57 countries included in this paper into these categories, 27 developed countries are included, 3 countries are determined to be in transition and 26 countries are considered to be developing, according to the above sources. To not overcomplicate the analysis, we decided to work with a binary variable, including the two categories developed and developing countries only. Therefore, we need to sort the three countries that were categorized as being in transition into one of the categories. After further research, we decided to categorize the transition countries, i.e., North Macedonia, Kazakhstan and Russia, as developing countries (International Monetary Fund, 2019), which results in our analysis consisting of 27 developed and 29 developing countries.

3.2.5.2 Opportunity-driven entrepreneurship

In general, people are assumed to start a business based on the following two main reasons – either out of necessity (i.e., because they have no other means of economic support and income; necessity-driven entrepreneurs), or out of an opportunity (i.e., to pursue a business opportunity; opportunity-driven entrepreneurs) (GEM, 2019). It is assumed that with higher levels of national income, the number opportunity-driven entrepreneurs increase, compared to the necessity motive. Commonly, female entrepreneurs (68.4%) are less likely to start a new venture due to an opportunity motive, compared to men (74%). Additionally, female opportunity-driven total early-stage entrepreneurial activity rates are highest among high-income countries, suggesting a difference in motives based on different countries (GEM, 2019). Thus, it seems crucial to examine the relationship between the opportunity-driven motive of (female) entrepreneurs on IP to fully grasp this phenomenon which is why this moderator variable is included. The variable is measured by the GEM, which analyzes different motives behind people following an entrepreneurship career. Hereby, survey-based questions are posed to respondents as part of the Adult Population Survey to capture the individuals' perceptions and experiences related to business opportunities. And more precisely, the variable is assessed by calculating the percentage of female entrepreneurs, compared to male entrepreneurs, who are driven by opportunities rather than necessity and is measured in percentages. Other than the opportunity-driven motive, the decision can for example also be necessity-driven, to continue a family tradition or to build wealth (GEM, 2019, 2022a). As it seems like the opportunity motivation has the biggest impact on IP, this motive was chosen as a moderator variable in our study.

4 Data analysis

The next section provides the results of this research. First, the findings of the descriptive statistics are delineated. Afterwards, the results of the OLS analysis between the dependent variable (IP), and the independent variable (FE) are summarized. Here, the different control and moderator variables and their effect are also laid out.

4.1 Descriptive statistics

In this part, all variables included in this study are being analyzed by using general descriptive statistics to gain a comprehensive understanding of the present data. This is crucial to get an overview of the data, how the data is generally distributed, its tendency, if it contains any outliers and how it is spread out. Moreover, patterns and relationships can be identified. Therefore, it is the foundation for the subsequent OLS analysis.

4.1.1 Innovation performance

Even though the GII dataset for the years 2012 – 2021 represent several cases, a few countries must be adjusted and deleted to eventually be able to compare the cases per country and year with the GEM dataset and then draw accurate conclusions. Thus, after carefully examining the countries and years, being presented in both relevant datasets, the initial 1464 cases of the GII are cut down to 570 cases (Table 5).

Table 5: Descriptive statistics of IP.

N	Valid	570
	Missing	0
Mean		43.343
Median		41.700
Mode		53.1
Standard Error of Mean		0.4615
Std. Deviation		11.0190
Variance		121.418
Skewness		0.215
Std. Error of Skewness		0.102
Kurtosis		-0.907
Std. Error of Kurtosis		0.204
Minimum		15.0
Maximum		68.4

a. Dependent variable: Innovation performance

b. Abbreviation: IP

c. Variable type: Continuous variable

d. Minimum/maximum value (of the total GII scores): 0 - 100

e. Dataset: Global Innovation Index (GII)

Measures of general tendency

In this case, the mean of the GII variable over the ten years and 570 cases (i.e., 57 countries) is 43.343, which indicates the average value of the GII score. The median value of 41.7 indicates the middle value of the distribution, such that 50% of the cases have a GII score below 41.7 and 50% obtain a score above 41.7. The mode of 53.1 indicates the most frequently occurring GII score. An interesting finding here is that the mean level of innovation across all countries has declined over the past ten years, with a mean value of around 37 in 2012 and a mean value of 31 in 2021.

What becomes clear in Table 5 is that the mean, median, and more of the variables of the GII have slightly different values, especially the mode differentiates from the mean and median values. This would suggest a distribution that may be slightly skewed towards the left (i.e., negatively skewed distribution). However, when examining Figure 2 more closely, the distribution seems relatively normal, the mean being the central value of the distribution, meaning the data is approximately evenly distributed around the central value.

Measures of dispersion

The *standard deviation* of 11.0190 and *variance* of 121.418 for the GII variable over ten years suggest that there is a considerable amount of dispersion in the GII scores across the countries over the years. This indicates that the level of innovation varies meaningfully among the countries in the dataset. The *minimum* value of 15 and *maximum* value of 68.4 indicate the range of GII scores observed across the countries over the ten years. Overall, the *range* that IP can take on is equal to 100, however, in this study, the range is equal to 53.4 due to our country

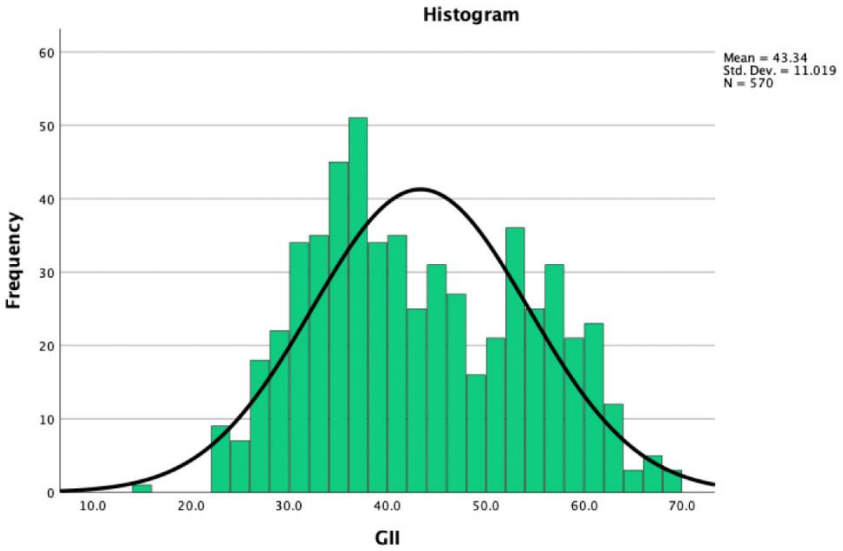
selection. Still, the range of 53.4 suggests that there is a substantial difference between the least and most innovative countries in the dataset. In addition, the *SEM*, being equal to 0.4615, indicates that the sample is an accurate representation of the true population mean. Overall, these statistics suggest that there is a wide range of innovation levels across countries over the ten years, with some countries having much higher or lower GII scores than others. Moreover, also the maximum and minimum values have decreased over the observed time frame. Continuously across the ten years, Switzerland was attributed the highest innovation score with the value ranging from 64.6 to 68.2. The minimum innovation score was attributed to Yemen six times, Sudan three times and Angola and Guinea one time, respectively and ranged between 11.6 and 19.3. However, in this paper, only Angola is employed of the aforementioned minimum innovation scorers. Moreover, it is interesting to note that the mode value is between approximately 20 and 30 for all the years and also the mean and median values are between approximately 25 and 40. Together with the maximum value never being higher than 70, this could indicate that the GII is a critical index, as these values can be considered comparably low compared to the theoretically possible maximum value of 100.

Measures of distribution

In this case, the skewness value is 0.215, with a standard error of 0.102. The skewness value is greater than twice its standard error, with a value of 2.1078, representing a potential conflict with normal distribution (IBM, 2021). This is confirmed by the median displaying lower numbers than the mean for each year (Gawali, 2021). Thus, the conclusion about the skewness as an indicator for normal distribution seems rather torn. Still, the histogram with the distribution curve (Figure 2) shows a relatively normally distributed data.

The *kurtosis* (i.e., measure of the extent of present outliers) of the distribution is -0.907, with a standard error of 0.204. The kurtosis value indicates a slightly platykurtic curve, obtaining lighter tails than normally distributed data does and thereby, exhibiting less outliers than a normal distribution (IBM, 2021). To highlight this, the standard error of kurtosis equals 0.204 which, generally, clarifies a normally distributed dataset. However, the ratio of kurtosis to standard error of kurtosis is 4.446, indicating a non-normal distribution. However, even though the descriptives show a potentially slight non-normal distribution, the verifying histogram indicates a normal distribution pattern (Figure 2). Furthermore, the kurtosis values are in the normally accepted range which is why normal distribution is assumed for the dependent variable.

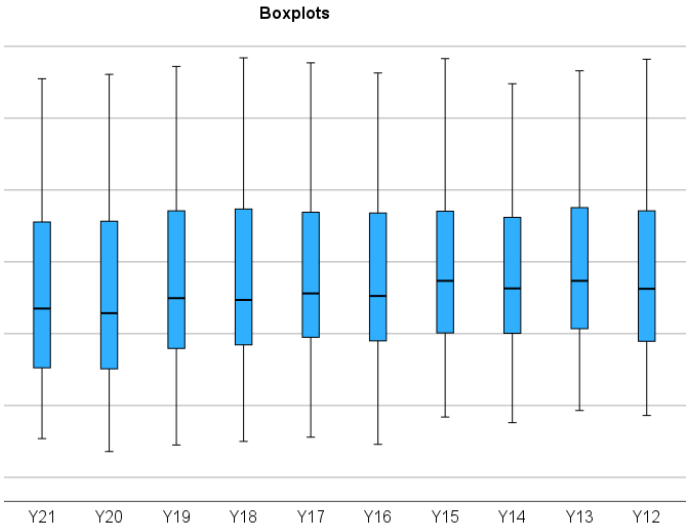
Figure 2: Histogram of the descriptive statistics of IP (2012 – 2021).



To further confirm our conclusion about an approximately normally distributed dependent variable, the boxplots for IP are displayed across all the analyzed years (Figure 3). As can be seen from the plots, the values have been relatively consistent over the years, with the maximum scores only varying four points and minimum scores only around eight points. Also, the median values and 25% as well as 75% quartiles stay relatively stable with a slightly sinking tendency. This, again, indicates a sinking innovative performance across all countries, which is an interesting result that will be discussed further later in this paper. Another result from analyzing the boxplots across the years is that the dataset does not contain any significant outliers. This is in line with what has been found through the analysis of the kurtosis of the dataset.

Consequently, after careful consideration of the measures of central tendency, measures of dispersion, and the measures of distribution, normal distribution can be assumed, expressing the data for the dependent variable is properly prepared to perform an OLS.

Figure 3: Boxplots for the IP 2012-2021.



4.1.2 Female Entrepreneurship

The main independent variable in this study is FE which is measured by the dataset GEM. The GEM dataset is a comprehensive dataset that provides valuable insights into entrepreneurship activities and aspirations across different countries and regions around the world. In particular, the GEM dataset includes the measures of the total early-stage entrepreneurial activity rate (in %), which is defined as the percentage of the adult population who are actively involved in starting or running a new business. One important breakdown within this variable is the gender distinction, which is measured by the percentage of females and males who are engaged in entrepreneurial activity. In this section, the focus will lay on the rate of the female total early-stage activity (FTEA) which is explored based on different countries included in the dataset. Specifically, the mean, standard deviation, minimum, and maximum of the FTEA%, as well as their distribution and potential outliers will be considered. By analyzing the descriptive statistics of those variables, a better understanding of FE dynamics per country can be understood, plus identifying potential factors that may influence women's participation in entrepreneurial activities.

Before a thorough analysis of the descriptive statistics can be performed, the dataset is transformed and reshaped for analysis purposes. Reshaping and transforming the dataset was necessary to enhance the conduciveness of the analysis. In addition, for a panel study, one should work with one observation per country per time period. So, the data was cleaned and renamed to remove errors of inconsistency and standardize the variable formats. Additionally, the dataset was reshaped with regards to its structure, meaning the format got changed from wide into long to properly prepare the data for the multiple regression analysis in the end.

Furthermore, since a panel study is conducted, whilst the focus lays on ten years (2012-2021) to analyze FTEA rates, another cleaning technique was performed to improve the data's quality and reliability. First, countries which only showed data for less than five years were deleted due to a relatively small sample size compared to what the expectations and boundaries of this study are. Such cases might even represent outliers which may considerably distort the analysis process due to anomalies. Additionally, published information with respect to the economies is compared, showing that two countries in the GEM are not present in the GII (i.e., Puerto Rico & Taiwan). Thus, in total, 20 countries were deleted from the dataset and excluded from the analysis (the excluded countries can be seen in Appendix 1), indicating a sample size of 570 cases in total.

Secondly, some countries demonstrate additional missing values, however, they still showed values for five or more years. Thus, we decided to impute mean values to estimate the missing values and ensure that the analysis is based on a complete dataset dataset (Patrician, 2002; e.g.Scheffer, 2002). The main reasons why mean values are imputed for the respective countries are the following: First, the aim is to preserve a proper sample size to ensure obtaining a sufficient number of observations in this study. Second, the intention behind presenting a relatively large sample size is to assure a satisfying level of representativeness in terms of the chosen number of countries as well as differing continents included in this analysis. Especially, when the missing values are not systematically different from the observed data, imputing mean values represents a seemingly reasonable way to estimate the missing values and ensure that the data remains representative of the population. And lastly, a relatively substantial reason

is to avoid biases in the analysis. If the decision would have been to simply delete the cases (i.e., countries) with missing data, it might lead to bias in the entire analysis, especially if the missing data is not missing completely at random. Thus, this may represent a severe bias in this study eventually which is why the decision was made to impute such mean values to establish a relatively accurate and reliable outcome.

So, after structuring and cleaning the GEM dataset accurately, a descriptive analysis is performed to explore the distribution of the independent variable FE (Table 6).

Table 6: Descriptive statistics of FE.

N	Valid	570
	Missing	0
Mean		10.538
Median		8.600
Mode		6.0
Std. Deviation		7.1896
Variance		51.690
Skewness		1.676
Std. Error of Skewness		0.102
Kurtosis		3.589
Std. Error of Kurtosis		0.204
Minimum		0.9
Maximum		51.1

1. Independent variable: Female Entrepreneurship
2. Abbreviation: FE
3. Variable type: Continuous variable (%)
4. Minimum/maximum value: 0 – 100
5. Dataset: Global Entrepreneurship Monitor (GEM)

Measures of central tendency

First, the sum of valid cases equals 570 without any missing values, after the imputation of mean values before. The *arithmetic mean* is 10.538, the *median* of female entrepreneurial activity is equal to 8.600% and the *mode* is equal to 6% which means that 6% is the most common value of FTEA% around the globe over the observation period of ten years.

Measures of dispersion

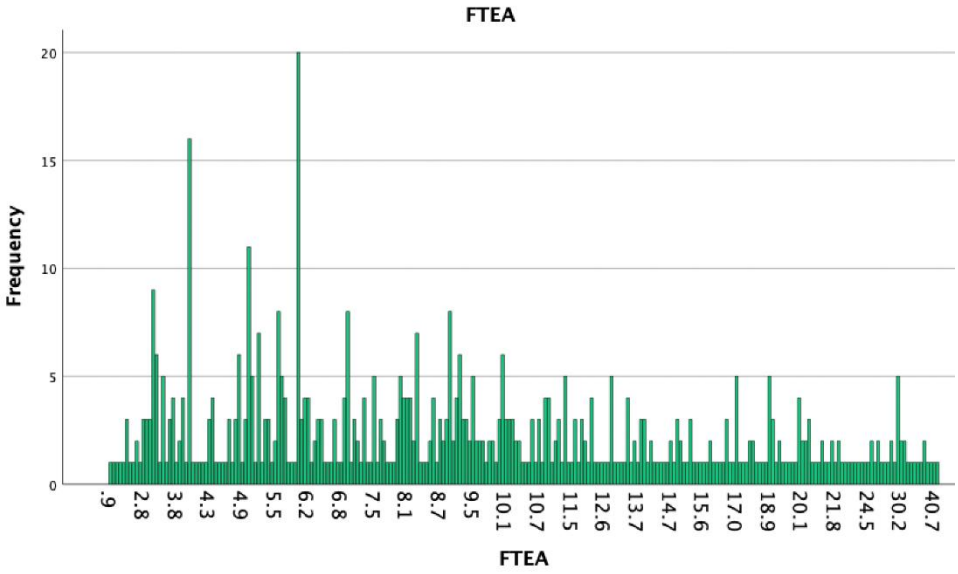
The *standard deviation* indicates the dispersion around the mean value of 7.1896%. Within a normal distribution, roughly 68% of instances lie within one standard deviation of the mean and 95% of cases fall within two standard deviations. For instance, in 2021, the Netherlands present an FTEA% of 13% which shows a z-score of (13% - 10.538%)/7.1896% = 0.342. This means that this data point is 0.342 standard deviations above the mean. Thus, in this case, a standard deviation of 7.1896% indicates that the data points are moderately dispersed around the mean of 10.538%. The independent variable's *variance* is equal to 51.690%, which shows a relatively wider spread of the data, suggesting that the data points are spread out over a wide range of values. Furthermore, the *minimum* FTEA% is equal to 0.9%, while the *maximum* FTEA% value is 51.1%. Thus, the *range* is equal to 50.2%. The range suggests that the data

points in the present dataset are widely dispersed and cover a relatively large range of values. Thus, a comparatively high degree of variability or heterogeneity in the data can be assumed.

Measures of distribution

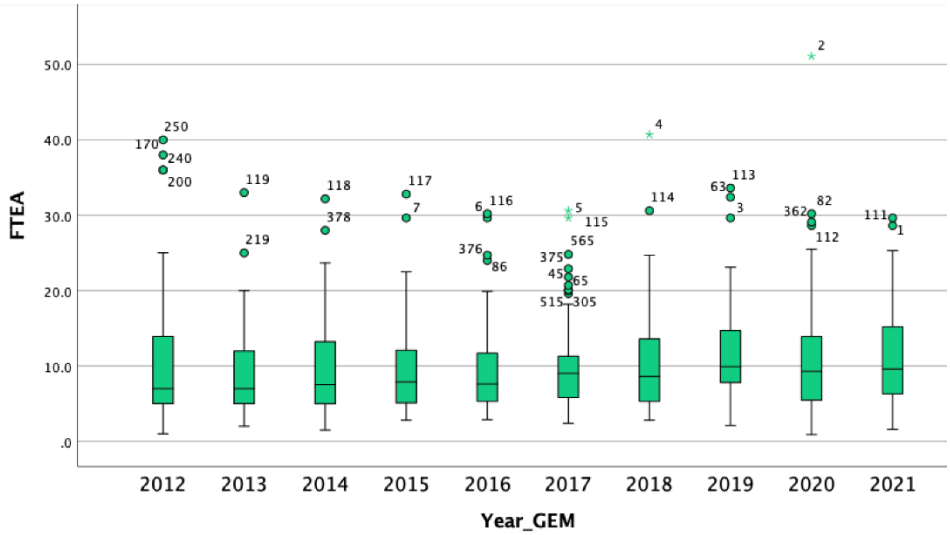
The present skewness value of 1.676 suggests a right-sided tail (Figure 4). Moreover, the skewness value of FTEA% is more than two times its standard error, which suggests a departure from symmetry. Additionally, the kurtosis value is equal to 3.589, assuming the dataset has rather extreme outliers than a normal distribution.

Figure 4: Histogram for the FE (2012-2021).



The box plot shows the median, quartiles, and outliers or extreme values for the independent variable (Figure 5). Here, the middle line represents the 50th percentile, while the interquartile range represents the difference between the 75th and 25th percentiles. The whiskers, above and below the box, show the spread of the data, meaning values that are further from the whiskers are represented by “o” signs. As can be seen in Figure 5, the variable FE includes a few far outliers, marked with a star.

Figure 5: Boxplot diagram of FE (2012-2021).

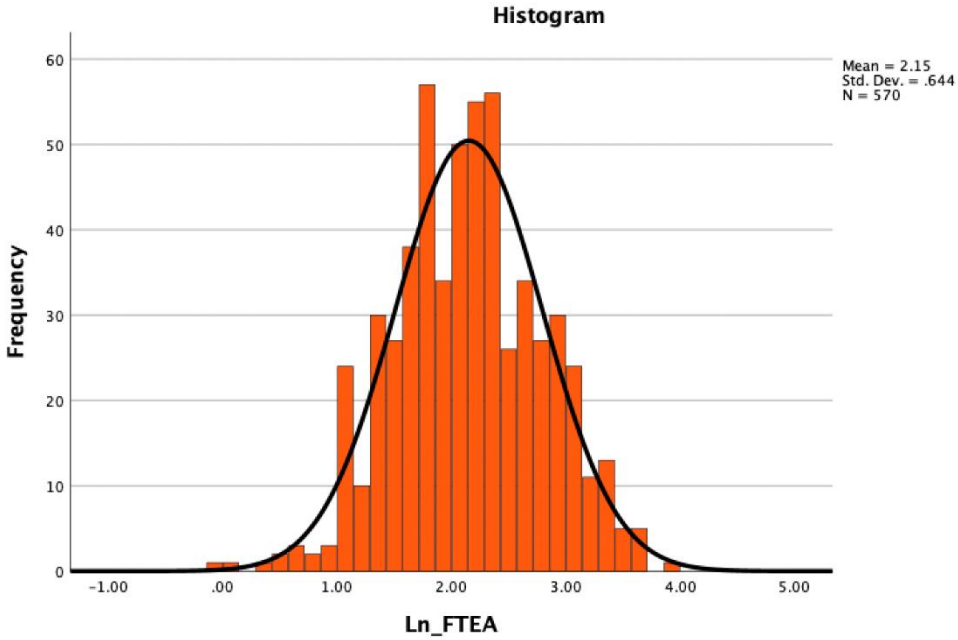


In summary, after exploring the descriptive statistics of the independent variable FE, it appears that the dataset is not normally distributed. Although normal distribution is mostly a theoretical concept, it is frequently observed in various fields in the real world, and therefore, it is assumed in this case as it is crucial for statistical tests, such as the multiple regression analysis. The normal distribution is symmetrical around the mean value, implying that 68% of the values lie within one standard deviation of the mean, while 95% and 99.7% of the values fall, respectively, within two and three standard deviations. This is clearly not the case in the prior descriptive statistics for the independent variable which is why certain adjustments have to be performed in order for the multiple regression to show valid results for this research (Laerd Statistics, 2018a).

One potential option is to use a logarithmic transformation, as the present sample only consists of positive values and is positively skewed - a common occurrence for percentage variables (Leydesdorff & Bensman, 2006). This transformation can help to make the data conform to the lognormal law of error for inferential purposes, as opposed to being asymmetrically skewed. By transforming the data in this way, the observations can be distributed more symmetrically around the arithmetic mean. It is important to note that this transformation does not necessarily provide a more accurate description of reality, but rather creates an artificial mental model of reality that conforms to a law of error. Overall, the decision to use a logarithmic transformation should be carefully considered considering the specific research question and the assumptions underlying the statistical analysis (Leydesdorff & Bensman, 2006).

Figure 6 displays the results of applying a logarithmic transformation to the independent variable. The table with the adjusted descriptive statistics can be seen in Appendix 2. These visuals demonstrate that the relevant distribution and dispersion values, which previously resulted in an asymmetrical distribution, now exhibit a more normal distribution after transformation. Notably, the histogram in Figure 6 visually indicates a normal distribution. Thus, the independent variable is now adjusted accordingly to perform a multiple regression.

Figure 6: Logarithmic transformation of FE.



4.1.3 Opportunity-driven entrepreneurship

Initially, the moderator variable ODE is restructured in terms of the adjustment of countries included in the GEM and GII, while mean values are imputed to cope with missing values over the years. The moderator variable is drawn from the dataset GEM between the correspondingly relevant years, namely between 2012 and 2021 to explore their moderating impact on the main relationship of this study.

First, the overall model fit and the statistical significance of the variable ODE (female) is analyzed with respect to the dependent variable, IP.

With respect to the model fit, one may identify that 1.4% variations of the control variable ODE can explain the IP of a country. Additionally, the model presents a suitable fit for this study (i.e., $adjusted\ R^2 - value > 0$) (Appendix 3). When examining the statistical significance (Appendix 4), F(1.568)=7.808, while the p-value is equal to 0.005, which essentially indicates that one may reject hypothesis 4.

Table 7: Descriptive statistics of ODE.

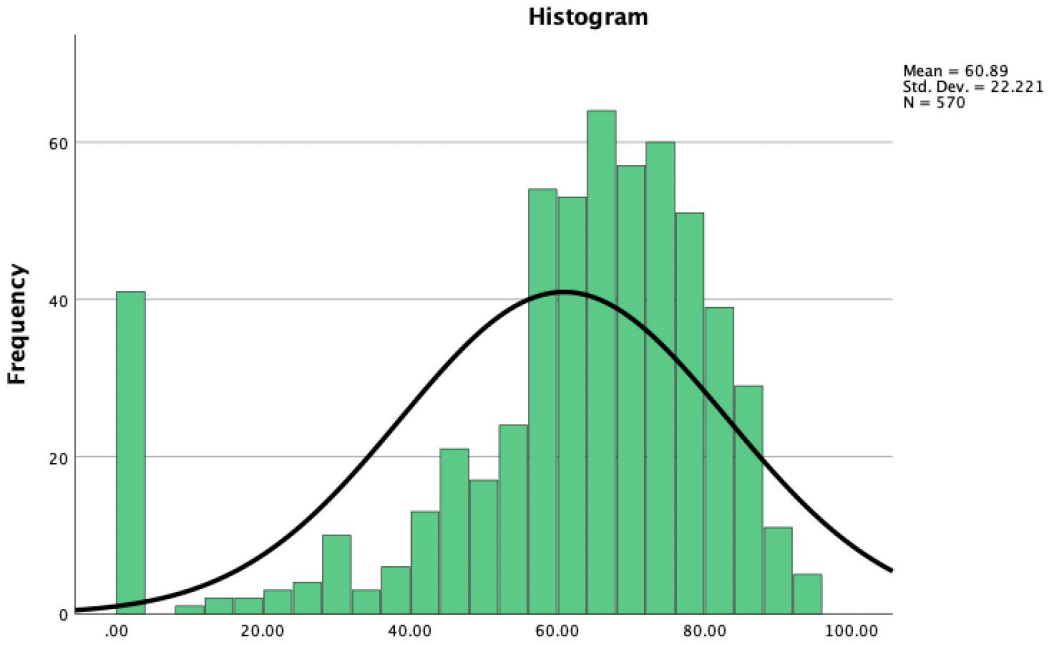
N	Valid	570
	Missing	0
Mean		60.8902
Median		65.9500
Mode		0.00
Std. Deviation		22.22123
Variance		493.783
Skewness		-1.453
Std. Error of Skewness		0.102
Kurtosis		1.745

Std. Error of Kurtosis		0.204
Range		95.00
Minimum		0.00
Maximum		95.00

1. Moderator variable: Opportunity-driven entrepreneurship
2. Abbreviation: ODE
3. Variable type: Continuous variable (%)
4. Minimum/maximum value: 0 – 95
5. Dataset: Global Entrepreneurship Monitor (GEM)

Overall, after analyzing the descriptive statistics and the histogram, one may conclude that the control variable is relatively normally distributed during the 10 years (Table 7 and Figure 7). Only for three years, the data exhibits slightly skewed distributions with slightly diverging numbers of outliers, too. To exemplify this, in year 2012, the control variable seems to be negatively skewed, whilst year 2021 suggests an approximately normal distribution (Appendix 5). This is, amongst others, due to the skewness values of respectively –0.325 and –0.768, as well as the respective kurtosis values (i.e., 2.979 and -0.014). Thus, overall, this control variable seems rather normally distributed.

Figure 7: Histogram of descriptive statistics of ODE (2012-2021).



4.1.4 Development stage

Table 8: Descriptive statistics of the DS of economies.

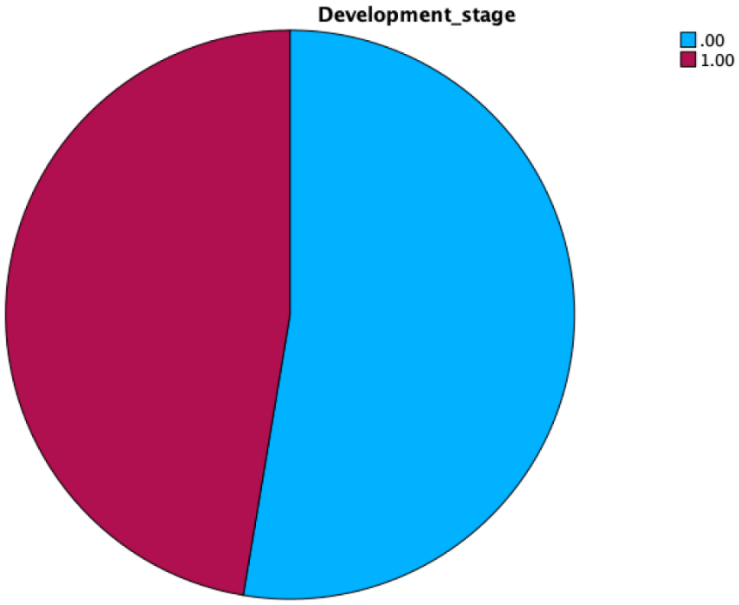
N	Valid	570
	Missing	0
Mean		0.4737
Median		0.0000
Mode		0.00
Std. Deviation		0.49975
Variance		0.250

Skewness		0.106
Std. Error of Skewness		0.102
Kurtosis		-1.996
Std. Error of Kurtosis		0.204
Range		1.00
Minimum		0.00
Maximum		1.00

1. Moderator variable: Development stage
2. Abbreviation: DS
3. Variable type: Categorical variable
4. Minimum/maximum value: 0 – 1
5. Dataset: Global Entrepreneurship Monitor (GEM) & Global Innovation Index (GII)

The descriptive statistics of moderator variable DS are shown in Table 8. More specifically, this moderator variable is a binary variable, 1 indicating a developed country, while 0 indicates a developing country in the present sample. From Figure 8, it becomes clear that the number of developing countries slightly outweighs the developed countries which are examined in this study. Further, the median and mode both support this.

Figure 8: Pie chart of the DS of economies.



4.1.5 Years

Table 9: Descriptive statistics of the years (2012-2021).

N	Valid	570
	Missing	0
Mean		2016.5
Median		2016.5
Mode		2012^a
Std. Deviation		2.875
Variance		8.264

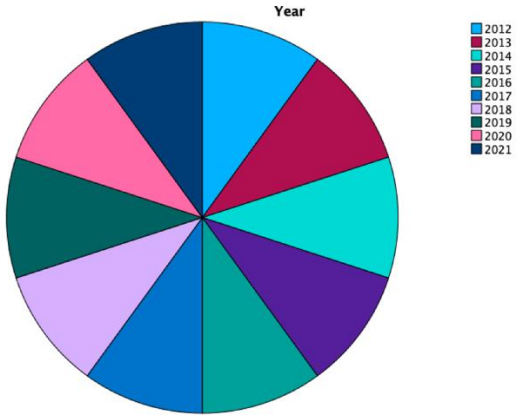
Range		9
Minimum		2012
Maximum		2021

a. Multiple modes exist. The smallest value is shown.

1. Control variable: Years
2. Abbreviation: -
3. Variable type: Categorical variable
4. Minimum/maximum value: 2012 – 2021
5. Dataset: Global Entrepreneurship Monitor (GEM) & Global Innovation Index (GII)

The first control variable, namely years, can be described as a categorical variable which ranges between the year 2012 until the year 2021. Hereby, all years are equally frequent included due to former data imputations and adjustments, which can be visually seen in Figure 9. The descriptive statistics to this variable can be seen in Table 9.

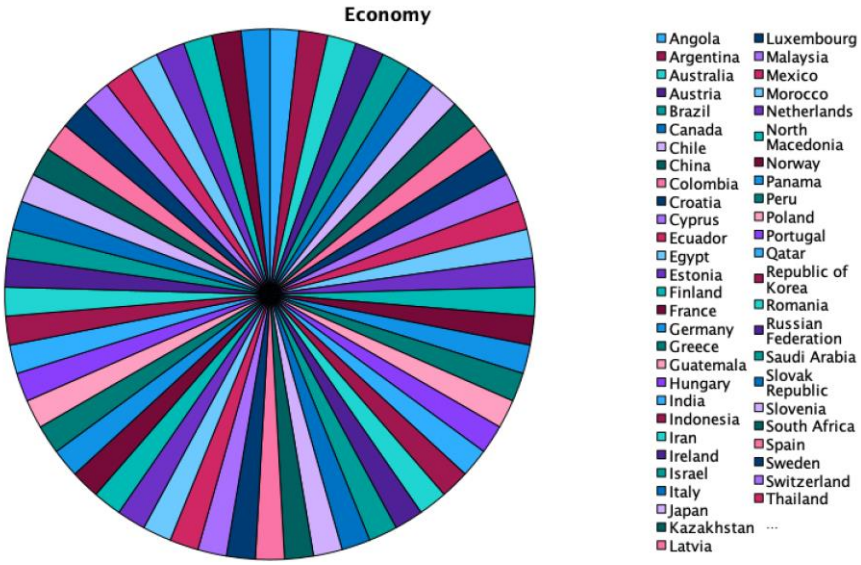
Figure 9: Pie chart of the years.



4.1.6 Countries

Finally, the second control variable's, namely countries, descriptive statistics are presented below. As can be seen in Figure 10, all countries occur equally frequent which might be, again, mainly due to missing value adjustments, meaning that the distribution of countries is uniform in this sample which may enhance the representativeness.

Figure 10: Pie chart of the countries.



1. Control variable: Countries
2. Abbreviation: -
3. Variable type: Categorical variable
4. Minimum/maximum value: 1 – 57
5. Dataset: Global Entrepreneurship Monitor (GEM) & Global Innovation Index (GII)

4.2 Ordinary least squares analysis

In this analysis, the independent variable is FE, while the dependent variable is the IP of a country. Furthermore, two control variables are included in this research paper, which are namely the years (i.e., ten in total) and the countries, while two moderator variables are taken into account, specifically a country's DS and ODE. By including control variables and moderators, this analysis may isolate the specific impact of FE on IP by testing for hypotheses about the effect of an individual predictor on the dependent variable, whilst also evaluating their relative importance and moderating impacts. Thus, the purpose of this paper is to understand how FE affects countries' IP, while controlling for other relevant factors as well as including potential moderating effects.

4.2.1 Ordinary least squares assumptions

Because of our decision to perform an OLS analysis to test for our hypotheses and describe relationships between the variables at hand, this analysis requires to check for the six assumptions described in 3.1.6 to ensure the result validity (Groß, 2003; Laerd Statistics, 2018a, 2023).

As a start, the scale of the variables is examined. To properly perform an OLS, the independent variable can be either categorical or numerous, whilst the dependent variable must be measured on a continuous scale (Gogtay et al., 2017). In this case, the dependent variable "IP" is measured in an interval format, while the independent variable FE is a continuous variable, and more specifically interval. Additionally, the control variables are categorical (i.e., years and

countries) and the moderator variables are continuous (i.e., developed/developing countries and ODE).

The *first assumption* presumes a linear relationship between the two variables, which can be verified by inspecting a scatterplot (Groß, 2003; Laerd Statistics, 2023). The scatterplot (Appendix 6) shows a negative, weak linear relation between the dependent and independent variable. Consequently, the first assumption can be validated.

The *second assumptions* states that no significant outliers entailed in the observations of the dependent variable (Laerd Statistics, 2023). This can be checked for in a scatterplot. The underlying reason for this assumption is that extreme outliers would have a misleading effect on the regression analysis, due to, for instance, reducing its fit of the regression equation and thereby, reducing the accuracy level of the outcomes. When examining the boxplots (Appendix 7), it appears that no significant extreme outliers are present. Still, we compared these results with a histogram to confirm the result. When inspecting each variable's histogram in Figures 2 and 6 respectively (see parts 4.1.1 and 4.1.2), it seems that no "true" outliers are obvious in the histogram.

Therefore, by analyzing significant outliers in the present data set, one may conclude that no extreme outliers are present, and thus, one may confirm assumption two.

The *third assumption* requires the absence of multicollinearity, which is why a correlation analysis is performed. Table 10 shows that the years potentially significantly correlate with FE, since the p-value = 0.01. The significance level can easily be identified by the stars (in table: *) and the p-value (in table: sig. 2-tailed). This potential correlation is, however, a rather markedly low and negligible positive correlation (r = 0.107). It also seems that the variable DS might significantly correlate with the main independent variable (i.e., FE), since $p < 0.001$. This potential correlation can be characterized as a relatively low negative one because r = -0.414. Additionally, the variable year seemingly negatively correlates with ODE, still the negative correlation can be defined as a low negative correlation (i.e., r = -0.359, p-value < 0.001). This means that, over the years, females being entrepreneurial due to opportunity-driven motivation has decreased, and vice versa. This may cause problems in the analysis later because multicollinearity makes it harder to interpret the present coefficients.

Table 10: Correlation analysis.

		FTEA	Year	Opportunity -driven E.	Development_ stage
FTEA	Pearson Correlation	1	.107*	.014	-.414 **
	Sig. (2.tailed)		.010	.732	<.001
	N		570	570	570
Year	Pearson Correlation		1	-.359 **	.000
	Sig. (2.tailed)			<.001	1.000
	N			570	570
Opportunity-driven E.	Pearson Correlation			1	.024

	Sig. (2.tailed)				.571
	N				570
Development _stage	Pearson Correlation				1
	Sig. (2.tailed)				
	N				

**. Correlation is significant at the 0.01 level (2-tailed).

Due to the fact that the present potential correlations are included in H_2, H_3, and H_4 we decided to test for multicollinearity with the VIF to inspect the strength of the potential correlation issue (Table 11). Since none of the VIF values is severely higher than 1, no attention is required with regards to multicollinearity between the predictor variables and consequently, multicollinearity is seemingly not a major problem in this case.

Table 11: Collinearity Diagnostics [a].

	VIF
(Constant)	
Ln_FTEA	1.230
Opportunity_driven_fEntrepreneurship	1.155
Year	1.169
Development_stage	1.213

a. Dependent variable: IP

The *fourth* assumption is also met, entailing the independence of observations. To test for potential autocorrelation issues, a Durbin-Watson test is performed (Appendix 8). Since the test value equals 1.785, no autocorrelation exists in the model.

Next, the *fifth* assumption requires homoscedasticity which is also met (Appendix 9). The result of this analysis displays homoscedasticity (i.e., variances along the line of best fit remain similar along the line) (Groß, 2003; Laerd Statistics, 2023). Thus, the data meets this assumption, too.

The *sixth*, and final, assumptions can be characterized by approximately normally distributed residuals (errors) of the regression line. Although optional, fulfilling this assumption facilitates the performance of statistical hypothesis testing, the generation of reliable confidence intervals, and prediction intervals. The two main common measures to check for this assumption is by either including a histogram or a Normal P-P Plot (Zhu, 2022). The residuals approximately follow a normal distribution (see Appendix 10 for the plot). Therefore, also the final assumption is met to perform an OLS.

5 Results and discussion

The linear regression analysis follows according to each of the hypotheses from section 2.5.

5.1 Hypothesis 1

H1: Female entrepreneurship is negatively associated with a country`s innovation performance.

Table 12 shows the correlation between IP and FE. The Pearson Correlation coefficient indicates a statistically significant and moderately strong negative relationship between FE and IP on a global scale, since r (570) = -0.384, p < 0.001. This essentially means that as the level of FE increases, the level of IP decreases.

Table 12: Pearson Correlation – Dependent and independent variable.

		IP	Ln_FTEA
Pearson Correlation	IP	1	-.384
	Ln_FTEA	-.384	1
Sig. (1-tailed)	IP	.	< .001
	Ln_FTEA	0.000	.
N	IP	570	570
	Ln_FTEA	570	570

Next, the model summary of the regression between FE and IP is presented in Table 13. The R-square shows what percentage of the variance in IP is explained by FE on a global scale. In this case, R^2 equals 0.157, meaning that only 15.7 % of the variance in the level of IP is explained by the level of FE in a country. Further, the Durbin-Watson statistics indicates whether there is autocorrelation in the model (Durbin & Watson, 1992). According to Field (2011), values between 1 and 3 are acceptable for Durbin Watson Statistics, and there is no autocorrelation present. In this case, the value is equal to 1.848, indicating no autocorrelation.

Table 13: Model summary – Dependent and independent variable.

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate	Durbin-Watson
1	$.396^a$	.157	.146	10.1853	1.848

a. Predictors: (Constant), ID_Country, Year, Ln_FTEA

b. Dependent variable: IP

Lastly, the Analysis of Variance (ANOVA) table (Table 14) is inspected. Firstly, the independent variable is analyzed to conclude whether or not it is statistically significant. The p-value equals <.001, meaning that FE does statistically significantly predict IP.

Table 14: $ANOVA^a$ – Dependent and independent variable.

Model		Sum of Squares	df	Mean square	F	Sig.
1	Regression	10830.186	3	3610.062	35.074	$<.001^b$
	Residual	58256.720	566	102.927		
	Total	69086.906	569			

a. Dependent variable: IP

b. Predictors: (Constant), ID_Country, Year, Ln_FTEA

Secondly, since the mathematical sign of the unstandardized coefficient of FE is negative, one can conclude that FE negatively predicts the IP of a country (Table 15). So, a 1% increase in FE would result in a $(|-6.209/100)|$ = 0.06209 decrease on the index scale of IP, which is statistically significant (p-value < 0.001).

Table 15: $Coefficients^a$ - Dependent and independent variable.

	Unstandardized coefficients			Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	342.275	299.951		1.141	.254
	Ln_FTEA	-6.209	0.675	-.363	-9.195	<.001
	Year	-.143	.149	-.037	-.958	.338
	ID_Country	.035	.015	.093	2.379	.018

a. Dependent Variable: IP

Consequently, we accept H_1 since there is a statistically significant negative relationship relation the two variables and by performing the above analysis, we, thus, conclude that FE negatively influences IP on a global scale.

The first possible explanation for the negative impact of FE on IP is related to the various barriers that women face in becoming entrepreneurs. These barriers have been discussed in the theoretical background and include factors such as the institutional environment, social environment, individual prerequisites, and the business environment. For instance, women may face legal and regulatory barriers that prevent them from starting a business or accessing financial resources (Aidis & Weeks, 2016; Estrin & Mickiewicz, 2011). They may also experience discrimination and bias in education and in their workplace, which can limit their opportunities to gain the skills and experience necessary for entrepreneurship (Ghouse et al., 2017; Meunier et al., 2022).

Moreover, women are more likely to have family responsibilities that make it difficult for them to pursue entrepreneurship and they do not perceive themselves as good entrepreneurs (Babcock et al., 2003; Ghouse et al., 2017; Sajjad et al., 2020; UNDP, 2020). This can limit their ability to dedicate the necessary time and resources to their business, leading to lower levels of innovation and competitiveness. Additionally, women often lack access to networks and mentors that can help them navigate the challenges of entrepreneurship and provide them with opportunities to collaborate and learn from others (Furstenthal et al., 2022; Guelich, 2022).

While these are general barriers that women face, it is important to note that these barriers may be more prevalent in developing countries, where the institutional and social environments are less conducive to FE (Aidis & Weeks, 2016; Dutta & Mallick, 2018; Mehtap et al., 2017; Murad et al., 2019). Therefore, the negative impact of FE on IPmay vary depending on the level of economic development of a country. To explore this further, the third hypothesis of the study examines the effect of the DS of a country on the impact of FE on IP.

Another reason as to why FE has a negative impact on IP could be the industries female entrepreneurs operate in, compared to male entrepreneurs. As explained in the theoretical background, females are expected to work in the service sector, or other sectors that conform to their roles such as beauty parlors, the food industry and sewing (Bates, 1995; Hallward-Driemeier, 2011; Verheul et al., 2006). Not only are females expected to work in these sectors, they are also more prevalent in the Wholesale/Retail sector (50% of women worldwide) and the Health, Education, and Social Service sector (18%) compared to the ICT sector where only

2.7% of the entrepreneurs are female (GEM, 2022a). The sectors in which women are mostly active are not characterized by high levels of innovation in general, compared to the ICT, the computer and electronic manufacturing, and the miscellaneous professional, scientific, and technical services sectors, where the highest innovation potential was found (Audretsch & Belitski, 2020; Low & Isserman, 2015). Therefore, the low impact on IP by females can be explained. It was found in other studies that if the companies founded by females are high-impact businesses that leverage market opportunities through innovation as a main driver are as successful as high-impact male-founded businesses (Stengel, 2021a; Tracy, 2011). However, it is not surprising that this effect does not outweigh the negative effect of FE on IP, as only a small percentage of firms founded by females are concentrated on innovation-heavy industries and can therefore be considered as these high-impact companies.

However, it needs to be considered that even though the result is statistically significant, the amount of variance explained by FE is only 14,7%. This could mean that other factors have a bigger influence on a country's IP than FE does. Those factors can include government policies, cultural attitudes towards entrepreneurship or access to resources. While specific government policies can be a driver for women, cultural attitudes and access to resources are both factors that usually bear more barriers than drivers to females specifically. Whilst this could also be a reason why the impact of FE is in total so small another factor could be male entrepreneurship. Not only do men have easier access to finance, society also usually sees entrepreneurship as a rather male career choice (UNDP, 2020). Therefore, the impact of male entrepreneurship and its variance is probably higher than that of FE.

Another aspect could be that the GII incorporates corporate entrepreneurship in their measurement of IP, by for example including R&D expenses or the number of joint ventures and strategic alliances (WIPO, 2020). Both indicators relate more to corporate entrepreneurship than individual entrepreneurship. As this paper is focusing on the impact an entrepreneur that is founding a new business by herself has, corporate entrepreneurship is excluded in this study. Moreover, the GEM does not consider corporate entrepreneurship, but only individual entrepreneurship of women and men. Therefore, the effect of individual entrepreneurship might also be weakened, as it only represents one part of entrepreneurship.

5.2 Hypothesis 2

H2: Over time, the impact of female entrepreneurship of countries on innovation performance has increased.

In order to analyze the effect of ascending years on the relationship between FE and IP, we decide to perform more specific linear regressions for every two years (i.e., 2012-2013, 2014-2015 etc.) in order to draw more explicit conclusions. Therefore, we divide the total examination period (i.e., ten years) into five two-year periods (Table 16):

Table 16: Periods.

Period	**Years**
1	2012-2013
2	2014-2015
3	2016-2017

4	2018-2019
5	2020-2021

First, the correlation tables (17-21) for each period are examined to identify potential multicollinearity issues. In each correlation table it becomes apparent that even though the tables show slight negative correlations between the two variables (e.g., increase in FE, decrease in IP, or vice versa), no statistically significant correlation exists between the two variables over the years. However, importantly to note is that none of the correlations indicates a strength of the relationships at all. Additionally, all negative correlations can be classified as very low, or low negative correlations.

Table 17: Correlations - FE and IP (2012-2013).

		GII	Ln_FTEA
Pearson correlation	GII	1	-.214
	Ln_FTEA	-.214	1
Sig. (1-tailed)	GII	.	.011
	Ln_FTEA	.011	.
N	GII	114	114
	Ln_FTEA	114	114

Table 18: Correlations – FE and IP (2014-2015).

		GII	Ln_FTEA
Pearson correlation	GII	1	-.453
	Ln_FTEA	-.453	1
Sig. (1-tailed)	GII	.	<.001
	Ln_FTEA	<.001	.
N	GII	114	114
	Ln_FTEA	114	114

Table 19: Correlations – FE and IP (2016-2017).

		GII	Ln_FTEA
Pearson correlation	GII	1	-.439
	Ln_FTEA	-.439	1
Sig. (1-tailed)	GII	.	<.001
	Ln_FTEA	.000	.
N	GII	114	114
	Ln_FTEA	114	114

Table 20: Correlations – FE and IP (2018-2019).

		GII	Ln_FTEA
Pearson correlation	GII	1	-.408
	Ln_FTEA	-.408	1
Sig. (1-tailed)	GII	.	<.001
	Ln_FTEA	.000	.

N	GII	114	114
	Ln_FTEA	114	114

Table 21: Correlations – FE and IP (2020-2021).

		GII	Ln_FTEA
Pearson correlation	GII	1	-.406
	Ln_FTEA	-.406	1
Sig. (1-tailed)	GII	.	<.001
	Ln_FTEA	.000	.
N	GII	114	114
	Ln_FTEA	114	114

Second, the model summaries are expected over the 5 periods (22-26) The most interesting values in this case represent the R^2values and the adjusted R^2 values. The R^2 values range from 0.165 to a maximum of 0.205, explaining to what extent the predictor variable affects the variation in the outcome variable. All the five R^2 values obtain relatively little explanatory power. Similarly, the adjusted R^2 value takes, additionally, the number of predictor variables included in the model into account. It penalizes the addition of extraneous variables that do not meaningfully improve the model's fit, leading to a lower adjusted R-squared value. Therefore, the adjusted R-squared value provides a more accurate measure of the model's explanatory power, particularly in cases where multiple predictor variables are used. In summary, the adjusted R^2 values range from 0.158 to 0.198, which are comparatively low values, too. This potentially means that the addition of other variables might be necessary to better explain the relationship between FE and IP.

Table 22: Model Summary^b- FE and IP (2012-2013).

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	$.453^a$	.205	.198	9.4455	1.853

a. Predictors: (Constant), Ln_FTEA

b. Dependent Variable: IP

Table 23: Model Summary^b- FE and IP (2014-2015).

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	$.453^a$	.205	.198	9.4455	1.853

a. Predictors: (Constant), Ln_FTEA
b. Dependent Variable: IP

Table 24: Model Summary^b- FE and IP (2016-2017).

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	$.439^a$	.193	.186	9.9823	2.367

a. Predictors: (Constant), Ln_FTEA
b. Dependent Variable: IP

Table 25: Model Summary[b] - *FE and IP (2018-2019).*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	$.408^{a}$	.167	.159	10.2960	1.830

a. Predictors: (Constant), Ln_FTEA
b. Dependent Variable: IP

Table 26: Model Summary[b] - *FE and IP (2020-2021).*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	$.406^{a}$	.165	.158	10.5745	2.011

a. Predictors: (Constant), Ln_FTEA
b. Dependent Variable: IP

Third, in the ANOVA tables (27-31) one may find out that during all periods, FE has a statistically significant effect on IP since the p-value is in all cases below the limit (i.e., $p < 0.05$). Additionally, the F-values range from 5.368 (period 1) to 28.878 (period 2), indicating that that the variation in IP associated with FE is real (and not due to chance).

Table 27: ANOVA[a] - *FE and IP (2012-2013).*

Model		Sum of Squares	df	Mean square	F	Sig.
1	Regression	589.202	1	589.202	5.368	$.022^{b}$
	Residual	12292.712	112	109.756		
	Total	12881.914	113			

a. Predictors: (Constant), Ln_FTEA
b. Dependent Variable: IP

Table 28: $ANOVA^{a}$ - FE and IP (2014-2015).

Model		Sum of Squares	df	Mean square	F	Sig.
1	Regression	2576.366	1	2576.366	28.878	$< .001^{b}$
	Residual	9992.284	112	89.217		
	Total	12568.650	113			

a. Predictors: (Constant), Ln_FTEA
b. Dependent Variable: IP

Table 29: ANOVA[a] - *FE and IP (2016-2017).*

Model		Sum of Squares	df	Mean square	F	Sig.
1	Regression	2667.300	1	2667.300	26.768	$< .001^{b}$
	Residual	11160.296	112	99.645		
	Total	13827.596	113			

a. Predictors: (Constant), Ln_FTEA
b. Dependent Variable: IP

Table 30: ANOVA[a] - *FE and IP (2018-2019).*

Model	Sum of Squares	df	Mean square	F	Sig.

1	Regression	2373.420	1	2373.420	22.389	$< .001^b$
	Residual	11872.964	112	106.009		
	Total	14246.384	113			

a. Predictors: (Constant), Ln_FTEA
b. Dependent Variable: IP

Table 31: ANOVA[a] - *FE and IP (2020-2021).*

Model		Sum of Squares	df	Mean square	F	Sig.
1	Regression	2475.568	1	2475.568	22.139	$< .001^b$
	Residual	12523.910	112	111.821		
	Total	14999.478	113			

a. Predictors: (Constant), Ln_FTEA
b. Dependent Variable: IP

Fourth, after IP is regressed on FE, all coefficients' tables (32-36) show that during each period, FE has a statistically significant negative impact on IP (p-value < 0.005). The magnitude of this negative impact has varied somewhat across the different time periods. More specifically, the impact of FE on IP appears to be highest in period 3 (2016-2017), with an unstandardized coefficient of -8.172, and lowest in period 1 (2012-2013), with an unstandardized coefficient of -3.258. In addition, in recent years, (i.e., after period 1 and 3), the negative effects of FE on IP seemingly remain approximately similar, specifically their unstandardized βs reach from -7.630 to -6.853 (Figure 11). For instance, during the years 2016-2017 (period 3), the impact of the predictor on IP is analyzed. The significance level was below 0.05, indicating that the hypothesis can be rejected. This means that during the period of 2016-2017, FE had a slightly negative effect on IP. More precisely, keeping all other variables constant, a one-unit increase in the natural logarithm of FE was associated with an 8.172 decrease in the innovation index score (i.e., in the GII).

Table 32: Coefficients[a] - *FE and IP (2012-2013).*

	Unstandardized coefficients			Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	50.859	3.072		16.556	<.001
	Ln_FTEA	-3.258	1.406	-.214	-2.317	.022

a. Dependent Variable: IP

Table 33: Coefficients[a] - *FE and IP (2014-2015).*

	Unstandardized coefficients			Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	60.140	3.088		19.473	<.001
	Ln_FTEA	-7.629	1.420	-.453	-5.374	<.001

a. Dependent Variable: IP

Table 34: Coefficients[a] - *FE and IP (2016-2017).*

	Unstandardized coefficients			Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	61.011	3.088		17.449	<.001
	Ln_FTEA	-8.172	1.580	-.439	-5.174	<.001

a. Dependent Variable: IP

Table 35: Coefficients[a] - *FE and IP (2018-2019).*

	Unstandardized coefficients			Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	60.376	3.734		16.169	<.001
	Ln_FTEA	-7.630	1.612	-.408	-4.732	<.001

a. Dependent Variable: IP

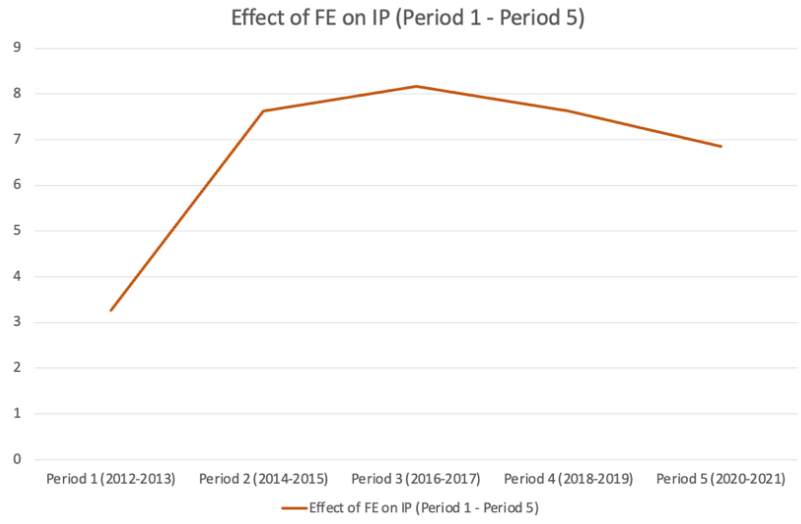
Table 36: Coefficients[a] - *FE and IP (2020-2021).*

	Unstandardized coefficients			Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	56.756	3.395		16.717	<.001
	Ln_FTEA	-6.853	1.457	-.406	-4.705	<.001

a. Dependent Variable: IP

Below, a visualized illustration can be seen which represents a summary of each period's negative effect (i.e., β-coefficient) on the relationship between FE and IP, that can be concluded from all five separate regressions run (Figure 11).

Figure 11: Development of the negative effect of FE on IP over the years.



Overall, these findings suggest that additional variables may be needed to better explain the relationship between FE and IP, as the proportion of variance explained by the predictor variable is relatively low across all five periods.

There could be several potential reasons for these differences. For example, it is possible that during period 3, there was a higher concentration of female entrepreneurs who lacked the necessary resources or support to fully realize their innovative potential, leading to a greater negative impact on IP. In period 1, FE shows the lowest negative impact on IP, potentially meaning that female entrepreneurs overcame a few more barriers during 2012-2013, still many remained which is why the negative impact remains.

Consequently, it is also worth noting that there could be other factors at play, such as changes in the overall economic climate or government policies that affected entrepreneurship and innovation differently across the different time periods. Further analysis would be needed to fully understand the reasons behind these differences.

5.3 Hypothesis 3

H3: Female entrepreneurship has a more positive influence on developed countries' innovation performance than on developing countries' innovation performance.

To examine H_3, two regression analyses are performed to be able to compare the effects of developed and developing countries respectively. So, two sub-samples have been created, namely one sub-sample for developed countries (see 5.3.1), whereby the sample size is equal to 270, as well as one for developing countries (see 5.3.2), hereby the sample size equals 300. The idea is to examine the relationship between FE and IP based on two separate samples of countries to draw further conclusions.

5.3.1 Regression analysis: Developed countries

In the following, the linear regression of FE and IP in developed countries is performed. In the model summary of this regression, it becomes clearly visible that FE does not determine the variability in IP regarding developed countries (i.e., R^2= 0.00) (Table 37).

Table 37: Model summary –Regression developed countries..

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate
1	$.007^a$	.00	-.004	7.9591

a. Predictors: (Constant), FTEA

Additionally, the F-value, depicting the overall effect, is relatively low (F-Stat = 0.012), whilst also the statistical significance is > 0.05 (Table 38). This entails that this conceptual model does not fit because it is statistically insignificant.

Table 38: $ANOVA^a$ – Regression developed countries.

Model		Sum of Squares	df	Mean square	F	Sig.
1	Regression	.762	1	.762	.012	$.913^b$

	Residual	16977.213	268	63.348		
	Total	16977.975	269			

a. Dependent variable: IP

b. Predictors: (Constant), FTEA

Furthermore, the β-coefficient, explaining the change in IP, is equal to -0.102 which is highly statistically insignificant (p>0.05) (Table 39). As a consequence, the aforementioned results indicate that there is no clear relationship between FE and IP for developed countries.

Table 39: $Coefficients^a$- Regression developed countries.

	Unstandardized coefficients			Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	51.640	1.805		28.607	<.001
	FTEA	-.102	.930	-.007	-.110	.913

a. Dependent Variable: IP

5.3.2 Regression analysis: Developing countries

Contrary, now the linear regression of FE and IP in developing countries is performed, whereby the sub-sample size is equal to 300 observations.

In the model summary of the developing countries regression analysis, it becomes clearly visible that FE does, to some extent, determine the variability in IP (i.e., R^2= 0.062) (Table 40).

Table 40: Model summary – Regression developing countries.

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate
1	$.249^a$	.062	.059	7.6094

a. Predictors: (Constant), FTEA

In addition, since the F-value is relatively moderate (F-Stat = 19.758), whilst the statistical significance <0.001 (Table 41), the conceptual model does fit because it is statistically significant.

Table 41: $ANOVA^a$ – Regression developing countries.

Model		Sum of Squares	df	Mean square	F	Sig.
1	Regression	1144.063	1	1144.063	19.758	$< .001^b$
	Residual	17255.175	298	57.903		
	Total	18399.238	299			

a. Dependent variable: IP

b. Predictors: (Constant), FTEA

Furthermore, the β-coefficient, explaining the change in IP, is equal to -3.058 which is statistically significant (p<0.001) (Table 42). Consequently, for every 1% increase in FE, IP

would decrease by 0.03058 index scale units i.e., after transforming the ln-variable into its original percentage format.

Table 42: $Coefficients^a$ - Regression developing countries.

	Unstandardized coefficients			Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	43.397	1.711		25.367	<.001
	FTEA	-3.058	.633	-.249	-4.445	<.001

a. Dependent Variable: IP

Based on the sub-sample comparison between developed and developing countries' effects on FE and IP, we reject H_3. With regards to the developing countries analysis, a clear and statistically significant negative effect can be observed. However, with respect to the developed countries, one may observe a relatively small, but statistically very insignificant effect on the relationship between FE and IP. To be more specific, since the β - coefficient is very small, the negative effect between the two main variables is reduced and thereby, almost getting close to zero. Thus, we may conclude that from a developing country perspective, a statistically significant negative relationship exists between FE and IP. To be more specific, if, e.g., developed countries are inspected, a 1% increase in FE would result in a (| -3.058/100 |) = 0.03058 decrease in IP. Additionally, the negative effect of developing countries is approximately 30-times as high as the (statistically insignificant) negative effect of developed countries, which is clearly showing that, comparatively, developing countries have a severe negative impact on the relationship between FE and IP. Thus, this relatively large negative coefficient strengthens the already negative main relationship. Contrary, from a developed country angle, we cannot find a statistically significant relationship between FE and IP. Therefore, even though the effect of FE on IP is seemingly more positive in developed countries, compared to developing countries, we may need further statistically significant insights in order to confidently accept H_3. Therefore, at this point in time, we reject H_3.

From the above regression analyses, a few discussion points can be made based on the comparative analysis to explain whether (or not) FE has indeed a relatively higher positive influence on a country's IP when the country is a developed country.

When examining the case of developing countries, factors such as socio-cultural aspects, lack of resources, regulatory environment, as well as measurement issues may play a key role in this context. In many *developing countries*, gender roles and cultural norms may limit the opportunities available to women, including access to education, financing, and networks (Aidis & Weeks, 2016; Meunier et al., 2022; Murad et al., 2019). This could result in an overall lower level of FE and a weaker link between FE and IP. Additionally, developing countries may have limited resources and infrastructure to support innovation and entrepreneurship, which could limit the overall level of IP (Bradley et al., 2012). Female entrepreneurs are especially disadvantaged in accessing these resources and face additional barriers due to gender bias, such as access to technology or family support and acceptance (Ghouse et al., 2017; Murad et al., 2019; Sajjad et al., 2020). Further, the regulatory environment in developing

countries may be less favorable to entrepreneurship, which could limit the potential for innovation and growth (World Bank, 2021). This could be especially true for female entrepreneurs who may face additional legal and regulatory barriers due to gender bias (Aidis & Weeks, 2016). And lastly, the negative relationship between FE and IP in developing countries could be an artifact of how these variables are generally measured. For example, if the measures of FE and IP are not comprehensive or accurate, the relationship between the variables could be distorted. To summarize, it is important to note that the relationship between FE and IP in developing countries is complex and multifaceted, and that there is likely no single explanation for any observed relationship. A careful analysis of the underlying data and the specific context is necessary to fully understand the relationship between these variables.

With respect to *developed countries*, it is generally assumed that a developed country serves as an environment in which innovation and entrepreneurship may flourish. However, when taking the overall negative effects of FE into account, the overall effect is going to be negative in the case of a developed country, too. This might be because, overall, developed countries may still possess deep-rooted gender biases and stereotypes that hinder the advancement of female entrepreneurs. Prevalent societal norms and expectations may limit access to resources, networks, funding, and opportunities for female entrepreneurs, resulting in reduced IP. Furthermore, developed countries may still have a lower representation of women in early-stage activities and decision-making roles in the business and entrepreneurial sectors. This underrepresentation can lead to a lack of diverse perspectives and ideas, inhibiting innovative solutions and hindering overall IP. Additionally, gender-based biases in financing decisions, lack of awareness or support for women-led ventures, and unequal access to capital can limit the growth and innovation potential of female-led businesses. Moreover, developed countries may have established networks and mentorship opportunities that are predominantly male-dominated and thereby relatively exclusive. The limited access to supportive networks and mentors for female entrepreneurs can hinder their ability to gain valuable insights, knowledge, and guidance necessary for innovation and business growth (e.g. Hampton et al., 2009). And lastly, developed countries may often have demanding work cultures and expectations that may pose unique challenges for female entrepreneurs who strive to balance their professional aspirations with family responsibilities. The lack of adequate support systems, flexible work arrangements, and childcare options can impact female entrepreneurs' ability to fully commit to their ventures, potentially affecting IP (Alsos et al., 2016). Thus, despite the fact that developed countries may have more resources and infrastructure to support entrepreneurship and innovation, female entrepreneurs may still face unique barriers and challenges in accessing these resources. This lack of support could contribute to lower levels of IP among female entrepreneurs. And lastly, it is possible that there are other factors or contextual features that are driving the negative relationship between FE and IP in developed countries. For example, there may be certain industries or sectors that are more resistant to female participation, or there may be cultural factors that discourage women from pursuing entrepreneurial activities. In summary, it is important to recognize that a statistically negative relationship between FE and IP in developed countries might initially be unexpected, and that there are likely specific contextual factors that would need to be examined to understand why such a relationship might exist. Especially, since this paper shows statistically insignificant results regarding the developed countries perspective, this concept may require more thorough examination to draw confident conclusions and getting a realistic overview.

5.4 Hypothesis 4

H4: Female entrepreneurship has a positive influence on a country´s innovation performance when their entrepreneurs´ motivation is mainly opportunity-driven.

First, the overall model fit and the statistical significance solely of the variable ODE (female) is analyzed with respect to the dependent variable, IP.

With respect to the model fit, one may identify that – a relatively small number - 1.4% variations of the control variable ODE can explain the IP of a country. Additionally, the model presents a suitable fit for this study (i.e., $adjusted\, R^2 - value > 0$) (Appendix 3). When examining the statistical significance (Appendix 4), F(1.568)=7.808, while the p-value is equal to 0.005, which is generally defined as statistically significant.

Followed by the sole insights about the variable ODE, the interaction term is analyzed as follows to examine and draw further conclusions about H_4:

In the correlation Table 43, it becomes apparent that the moderating effect of ODE has a weak, negative correlation on the relationship between FE and IP (r = -0.098*). The statistical significance value is equal to 0.019, indicating statistical significance. Specifically, this means that the effect of FE on IP is weaker when the opportunity-driven motivational level is higher (i.e., moderating effect).

Table 43: Correlations – Moderation regression ODE.

		GII	LnFTEA_centered	ODE_centered	LnFTEA_ODE_centered
GII	Pearson Correlation	1	.384**	.116**	-.098*
	Sig. (2-tailed)		<.001	.005	.019
	N	570	570	570	570
LnFTEA_centered	Pearson Correlation		1	.014	-.002
	Sig. (2-tailed)			.732	.970
	N	570	570	570	570
ODE_centered	Pearson Correlation			1	-.064
	Sig. (2-tailed)				.129
	N	570	570	570	570
LnFTEA_ODE_centered	Pearson Correlation				1
	Sig. (2-tailed)				
	N	570	570	570	570

Furthermore, the R-value is equal to 0.413 which presents a suitable value to continue the analysis of the moderating effect (Table 44). Still, the R^2-value shows a value of 0.170, indicating that 17% of variation in IP can be explained by the moderating effect. This effect is, however, relatively low which can be translated into ODE may only explain little variance in the main relationship. Further, the Adjusted R^2-value is equal to 0.166, which means that overall, 16.6% of the general variance might be explained by this moderator.

Table 44: Model summary – Moderation regression ODE.

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate	Durbin-Watson
1	$.413^a$	.170	.166	10.0638	2.109

a. Predictors: (Constant), LnFTEA_ODE_centered, LnFTEA_centered, ODE_centered

Next, the ANOVA table (Table 45) is examined to determine the model's significance to determine the outcome. Herein, the p-value equals <0.001, which lay within the desired confidence interval of 99%. Thus, the result is statistically significant. The F-ratio is equal to 38.714 which is relatively high and thus, we may draw relevant conclusions from this analysis.

Table 45: $ANOVA^a$ – Moderation regression ODE.

Model		Sum of Squares	df	Mean square	F	Sig.
1	Regression	11762.753	3	3920.918	38.714	$<.001^b$
	Residual	57324.153	566	101.279		
	Total	69086.906	569			

a. Dependent variable: IP

b. Predictors: (Constant), LnFTEA__ODE_centered, LnFTEA_centered, ODE_centered

The interaction effect is statistically significant since the p-value < 0.05 (p = 0.018), meaning the H_4 is rejected which entails that there is a moderating effect (Table 46). So, the interaction term of ODE and FE obtains a slightly negative effect (β = -0.072) on IP. In other words, the magnitude of the coefficient (-0.072) indicates that for every unit increase of the moderating variable (i.e., ODE), the effect of FE on IP decreases by 0.00072 index scale units (i.e., after ln-transformation), holding all other variables constant.

Therefore, the relationship between FE and IP does depend on the level of ODE.

Table 46: $Coefficients^a$- Moderation regression ODE.

		Unstandardized coefficients		Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	43.358	.422		102.849	<.001
	LnFTEA_centered	-6.593	.655	-.385	-10.063	<.001
	ODE_centered	.058	.019	.116	3.028	.003
	LnFTEA_ODE_centered	-.072	.030	-.091	-2.378	.018

a. Dependent Variable: IP

Interpreting these results, it becomes clear that the motive to start a business does moderate the impact of FE on IP. The results are statistically significant, but the negative influence is only small. The interaction effect of ODE and FE is -0.072. This suggests that the negative relationship between FE and IP is stronger (i.e., negatively) when ODE is present. In other words, the negative effect of FE on IP is strengthened (i.e., negatively), to a certain extent, by the presence of ODE. So, the moderating effect does not make the relationship between FE and IP positive at all. Therefore, H_4 can be rejected, meaning an entrepreneurially opportunity-driven motivation has an effect on the relationship between FE and IP, but the effect is negative.

However, we can conclude that there is a positive relationship between the opportunity-driven motive to entrepreneurship and IP in general (β = 0.058), if the interaction term is present. This confirms our initial suspicion, that people who are preoccupied by the fulfillment of their basic needs such as the need for food, shelter, employment, and prosperity and who follow an entrepreneurship career out of this reason, are probably rather necessity- than opportunity-driven. Therefore, the level of innovativeness is rather low in these instances, as the goal of the entrepreneur is fulfilling basic needs rather than growth needs such as the need for creativity, meaning and inner potential (Maslow, 1943), which would be the case if an entrepreneur follows an entrepreneurship career out of an opportunity motive. In these cases, the IP will be higher. However, a bigger IP effect of females being driven by opportunity was expected. The possible reasons why this effect was not found will be explained in the following.

It must be noted that the number of female entrepreneurs starting a business out of opportunity is smaller than the number of male entrepreneurs starting a business out of opportunity. As described before, female entrepreneurs are less likely to start a new venture due to an opportunity motive (68.4%), compared to men (74%). Contrary, the number of females starting a business out of necessity, because they have no other means of economic support or because they lack employment is higher than the number of men (GEM, 2019). Women are, overall, more likely (27%) than men (21.8%) to start a new business due to a necessity motive in most countries. As was found above, ODE leads to higher levels of IP. Therefore, if there are less females who are opportunity-driven than men, and if the number of females driven by necessity instead is higher than the number of men driven by necessity, it becomes clear why the moderating effect of this variable is relatively small and negative in the present analysis. If the number of females driven by opportunity instead of necessity was higher, the moderating effect of the opportunity motive might probably become rather positive and stronger. Moreover, when considering that H3 was also rejected, it is not too surprising that also H4 did not bring positive results. Generally, we have proposed that in developed countries, generally, FE is more opportunity- than necessity-driven, which leads to higher IP. As the effect of FE on IP in developed countries in general is not positive, it makes sense that also the effect of females being opportunity-driven on IP is not positive. The reasons for this effect, again, can be the structural, social and cultural barriers women are facing that hinder them from following an entrepreneurship career even more when they are opportunity-driven than if they were necessity-driven. If a woman is opportunity-driven, she has the possibility to also follow a different career path (as opposed to women who must become entrepreneurs out of necessity), so she might decide to not become an entrepreneur if she is faced with strong barriers, therefore resulting in a negative relationship.

6 Conclusion

After analyzing the relationship between FE and IP, it can be concluded that FE in general has a negative impact on IP, which is a statistically significant finding. This finding accepts hypothesis H_1, which suggests that FE negatively impacts IP. Additionally, it was found that the impact of FE on IP has not grown over the past ten years, which indicates that even though the topic of FE gains more attention, there is still a long way to go to reduce the existing barriers and achieve gender equality.

The barriers faced by women in entrepreneurship were detailed in the theoretical background, and it became even clearer through this analysis that these barriers strongly outweigh the drivers for FE. It is not surprising that FE has a negative impact on IP, and that this effect is also not positive in developed countries or when women are opportunity-driven, as these barriers limit women's ability to start and grow successful businesses. The need to address the barriers faced by women entrepreneurs is clear, and it is essential to develop policies and initiatives that create a more favorable environment for FE.

Although it was found that FE does have a negative impact on IP, it is important to note that all the effects observed were only very small. This suggests that there are a multitude of factors influencing FE and its impact on IP. The complexity of these factors makes it difficult for governments to effectively address the existing gender disparities. Moreover, the motives behind why a woman starts a company must be considered when examining the impact of FE on IP, but this is not the only factor to look at. The findings of hypothesis H_3 and H_4 support the idea that other factors can moderate the impact FE has on IP. However, the influencing factors are manifold and can, for example, also include different levels of education, as well as social pressures and perceptions of women.

In conclusion, the study provides evidence that FE in general does have a negative impact on IP, and this impact has not increased over the past decade. The barriers that women face in entrepreneurship outweigh the drivers, which explains the weak impact on IP. Although the findings highlight the need to address gender disparities, it is important to recognize the complexity of the factors that influence the relationship between FE and IP. The results of the study emphasize the need for more research to gain a more comprehensive understanding of the factors that influence FE and its impact on IP.

6.1 Future implications

Due to the overwhelming evidence of female entrepreneurs being underrepresented in different sectors and countries worldwide, we propose recommendations that will address these issues.

As a primary method for managers, it's evident that there is still an extensive effort required to tackle the obstacles experienced by women entrepreneurs. Despite creating initiatives that endeavor to encourage FE and overcome hindrances, our research indicates these efforts may be insufficient in addressing the root cause. Therefore, it is crucial to develop more comprehensive policies and programs that serve their specific needs. Taking into account the different obstacles they face in terms of institutional and social barriers, there should be initiatives aimed at improving access to finance, networks, mentors while also addressing deeply rooted cultural and gender biases. In addition to this acknowledgement, managers should recognize that female entrepreneurs have unique motivations for starting businesses. Managers should consider the diverse needs and aspirations of female entrepreneurs when developing programs and policies.

Second, it is crucial for researchers to delve deeper into this issue. Specifically, we need more nuanced and comprehensive research on the various factors that influence this relationship. Though our study identified relevant drivers and barriers, there may be other contextual factors at play which can vary from situation to situation. Thus, future research must strive to identify

these specific variables and explore how they interact with each other in influencing the link between FE and IP.

Finally, our findings have important implications for policy makers, as they suggest that there is a need for more comprehensive and targeted policies aimed at promoting FE with respect to mobilizing financing as well as other support. While there have been some efforts to promote FE, our study suggests that these policies may not be enough to fully address the underlying barriers faced by women entrepreneurs. Therefore, it is crucial for policy makers to take into account the needs of female entrepreneurs when designing policies. By developing more comprehensive and targeted policies, they have an opportunity to overcome institutional and social barriers that limit women's access to opportunities. For instance, initiatives that provide financial resources, enhance their networks, and offer mentorship could be potential game changers for female entrepreneurs. Additionally, policy makers should remain attentive toward cultural and gender biases in this field. Furthermore, policymakers must recognize the varied motivations of female entrepreneurs when developing policies and programs and should seek to create an enabling environment that supports the growth and development of women-led businesses.

6.2 Limitations

While the study of the relationship between FE and IP is an important area of research, it is not without its limitations. This section will discuss some of the key limitations of our study and their implications for the interpretation of our findings.

The *first challenge*, with regards to this paper, is that the innovation indices that measure the innovation on a country-level do not differentiate between corporate entrepreneurship and individual entrepreneurship. R&D expenditures, for example, are mostly accounted for by large corporations with 250 employees or more. In fact, 80% of the European business R&D expenditures consist of large corporations (Hollanders & Es-Sadki, 2022). As this research concentrates on entrepreneurship as the concept of individuals founding new companies, not large corporations, factors like R&D expenses are not important to be considered in this case. This might influence and distort the findings to some extent.

The *second challenge* entails that we have not included all nations in the two indices in this study, only 57, since either (1) data was not covered in both indices, which would have hardened comparisons, or (2) because a few countries had too many missing data during certain periods. Eventually, however, we have a greater sample of developing countries than from developed countries which may falsify the outcomes to some extent since we aimed on exploring the relationship of FE and IP on a balanced global scale.

A *third limitation* of this study is related to the analysis conducted. First, we used imputed mean values to handle missing data, which may have introduced bias and reduced the precision of our estimates. While imputation can be a useful technique for handling missing data, it assumes that the missing values are missing at random, which may not be the case in our data. Second, we had to transform the main independent variable, namely FE, (measured by GEM data) due to normality issues, which may have affected the interpretation of our results. Specifically, we took the natural logarithm (ln) of the GEM data to achieve normality, but this transformation may have altered the underlying relationships between the variables.

To be more specific, in the following, slight variations are illustrated when comparing the unimputed mean analyses with the imputed mean analyses we chose to apply in this study:

Regarding model 1 and H_1, two key findings emerge. Firstly, the sample size decreases by approximately 24.9% (N = 428). Secondly, the coefficient shows a slight decrease (β = -6.109), indicating a slight decrease in the negative effect of approximately 6.9% (Table 47).

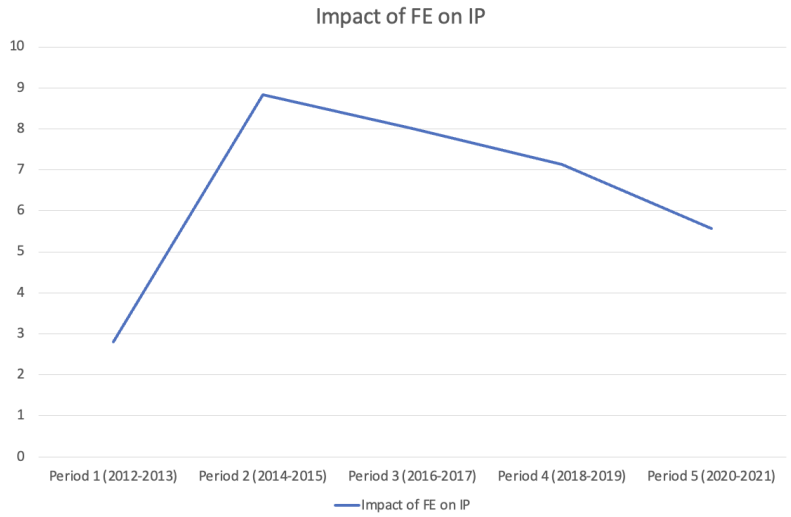
Table 47: Linear regression of FE and IP (unimputed data analysis).

	Unstandardized coefficients			Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	56.744	1.728		32.832	<.001
	FE (LnFTEA)	-6.109	.799	-.348	-7.649	<.001

a. Dependent variable: IP

Next, when inspecting model 2, relating to H_2, slight variations become clear when analyzing the timely development (Figure 12). Without imputing mean values for the main independent variable, the impact on IP is least negative during period 1 (2012-2013), while it is highest during period 2 (2014-2015) compared to period 3 (2016-2017) in the actually applied model.

Figure 12: Timely development of FE – unimputed mean analysis.



Further, when analysing model 3 (related to H_3), one can see that the model remains statistically insignificant since p-value > 0.05 (p = 0.593) for developed countries (Table 48). However, the models slightly differ when studying the β-coefficient which is -0.556 compared to -0,102 in this paper. Still, the model remains statistically insignificant (p-value=0.593).

Table 48: $Coefficients^a$- Moderation regression developed countries (unimputed data analysis).

	Unstandardized coefficients			Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.

1	(Constant)	52.382	2.018		25.961	<.001
	Mod_FTEA_Dev	-.556	1.040	-.035	-.535	.593

a. Dependent Variable: IP

Contrary, when testing the moderating influence of developing countries on IP without imputing mean values, the model remains statistically significant (p-value = 0.002) (Table 49). Still, the β-coefficient is smaller (β = –2.475), compared to β = -3.058 in the original analysis (value decrease of 19.65%), indicating that by unimputing mean values for missing data, the negative moderating impact of developing countries would be lower (less negative). Thus, also this might be encountered in this context.

Table 49: $Coefficients^a$- Moderation regression developing countries (unimputed data analysis).

	Unstandardized coefficients			Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	42.261	1.924		21.967	<.001
	Mod_LnFTEA_ODE	-2.475	.780	-.204	-3.171	.002

a. Dependent Variable: IP

And last but not least, in model 4 (related to H_4), the previous β–coefficient of -0.072 is now equal to 0.003, indicating a positive effect (Table 50). Therefore, the interpretation of the moderator influence on the negative main relationship would meaningfully differ as well: Since the β– coefficient is positive (i.e., has a positive impact on the negative main relationship), the initially negative relationship would go close to zero. In other words, high opportunity-driven entrepreneurial motivations among female entrepreneurs no longer have a negative effect on IP but rather a neutral or non-discernible effect. Nevertheless, it is important to note that this model remains statistically insignificant with a p-value > 0.05. Therefore, further research should focus on the motivational background to uncover specific implications and gain a deeper understanding of the findings.

Table 50: $Coefficients^a$- Moderation regression ODE (unimputed data analysis).

	Unstandardized coefficients			Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	43.466	.523		21.967	<.001
	Mod_FTEA_ODE	.003	.034	.004	-3.171	.925

a. Dependent Variable: IP

Another primary, and *fourth limitation* of our study is related to the applied data sources. While we analyzed data from the GEM and the GII, these sources have their own limitations. For example, the GEM data only covers a subset of countries and may not be representative of the global population. Additionally, the GII uses a composite index to measure IP, which may not capture all aspects of innovation relevant to our research question. Moreover, while the inclusion of multiple factors and indicators in an index can provide a more comprehensive

understanding of a phenomenon, overly specific indexes can also be problematic. In this case, the broadness of the indexes made it difficult to pinpoint the precise factors driving the relationship between FE and IP. Moreover, the complexity of factors that influence a country's IP means that it is challenging to isolate the effect of FE on this outcome. Many of the factors that contribute to a country's IP also act as barriers to FE. This means that the relationship between the two indexes is hard to grasp fully. To address this limitation, future research could use indexes that are more easily understood and interpreted, particularly with regards to innovation. This would provide a more nuanced and detailed understanding of the relationship between FE and IP, while also allowing for a clearer identification of the factors that contribute to this relationship.

Despite these limitations, this study provides important insights into the relationship between FE and IP on a global scale. By acknowledging these limitations and their implications, hopefully a more nuanced understanding of the findings is provided and future research in this area might be guided accordingly.

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8 Appendix

Appendix 1: *GEM dataset - excluded cases due to many missing values.*

Excluded countries	Number of cases
Barbados	3
Belgium	4
Botswana	4
Bulgaria	4
Burkina Faso	4
Cameroon	3
El Salvador	3
Jamaica	3
Lebanon	4
Lithuania	3
Madagascar	3
Oman	3
Philippines	3
Singapore	3
Trinidad & Tobago	3
Tunisia	2
Turkey	4
Uganda	3

Appendix 2: *Descriptive statistics after logarithmic transformation of FE.*

N	Valid	570
	Missing	0
Mean		2.1508
Median		2.1518
Mode		1.79
Std. Deviation		0.64405
Variance		0.415
Skewness		-0.037
Std. Error of Skewness		0.102
Kurtosis		-0.053
Std. Error of Kurtosis		0.204
Minimum		-0.11
Maximum		3.93

Appendix 3: *Model summary of ODE (female).*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	$.116^{a}$	.014	.012	10.9537

a. Predictors: (Constant), opportunity-driven entrepreneurship (female)

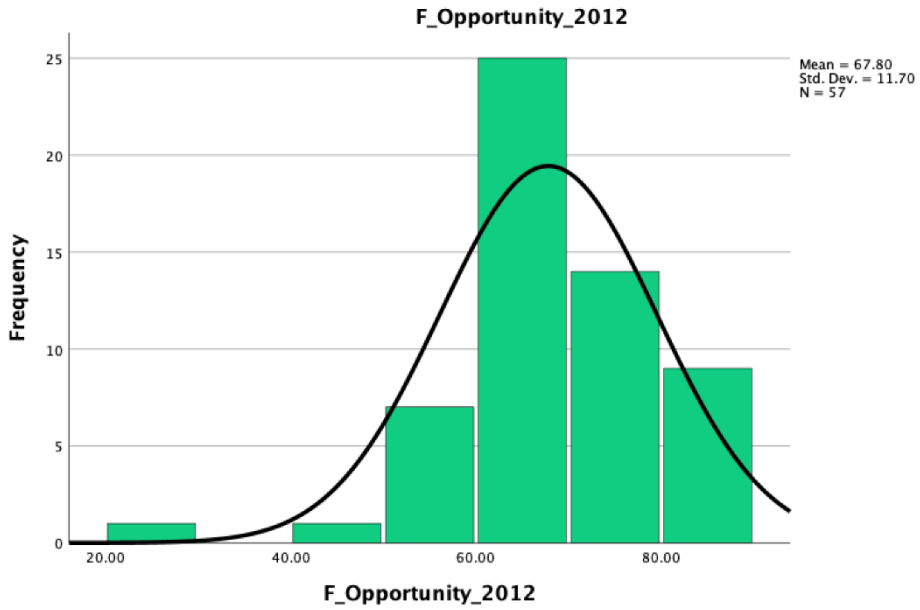
Appendix 4: $ANOVA^{a}$.

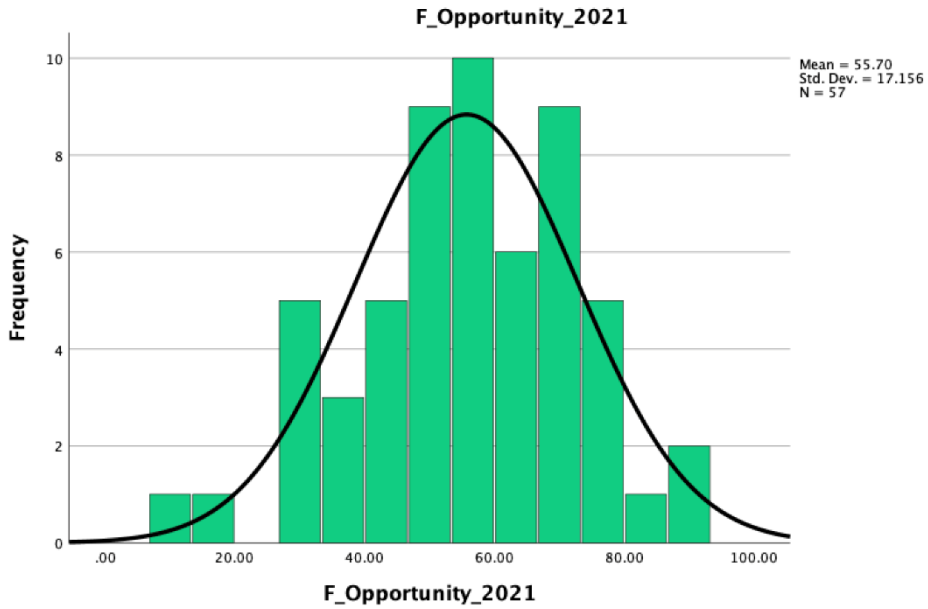
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	936.780	1	936.780	7.808	$.005^{b}$
	Residual	68150.126	568	119.983		
	Total	69086.906	569			

a. Independent variable: IP

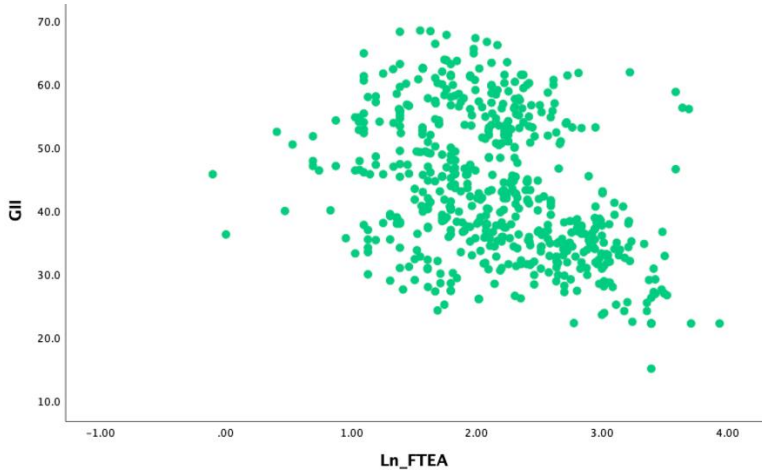
b. Predictors: (Constant), opportunity-driven entrepreneurship

Appendix 5: *Histograms of female ODE 2012 vs. 2021.*

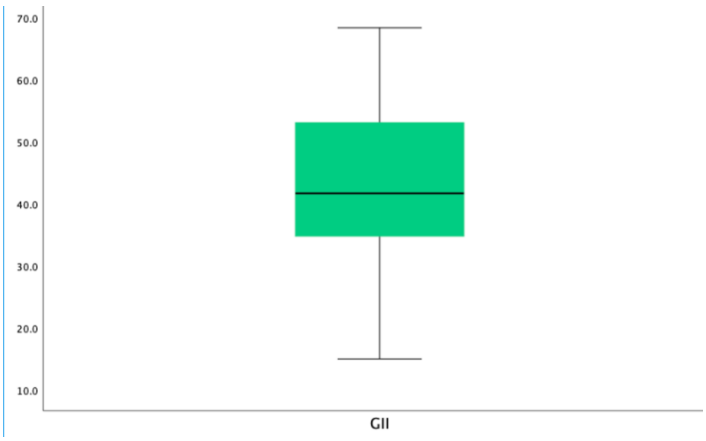


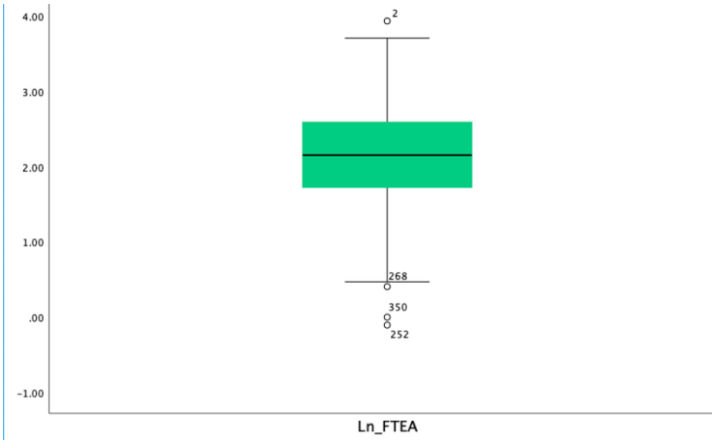


Appendix 6: *Scatterplot – Linearity check.*



Appendix 7: *Boxplot – IP (above) and FE (below).*





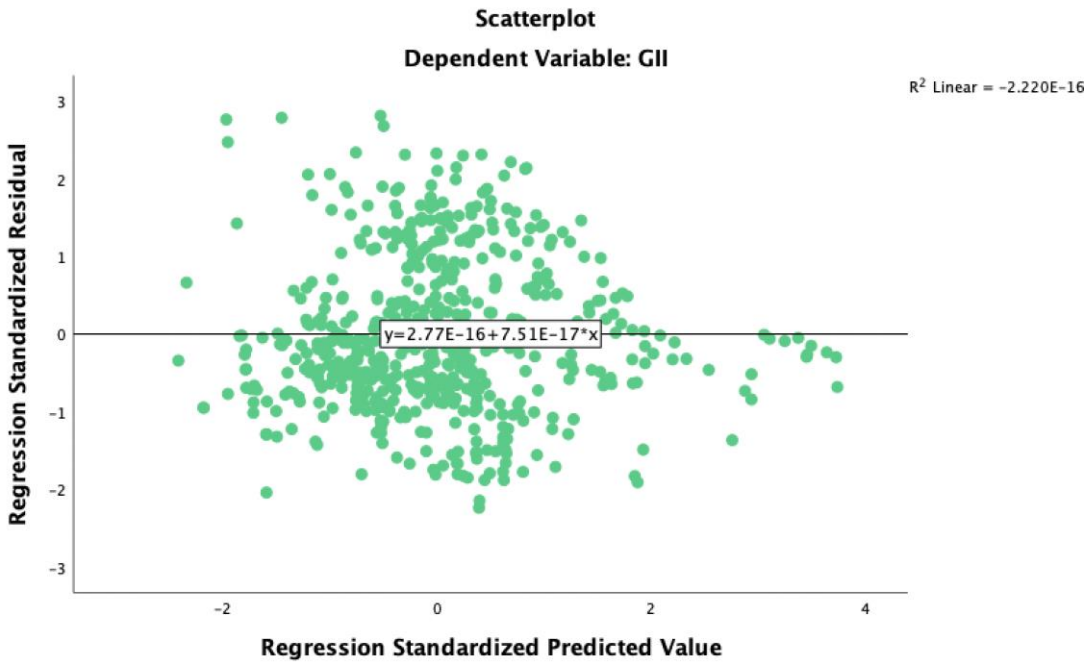
Appendix 8: *Model summary – Linear regression for autocorrelation.*

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate	Durbin-Watson
1	.741[a]	.509	.507	7.7396	1.785

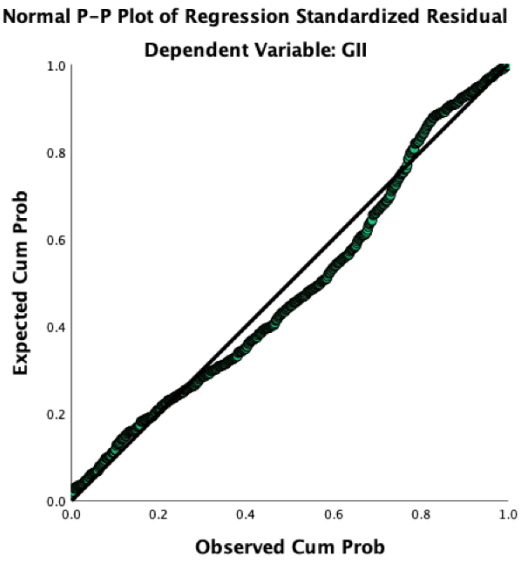
a. Predictors: (Constant), Ln_FTEA, opportunity-driven entrepreneurship, Development_stage

b. Dependent variable: IP

Appendix 9: *Scatterplot – Homoscedasticity check.*



Appendix 10: *Normal P-P Plot – Normal distribution analysis.*


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: GII
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0