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The Role of AI on Entrepreneurship

Abstract

The integration of artificial intelligence (AI) into the entrepreneurial ecosystem is revolutionizing business creation, innovation, and economic growth. This paper examines the multifaceted role of AI in entrepreneurship, focusing on its impact on business innovation, market competition, and overall economic prosperity. Through an extensive literature review and empirical analysis, key AI-driven factors influencing entrepreneurship are identified, including automation, enhanced data analytics, predictive modelling, and AI-driven decision-making processes.

The study highlights how AI enhances productivity and innovation while also presenting challenges such as job displacement, ethical considerations, and the need for reskilling. By leveraging AI, entrepreneurs can unlock new opportunities, drive economic growth, and foster a dynamic and resilient entrepreneurial landscape. The paper concludes with policy recommendations aimed at fostering an AI-friendly entrepreneurial ecosystem, advocating for continuous learning and adaptive regulatory frameworks to effectively harness AI's potential.

This research provides valuable insights for policymakers, educators, and entrepreneurs, offering a roadmap for navigating the evolving digital economy and maximizing AI's transformative potential in entrepreneurship.

Role of AI on Entrepreneurship

1. Introduction

The various definitions of entrepreneurs are introduced by various scholars, which leads to a lack of a common definition that who is an entrepreneur and what entrepreneurship entails (Kibassa, 2012). Entrepreneurship is defined as the process that consists of combining the resources and the innovative use of them to discover and make use of opportunities (Ratten, 2023). Ducker defined entrepreneurship as an act from which resources have attained the capacity to turn into wealth (Alexandre, 2021) Entrepreneurs lead to job opportunities, increased competitiveness, and social achievement by introducing new ideas, services, and products. It plays an important role in driving economic growth. Employment creation, productivity growth, innovation, and economic development are the highlighted economic benefits of entrepreneurship. Entrepreneurs contribute to economic prosperity by contributing in the economy by introducing high-quality innovation, fostering productivity, and creating employment opportunities (Praag & Versloot, 2007)

Entrepreneurs are the drivers of Sustainable growth and economic growth activities. Entrepreneurship is enhanced by social entrepreneurship, strengthening institutional framework, and help from worldwide organizations. These factors are the contributors towards strengthening entrepreneurship in the economies (Sharma, 2020). Entrepreneurship leads to the societal and economic development of the nations. There is a direct effect on economic development through entrepreneurship culture, and the education factor in entrepreneurship leads to development through enterprise innovation. Entrepreneurship can be increased by providing resources, support, and incentives to start businesses. By adopting policies that facilitate an innovation culture, there would be seen an increasing entrepreneurship as well as economic development (Zemlyak et al. 2023).

Successful entrepreneurship is the result of shifts towards knowledge-based economies and institutions like universities and research programs, and knowledge-sharing activities which include public/private partnerships. Public and private sectors that are interested in making policies on entrepreneurship further lead to innovation and technological change (Link, 2007). To develop

an entrepreneurship culture in a society, entrepreneurship education programs, and policies are focused on providing a skillset of soft skills with hard skills which includes networking and selfconfidence on one hand and the knowledge of business startup, planning, and managerial skills on the other hand (Bauman & Lucy, 2021). A supportive ecosystem fosters the entrepreneurship culture. This ecosystem includes providing capital, mentorship and guidance, and networking opportunities for individuals. These resources are required for entrepreneurs to grow and launch new products that drive economic growth (Ratten, 2020). Technology has revolutionized the way things happen. E-commerce and online marketplaces, cloud computing, and data management, social media and digital marketing, mobile technology, AI and automation, cryptocurrency, remote work, and the gig economies, etc. have enhanced the future of entrepreneurship. It plays a critical role in shaping the future of entrepreneurs and increases the opportunities and demands of entrepreneurs (Tavakoli, 2013).

Everything is being changed after the fourth industrial revolution. It is the 21st century industrial revolution, the fourth industrial revolution that blurred the boundaries of physical, digital, and biological worlds. It is the era of connectivity, advancement, automation, and technology. It is named as the digital revolution. An era of advancements in artificial intelligence, with other technologies (Davis, 2016). Industry 4.0 is built on the foundations of the first three industrial revolutions. The first industrial revolution of the steam engine, allowed production to be mechanized then the second industrial revolution included electricity and scientific advancements. Computers and technology were the third revolution which led to the automation of manufacturing. The fourth revolution which is named as the digital revolution has the potential to raise global income levels and improve the quality and living standards of people all around the world (Chou, 2018). AI is a driving force shaping our world. Today computers are knowledge machines that are trained to learn themselves and solve problems. AI at the forefront of the 4th industrial revolution includes personal assistants, robotics, context-aware processing, image processing, and facial recognition. It has revolutionized industries by providing prescriptive solutions in fields like economics, finance, marketing, and healthcare (Sahai & Rath,2021).

Artificial intelligence (AI) has transformed numerous aspects of our world, improving accuracy, efficiency, and innovation across various areas. A keystone of its success depends on its exceptional data processing capabilities. AI can analyze massive datasets in a matter of seconds,

enabling organizations to gain valuable insights and make decisions from that data (Agrawal et al., 2018). Machine learning (ML), a subfield of AI, which specializes in the analysis of patterns within data. This ability leads to improved predictive knowledge, which in turn leads to better resource allocation and better decision-making (Jordan & Mitchell, 2015).

Repetitive tasks can be efficiently automated, freeing up human capital to focus on more strategic efforts. It promotes a culture of innovation and creativity in organizations because people's creativity is directed toward solving higher-level problems (Brynjolfsson & McAfee, 2014). The AI is playing an important role in handling environmental issues. AI-powered climate models allows far more precise and accurate predictions and facilitates sustainable development strategies (Reichertz et al., 2021). Artificial intelligence (AI) has surpassed the world of science and filter through a lot of aspects of our lives. It has wide range of uses in different fields and disciplines, making it versatile. In healthcare, artificial intelligence is changing patient care. Artificial intelligence diagnostic tools based on machine learning (ML) help medical professionals analyze medical images, detect diseases at earlier stages and make more accurate diagnoses (Yu et al., 2020). Additionally, AI-powered predictive analytics allow for personalized treatment plans and improved patient outcomes (Miotto et al., 2018).

The financial sector has also acknowledged AI's capabilities. Artificial intelligence algorithms are used to improve financial processes and reduce risks. For example, AI effectively detects fraud in real-time and protects financial institutions and consumers (Válaszka et al., 2020). Manufacturing industries have undergone a significant transformation due to AI. The implementation of smart factories, which take advantage of AI and machine learning, automates production processes, optimize resource allocation, and ensure consistent product quality (Qin et al., 2021). The transportation sector has shown a significant improvement, thanks to Artificial Intelligence. Autonomous/self-driving vehicles, equipped with AI and sensor technology, are changing the shape of the automobile industry. These vehicles can significantly improve road safety by reducing accidents caused by human error (Madden et al., 2020). The education sector is also taking a lot of advantage of AI's potential, like Adaptive learning platforms, which are powered by artificial intelligence. These platforms assess students' strengths and weaknesses and adjust the content and pace of instruction to get the maximum outcome and provide the best learning experience (Rose et al., 2019).

The increasing integration of artificial intelligence (AI) into various economic sectors has sparked a critical discussion about its impact on economic growth and job creation. While some express concerns about job displacement/loss. AI automation simplifies workflow, minimizes errors, and ultimately increases productivity (Manyika et al., 2017). This means improving the ambition of companies and economic growth at the national level. AI-powered solutions in different fields ranging from personalized medicine to independent vehicles, will create an effective impact on economic opportunities and wealth creation (Agrawal et al., 2018).

But in discussions about AI, the risk of job loss from it remains large, in response AI also presents a defending counterpoint: the creation of new employment opportunities (Frey & Osborne, 2017). An example of this trend is the growing demand for AI experts, data scientists, and AI ethicists (Bughin et al., 2018). These newly created roles require a unique skill set, highlighting the need for continuous learning and workforce development initiatives. In conclusion, artificial intelligence (AI) has the power to be a game-changer, opening doors to neverbefore-seen before economic expansion and employment creation. Societies can use AI to create a more successful and promising future for everybody by solving issues like job displacement and the need for reskilling.

1.1 Problem Statement

The dynamic perspective of entrepreneurship is evolving continuously. There is a need to understand the relationship between artificial intelligence and entrepreneurship at the macro level. There is a challenge that lies in identifying the factors of artificial intelligence that significantly affect entrepreneurial activities. By addressing this gap, we aim to quantify the influence of AI on entrepreneurial ventures and decipher the factors that truly impact the entrepreneurial ecosystem.

1.2 Objectives of the Study

- How to measure Artificial intelligence at the Macroeconomic level.
- Determining the factors of artificial intelligence that impact entrepreneurship and how artificial intelligence influences entrepreneurship.

1.3 Organization of the Study

This study unfolds in a structured manner to comprehensively investigate the role of artificial intelligence on entrepreneurial activities. Beginning with an introduction that sets the context, it navigates through a concise literature review to understand existing insights. The model and methodology section outlines the research design and it includes model specification and estimating techniques. The interpretation part reports the empirical findings. The last part consisted of conclusions along with the implications and policy recommendations for the future.

2. Literature Review

Shepherd & Majchrzak (2022) explores how artificial intelligence (AI) might improve entrepreneurship and suggests that when coupled with entrepreneurial procedures, AI can be a powerful tool. It highlights ways in which entrepreneurs might use AI, such as in the "feeling economy" and skills redistribution, by drawing on the body of existing research. It synthesizes results from the literature on entrepreneurship with artificial intelligence. Findings show that AI can support entrepreneurial decision-making, but they also raise concerns about possible drawbacks. The study concludes by highlighting the crucial role that entrepreneurs play in influencing the impact of AI and arguing in favor of proactive management and a nuanced grasp of its impacts.

Chatterjee et al. (2022) highlights that in addition to examining the moderating impacts of AI-CRM capabilities and strategic planning, the study examines the factors driving corporate digital entrepreneurship in Indian SMEs. Based on a conceptual model and structural equation modeling with 315 participants, the research indicates that digital entrepreneurship is highly influenced by perceived usefulness, ease of use, and willingness to adapt. These interactions are further moderated by the use of AI-CRM capacity and strategic planning, which provides SMEs with important insights on how to improve existing procedures through digitization. All things considered, the study closes a knowledge vacuum regarding AI's significance in SME entrepreneurship, especially in developing nations like India.

Gupta et al. (2023) examines the relationship between sustainable entrepreneurship and artificial intelligence (AI) by examining 482 academic articles published between 1994 and 2022. It looks into how artificial intelligence affects sustainable development, with an emphasis on

environmental sustainability. The goal of the study is to comprehend current themes, approaches, and conclusions in the field of AI integration with sustainable development. This analysis clarifies how AI may support sustainable entrepreneurship practices and help achieve more general sustainability objectives. By offering insightful information to both academics and industry stakeholders, the article advances our understanding of how sustainable entrepreneurship is changing in the age of artificial intelligence and machine learning.

Agrawal et al. (2015) explore that the economy may be significantly impacted by technology as it continues to advance. AI may result in a dispersion of businesses controlling society, the loss of jobs, and a rise in inequality. AI has the potential to boost productivity to such an extent that humans would have enough money. At the NBER Conference on Artificial Intelligence, we discussed a wide range of concepts. Most likely, it will be the upcoming generalpurpose technology (GPT). The majority of machine intelligence was rules-based, meaning that algorithms were created by human professionals to provide instructions. The type of technology, rate of diffusion, and rate of AI advancement will all be impacted by policy. AI is not the subject of empirical research on how privacy regulations affect innovation.

Brock & Wangenheim (2015) state that AI is seen by some as an unmatched revolutionary technology with the potential to completely change humanity. It is the resurgence of interest in artificial intelligence (AI) among academics and managers alike. However, there isn't much dependable guidance available for managers on integrating AI into their company's operations. AI is commonly applied with other cutting-edge digital technologies in businesses' digital transformation initiatives. In the areas of data, intelligence, integration, leadership, and teamwork, it provides precise guidance.

Davenport et al. (2019) explore that as time goes on, artificial intelligence (AI) will undoubtedly alter consumer behavior and marketing tactics. He suggests a multifaceted approach that takes intelligence levels into account when understanding the effects of AI. He suggests that replacing human managers with AI will increase its effectiveness. AI will function as a sales process in a variety of businesses. Online retailers now rely on customers placing orders as part of their business model. He goes on to explain why a large number of academics believe artificial intelligence will transform marketing tactics and consumer behavior. Because humans are more

hesitant of AI than they are, especially as AI becomes more aware of itself, AI might be more trustworthy than humans.

Furman & Seamans (2019) stated that Artificial intelligence was measured both in terms of the resources used and the results produced. They examine current studies that suggest automation and artificial intelligence (AI) have the potential to boost productivity growth, especially in the near term. Concerns have been raised about computing, mechanization, and, more recently, artificial intelligence (AI) and robotics, which could lead to job losses and lasting harm to the labor market. Slowing economic development over the past few decades has highlighted the significance of AI. In many ways, there has been a rise in the amount of money invested in AI by established businesses, venture capitalists, and start-ups. The potential for artificial intelligence to drastically alter the economy exists. They contend that robotics and AI do increase productivity growth, but their effects on labor are not uniform.

Huang & Rust (2018) explored that although artificial intelligence (AI) is posing a threat to human jobs, it is gradually changing services by carrying out new duties. They put forth a notion that claims that task-level, as opposed to job-level, AI job replacement happens fundamentally. The progression of AI task replacement from lower to higher intelligence is expected to cause changes in the relative relevance of intelligence over time for personnel in the service industry. Machines that display elements of human intelligence (HI) are the embodiment of artificial intelligence (AI), which is being used in more and more applications. It is a significant source of innovation nowadays. Insights for business strategic decisions in the industrial revolution are provided by this theory of AI job replacement, which is both descriptive and predictive.

Nambisan et al. (2019) explained that Digital technology has revolutionized entrepreneurship in several ways. The term "digital transformation" has become widely used in business media to describe how digital technology can have a transformative effect on businesses. Technologies have a significant impact on wealth creation and capture as well. Additionally, entrepreneurship has ramifications for society and the country as a whole, which may influence organizations that formulate public policy. Governmental organizations and other public institutions have been forced by digitization to reconsider the laws, policies, and regulations about a variety of topics.

Soni et al. (2020) examine the many ramifications of artificial intelligence (AI) and find effects on businesses, governments, communities, and individuals that are both favorable and unfavorable. This affects research and innovation overall due to AI. This paper discusses the effects of academic achievements and successful developments in the field of artificial intelligence on entrepreneurship. The study contributes to the examination of the variables driving AI advancement. To explore entrepreneurial activities related to artificial intelligence, research will expand our understanding of the innovations and the effects of AI on firms. It will provide us a clearer picture of how AI can impact company operations and the world economy Agrawal et al. (2019) investigate whether human labor will serve as a new technology's complement or as a replacement. They claim that these new advancements reduce the expenses associated with offering work. They demonstrate how prediction enables riskier decisions to be made and how this affects productivity as it is observed, potentially increasing outcome variance. Better and more informed decisions follow naturally from having more accurate predictions. Games, image recognition, and language translation have all been mastered by AI. In this study, they develop a straightforward model that carefully considers the precise technological output that recent advancements in AI have produced. Their strategy is to get into the specifics of what's going on in the artificial intelligence space right now.

Wirth (2018) viewed that Applications based on artificial intelligence are starting to appear in many different professional domains. There is a lot of conjecture and discussion sparked by news about AI-based solutions in digital marketing, logistics, healthcare, and industrial production processes. The market research sector appears to be both eager and apprehensive to adopt this new technology. The author defines artificial intelligence (AI) in this article along with its three variations: strong, hybrid, and narrow. He offers the following advice as he wraps up his analysis of the viability of creating AI-based marketing analytics solutions: it's time to embrace AI.

Wiklund et al. (2019) state that the significance, rigor, and scope of entrepreneurial research have all increased significantly. By all standards, their topic is now widely recognized as a legitimate academic field and has received significant academic acceptance. Nonetheless, several global forces are calling for a reevaluation of relevance and perhaps a closer examination of it. They talk about what relevance it is, how the field might get it, and how to effectively convey it to the various parties involved in our field. The academic integrity of the business school is in

jeopardy. With tenure track roles being transformed to non-tenure track appointments with a focus on teaching, business schools are now placing a greater emphasis on teaching. These jobs are occasionally filled by adjuncts who are solely focused on teaching. Research projects that were once carried out by business schools are being undertaken more frequently at the same time

M. Townsend & A. Hunt (2019) contributed the last result of decades-long efforts to create and understand intelligence as a general property of systems, rather than as a specific attribute of humans" is the swift rise of computationally complex artificial intelligence (AI) systems. After numerous ups and downs, the area is currently primarily focused on developing a systems-based type of machine intelligence that can perform impressively on a wide range of cognitive tasks that were previously regarded to be unachievable for software systems. The practice of entrepreneurship is changing due to the rapid advancement of AI. The amount of venture capital available to AI businesses has increased dramatically in recent years. Their research tackles the theoretical ramifications of extending AI systems to theories of entrepreneurial activity, judgment, and decision-making in light of these significant advancements. To provide their ideas some tangible support, we concentrate on the parts that follow on how quickly developing AI systems gives entrepreneurs new tools to solve important modal uncertainty features.

Obschonka & B. Audretsch (2020) investigate that the disruptive potential of big data and artificial intelligence (AI) has garnered increasing interest and concern in several research and application disciplines in recent years, but it has not yet gotten considerable examination in current research on entrepreneurship. Here, they offer some thoughts and a selection of publications about the significance of artificial intelligence (AI) and big data for this developing field of entrepreneurship research study and application. They emphasize the reciprocity of the coevolving fields of entrepreneurship research and practice, while remaining aware of the potentially overwhelming nature of the rapid progress in machine intelligence and other big data technologies for modern structures in entrepreneurship research.

3. Model and Methodology

3.1 Introduction

In this study, we aim to investigate the role of AI on entrepreneurship. Our analysis focuses on a comprehensive econometric model that examines the relationships between various indicators of Entrepreneurship and Artificial intelligence. The model includes key variables such

as energy demand, interenet use, physical capital to labor ratio, patents and economic complexity index. Through deep econometric analysis, we explore the quantitative effects of these factors on entrepreneurship, highlighting the processes by which artificial intelligence affects entrepreneurship and how to measure AI at macroeconomic level. The methodology applied involves regression analysis to estimate the coefficients of the independent variables and assess their statistical significance. The findings of this investigation aims to offer useful information for policymakers who want to utilize digital advancements for sustainable economic development by explaining the relationship between artificial intelligence and entrepreneurship.

3.2 Theoretical Framework and Model Specification:

In our study, we investigate a complex relationship between artificial inteiilgence (AI) and entrepreneurship. The theoretical approach is based on the various factors that contribute to the artificial intelligence and influence economic outcomes. We will highlight the theoretical foundations of the variables by using the literature.

The concept of entrepreneurship is complex and includes elements like innovative thinking, taking calculated risks, and seeing opportunities. Within the framework of AI's impact on entrepreneurship, academics have stressed the significance of comprehending how AI technologies affect entrepreneurial endeavors. For example, Shane and Venkataraman (2000) contend that opportunity recognition and exploitation are what drive entrepreneurship. With its strengths in automation, pattern recognition, and data analysis, artificial intelligence (AI) can help entrepreneurs find opportunities in the market, streamline operations, and develop novel goods and services (Cohen et al., 2020).

Since energy availability and affordability have a direct impact on production costs, operational effectiveness, and market competitiveness, energy demand is a crucial factor impacting entrepreneurial activity (Apergis et al., 2016). Economic theories of supply and demand are frequently included into theoretical viewpoints on energy demand, with an emphasis on elements like industrialization, economic growth, and technological advancements (Hamilton, 2009). With predictive analytics, smart grid management, and energy optimization algorithms, AI technologies have the ability to optimize energy usage and efficiency across a variety of industries in the context of entrepreneurship (Meng et al., 2020).

In accordance to these frameworks, adoption and utilization of internet technologies in entrepreneurial contexts are shaped by individual views, attitudes, and outside factors. Regarding artificial intelligence's impact on entrepreneurship, using the internet provides access to platforms, tools, and data sources that are driven by AI and that support a range of entrepreneurial endeavors, such as e-commerce, market research, and consumer interaction (Hsieh and Lin, 2018). As a result, the theoretical framework for internet use investigates the ways in which AI-enabled internet technologies impact strategy development, business model innovation, and entrepreneurial behavior.

Economic theories of production and resource allocation from the classical era frequently inform theoretical viewpoints on the physical capital to labor ratio in entrepreneurship. Neoclassical economics holds that variables like technology, factor pricing, and production technologies determine the best way to allocate labor and physical capital inputs (Solow, 1956). With automation, optimization, and predictive analytics, AI technologies have the potential to improve the productivity and efficiency of labor as well as physical capital in the context of entrepreneurship (Brynjolfsson and McAfee, 2014).

Economic theories surrounding patents highlight how crucial patent protection is for promoting investment, market competition, and innovation (Arrow, 1962). When it comes to the impact of artificial intelligence (AI) on entrepreneurship, patents are a good way to measure technological innovation and competitive advantage because AI technologies help create new software, algorithms, and AI-driven goods (Cohen et al., 2019). As a result, the theoretical framework for patents investigates how the use of AI affects the production, defense, and monetization of intellectual property in entrepreneurial settings.

Economic complexity index (ECI) theoretical frameworks in entrepreneurship frequently focus on the dynamics of economic systems and the interdependencies between industries and regions, utilizing concepts from network economics and complexity theory (Hidalgo and Hausmann, 2009).According to Battiston et al. (2017), the ECI measures the diversity, sophistication, and interconnection of economic activities in relation to AI's impact on entrepreneurship. This indicates the potential for innovation, specialization, and value creation.

The framework in this model that we will find the relationship between our dependent and independent variables.

The **functional form** of the model is expressed as:

Entrepreneurship=f (Energy Demand, Internet Use, Physical Capital to Labor Ratio, Patents, Economic Complexity Index).

Thus, we will change this functional equation into an **econometric model** to run a linear regression analysis to use the statistical data to find this problem;

Entrepreneurship = $\beta 0 + \beta 1$* Energy Demand + $\beta 2$ * Internet Use + $\beta 3$ * Physical Capital to Labor Ratio + $\beta 4$ * Patents + $\beta 5$ * Economic Complexity Index + ε

Here:

- Entrepreneurship represents the level of entrepreneurial activity or outcomes.
- Energy demand is the Energy use per 1000 GDP
- Internet Use is the individuals using the Internet
- The proxy of Physical capital to labor ratio is Gross fixed Capital formation.
- Patents is the combination of Patents application for residents and non residents and dividing into the total population.
- Economic Complexity index
- $\beta 0$ is intercept term, $\beta 1$, $\beta 2$, $\beta 3$, $\beta 4$, $\beta 5$ and $\beta 6$ are coefficients of the independent variables ϵ is the error term.

3.3 Description of variables and data source:

The study is based on the secondary panel data over the period from 1980 to 2023 of all over the world for empirical investigation. Table below shows the symbol, descriptive, definition, and data source of the dependent and independent variables which will be used in this study. Here New Business destiny (NBD) is taken as the dependent variable and independent variable is energy use, internet users, eci, gross fixed capital formation and patents.

Table 1: Showing symbols, definitions and sources of variables

Symbol	Name of Variable	Description	Source

NBD	New Business destiny	New business density (new registrations per 1,000 people ages 15-64)	WDI
Eu	Enery Use	Energy use (kg of oil equivalent) per $1,000 GDP	WDI
GFC	Gross Fixed Capital formation	Gross fixed capital formation (% of GDP)	WDI
ECI	Economic Complexity Index	ECI	WDI
Net	Internet Users	Internet users (% of pop.)	WDI
TechP	Patents	Patent Application Residents+ Non-residents	WDI

3.4 Econometric Methodology

One crucial aspect of panel data analysis is determining whether to employ a random effects model or a fixed effects model. To address this, the Housman test, proposed by Houseman in 1978, is commonly employed. This test serves to discern whether the data exhibits characteristics more aligned with a random effects model or a fixed effects model. The null hypothesis in the Housman test posits that the model is best represented by a random effects structure, while the alternative hypothesis suggests a fixed effects framework.

For this study spanning from 1980 to 2023, assuming the data are stationary, a panel study analysis will be conducted. The focus lies in ascertaining the most appropriate model – random effects or fixed effects – through the application of the Housman test.

The Fixed effect model will be used to do this penal data regression analysis. We use the fixed effect model (FE) if we are studying the impact of variables over the period. The functional form of FE is;

$$Yit = \beta 1Xit + \alpha i + uit$$

Where; Y is the dependent variable, X is an independent variable, i represents the entity and t represents the time, αi (i=1….n) is an intercept for each cross-section or entity, β1 is the coefficient and u is the residual (Princeton, 2007) .Our general equation will be;

Entrepreneurship = β0 + β1* Energy Demand + β2 * Internet Use + β3 * Physical Capital to Labor Ratio + β4 * Patents + β5 * Economic Complexity Index + ε

4. Data Analysis

FE and RE

We are using STATA to estimate the coefficients of the variables. First of all, we checking the data is strongly balanced, run simple regression then the FE is applied to the variable. Now we will apply the RE model to estimate the Hausman hypothesis. The null hypothesis under the Housman Test is a model is random effects and the alternative hypothesis is fixed effect.

Table 2: Random Effect Model

lnb	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
leu	-.492	.155	-3.17	.002	-.796	-.188	***
lgfc	.448	.106	4.23	0	.241	.656	***
lnet	.162	.036	4.49	0	.091	.233	***
eci	.289	.085	3.41	.001	.123	.455	***
ltechp	.014	.036	0.39	.699	-.057	.085	
Constant	.716	.842	0.85	.396	-.936	2.367	

Mean dependent var	0.639	SD dependent var	1.344
Overall r-squared	0.130	Number of obs	564
Chi-square	66.095	Prob > chi2	0.000
R-squared within	0.097	R-squared between	0.157

**** p<.01, ** p<.05, * p<.1*

Source: Calculated by the researcher)

As indicated by business density, the random effects model offers important new insights into the variables impacting entrepreneurship. Key findings show that energy use has a negative impact on business density (coefficient: -0.492, p = 0.002), but that energy use has a positive impact on economic complexity index (coefficient: 0.289, p = 0.001), gross fixed capital formation (coefficient: 0.448, p = 0.000), and internet users (coefficient: 0.162, p = 0.000). These correlations imply that while investments in infrastructure, more internet access, and a more complex economy

encourage entrepreneurship, higher energy use may impede the establishment of new businesses. Business density is not substantially influenced by the quantity of patents (coefficient: 0.014, p = 0.699), suggesting that the quantity of patents by itself is not a powerful predictor of entrepreneurship.

All things considered, the model accounts for 13% of the variance in business density (Rsquared = 0.130), with notable within- and between-entity variability (R-squared within = 0.097 and between-entity variability (R-squared between = 0.157). These findings highlight the complex nature of entrepreneurship and imply that measures meant to boost economic complexity, increase capital investment, and improve internet access could all be useful in stimulating entrepreneurship.

Even while the variables it includes are important, there are other important aspects that also have a substantial impact on entrepreneurship but are not included in this model.

Table 3: Hausman Specification Test

Coefficients	(b)	(B)	(b-B)
	FE	RE	Difference
EU	-.491	-.542	.050
GFC	.448	.400	.047
Net	.162	.140	.021
Eci	.288	.303	-.014
TechP	.013	.061	-.047

Test: Ho: difference in coefficients not systematic chi2

(5) = (b-B)'[(V_b-V_B) ^ (-1)] (b-B)

= 808.10

Prob>chi2 = 0.0000

Note: Hausman Specification test has been used in the selection of the fixed effects or random effects model

The Hausman test result (with a Prob > chi2 value of 0.0000) suggests that a fixed-effects model is more appropriate for your analysis. This is because the test rejects the null hypothesis that there is no systematic difference between the coefficients estimated by the fixed-effects (FE) and random-effects (RE) models. In other words, there's a significant difference between the two models, likely due to unobserved country-specific factors or past business density influencing

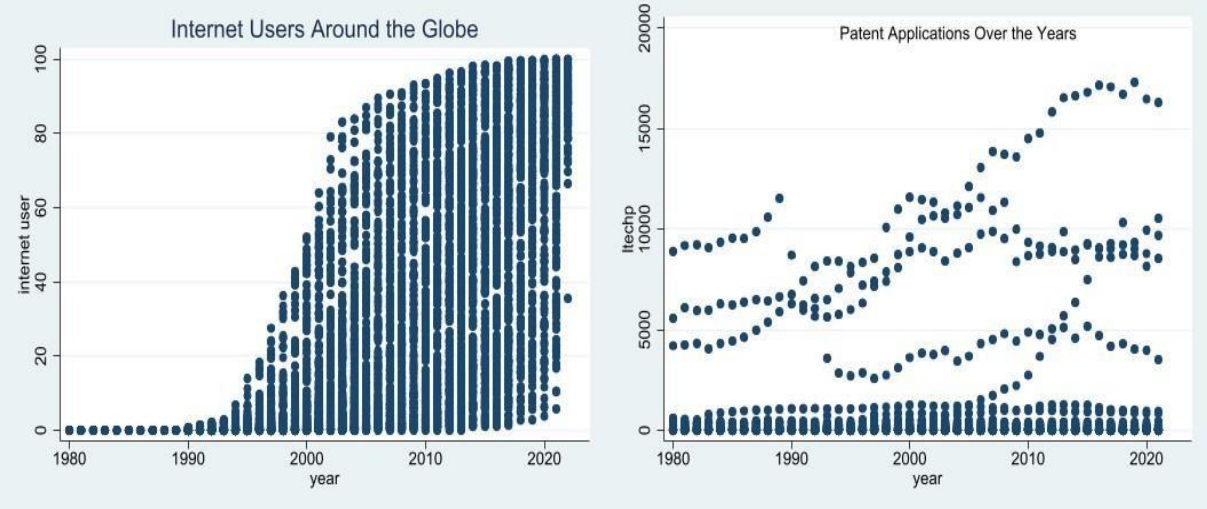
current factors like internet users (Net). The fixed-effects model provides more reliable estimates of how AI, energy use (EU), gross fixed capital formation (GFC), patents (TechP), and economic complexity index (Eci) influence business creation across different countries.

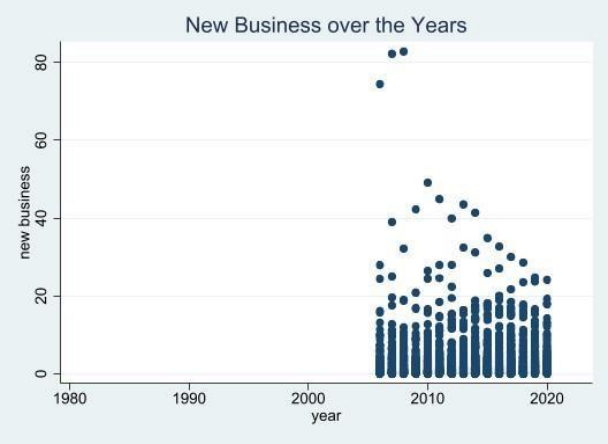
Table 4: Fixed Effect Model

	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
	-.542	.170	-3.19	.002	-.876	-.208
lgfc	.400	.105	3.78	0	.194	.608
lnet	.140	.036	3.83	0	.068	.212
eci	.303	.100	3.02	.003	.106	.500
ltechp	.061	.047	1.30	.195	-.031	.155
Constant	.999	.906	1.10	.271	-.781	2.78

As indicated by business density (lnb), the fixed-effects model results offer comprehensive insights into the variables influencing entrepreneurship. A considerable amount of the variability in business density may be explained by the included factors taken together, as the total model is statistically significant (Prob > F = 0.0000). One of the main conclusions is that energy use (leu) significantly reduces business density, with a value of -0.542 (p = 0.002). On the other hand, company density is positively impacted by gross fixed capital creation (gfc), with a coefficient of 0.401 (p = 0.000). Additionally, there is a positive and substantial impact from the percentage of internet users (inet) (coefficient: 0.140, p = 0.000). Furthermore, a beneficial impact is indicated by the Economic Complexity Index (eci), which has a coefficient of 0.304 (p = 0.003). However, there is no apparent connection between business density and patents (techp) (coefficient: 0.062, p = 0.195).

Scatter Plot of New Businesses, Patent Application & Internet Users over the Years in the world





In conclusion, the fixed-effects model shows that economic complexity, internet usage, and gross fixed capital formation all positively contribute to business density, however energy use has a negative impact on entrepreneurship. These findings highlight the value of digital connection, infrastructure investment, and economic complexity in promoting entrepreneurship. However, there is no discernible difference in the number of patents, indicating that a simple increase in the number of patents would not be enough to improve business density.

5. Conclusion and Policy Implication:

With firm density as the dependent variable, the analysis of artificial intelligence's (AI) impact on entrepreneurship has offered thorough insights into the intricate interactions between

variables affecting entrepreneurial activity. This study has demonstrated systematic differences in the estimated coefficients compared to random-effects models by using a fixed-effects model, which was assessed more appropriate based on the Hausman test. This suggests the presence of unobserved country-specific factors or past business density influencing current variables like internet usage and energy consumption. The findings point to a complex interaction between a number of factors and entrepreneurship. Interestingly, whereas energy use is clearly a major barrier to firm density, other variables that positively correlate with entrepreneurial activity include gross fixed capital formation, internet usage, and the economic complexity index. These results highlight the complex nature of entrepreneurship and the necessity for targeted governmental interventions to promote an atmosphere that is favorable to the establishment and expansion of businesses. Policy implications arising from the analysis of the role of artificial intelligence (AI) on entrepreneurship, with a focus on business density as the dependent variable, are multifaceted and require a comprehensive approach to foster a conducive environment for entrepreneurial activity. Firstly, promoting digital connectivity should be prioritized, with governments investing in initiatives aimed at enhancing broadband infrastructure and expanding internet access to underserved communities. This includes not only improving physical infrastructure but also implementing policies to bridge the digital divide and ensure equitable access to digital technologies. Secondly, recognizing the pivotal role of infrastructure in facilitating entrepreneurship, policymakers should prioritize investments in physical infrastructure projects such as transportation networks, energy grids, and telecommunications infrastructure. These investments are crucial for providing the necessary foundation for business operations and enabling entrepreneurs to access markets efficiently. Thirdly, fostering economic complexity is essential for stimulating entrepreneurship, necessitating policies that support innovation, research and development, and knowledge-intensive industries. This may involve providing incentives for research collaboration, supporting technology transfer initiatives, and promoting the growth of high-tech industries. Fourthly, given the adverse impact of energy consumption on entrepreneurship, policymakers should implement measures to promote energy efficiency and renewable energy adoption. This includes setting energy efficiency standards, incentivizing the use of renewable energy sources, and supporting sustainable business practices. Lastly, while patents play a crucial role in fostering innovation, policies should aim to strike a balance between incentivizing innovation and preventing monopolistic practices. Policymakers should explore

alternative mechanisms to encourage innovation, such as open innovation platforms and collaborative research initiatives. Overall, addressing these policy implications requires a coordinated effort from governments, businesses, and civil society to create an enabling environment that fosters entrepreneurial success, drives economic growth, and promotes sustainable development.

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