



Impact of Digital Innovation and E-Governance on Sustainable Entrepreneurship: The Role of Business Sophistication in Belt and Road Initiative Countries

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ABSTRACT

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This study examines the role of digital innovation and e-governance on sustainable entrepreneurship, with the moderating effect of business sophistication. This research comprises strongly balanced panel data of 73 Belt and Road Initiative (BRI) participating nations from 2011 to 2022. Baseline analysis results suggest the long-term panel analysis such as two-step system GMM is best in this case. Moreover, number of groups are greater than time. While the results robustness is conducted through alternate variables as well with Seemingly Unrelated Regression (SUR), Dynamic Pooled Ordinary Least Squares (POLS), and Static POLS regression alternate methods. The results of the direct channels show that digital innovation connectivity and e-governance statistically have a significant and positive effect on sustainable entrepreneurship. However, the interaction between business sophistication, digital innovation, and e-governance shows mixed effects, which drive BRI-participating nations to focus more on business-enabling innovative technologies and better governance-driven technology innovation systems to boost sustainable entrepreneurship. Furthermore, globalization and policy shocks, such as China's digital economy in 2015 and the BRI in 2013, have enhanced sustainable entrepreneurship. In addition, the consumer price index indicates that the inflation rate has a mixed negative effect on sustainable entrepreneurship.

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1.0 Introduction

The idea of sustainable entrepreneurship has been introduced into the scholarly world as a blend of the conventional business environment, as well as social and environmental dimensions. Entrepreneurship sustainability is a fairly recent field of research. It is a new idea that is still to be fought out. This is why one should pay a lot of attention and meaning to an ongoing debate regarding its particular definition, conceptualization, and internal and external forces (Anand et al., 2021; Criado-Gomis et al., 2018).

The adoption of technology has changed the world of industries introducing new business opportunities through platform, blockchain, AI, VR, and IoT (von Briel et al., 2018). This is supported by the growth in the number of digitally sustainable patents and venture capital investments. The main focus of digitalization debate is the revolutionary nature of digital technologies and the way they have been integrated into people's lives (Nambisan, 2017). The digital technology has revolutionized the way governance is conducted that e-governance has emerged in the public policy. E-governance incorporates the use of digital means in the governmental processes, enhancing participation and efficiency of the population. With the emergence of sustainability as an essential factor, there is a need to study governance frameworks that encourage sustainability changes (Abbas et al., 2024). Abuljadail et al. (2023) demonstrate that digital communication could increase sustainability by decreasing the quantity of vehicles. Misra (2012) and Das and Mishra (2018) touch upon the issue of communication in SDGs, the transition of Governance 2.0 to efficient e-governance.

The countries that engaged in Belt and Road Initiative (BRI) offer an international system of cooperation and development. The BRI was initiated by China in 2013 and is meant to increase connectivity of the region by investing, trading and connecting infrastructures in Asia, Europe, and Africa (Ullah, Pinglu, Ullah, and Hashmi, 2021). The importance of sustainable entrepreneurship has increased today because of the involvement of countries in BRI projects to gain economic benefits in the long run. Technologies and e-government systems that are digital innovation affect the world of entrepreneurship. E-governance is based on the application of digital technologies to enhance the delivery of public services and transparency (Nadirov & Dehning, 2023). Digital innovation uses AI, big data, and IoT to develop business solutions that would lead to economic growth (von Briel et al., 2018). This is capable of bringing business sustainability. A combination of e-governance and digital innovation can have a considerable effect on sustainable entrepreneurship through the establishment of an innovative favorable environment, the removal of barriers to entry, and development of a culture of sustainability.

One research question worth the investigation is to what level, business sophistication, and digital innovation factors as well as e-governance influence in terms of sustainable entrepreneurship. Such a standard measurement of sustainable entrepreneurship is yet to be developed; however, the study contributes to the literature offering a new whole index of the measurement of sustainable entrepreneurship in terms of business sustainability and entrepreneurship market dynamics to follow the proposed framework of sustainable entrepreneurship that is suggested by Gu and Wang (2022).

According to Buijhanan (2024), a significant number of researchers voice that technology entrepreneurship is commonly referred to as a cross-cutting of two concepts: entrepreneurial activity and technological innovation. Entrepreneurs in the new ventures can initiate new ventures in order to see the technological opportunities and exploit them. The methodological weaknesses and the possible predispositions of the research are limitations of this study. These findings offer research direction directions going forward. It is likely to have publication bias because this study favors prestigious publishing places. The choice of the database may be poor in regard to inclusivity, and the quality of research may be quite low. Greater variety of information on this topic should be provided by including grey literature and longitudinal studies in future evaluation.

Nayak and Pillai K (2024) examined the entrepreneurial sustainability studies of emerging economies. This review established that SE research is immature in the developing countries, especially the ones that are BRI-participants. These aspects are at individual, corporate and institutional level and cultural and social are the sub themes of sustainable entrepreneurship. The review contributes to the literature of sustainable enterprises in emerging economies and the variables concerned are individual-level factors, socio-cultural factors, and opportunities. They are the variables that should be studied in the future to comprehend SE practices. The context of emerging economies restricts the applicability of the model since most of the extant research is on the advanced economies. Additional empirical research should be conducted on gaining insight into entrepreneur motivation and especially in comparison between emerging and developed economies. Although sustainable development is an appealing notion to people and academic institutions, they still have minor roles in housing sustainable entrepreneurship studies and sustainable development goals attainment. SE opportunities and viable sustainable business models should be investigated in the future.

Recently, the index suggested by the Global Innovation Forum has been the topic of rare studies particularly in developed economies, and it would be missing in comparative study in large-sized projects like the BRI. This paper will fill this open area and investigate 73 nations that participate in BRI with an aim of offering a holistic picture of such dynamics in various economic times. Also, longitudinal data analysis on the subject is not widespread, as the data of the global innovation index indicators have been published since 2013.

(1) To identify how digital innovation has an effect on sustainable entrepreneurship are the main Research Objectives. (2) To establish to what extent e-governance has affected sustainable entrepreneurship. (3) To examine the mediating position of the sophistication of business amid digital innovation and sustained entrepreneurship. (4) To examine how the business sophistication moderates the relationship between e-governance and sustainable entrepreneurship.

2.0 Literature Review

2.1 Sustainable Entrepreneurship

The social pillar focuses on human wellbeing and equity whereas the ecological pillar is focused on the ecological balance. Triple-bottom-line sustainability has been discussed in terms of measures like GDP per capita, CO2 emissions and human capital measures (Huang et al., 2023; Schaltegger and Wagner, 2011). Nonetheless, they usually overlook aspects, which vary with time

such as infrastructure policy, and entrepreneurial intentions. The decisions made by entrepreneurs play an important role in the growth and activities of the regions. Sustainable entrepreneurship is based on the triple bottom line (TBL), knowledge of which includes ecological, social and economic development (Gu & Wang, 2022). According to Han (2019), entrepreneurship can be attributed to the fact that China has experienced economic growth over the last 40 years. Sustainable entrepreneurship requires achieving environmental protection and business requirements to be balanced. Eco-friendly entrepreneurial individuals are those players who put into consideration ecological factors during their decision making. Although green transition affects the growth of a region, it may result in the growth of services and the economy. Entrepreneurs that prioritize social interests put into consideration unemployment when making business decisions.

2.2 Digital Innovation

The authors state that digital technologies shift the nature of entrepreneurial activities (von Briel et al., 2018). Cloud computing will help them accelerate and simplify the startup process by cutting down the communication costs, artificial intelligence can be used to cut the labor costs whereas crowdfunding will open up more funding possibilities. It has also been elaborated on how innovation in digital technologies could be used to generate value among customers.

According to George et al. (2021), digital sustainability refers to the corporate measures that should be implemented to promote the purpose of sustainable development through the innovative technology implementation that produces, consumes, moves, or creates electronic data. They look at the way digital technologies can prioritize such issues as climate change and sustainable development. Digital technologies have been applied by entrepreneurial organizations in the creation of new solutions to complicated social issues. In short, digital sustainable entrepreneurship is the subject of research concerning the role digital technologies play as an instrument of promoting entrepreneurial activities aimed at participating in sustainable business processes (Gregori, 2020g). The idea of the spillover of the value of sustainable entrepreneurship was introduced by them. By their definition it is the seizure of the socio-environmental value exceeding that which is targeted to consumers as an outcome of digital technologies making it possible to build communities, joint innovation, and engage additional stakeholders through social media and blogging services. This could be an innovation and technology strategy to help in the generation of sustainability of entrepreneurial value creation. Their results showed that digital technologies help in the creation of value propositions that can be social, economic and environmental benefits. As well, these technologies offer unique composite arrangements in value creation of elements, which enhance co-creation, communal advancement, and general more-strategy inclusion to stakeholders. Digital use can also be used to foster the multidimensional value capture through impact complementarities, scaling of social-environmental value, and spill over effects.

2.3 E-Governance

Governance is characterized by standards of how one prefers to run shared resources including sustainability, effectiveness, accountability, and democracy (Schmitter, 2019). E-

governance applies information and communication technology (ICT) in governance in order to address the demands of the population. It is empirically proven that the e-governance will decrease corruption, transparency, convenience, GDP growth, interaction of citizens with governments, and cost-reduction. Governments are able to deliver better services and information to people through the ICT (Ullah, Pinglu, et al., 2021a). Digital governance reforms in India have enhanced processes of doing business (Yadav et al., 2020). E-governance is one of the strategic approaches that have been promoted in the public institutions in a bid to meet the Sustainable Development Goals. According to Abuljadail et al. (2023), digital communications can help to make local governance more sustainable. Das and Mishra (2018) emphasized the transformational nature of e-governance in providing better effectiveness to the system, which was further supported by Dalela et al. (2020), who also approved the application in India.

Information and communication systems do not attract as intense study on sustainable development as the regional consideration. Morales and Robalino-Lopez (2020) mentioned that through the formation of common digital space, e-governance is potentially capable of bridging digital divide among government, society, business, and citizens. The development will provide opportunities to institutions that would like to establish effective e-governance systems that are important to achieve the Sustainable Development Goals (SDGs) (Ufua et al., 2021). The studies indicate that a lack of e-governance is a challenge to the implementation of SDGs within the Belt and Road Initiative (BRI) (Ullah, Pinglu, et al., 2021a; Ullah, Pinglu, Ullah, and Hashmi, 2021). Indeed, the policy of e-governance has increased the number of new firms registered in China through enhancing efficiency of the government, reducing cases of risk-seeking behaviours, as well as promoting finance access, which suggested how a better delivery of the public services could be achieved (Gan et al., 2023).

2.4 The Role of Business Sophistication

Business knowledge also plays a bigger role in the efficiency of manufacturing industrial products and services, thus making a country more competitive in terms of increased productivity. Business sophistication entails the quality of the operations of the enterprise as well as that of the national business networks that are essential in the countries that have depleted the rudimentary means of raising output. Local supplier contacts should help to determine the quality of business networks and supportive industries. The closer the suppliers and companies are to each other geographically, the more efficient they become, the higher the possibility of innovation, as well as, the lower the barriers to entry (Razavi et al., 2012). The quality of business networks and business operations are considered as business sophistication (Salas-Velasco, 2018). Salas-Velasco (2018) states that sophisticated business processes are encouraged by advanced strategies resulting in the development of unique products. Knowledge and technology help companies to make competitive products (Coenen and Lopez, 2010). Kirikkaleli and Ozun (2019) discovered that innovation and macroeconomic stability are encouraged by the sophistication of businesses. Business networks allow companies to optimize their operation due to the sophistication that allows international partnerships and access to the market. Digital innovation can enable companies to be more sustainable using proper management of resources and energy efficiency.

Business networks promote sharing knowledge to have sustainable entrepreneurship. BRI countries establish networks which support entrepreneurs to use sustainable practices (Ghimire et al., 2024). Companies that are highly sophisticated in their business are in a better position to adopt sustainable principles and use e-governance systems to promote transparency and efficiency in their business processes.

2.5 Related theories in this study

Sustainable Ecological Theory emphasizes the necessity of equilibrium and adaptation in the environment, the same case of sustainable business practices Lin et al. (2023), Gast et al. (2017) and Hickel (2020) articles. Unique ideas are favored through diffusion of Innovation Theory, which involves a technology spread through the work of an early adopter in the promotion of e-governance and digital innovation in accordance with (Freudenrich et al., 2020) and (Bischoff, 2021) works. Through e-governance, ICT is used to improve efficiency, transparency and citizens engagement of government to ensure a sustainable development through streamlining of processes and eliminating corruption. This is needed in enhancing innovation and sustainability especially in the emerging economies. Strong business networks can help firms to utilize digital innovation to become sustainable. The Stakeholder Theory has emphasized the need to generate value to all stakeholders, promoting inclusive and sustainable entrepreneurial activities that can serve as a broad group of stakeholders Freudenreich et al. (2020) and Bischoff (2021), in BRI-participating countries.

3.0 Methodology

The research design, data collecting method, variable measurement, and general study framework models are covered in this part, with the creation of hypotheses in Figure 1.

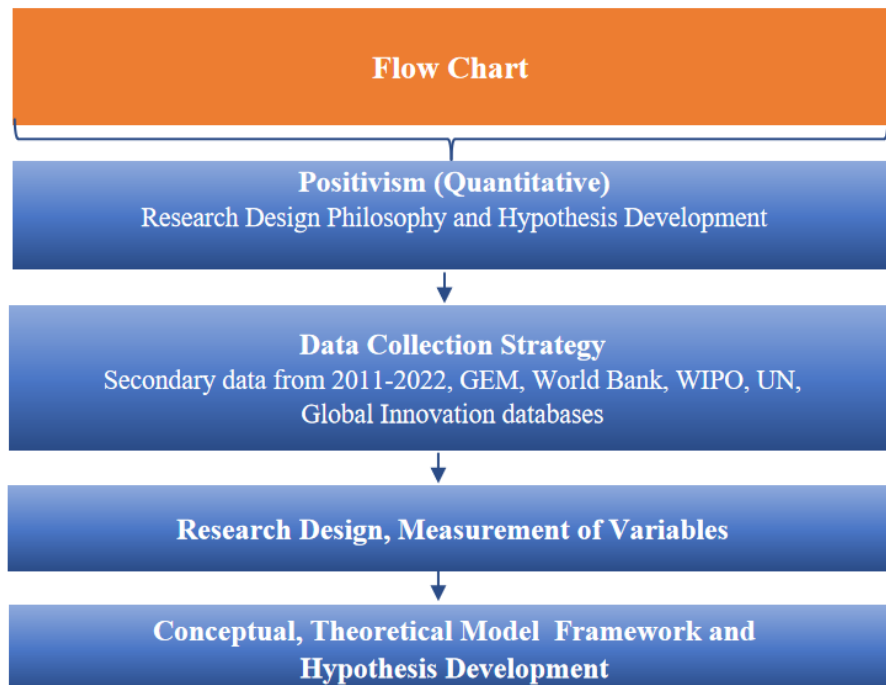


Figure 1: Flowchart of Research Design and Theoretical Framework of Study

3.1 Research Design and Hypothesis Development

The study theoretical framework and research design, which was devoted to the effects of e-governance and digital innovation on sustainable entrepreneurship, where business sophistication takes the place of a moderator. The measurement of the dependent variable is based on Gu and Wang (2022) and Shahid et al. (2023) studies.

These are the proxies suggested by Holzmann and Gregori (2023) to measure digital innovation Holzmann and Gregori (2023). Similar proxy was also followed by Fernandes et al. (2022) and Afawubo and Noglo (2022) in their study of digital innovation. At the same time, the Innovation Diffusion Theory describes the process of the spread of new ideas (Bhuiyan, 2024). Thus, with references to these past studies, and theories, the proposed hypothesis H1 is as follows: H1 implies that the concept of digital innovation has a positive impact on sustainable entrepreneurship (SE). The working of e-governance proxy is traced back to (Rahman, 2021; Ullah, Pinglu, et al., 2021b). Besides, Rajesh Kumar et al. (2020) validate that G-governance is a positive factor in the construction of businesses. Therefore, according to the past readings and theories, the hypothesis of the given study is as follows. H2 is that e-governance positively influences sustainable entrepreneurship to a considerable degree.

The moderating variable, business sophistication, measures the extent of business sophistication in promoting innovation and this is measured using knowledge workers, business linkages and knowledge absorption. This indicator was trailed back to Ghimire et al. (2024) and Ullah et al. (2025) works. Past studies suggest that business sophistication involves the nature and the complexity of business operations, which include superior networks, efficiency in operations, ability to innovate, quality services, well-trained employees, and supply chains of complexity. All these factors enhance the ability of an economy or organization to facilitate competitive, high value and sustainable economic operations. E-governance and digital innovation can be used to create a culture that promotes corporate business performance. It enhances openness, democratization of decision making, stakeholder credibility, and reducing of the processes.

3.3.1 Data Description, Collection Method, and Normalization Process

The sample size in this study comprises a 73 strongly balanced panel of BRI-participating countries of 2011-2022 having 12 years strong balanced panel data. Two reasons made the data be taken in 2011; first, due to the shock of BRI initiative being initiated in 2013, it is essential to consider at least two years before data to provide reliable results and second, the data on relevant proxies of sustainable entrepreneurship were data available in 2013. This paper is composed of 72 as illustrated in Appendix-B countries, which are part of the BRI, including China, Pakistan, Russia, and most of the others in Asia, Africa, and Europe.

At the first, data were retrieved on the links through the site listed in Appendix-A. The second stage involved a transformation of the data into a panel of all the countries and missing information was done through averages. The Stata-17 version software was used in the analysis of the data. The first step is the uploading and training of the dataset xtset command implying a highly balanced panel. Then, using the cut ratio of (1 99) the data is normalized by the winsor2 command to assign weights eliminating outliers.

3.3.2 Analysis Strategy and Diagnostics

This study attempts to expand upon the literature in the first step, in an attempt to acquire a deeper understanding of the nature and interrelations between the variables. The paper is devoted to the applications of the advanced econometric techniques in STATA-17. In the second step due to the relevancy and significance, and the gaps in the available literature. Sustainable entrepreneurship is long term impact on the businesses without affecting the resources of the future generations. Most significantly our dataset is highly panel of over 12 years, and literature indicate that in case a panel is 10 years or above analysis at long run should be carried out.

4.0 Findings and Results

Table 1 provides tests of diagnosis that were implemented to test the model assumptions. The heterogeneity of the slope is high in both direct and indirect models and this means the null hypothesis is that the slope coefficients are equal. Both of the models exhibit heteroskedasticity and this makes them require strong standard errors.

Table 1: Results of Slope Heterogeneity, Heteroskedasticity, Cross-Sectional Independence (CSD), PCA adequacy Bartlett sphericity and KMO Tests

HAC Kernel: bartlett with average bandwidth	Direct Model Delta (p-value)	Moderating Model Delta (p-value)	Decision
Testing for slope heterogeneity (Blomquist, Westerlund, 2013. Economic Letters): HAC Kernel: bartlett	17.319 (0.000)	4.212 (0.000)	H ₀ : slope coefficients are homogenous
Breusch-Pagan / Cook-Weisberg for heteroskedasticity	48.37 (0.0000)	48.37 (0.0000)	
LM and White's test	87.45 (0.0000)	198.21 (0.0000)	
Cameron & Trivedi's decomposition of IM- test: Total df = 25 and 51	225.33 (0.0000)	252.91 (0.000)	H ₀ : Homoskedasticity Ha: Unrestricted heteroskedasticity
Heteroskedasticity: df = 19 and 42	87.45 (0.0000)	198.21 (0.000)	
Skewness: df = 5 and 7	130.15 (0.0000)	44.67 (0.000)	
Kurtosis: df = 1 and 1	7.74 (0.0000)	10.03 (0.0015)	
Pesaran's test of cross-sectional independence	34.609 (0.0000)	25.603 (0.000)	Refers to Second Generation Unit Root CIPS Test
Friedman's test of cross-sectional independence	169.666 (0.0000)	107.965 (0.0039)	
Skewness and kurtosis tests	Pass	Pass	
Shapiro–Wilk W test	Pass	Pass	Normal Data
Shapiro–Francis W' test	Pass	Pass	
Output of Sphericity Bartlett Statistics and the PCA KMO adequacy of Indexes			
	Bartlett test of sphericity		Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO)
	Chi-square	DF	
Digital Innovation Connectivity	6843.484***	45	0.801
Sustainable Entrepreneurship Index	4281.592***	66	0.683

Note: *** p<0.01, indicating significance at the 1% level. Author Estimations Using Stata-17. □

4.2 Results of Main Models and Robustness Check with Alternate Variables

Table 2 presents System GMM results showing that sustainable entrepreneurship exhibits strong persistence, with lagged SEI consistently positive and significant across models. Digital innovation and e-governance both positively and significantly enhance sustainable entrepreneurship, while business sophistication also contributes positively; however, its interaction with digital innovation yields diminishing returns, whereas its interaction with e-governance strengthens outcomes.

Table 2: Results for the Nexus Digital Innovation, E-Governance, and Business Sophistication on Sustainable Entrepreneurship

Variables	(1) (2)		(3) (4) (5)		
	Two-step System GMM (1-2)		Robust through Sys-GMM with alternate variables (3-5)		
	Main Model 1	Main Model 2	Robust Model 1	Robust Model 2	Robust Model 2
Lag. Sustainable Entrepreneurship Index $(t-1)$	0.305*** (0.009)	0.490*** (0.012)	0.600*** (0.014)	0.493*** (0.010)	0.491*** (0.012)
Digital Innovation Connectivity (DICI)	0.688*** (0.017)	0.184*** (0.013)	0.392*** (0.019)	0.182*** (0.013)	0.183*** (0.013)
E-governance Ranking (E-Gov)	0.011*** (0.001)	0.003** (0.001)	0.007*** (0.000)	0.003** (0.001)	0.003* (0.002)
Business Sophistication (BS)	0.018*** (0.001)	0.126*** (0.036)	0.010*** (0.001)	0.132*** (0.032)	0.111** (0.044)
DICI*BS	-0.011*** (0.000)		-0.007*** (0.000)		
E-Gov* BS		0.001* (0.000)		0.001* (0.000)	0.001* (0.000)
Globalization	0.045*** (0.002)	0.027*** (0.002)	0.030*** (0.002)	0.026*** (0.002)	0.026*** (0.002)
CFT				-0.001*** (0.000)	
Business Freedom					0.001 (0.001)
Digital Economy Shock 2015	0.110*** (0.013)	0.913*** (0.025)		0.926*** (0.026)	0.129*** (0.013)
Constant	-4.343*** (0.201)	-3.265*** (0.223)	-2.763*** (0.149)	-3.120*** (0.210)	-2.379*** (0.288)
Year Effect	-	YES	YES	YES	YES
Observations	803	803	803	803	803
R-Square	-	73	-	73	73
AR1	-4.867	-3.546	-3.619	-3.549	-3.543
AR1 (p-value)	0.000001	0.000392	0.000296	0.000386	0.000396
AR2	1.669	-0.0349	-0.256	0.00979	-0.0487
AR2 (p-value)	0.0951	0.972	0.798	0.992	0.961
Sargan	374.7	177.1	209.5	176.1	177.1
Hansen	68.39	66.27	64.86	63.94	66.10
Hansen (p-value)	0.106	0.104	0.109	0.124	0.0904
J-Stat/Instruments	63	70	69	70	70
Wald/chi2	37626	298629	580935	717863	303400
Wald/chi2(p-value)	0	0	0	0	0
Groups	73	73	73	73	73

Note: p<0.01***, p<0.05 **, p<0.1*, respectively signifying levels at 1%, 5%, and 10%. Author Estimations Using Stata-17.

4.3 Results of China's Belt and Road Initiative and Digital Economy Initiative Time Effect as Year-Wise Comparison

The results of a time effect analysis year to year after the years of BRI were presented in table 9 and the analysis was carried out with the help of a System GMM and paid attention to the interaction between e-governance and digital innovation connectivity and business sophistication. This demonstrates that the beneficial effects of e-governance and greater business feasibility had a very positive influence on the sustainable entrepreneurship on the shock year.

Column 3 shows that interaction between digital innovation connectivity and business sophistication in the shock year 2015 has generated a significant desirable effect with a value of 0.110 at the significant level of 1 percent as well as the EGov*BS interaction. This indicates that the digital innovation and improved business practices significantly boosted sustainable entrepreneurship during the 2015 shock.

Table 3: Results of Years wise Time Effect After BRI Years

Years	(1)	(2)	(3)	(4)
	Two-step system GMM Time Effect			
	EGov*BS	EGov*BS	DICI*BS	DICI*BS
Base year 2011-12	Shock Year 2015	After BRI	Shock Year 2015	After BRI
2013		1.368*** (0.036)		0.871*** (0.031)
2014		0.603*** (0.026)		-0.072*** (0.019)
2015	0.913*** (0.025)	0.926*** (0.026)	0.110*** (0.013)	0.247*** (0.024)
2016		0.734*** (0.023)		0.029 (0.022)
2017		1.105*** (0.028)		0.375*** (0.021)
2018		0.795*** (0.024)		0.035* (0.019)
2019		0.768*** (0.025)		0.017 (0.018)
2020		0.795*** (0.025)		0.078*** (0.018)
2021		0.627*** (0.022)		-0.074*** (0.019)
2022		0.749*** (0.022)		0.060*** (0.018)
Observations	803	803	803	803
Groups	73	73	73	73

Note: p<0.01***, p<0.05 **, p<0.1*, respectively signifying levels at 1%, 5%, and 10%. Author

4.4 Alternate Methods Robustness Check Results of Study Overall Models

In the first model (column 1), the coefficient, which implies a 1 percent level of significance, is 0.005 and this implies that improved e-governance is a means to promote a

sustainable entrepreneurship. The same effect was carried on to all other models, and this emphasizes the role of governance in entrepreneurship. Positive but noteworthy effects are also made by business sophistication. In column 2, BS exerts a positive but insignificant effect of 0.031 at the 1% significance level, which denotes that, sustainable entrepreneurship does better in countries where there is greater business sophistication. The size of the exact link differs slightly but this is a consistent link across the models. The interaction term Egov*BS positively impacts the sustainability of entrepreneurial activities with a considerably high level of significance which is 1% in column 3. Therefore, their mutual interaction is useful in sustainable entrepreneurship. The robustness checks conducted with the help of OLS and Dynamic OLS is another way to verify the results of the research.

Globalization is a positive control variable that affects sustainable entrepreneurship, and the coefficient figures of all the models are positive. The impact of 2015 digital economy shock on sustainable entrepreneurship is significantly positive, which implies the level of significance of 1% in all models. This implies the protracted effects of this milestone event in ensuring entrepreneurship with an overall positive and substantive effect on SEI. Table 10 indicates that the values of R-squared between 0.757 and 0.880 are very well matched, but the values below 0.4575 to 0.4946 are very well precise as the RMSE. The overall relevance of the models is supported by large F-statistics and large p-values (0.000).

Table 4: Robustness Check

Variables	(1)	(2)	(3)	(4)	(5)
	SUR Robustness Check			Robust Pooled OLS	Dynamic OLS
	SEI	SEI	SEI		SEI
Lag. Sustainable Entrepreneurship Index (t-1)					0.670*** (0.022)
Digital Innovation Connectivity (DICI)	0.351*** (0.027)	0.710*** (0.039)	0.388*** (0.028)	0.712*** (0.039)	0.339*** (0.045)
E-governance Ranking (E-Gov)	0.005*** (0.001)	0.004*** (0.001)	0.002** (0.001)	0.004*** (0.001)	0.002*** (0.000)
Business Sophistication (BS)	0.031*** (0.002)	0.031*** (0.002)	0.021*** (0.003)	0.031*** (0.002)	0.011*** (0.002)
DICI*BS		-0.014*** (0.001)		-0.014*** (0.001)	-0.006*** (0.001)
Egov*BS			0.0001*** (0.000)		
Globalization	0.021*** (0.003)	0.025*** (0.003)	0.021*** (0.003)	0.025*** (0.003)	0.012*** (0.002)
Consumer Price Index (Inflation)	-0.001 (0.001)	-0.001 (0.001)	-0.002* (0.001)		
Digital Economy Shock 2015	0.546*** (0.045)	0.374*** (0.044)	0.522*** (0.045)	0.373*** (0.044)	
Constant	-2.982*** (0.233)	-2.930*** (0.216)	-2.699*** (0.235)	-2.949*** (0.215)	-1.150*** (0.177)
Year Effect	YES	YES	YES	YES	YES
Observations	876	876	876	876	803
R-squared	0.757	0.792	0.765	0.792	0.880
Params	6	7	7	-	-
RMSE	0.4946	0.4575	0.4862	-	-
F	450.51	472.39	404.18	-	360.74
P>F	0.0000	0.0000	0.0000	-	0.000
Groups	73	73	73	73	73

Note: p<0.01***, p<0.05 **, p<0.1*, respectively signifying levels at 1%, 5%, and 10%. Author Estimations Using Stata-17.

5.0 Discussion and Conclusion

The results show that business sophistication has a positive significant meaning to sustainable entrepreneurship meaning that greater business development, efficiency and innovation abilities make sustainable business favorable to entrepreneurship that aims to emphasize sustainability, thus connecting it with the stakeholder theory. Business sophistication offers the equipment and facilities needed to effectively compete in the business environment. The findings of Salas-Velasco (2018) suggest that the more advanced and innovative a company is, the more efficient the production is. This work attracts the attention to the sophistication of business and innovation in particular which results in high efficiency. Business sophistication is an embodiment of two factors. The conclusions support the finalization of the findings of Ghimire et al. (2024), who argue that the digital economy is enhanced by innovation in the business sophistication sphere. Therefore, business sophistication assists in enhancing the entrepreneurial operations by enhancing business sustainability.

But in the case of interaction of the factors, there can be some disadvantages of the factors. Specifically, the negative effect of interaction of both DIC1 and BS is obvious when the values of both are high. Hence, it can be said that the high levels of innovative digital solutions combined with the high levels of business strategies could be accompanied by some disadvantages associated with the dual direction of trying to go both ways which may produce even greater inefficiency or other problems. Similarly, e.g., high digitization and innovations could compel businesses to redirect their attention to technology-intensive complex business which might be effective in making profits and competing in the markets. Nevertheless, these enterprises are not viable in the long term. The results are harmonized with the diffusion of innovation theory and reveal possible obstacles in diffusion process. This means that as firms become increasingly complicated, they might not be able to effectively implement new digital innovations and this can hinder the entrepreneurial activity in the long run. These conclusions are allied with the conclusions that there has been a change in industries because of the emerging technologies and that there are new digitally connected marketplaces that have made it possible to be more productive. Nevertheless, the results of this research show that digital divide still exists in the world. This is especially acute in the developing countries. Consequently, there is a need to provide a balance between innovation and regulation in order to address the requirements of the ethical utilization of the technological products and preserve the consumer rights. Therefore, nations must focus on digital divide in the network society context to understand better how technology is affecting human society and business sustainability to optimize the role of the technology, and to avoid complexities associated with technology and its influence on society.

The concerns of the stakeholders and the need to enhance sustainability in general enhances the ability of enterprises to operate morally within the ecological limits. In recent times, Kreiterling (2023) disclosed that government governance is critical to sustainable entrepreneurship than electronic readiness. Thus, it is according to the disruptive innovation theory that smaller companies can effectively compete with established businesses by targeting neglected segments. Therefore, our analysis demonstrates that good and advanced business strategies are closely linked to effective e-governance that results in the provision of a better environment to support the activity. At a high level of implementation of e-governance, complex businesses may come in a positive manner to adapt and comply more with the environmental regulations. The interplay between e-governance and business sophistication on one another enhances the impact of the other policies, which must be profit-driven to businesses. The findings of our study affirm the major conclusions of the study that e-governance is the remedy to fill the digital divide with all people

being equal issues regarding delivery services and information as they would be in a market-led regime that promotes economic growth with inclusivity. These outcomes are connected to the stakeholder theory through an increase in the scope of stakeholders to businesses. Therefore, the results are consistent with the theory of globalization and Amoa-Gyarteng and Dhliwayo (2024), who investigated how globalization affected the economy of countries. This implies that BRI countries are experiencing inflation issues and instability with rising prices, which must be fixed and enhanced sustainable futures and business operations to ensure sustainable development of the society.

The Belt and Road Initiative as well as the 2015 digital economy had positive impacts on sustainable entrepreneurship. This demonstrates that dire economic and policy reforms can lead to entrepreneurial operations that can be in line with sustainable development goals. The results support the fact that the digital Belt and Road platform will not only enhance the growth of economies but also the national innovation resources and digital infrastructure, as Ghimire et al. (2024) propose. Therefore, our in this study BRI lead to the appearance of new opportunities, resources, and technologies, which positively impact the business field regarding the aspect of sustainable development. There has been increased standard of infrastructure development in the partner countries as a result of the BRI including the development of logistics, transport, and communication networks. This has subsequently lowered the entry barriers by the entrepreneur and enhanced sustainable business promotion. Businesses that produce clean energy, transportation, and other environmental areas have been opened by entrepreneurs. There has also been an investment in sustainable technologies and green infrastructure projects brought about by the BRI. It has provided entrepreneurs with a pool of significant funds and foreign investments to start the businesses that will help the environment and social development.

Shabana Nawaz: Problem Identification and Theoretical Framework

Ahmad Tisman Pasha: Data Analysis, Supervision and Drafting

Conflict of Interests/Disclosures

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