Digital Risk in International Business Management and Allied Areas in India, the UAE, and Austria

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1 Introduction

The emergence of a new digital research frontier has occurred at the same time that international business (IB) has undergone significant transformation (Hennart, 2019). Companies operating on a global scale that are connected digitally have access to a wide variety of new opportunities, including the ability to obtain global resources, reach customers located in other countries, and improve global operations. However, top executives in companies must remember not to minimize the dangers that come along with these opportunities. Multinational corporations prioritize risk management. The IB disregarded the dangers that could be posed by digitization and instead concentrated on the dangers that could arise from politics, finances, and transactions (Rugman, 2009). IB researchers have to ask themselves a lot of questions because there is a need for additional research into digital threats.

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1.1 Research Objectives

The digitalization of industry is the fourth major industrial revolution. Connectivity to the digital realm may differ between nations, sectors, and companies as a result of international geopolitics, public health crises, and sluggish economic growth around the world. Multinational corporations (MNCs) both enable and benefit from increased connectivity, which transforms international business. Because digital connections can be used across national boundaries at a lower cost than traditional internet protocol (IB) connections, they are only available in certain countries. The new era of international business is dominated by digital global connectivity, which also serves to address growing levels of uncertainty. The process of digitization is fraught with numerous dangers, and despite its importance to business on a global scale, it has received little attention, either theoretical or empirical.

Risk management assumes that physical goods, services, investments, and capital flowed through tangible barriers. Intangible barriers to instant flow of ideas, data, and knowledge are decreasing. Figure 1 shows the actions MNCs must take individually and collectively to avoid digital risks. These actions include developing, deploying, and harnessing digital intelligence for local adaptation, transnational resilience, and global orchestration of digitally enabled cross-border activities. This paper discusses international business and related digital risks.

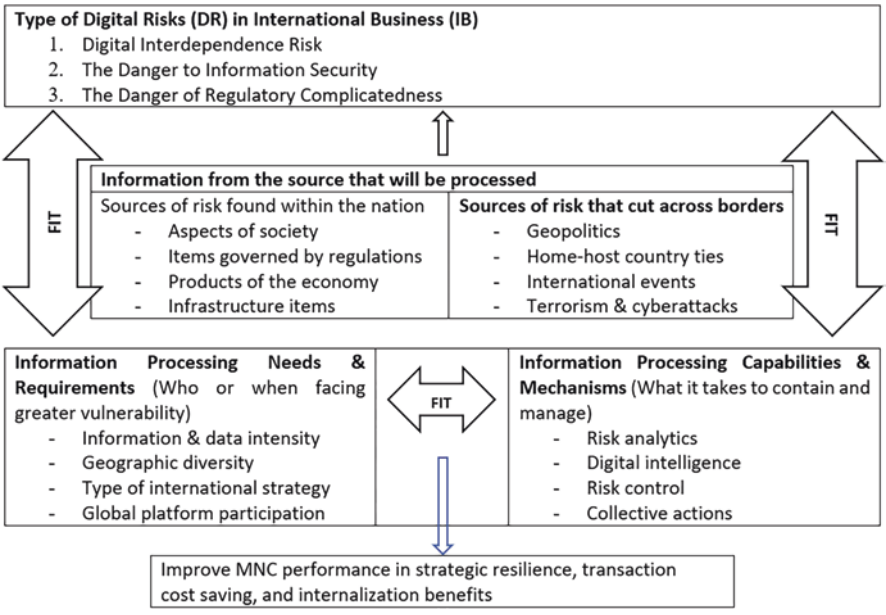

Fig. 1 A framework for the processing of information regarding IB digital risks. A comprehensive outline of the dangers posed by digitization (Information obtained from Yadong Luo in 2022)

1. *Identify* the key determinants to predict digital risks based on their feature importance.
2. *Design* artificial intelligence quantitative and qualitative models to address the risk features.
3. *Suggest* strategies for MNCs to effectively handle the business risks as a value-added proposition.

This study has five sections, including the introduction. Section 2 reviews the literature on digital risks, including types, sources, interdependencies, and information-processing needs and capabilities. Section 3 describes the framework, methodology, and data. Section 4 analyzes digital risk factors. Section 5 discusses limitations and future research (along with acknowledgment, contributions by authors, and conflict of interest, with source of funding for the research).

2 Literature Review

In this research, we apply Luo's framework to business firms in economic blocks like BRCS (Brazil, Russia, China, and South Africa), GCC (Gulf Cooperation Council), EU (European Union), and QUAD (Australia, Japan, and the United States) in general and India, the UAE, and Austria in particular to predict business risks that have been scantly researched by researchers.[1] Figure 1 presents Luo's model for the management of digital risks in multinational corporations (multinational companies). The theory of information processing, which states that information-processing systems deal with work-related uncertainty, serves as the theoretical foundation for the framework.

The framework emphasizes the most important points. First, the complexity of operational tasks and the requirements for information processing are both increased by digital threats. Second, the level of digital risk that is posed by multinational corporations varies according to the nature of their businesses and the requirements of their information systems. Those who have access to a significant amount of information and data, a geographically diverse user base, and participate on global platforms are at risk. Third, multinational corporations (MNCs) have the ability to manage these requirements by enhancing their information-processing capabilities. Some examples of these capabilities include risk analytics, digital intelligence, risk control, and collective actions. The management of digital risk necessitates an alignment between the requirements and capabilities of information processing and the nature of digital risk. This fit has an effect on efficiency and cost because multinational corporations are sensitive to the disruptions that digital technology causes. The field of information-processing theory places a greater emphasis on the

[1] For an excellent explanation of various digital risks, its sources, and how to manage them, please see Luo (2022).

information-processing mechanisms and capabilities of organizational design than does the field of transaction cost economics.

2.1 Digital Interdependence Risk

This results in unanticipated communication breakdowns, contagions, and interruptions between a focal multinational corporation (MNC) and its worldwide business partners, vendors, suppliers, distributors, customers, and corporate members. The global financial crisis of 2008 demonstrated how rapidly contagion can spread via links between capital markets. Businesses become more dependent on digital connections and platforms as a result of digitization, which also enables multinational corporations to better respond to unforeseen disruptions and difficulties (e.g., COVID-19 pandemic). The new era of IB is characterized by digital global connectivity, which is both a defining trait of this era and an essential catalyst for addressing new challenges and unknowns. How companies handle digital risk avoidance for their global operations varies greatly from one another.

2.2 Global Information and Cybersecurity Risk

Financial loss or other harm from a multinational corporation's fragile information and communications systems can lead to cyberattacks or data breaches. Customers worldwide are hesitant to use digital outlets that do not protect their personal information. They want the highest level of security, availability, reliability, and performance (Nambisan et al., 2017; UNCTAD, 2015). As corporate data crosses borders, security concerns grow (EIU, 2014). Internal and external security breaches are a new category of IB risk that manifest economically and socially (World Bank, 2016). Indirect damage from security breaches includes data loss, customer trust, and company reputation. Companies must guard against tangible and intangible threats. Cyberterrorism and cyberespionage threaten national security, and cyberattacks pose a new international business risk for multinational corporations (MNCs).

Theft of intellectual property, data breaches, and market manipulation are just some of the types of cybercrime that add up to a yearly cost of $400 billion to the world economy. In the future, more businesses will be impacted by cyberattacks, and those businesses that lack the necessary technology and security measures will be especially susceptible to these attacks. Firewalls are the industry standard for securing devices and zones, but risk management in the digital age calls for an approach that utilizes managed services and can protect IT ecosystems over time. The focus of cybersecurity moves from individual devices to services.

2.3 Digital Regulatory Complexity Risk

More emphasis is being placed on customers, digital taxes, the protection of sensitive information, and national security. The scope of these regulations necessitates the preparation of digital risk mitigation strategies. Adopting strategies for customer master data management is one of the ways that banks and other financial institutions can enhance their digital capabilities in preparation for Europe's General Data Protection Regulation. Many different national governments are currently debating whether or not they should place restrictions on the transmission and storage of data across international borders. There are those who advocate for governments to mandate that businesses process and store data on locally hosted servers. This law is interpreted differently in a variety of nations including Indonesia, Nigeria, Russia, Vietnam, and others as a result of differences in the digitalization-related regulations, rules, and standards that are in place in those nations. Disruptions at the international level are caused by the multiplicity, variance, and incompatibility of these factors. Laws in many countries are comparable to one another (Manyika et al., 2016).

2.4 Within-Country (Target Country) Sources

These include restrictions on digital connectivity and commerce as well as discrimination against foreign companies. These laws protect consumers from being defrauded digitally and online. Inadequate protection of digital intellectual property rights (such as AI) and a lack of transparency in economic and regulatory policies pertaining to digital connectivity are also contributing factors. The health of a target country's key sectors (e.g., electronics, the internet, and information and communication technology) will have an effect on the global connectivity of a foreign company. There is a correlation between physical conditions and digital risks. Broadband (fiber optics, 4G or 5G), international Internet bandwidth, internet data routes, mobile telecommunications, communications satellite, network infrastructure, data centers, cloud, big data, and the internet of things are examples of investments that have been made by both the public and private sectors (UNCTAD, 2015; World Bank, 2016).

2.5 Cross-Country Sources

The sources that span multiple countries become geopolitical. The United States is currently engaged in a trade dispute with a number of other countries, most notably China. As a result of this dispute, many governments have increased their scrutiny of foreign company takeovers, with a particular emphasis on the implications of information and communications technology (ICT) and other digital developments

for national security and technological advantage. Digitization and information and communication technology standards are beginning to diverge among economies. Worsening ties between the home country and the host country make the situation more complicated. The deterioration of MNCs' relationships with their home countries can be detrimental to their businesses (or regions). The advent of the digital age has made multinational corporations (MNCs) more susceptible to international threats such as cyberattacks and acts of terrorism. Businesses are put in jeopardy as a result of the ease with which cybercriminals can carry out attacks overseas in secret or through proxies brought about by digital technologies (Kshetri, 2005).

According to the information-processing theory, cross-unit operations or responsibilities are difficult and fraught with uncertainty due to the complexity of the task, the interdependence of the subunits, and the dynamic nature of the task environment. These three factors all contribute to the overall complexity and unpredictability of the company. More processing power is required when dealing with complexity and ambiguity. The amount of MNC information and data intensity both contribute to an increase in the complexity of a digital task. There is a possibility that task interdependence will increase when a multinational corporation (MNC) participates more actively in global platforms or adopts a more globalized strategy. Environmental dynamism can be increased by a company's expansion of their global supply chain or their presence in foreign markets (Kano et al., 2020). Key determinants of information-processing demands for digitally connected activities, as well as firm-specific exposure and digital risk vulnerabilities, include the intensity of information and data, geographic diversity, the type of international strategy, and participation in global platform activities.

2.6 Information and Data Intensity

Some multinational corporations are more dependent than others on the flow of information both within and outside the company. Global executives develop a digital architecture to facilitate internal communication and data sharing, collaboration with global suppliers and customers, virtualization of global teams, and connection to global suppliers and customers. An ERP system, an HCM system, a CRM system, a data management platform, cloud computing, and a social marketing platform are all included in this architecture. Increased digital connectivity may alleviate some of the challenges associated with distance, space, and time in governance, but it may also drive up the costs of organizing and monitoring (Monaghan et al., 2020).

According to the theory of information processing, organizations that are susceptible to risk require additional information processing (Egelhoff, 1991). Companies with a lot of information have to worry about both cybersecurity and regulatory risks. Technology and politics have become the new battlefield. Several countries, particularly those that are already considered to be technological leaders, compete

for information and communication technology standards and technologies in order to increase their economic and market power (Sacks, 2020). Because of regulatory and ICT tensions, many multinational corporations are unable to participate in activities associated with global value chains. ICT is rapidly transitioning into a foundational infrastructure for the digital age (UNCTAD, 2015). The global supply chain and production network of a company rely heavily on digital infrastructure, which includes things like automated processes, algorithms supported by artificial intelligence, and cloud computing, among other things.

2.7 Geographic Diversity

An MNC's internationalization (from supply chain expansion to market expansion) and global diversification across regions and countries are both aspects of what is meant by the term "geographic diversity." Diversification is a hallmark of global corporations. Multinational companies that diversify their operations put themselves at risk of being attacked digitally for several reasons. Diverse multinational companies need to cover more geographic ground, which will expose them to digital threats (both physical and institutional) in a greater number of countries. Second, the interdependence of a multinational corporation (MNC) with foreign resources, regulators, competitors, partners, vendors, platforms, and other ecosystem players is increased by diversity (Dellestrand & Kappen, 2012). This results in increased interdependence, information security, and regulatory risks in various countries. More diversity results in an increase in the number of information-processing nodes both within and between countries, as well as an increase in the number of digital risks resulting from interactions between organizations (Stallkamp & Schotter, 2021).

The increasing complexity of the global operations of multinational corporations is directly correlated to the diversification of their workforces. In order to better manage digital risks, many executives are increasing the amount of money they invest in their company's digital architecture (e.g., ERP, HCM, CRM, global talent bank, data management platform, cloud computing, and data analytics). This could result in failures of the internet and intranets, the leaking of sensitive information, and inadequate digital infrastructure in multiple countries. For the purpose of risk assessment, the MNC needs to process data from both the domestic and international levels. When it comes to the management of digital risks, multinational corporations (MNCs) will have to comply with more stringent information-processing requirements as their geographic diversity increases.

2.8 International Strategy

Leaders of multinational corporations (MNCs) often employ multi-domestic, global, hybrid, or transnational strategies when competing on a global scale (Bartlett & Ghoshal, 1989). A multi-domestic strategy, also known as a local adaptation orientation, is characterized by high levels of local adaptation and responsiveness in the respective countries in which MNC subunits compete. This strategy places an emphasis on competition within each country and segments foreign markets based on national boundaries. Decisions on both a strategic and operational level are made by foreign subunits in order to adapt products and services to specific local markets. Because of this strategy, the multinational corporation will be put in jeopardy in the country on multiple fronts, including the economic, social, and regulatory fronts. Additionally, the requirement for intra-MNC digitization interdependence and interconnection is lessened when a multi-domestic strategy is implemented (Bartlett & Ghoshal, 1989).

The globalization of markets presupposes the standardization of products across all of those markets. The command center operates under the presumption that overseas subunits are dependent upon one another and prioritizes integrating them (Prahalad & Doz, 1987). This approach takes advantage of both global scale and innovations developed locally. This strategy is put into action by the integrated ERP solution known as "SAP Business One," which is designed for use by multinational corporations, their overseas subsidiaries, and their suppliers. A core solution for the application that is both flexible and scalable is beneficial to growth and innovation. This architecture satisfies the global legal and linguistic requirements through the utilization of a single code base. Because each function related to the company is combined into a single package, it is very simple to install, configure, and operate. The use of open application programming interfaces (APIs) or certified standard integration packages makes system integration simple. This architecture is helpful under a global strategy, or higher global integration orientation, because multinational corporations (MNCs) face more cross-country risk forces, such as trade ties between their home country and the host country and geopolitics that affect digital globalization.

Positioned between multi-domestic and global strategies is that of transnational hybrid strategy (Prahalad & Doz, 1987). This hybrid strategy requires a shared vision, individual commitment, and an integrated organizational network that is still flexible in order to achieve global efficiency and local responsiveness (Baaij & Slangen, 2013). Leaders of MNCs who adopt this strategy intend to stimulate communication within the company, with the goals of preventing conflicts over integration and localization and increasing the flexibility and discretion of foreign subunits. In order to keep their local responsiveness while also transferring their specialized skills to other members of the network, hybrid businesses must collaborate. Because of these two mandates, information-processing requirements are becoming more and more stringent, and the design of the digitization system must be flexible enough to account for variations and unforeseen circumstances.

Foreign subunits need to be sufficiently differentiated so that they can respond appropriately to the various demands, markets, and policy environments they will encounter (Sturgeon, 2020).

2.9 Global Ecosystem

Because of digitization, businesses in many countries and industries are being forced to consider the products and services they offer as components of a larger whole. It is simple to transfer digital assets across organizational boundaries and national borders, as well as to modify and recombine them for use in a different market (Nambisan et al., 2017). The digital platform and ecosystem strategy of a multinational corporation is driven by data. When a platform is used on a global scale, data may travel across national boundaries. This presumption is being called into question as governments in almost every region of the world impose restrictions on how, when, or how much data can be transferred between countries in business transactions (World Bank, 2016). This evidence demonstrates both the benefits and the risks of global platforms.

3 Conceptual Framework, Methodology, and Data

3.1 Conceptual Framework

The psychological stance that companies take toward domestic and international markets for digital goods and services is one component of what is known as digital business risks (DBR). During times of widespread macroeconomic unpredictability, like financial crises and pandemics like COVID-19, businesses have a propensity to speculate, be optimistic, or be pessimistic about a particular digital trade. DBR explains why this happens.

$$\left(Y_{1ijt}\, Y_{2ijt}\right) = f\left(X_{ijt}, Z_{ijt}\right) + \varepsilon_{ijt} \tag{1}$$

The conceptual framework of the research is shown in Eq. 1 and Fig. 2. It is anticipated that the DBR output (Y_{itj}) will fall for India, Austria, and the UAE in particular, as well as for QUAD, BRCS, GCC, and EU in general. This output measure for the DBR is included in the framework. Inputs (X_{ijt}) are indicators of firms' trade diversity, trading partner reputation in terms of logistics and infrastructure to support trade in India, Austria, the UAE, QUAD, BRCS, GCC, and the EU. In addition, inputs (X_{ijt}) are indicators of infrastructure to support trade in India, Austria, and the UAE. The political and financial crises, pandemic events, and macroeconomic variables depicted in Fig. 2 are all behavioral factors that are related

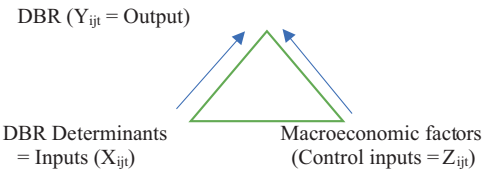

Fig. 2 Conceptual framework input-output relation of digital business risk (DBR) with DBR determinants and macroeconomic factors (Source: Authors' own creation)

to Sustainable Development Goal 8 (growth and economic development) and Sustainable Development Goal 9 (information and communication technologies). The research makes use of artificial intelligence (AI) to model DBR and capture behavioral factors rather than hypotheses.

3.2 Rationale for Focusing on Regional Economic Blocks Like BRICS, GCC, EU, and QUAD (AJUS)

3.2.1 BRICS

Brazil, Russia, India, China, and South Africa account for 41% of the world's population, 24% of global GDP, and 16% of global trade. BRICS drive economic growth. BRICS countries have different pharmaceutical trades, international participation, and other interests. The BRICS' rise as a unique organization with increasing transnational health and trade cooperation strains global governance systems and procedures. Academics, legislators, and consultants seek leadership and inspiration from national governments and regional blocks. BRICS nations may fill the leadership void left by retreating countries. More research is needed to determine if the BRICS can fill this gap. A constitutional definition of authority has contributed to Brazil's federal-state cooperation. Uncoordinated efforts to pool resources in Russia have led to inefficiency. BRICS countries provide diplomatic and technical support for global health programs

3.2.2 Gulf Cooperation Council (GCC)[2]

Dynamic, active, and diverse are the GCC and BRICS economies. The GCC and BRICS countries are attracting foreign investment as they enter the global economy and grow faster than the industrialized world (Bhuyan et al., 2016). According to the World Federation of Exchanges, the GCC and BRICS have a $12,809 trillion market

[2] Gulf Cooperation Council (GCC) comprises of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE).

cap. It is 1200 trillion dollars more than Europe, the Middle East, and Africa combined. The GCC and BRICS are important sources of demand and supply. In 2018, the UAE was 11.5% citizens and 88.5% expats. Fifty-nine percent of non-UAE citizens are South Asian. BRICS and GCC markets are affected by macroeconomic conditions (Mensi et al., 2014).

GCC and BRICS economies are internal. Many GCC and BRICS economies and financial systems are externally driven. The GCC and BRICS, which share gold and oil, benefit when the QUAD (the United States, Australia, and Japan) and other developed countries do well. Both China and India consume a lot of oil. Russia, a leading producer of crude oil and natural gas with ties to industrialized economies, is an energy powerhouse. Worsening economic conditions in developed economies would reduce capital flows from advanced to GCC and BRICS economies and exports to developed markets rich in oil, the GCC. The BRICS nations are able to make some modifications to the rich GCC block's model and then use it as their own. Collaboration in information technology may be led by BRICS. The information technology (IT) exports of India are projected to skyrocket in 2022. This year, it is anticipated that Indian exports will grow by 4.7%. Predictions pertaining only to India:

- It is possible that outbound shipments will exceed $400 billion.
- According to projections made by the WTO, India's exports will increase by 4.7% in 2022.
- The value of software exported could reach 148 billion dollars. This is more than the oil sales of GCC.
- In the coming weeks and months, India's software companies will experience significant growth.

Because the BRICS have the largest engineering population in the world, it is possible that software exports will skyrocket in 2022–2023 and beyond. Exports of software are a part of growth driven by exports, but their momentum is picking up

3.2.3 Australia, Japan, and the United States (AJUS-QUAD Partners)[3]

AJUS-QUAD is a trilateral technology accelerator between Australia, Japan, and the United States. It speeds up the development and use of key technologies. It is a deal between governments, research organizations, and private companies, including non-defense tech companies. The AJUS alliance is a foundational contribution to a

[3] A growing momentum toward monolateral cooperation in the Indo-Pacific to "meet the challenges of the twenty-first century" was fueled by the formation of AJUS in September 2021, which was an "enhanced trilateral security partnership" between Australia, Japan, and the United States. The agreement promotes the exchange of information and technologies; integrates security and defense research, technology, industrial bases, and supply chains; and enhances the combined capabilities and interoperability of the three countries. The grouping could improve security in the Indo-Pacific region despite the fact that it is limited to the three Anglo partners (Jagannath, 2022).

free, open, and inclusive Indo-Pacific. QUAD discusses COVID-19, vaccines, technological innovation, supply chain resilience, and climate change.

3.2.4 European Union

Within its borders, the European Union (EU) seeks to promote peace, its values, and the well-being of its citizens; offer freedom, security, and justice without internal borders; regulate asylum and immigration; prevent and combat crime; establish an internal market; and accomplish sustainable development based on balanced economic growth, price stability, and a highly competitive market economy that supports emoji. The global objectives of the European Union are to uphold and promote its values and interests, contribute to peace and security and sustainable development, and promote solidarity and mutual respect among peoples, free and fair trade, poverty eradication, and human rights, as stated on the website of the European Union (https://european-union.europa.eu/priorities-and-actions/eu-priorities-en).

3.3 Methodology

3.3.1 Traditional OLS and Ridge Regression

Because of multicollinearity, the design matrix is almost entirely singular, which means that X and $X'X$ do not have full rank. It is not possible to obtain the OLS estimate. As a result, one must pay attention to the multicollinearity of the data. The traditional approaches involve either gathering more data or reducing the number of variables. Increasing the amount of data collected can be prohibitively expensive or impractical. When trying to reduce multicollinearity in a model, dropping variables from the model could cause specification bias, which would make the solution worse than the original problem. Our objective is to derive the maximum amount of information from the data at our disposal, and this objective is what has inspired researchers to devise novel statistical methods, such as ridge regression (Vinod, 1978), in order to address the issue of multicollinearity. Ridge regression with Y_1 and Y_2 joint distributions was the method that we used in this study.

3.3.2 Artificial Neural Network (ANN)

Artificial neural networks (ANN) were developed by researchers in the fields of psychology, neuroscience, and engineering to approximate the way information is processed. ANN assists multinational corporations in responding to news, learning, processing information, and making decisions. ANN operates under the assumption of bounded rationality, which holds that market participants adjust their prior

subjective beliefs based on their previous errors. The ANN makes the assumption that economic decision-makers react to external shocks in an asymmetrical and nonlinear fashion. The ANN provides an intuitive approximation of the decision-making process in economics and business. For two reasons that are interrelated, the emerging market logistics, information and communication technology, and other sectors are fertile ground for ANN. One reason is that the data are frequently noisy because of the shallowness of the market or the rapidity with which news spreads, which means that asymmetries and nonlinearities cannot be assumed to be eliminated. Second, participants in the market frequently learn about recent policy news, changes in the law, and other changes in the market through trial and error. An artificial neural network (ANN) uses a combination of learning and searching to arrive at its estimates of synaptic weights, also known as parameter coefficients (McNellis, 2005): (a) the perceptron, (b) the feed-forward neural network, (c) the multilayer perceptron, (d) the convolutional neural network, (e) the radial basis functional neural network, (f) the recurrent neural network, and (g) the LSTM – long short-term memory. In our research, we derived synaptic weights by using a multilayer perceptron artificial neural network (ANN). A comparison of (d) and (h) is not within the purview of the present investigation.

3.3.3 Random Forest Tree (RFT) Model

The ensemble machine learning (ML) technique known as random forest is trained using a large number of decision trees. Because decision trees are relatively straightforward, it is possible that a single tree won't be enough to construct a machine learning model. In order to make decisions, random forest combines the characteristics of many different decision trees. Therefore, it is a "forest" of trees; consequently, it is called "random forest." This method makes use of "randomly created decision trees," as the name of the method suggests. RFT utilizes bootstrap trees in order to make predictions and classifications (sometimes referred to as bagging). Multiple decision trees are aggregated into one larger tree in place of using just one. One of the drawbacks of using a decision tree is overfitting. It is possible to alleviate some of this difficulty by employing RFT regression rather than decision tree regression. In comparison to more conventional regression models, RFT is both quicker and more reliable.

RFT creates sample data sets for each model by selecting rows and features at random from the entire data set. Bootstrap. The random forest regression method is comparable to any other machine learning approach.

3.4 Empirical Model

The output, input, and control factors are detailed in Table 1. The framework is empirically analyzed using Eq. 2 covering OLS, ridge regression, RFT, and ANN specifications.

Table 1 Details of output (Y_{ijt}) and inputs (X_{ijt} and Z_{ijt})

	World Bank WDI factor description	Fig. 1 Relation	Factor implication
Y_1	The index of the net barter terms of trade (2000 = 100)	2.1	The higher the ICT coverage, the higher the barter index
Y_2	Individuals using the internet (% of population)	2.1	Imply higher penetration facilitating trade
X_1	Business extent of disclosure index (0 = less disclosure to 10 = more disclosure)	2.1	Higher ICT coverage facilitates greater disclosure
X_2	(Expressed as a percentage of the net difference Between exports and imports of commercial services) computer, communications, and other services	2.8	Positive metrics imply competitive advantage in exporting country and negative metrics imply competitive disadvantage in importing country
X_3	Broadband subscriptions that are fixed (per 100 people)	2.2	Imply higher ICT penetration
X_4	GDP per capita growth (annual %)	2.4	Higher per capital income implies capacity to access ICT tools
X_5	ICT goods net of exports-imports (% net goods total exports-total imports)	2.8	Positive ICT good metrics imply competitive adv. In exporting country and negative metrics imply competitive disadvantage in importing country
X_6	ICT service exports as a percentage of total service exports (base year)	2.8	Imply ICT services competitive advantage in exporting country
X_7	ICT investment with private sector participation (in current US dollars)	2.9	The higher the PP in ICT, the higher the competitive advantage in both the exporting and importing countries
X_8	The overall logistics performance index ranges from 1 (low) to 5 (high)	2.6	Imply supply chain higher performance due to ICT coverage
X_9	Index of the performance of logistics: infrastructure quality relating to commerce and transportation on a scale of 1 (low) to 5 (high)	2.6	Imply supply chain higher performance due to ICT coverage
X_{10}	Manufacturing sector net of exports-imports	2.8	Positive manufacturing sector metrics imply competitive adv. in exporting country and negative metrics imply competitive disadvantage in importing country
X_{11}	Merchandise by the reporting economy that is net of exports and imports, expressed as a percentage net of total exports and imports of merchandise	2.7	Positive metrics imply external trade diversity in these economies reducing business risks due to ICT coverage
X_{12}	Merchandise after deducting exports and imports to economies in the Arab World (expressed as a percentage after deducting total exports and imports of merchandise)	2.7	Positive metrics imply external trade diversity in Arab World reducing business risks due to ICT coverage

(continued)

Table 1 (continued)

	World Bank WDI factor description	Fig. 1 Relation	Factor implication
X_{13}	Merchandise after deducting exports and imports to economies with high incomes (percentage after deducting total exports and imports of merchandise)	2.7	Positive metrics imply external trade diversity in HIC reducing business risks due to ICT coverage
X_{14}	Merchandise net of exports-imports to LMIC (% net of total merchandise exports-imports)	2.7	Positive metrics imply external trade diversity in LMIC reducing business risks due to ICT coverage
X_{15}	Merchandise net of exports-imports to LMIC in EU and Central Asia (% net of total merchandise exports-imports)	2.7	Positive metrics imply external trade diversity in LMIC in EU and Central Asia reducing business risks due to ICT coverage
X_{16}	Merchandise net of exports-imports to LMIC in Latin America and the Caribbean (% net of total merchandise exports-imports)	2.7	Positive metrics imply external trade diversity in LMIC in Latin America and Caribbean reducing business risks due to ICT coverage
X_{17}	Merchandise net of exports-imports to MENA (% net of total merchandise exports-imports)	2.7	Positive metrics imply external trade diversity in LMIC in MENA reducing business risks due to ICT coverage
X_{18}	Merchandise net of exports-imports to South Asia (% net of total merchandise exports-imports)	2.7	Positive metrics imply external trade diversity in LMIC in South Asia reducing business risks due to ICT coverage
X_{19}	Merchandise net of exports-imports to sub-Saharan Africa (% net of total merchandise exports-imports)	2.7	Positive metrics imply external trade diversity in LMIC in sub-Saharan Africa reducing business risks due to ICT coverage
X_{20}	Merchandise net of exports-imports to LMIC outside region (% net of total merchandise exports-imports)	2.7	Positive metrics imply external trade diversity in LMIC outside region reducing business risks due to ICT coverage
X_{21}	Merchandise net of exports-imports to LMIC within region (% net of total merchandise exports-imports)	2.7	Positive metrics imply external trade diversity in LMIC within region reducing business risks due to ICT coverage
Z_1	Natural logarithm of GDP (constant 2015 US$)	2.1	Imply size of the country (control variable)
Z_2	Pandemic events (PE)	2.1	Like swine flu, malaria, smallpox, SARs, and recently the COVID
Z_3	Economic and financial crises (EC)	2.1	2008–2009 economic and financial crises

3.4.1 Empirical Model

$$Y_{jjt} = \alpha_{ijt} + \beta_{ijt} \sum X_{ijt} + \pi_{ijt} \sum Z_{ijt} + \varepsilon_{ijt} \tag{2}$$

where:

Y_{ijt} = Two outputs of DBR (Y_1 and Y_2) for three individual countries (India, the UAE, and Austria) and the four blocks j (QUAD, GCC, BRCS, EU) and t = 2000–2020.

X_{ijt} = Set of DBR indicator inputs (drawn from world development indicators (WDI) database of the World Bank) for countries in the blocks j and t = 2000–2020.

Z_{ijt} = Set of macro-factors such as GDP (2015 constant US$) representing the size of the country, pandemic, and economic crises events in the four blocks j and t = 2000–2020. The control inputs have a greater impact on DBR in the economies under study.

J = 14 economies grouped into seven groups comprising of three specific countries where one represents India, two represent Austria, three represent the UAE, and four regional blocks represented by QUAD (three developed countries excluding India), BRCS (four countries excluding India, i.e., Brazil, Russia, China, and South Africa), GCC block (excluding the UAE – five developing oil-rich economies: Bahrain, Kuwait, Oman, Qatar, and Saudi Arabia), and the European Union (excluding Austria) and t = time from 2020–2020.

ε_{ijt} is the error term for the ith country, jth block for time t = 2000–2020.

Third column in Table 1 aligns the output, input, and control factors to risk dimensions depicted in Fig. 1, which are explained in Sect. 2 under 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, and 2.9. The significance and influence of sector-specific studies in enhancing both domestic and international trade performance of business corporations cannot be overstated. This is the uniqueness of this research.

4 Model Results

Figure 3 shows that the root mean square error (RMSE) is highest in OLS model compared to ridge regression, RFT, and ANN models for predicting BDR.

So we focus our discussion of results on the RFT and ANN models for predicting accuracy of BDR. Figure 4 displays the feature importance of RFT in decreasing order in our data set.

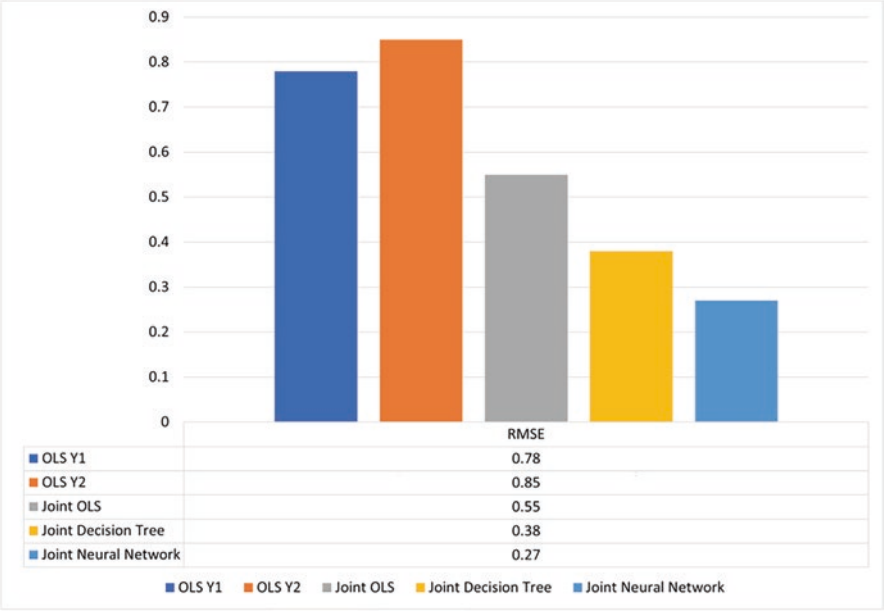

Fig. 3 Comparison of OLS, ridge regression, RFT, and ANN models

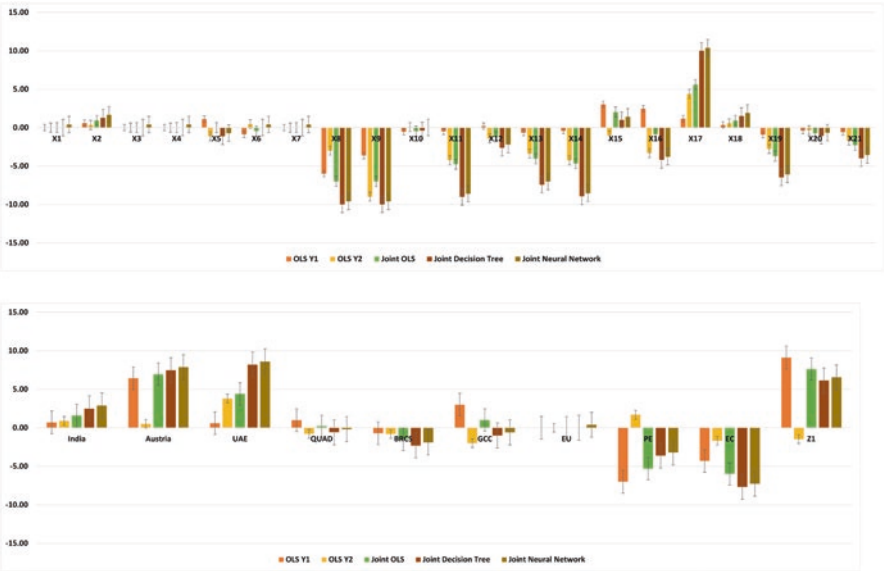

Fig. 4 Feature importance on BDR

4.1 SH*apley* A*dditive ex*P*lanations (SHAP)*

SHAP is most likely in the lead for ML explainability. This method involves the reversed engineering of the outcome of a prediction algorithm. Researchers make use of SHAP values in order to comprehend the choices made by a complex model (gradient boosting, neural network, etc.). SHAP is a concept in game theory. Take into consideration a predictive model, a "game," and "players" in the game. SHAP determines the degree to which each feature contributes to prediction. One observation is equal to one "game." The SHAP focuses on the possibility of local interpretation. The SHAP value plot depicts predictor-target relationships that are both positive and negative (in our case, ICT governance framework Y1 and Y2). These train data dots are used in this graph. Displays: Importance of feature: Variables are ordered descending.

- Horizontal placement shows whether a value affects a higher or lower forecast.
- Color indicates whether a variable is high (red) or low (blue) (in blue).

4.2 *Discussion of RFT and ANN Model Results*

Figure 4 displays the summary results of all models factor-wise. The following factors have positive impact on BDR in decreasing order of importance:

The X_{17} factor represents the disparity between MENA's exports and imports (as a percentage of the total amount of merchandise exported and imported). The trade surplus in low- and middle-income countries in the Middle East and North Africa (MENA), which increased ICT coverage, increased business risks. This corroborates the findings presented in Sect. 2.1, which state that the diversity of MNCs contributes to an increase in digital risks for a variety of reasons. The finding lends credence to this assertion. Diverse multinational companies need to cover more geographic ground, which will expose them to digital threats (both physical and institutional) in a greater number of countries. More geographic ground must be covered in order to cover more ground. Second, increased diversity heightens a multinational corporation's reliance on external ecosystem players such as foreign resources, regulators, competitors, partners, vendors, and platforms (Dellestrand & Kappen, 2012). This results in an increase in the risks associated with global interdependence, information security, and regulatory oversight. More diversity results in more information-processing nodes both within countries and between them, as well as an increase in the number of digital risks resulting from exchanges between organizations (Stallkamp & Schotter, 2021).

X_{18} factor, merchandise net of exports-imports to *South Asia* (% net of total merchandise exports-imports). The implication is the same as for the factor X_{17} factor for MENA trade surplus resulting in trade diversity.

X_2, along with the factors of computer, communication, and service (net commercial exports-imports). Because of the same factors as X_{17} and X_{18}, DBR increased

as a result of a competitive advantage in India, the UAE, and Austria. This finding is in line with Luo's observation, which states that the volume of information and data, geographic diversity, the type of international strategy, and participation in global platforms all contribute to the specific exposure and digital risk vulnerabilities of a company.

X_{15} factor, merchandise net of exports-imports to LMIC in *EU and Central Asia* (% net of total merchandise exports-imports) was next important feature in predicting DBR. Surplus trade diversity in LMIC in *EU and Central Asia* increased DBR risks due for the same reasons as adduced for X_{17} and X_{18}.

UAE dummy had positive impact on DBR. This implies that ICT competitive advantage in the UAE increased DBR. The reasons are similar to those discussed under factor X_{17} above.

Austria dummy had positive impact on DBR. This implies that ICT competitive advantage in Austria increased DBR. The reasons are similar to those discussed under factor X_{17} above.

Z_1 factor, natural logarithm of GDP (constant 2015 US$) was next important feature in predicting DBR. This implies that the size of the country (control variable) was also important in predicting DBR. The higher the size of the country translates to developed economy and also developed ICT. The reasons are similar to those discussed under factor X_{17} above.

India dummy had positive impact on DBR. This implies that ICT competitive advantage in India increased DBR. The reasons are similar to those discussed under factor X_{17} above.

A net merchandise trade surplus was achieved as a result of exporting to MENA, South Asia, the EU, and Central Asia. This led to an increase in the digital business risk in India, the UAE, and Austria due to the depth and breadth of their ICT sectors. These findings imply that, in accordance with Sturgeon (2020), the leaders of MNCs in these economies adopt a hybrid strategy in order to achieve two goals: stimulating intra-firm communication in order to avoid integration and localization conflicts and increasing flexibility and discretion to foreign subunits. In order to maintain a local presence while also transferring specialized skills within the network, hybrid companies are required to do so. Because of these two mandates, information-processing requirements must be met, and the design of the digitization system must be flexible enough to account for variations and unforeseen circumstances. It is necessary for foreign subunits to have a sufficient amount of differentiation in order to meet the varied requirements of various markets and policy environments

The following factors have negative impact on BDR in decreasing order of importance:

X_9 factor, logistics performance index: Quality of trade and transport-related infrastructure (1 = low to 5 = high) was high in India, the UAE, and Austria. This implies supply chain higher performance in these three countries due to higher ICT coverage. These resulted in reduced DBR in these countries.

X_8 factor, logistics performance index: Overall (1 = low to 5 = high) was high in India, the UAE, and Austria. This implies supply chain higher performance in

these three countries due to higher ICT coverage. These resulted in reduced DBR in these countries similar to quality of trade and transport-related infrastructure.

X_{14} factor, merchandise net of exports-imports to *LMIC* (% net of total merchandise exports-imports). Positive metrics in external trade diversity in LMIC thus reduce business risks due to ICT coverage. This result is contrary to results discussed under X_{17} and X_{18}.

X_{11} factor, merchandise net of exports-imports by the reporting economy, residual (% net of total merchandise exports-imports) was next important feature in predicting reduced DBR. Positive metrics imply external trade diversity in these economies reducing business risks due to ICT coverage.

X_{13} factor, merchandise net of exports-imports to *high-income economies* (% net of total merchandise exports-imports) was next important feature in predicting DBR. Positive metrics imply external trade diversity in HIC reducing business risks due to ICT coverage.

X_{19} factor, merchandise net of exports-imports to *MENA* (% net of total merchandise exports-imports) was next important feature in predicting DBR. Positive metrics imply external trade diversity in LMIC in MENA reducing business risks due to ICT coverage.

X_{21} factor, merchandise net of exports-imports to *LMIC within region* (% net of total merchandise exports-imports) was next important feature in predicting DBR. Positive metrics imply external trade diversity in LMIC within region reducing business risks due to ICT coverage.

X_{16} factor, merchandise net of exports-imports to *LMIC in Latin America and the Caribbean* (% net of total merchandise exports-imports) was next important feature in predicting DBR. Positive metrics imply external trade diversity in LMIC in Latin America and Caribbean reducing business risks due to ICT coverage.

X_{20} factor, merchandise net of exports-imports to *LMIC outside region* (% net of total merchandise exports-imports) was next important feature in predicting DBR. Positive metrics imply external trade diversity in LMIC outside region reducing business risks due to ICT coverage.

X_5 factor, ICT goods net of exports-imports (% net goods total exports-total imports) was next important feature in predicting DBR. Positive ICT good metrics imply competitive advantage that reduces DBR.

EC (2008–2009 economic and financial crisis) factor was next important feature negatively impacting predicting DBR. One plausible reason is that contagion of global financial crisis resulted in reduced in ICT infrastructure, reduced trade across borders, and hence increased DBR as detailed under Sect. 2.9 Global Diversity.

PE (pandemic events) that are control factors was next important feature in predicting DBR. This implies that pandemic events like swine flu, malaria, smallpox, SARs, and recently the COVID impacted the DBR negatively for the same reason as detailed for EC factor above.

BRICS dummy was next important feature negatively impacting in predicting DBR. One plausible reason is that ICT is well developed in BRICS and hence these economies have competitive advantage in ICT and thus experience lower DBR.

GCC dummy was next important feature negatively impacting in predicting DBR. One plausible reason is that ICT is well developed in GCC similar to BRICS and hence these economies have competitive advantage in ICT and thus experience lower DBR.

QUAD dummy was the next important feature negatively impacting in predicting DBR. One plausible reason is that ICT is well developed in QUAD similar to BRICS and GCC and hence these economies have competitive advantage in ICT and thus experience lower DBR.

In conclusion, a hybrid strategy tends to bring about a reduction in DBR when it is adopted by trading countries. This is the case because of a higher logistics quality index, a higher logistics performance index, and the diversity of its external trade with low- and middle-income countries as well as high-income economies. To be successful in these countries, the digital platform and ecosystem strategy of an MNC need to place a significant emphasis on data. When a platform has a global reach, it is reasonable to assume that data can be transferred between countries; however, this assumption is coming under increasing scrutiny as governments in almost every region of the world impose restrictions on how, when, or to what extent companies can transfer data between countries (World Bank, 2016). Global platforms and ecosystems bring with them both opportunities and dangers, as was demonstrated earlier.

5 Conclusion

Digital connections are country-specific because they can be used across national boundaries for less money than traditional IB connections. Digital global connectivity dominates the new era of international business and addresses rising uncertainties. Digitization carries myriad risks, a pivotal issue for global operations that has received little theoretical or empirical attention. In this background, this paper specifically addresses the three questions on digital risks in international business and related areas: (1) Identify the key determinants to predict digital risks based on their feature importance, (2) design artificial intelligence quantitative and qualitative models to address the risk features, and (3) suggest strategies for MNCs to effectively handle the business risks as a value-added proposition.

A comprehensive output-input framework was developed to address the research questions. The digital business risk (DBR) for India, Austria, and the UAE in particular and QUAD, BRCS, GCC, and EU economic blocks in general is the DBR output (Y_{itj}) to be predicted to mitigate. This is a key DBR output measure in the framework. The inputs (X_{ijt}) are indicators of firms' trade diversity, trading partner's reputation in terms of logistics and infrastructure to support trade, in India, Austria, and the UAE besides other economic blocks like QUAD, BRCS, GCC, and the

EU. The conceptual framework in Fig. 2 encompasses many behavioral factors related to sustainable development goal SDG-8 (growth and economic development) and SDG-9 (ICT) captured by political and financial crises besides pandemic events and macroeconomic variables in general. Thus, instead of focusing on hypotheses, the study captures the importance of the behavioral factors in DBR modeling by applying AI tools.

In conclusion, a net merchandise trade surplus caused by exporting to economies in the Middle East and North Africa (MENA), South Asia, the European Union (EU), and Central Asia resulted in an increased digital business risk in the exporting countries of India, the United Arab Emirates (UAE), and Austria. These three countries had a competitive advantage in terms of the depth and breadth of their information and communications technology (ICT). There is a tendency for DBR to be lowered by circumstances such as a higher logistics quality index, a higher logistics performance index, external trade diversity to LMIC, MENA, and high-income economies, as well as economic crisis and pandemic events. To lessen the impact of DBR, multinational corporations (MNCs) might work out some sort of hybrid strategy with their trading partners. Data serves as the primary motivator for a multinational corporation's digital platform and ecosystem strategy when operating in these countries. It is reasonable to assume that data can be transferred across national borders when using a platform that has a global reach, such as the internet. On the other hand, the fact that governments in almost every region of the world impose restrictions on how, when, or to what extent companies can transfer data across their border's casts doubt on the veracity of this assumption. The evidence presented here demonstrates both the benefits and the dangers that are associated with utilizing global platforms and ecosystems.

The area under study requires interventions in policy and regulation to bolster digital intellectual property rights (e.g., AI), as well as transparency in the process of enforcing economic and regulatory policies regarding digital connectivity. The economic conditions of a target country, such as the health of key sectors (e.g., electronics, the internet, and information and communication technology), will affect the global connectivity of a foreign company. The nation's digital risks can be affected by the physical conditions. Investments in areas such as broadband supply (fiber optics, 4G or 5G coverage), international internet bandwidth, internet data routes, mobile telecommunications, communications satellite, network infrastructure, data centers, cloud, big data, and the internet of things made by both the public sector and the private sector (IoT).

According to Sturgeon (2020), the leaders of multinational corporations in the three economies adopt a hybrid strategy in order to stimulate intra-firm communication and increase the flexibility and discretion of their foreign subunits. In order to maintain their local responsiveness while also transferring their unique skills, hybrid companies need to network. Because of these two mandates, information-processing requirements are being solidified, and the design of the digitization is being forced to accommodate variations and contingencies. It is essential for foreign subunits to have a sufficient level of differentiation in order to successfully navigate the varied demands, markets, and policy environments they will encounter.

5.1 Directions for Future Research

The study is limited with focus on three individual countries India, Austria, and the UAE with aggregate secondary WDI data in four regional blocks EU, BRICS, GCC, and the QUAD. Future studies may expand the database to specific countries in each block to broaden the research agenda for in-depth research on digital risk in international business and allied areas.

Authors' Contribution All four authors have equally contributed in developing this conceptual paper using their respective domain knowledge.

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