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The curvilinear relationship between digitalization and export propensity: The role of home country corruption in emerging economies

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ABSTRACT

Drawing on resource-based and institutional considerations, we suggest a curvilinear relationship between digitalization and the export propensity of emerging economy enterprises (EEEs), while also arguing that this association is influenced by the level of corruption in the home country. We run a multilevel analysis on a dataset of firm- and country-level characteristics for 35 emerging economies and 17,265 observations. Our predictions confirm an inverted U-shaped relationship between digitalization and export propensity. Additionally, we find that corruption steepens this curvilinear relationship. These insights contribute to a nuanced understanding of the interplay between digitalization, corruption, and the internationalization efforts of EEEs.

1. Introduction

The interplay between digitalization and business internationalization has been a topic of interest since Lovelock and Yip (1996), who emphasized the role of information technology in driving globalization. Digitalization, which refers to the adoption and integration of digital technologies into business processes (Autio, 2017; Brieger et al., 2022; Crespo et al., 2023; Luo and Bu, 2016; Verhoef et al., 2021), has enabled exporting firms to target and serve international markets more effectively (Brouthers et al., 2022; Katsikeas et al., 2020; Meyer et al., 2023). In fact, as firms increasingly engage in exporting, one of the most accessible foreign market entry modes (Lu and Beamish, 2006), particularly for resource-constrained enterprises in emerging economies, the question of how digitalization enables export activities has gained prominence among researchers and practitioners (Dong et al., 2024).

However, much of the literature has focused on the positive, linear impacts of digitalization, particularly in developed economies. Researchers have explored enabling technologies such as internet and websites (Brieger et al., 2022; Jean and Kim, 2020), social media (Gregory et al., 2019), and digital platforms (Ardito et al., 2021). Nevertheless, recent evidence suggests that the relationship between digitalization and internationalization may follow a non-linear pattern (Bhandari et al., 2023). Although initial digital investments may enhance exporting (Verbeke and Hutzschenreuter, 2021), high levels of digitalization can hinder firms, particularly in emerging economies where infrastructure, skilled labor, and international experience are often limited (Peng et al., 2008; Nuruzzaman et al., 2020). These constraints often translate into firm resource limitations, making it difficult to fully leverage digital technologies. This may lead to diminishing returns, creating a gap in understanding the nexus between digitalization and export activities.

To address this gap, our study investigates the curvilinear relationship between digitalization and export propensity, particularly for emerging economy enterprises (hereafter EEEs). Our main research question is thus: how does EEEs' digitalization affect the likelihood of becoming an exporter? Drawing on the resource-based view (hereafter RBV) (Barney, 1991), we argue that digitalization will have a non-linear relationship with export propensity. In effect, digitalization may enhance this propensity by lowering barriers to market entry (Watson et al., 2018). Yet, excessive reliance on digital technologies may become counterproductive, especially in contexts where firms often lack the resources needed to manage advanced systems (Verbeke and Hutzschenreuter, 2021). Hence, we also respond to calls for considering the "dark side" of the impact of digitalization on exporting (Dong et al., 2024).

In addition to the direct effects of digitalization, we consider the moderating role of home-country corruption, a pervasive institutional challenge in many emerging economies. Firms operating in such

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environments often face increased transaction costs, regulatory unpredictability, and higher operational risks (Adomako et al., 2021). While some view corruption as an operational barrier that stifles internationalization, others argue that it may "grease the wheels" by facilitating faster access to critical resources, reducing bureaucratic delays, and enabling smoother interactions with local authorities (Hanousek and Kochanova, 2016). These complexities of corruption in emerging economies make it a crucial factor influencing the relationship between digitalization and export propensity.

In this sense, firms in emerging economies are often better positioned to benefit from their home-country's institutional resources, which can facilitate exporting (Adomako et al., 2021; Khanna and Palepu, 2010). However, the same environment can dampen their international efforts, particularly in the presence of corruption, which remains widespread in many developing countries (Petrou and Thanos, 2014; Wang et al., 2018; Tamvada et al., 2022). Researchers continue to debate whether corruption acts as an unavoidable "grease" for smoother international operations, or whether it constitutes an ethical and financial burden on firms (Fuentelsaz et al., 2020; Marano et al., 2016). The effects of such practices on the relationship between digitalization and export propensity remain inconclusive and underexplored, highlighting the need for further investigation.

To fill this gap, we examine how home-country corruption moderates the link between digitalization and export propensity. Understanding this influence can provide deeper insights into the conditions under which digitalization effectively supports international expansion. Hence, our second research question is: how does home-country corruption impact the relationship between EEEs' digitalization and export propensity? Drawing on an institution-based view (hereafter IBV) (Peng et al., 2008), we suggest that corruption amplifies the curvilinear effects of digitalization. In countries with high corruption, the positive effects of digitalization at lower levels and the negative effects at higher levels will be both intensified.

Empirically, we test our hypotheses by using data from the World Bank Enterprise Survey (WBES), the World Development Indicators (WDI), and the Worldwide Governance Indicators (WGI). Our data comprises 17,265 firm-level observations across 35 emerging economies. Due to the hierarchical structure of our data, we perform a multilevel logistic regression. In addition, we perform a battery of robustness tests.

Our study contributes to the literature in two important ways. First, we demonstrate the curvilinear relationship between digitalization and export propensity, addressing an important gap for deeper investigation of the non-linear effects of digitalization (Bhandari et al., 2023). While prior research on digitalization and internationalization has largely focused on advanced economies (Jean and Kim, 2020), our study provides new insights into how the adoption of digital technologies influences EEEs decision to export. Second, we elucidate the moderating role of home-country corruption, offering a deeper understanding of how institutional factors affect the export strategies of EEEs and answering calls for more context-specific research on their internationalization (Nuruzzaman et al., 2020). In doing so, we shed light on the boundary conditions under which digitalization shapes exporting in emerging economies. Thus, our study holds implications for firms and policymakers in emerging economies seeking to harness digitalization while navigating institutional constraints.

The remainder of this paper is organized as follows. The following section develops the framework that leads to our hypotheses. We then describe our methodology and results. Finally, a discussion of main findings, limitations, and future research lines conclude the paper.

2. Literature review and hypotheses development

2.1. Digitalization, corruption and export propensity in emerging economies

In this study, we combine resource- and institution-based considerations to provide a comprehensive understanding of the interplay between digitalization, corruption, and export propensity among EEEs. On the one hand, the RBV suggests that firms can achieve competitive advantages by leveraging their unique internal resources and capabilities (Barney, 1991, 2001). Digitalization, in this sense, can act as a catalyst, enabling EEEs to enhance and deploy resources more efficiently, especially to overcome barriers to exporting. On the other hand, the IBV emphasizes the critical role of institutions, both formal and informal (North, 1990), in shaping firm strategy (Peng et al., 2008). According to this perspective, institutional factors influence resource allocation within a country (Amankwah-Amoah et al., 2019; Baumol, 1990) and impact strategies based on the prevailing institutional environment.

While these theoretical frameworks are applicable across different contexts, their implications are particularly relevant in emerging economies, where firms face unique challenges. In comparison to advanced economies, firms in emerging countries contend with substantial information asymmetry and institutional barriers, such as weak legal frameworks and unreliable infrastructure, which hinder their export activities (Hosseini et al., 2019). These challenges require EEEs to adopt rapid and adaptive decision-making processes to navigate the uncertainty and complexity of international markets (Elia et al., 2021). In contrast, advanced economies benefit from a stronger institutional foundation, with superior digital technologies (e.g., artificial intelligence, cloud computing, robotics) and policies that support digital transformation, such as the OECD's "Go Digital" initiative (Erdey et al., 2024). Such advantages highlight the disparities between advanced and emerging economies, underscoring the challenges EEEs face when competing internationally.

In fact, previous research highlights the positive effects of digitalization on internationalization in developed economies, particularly in enhancing export activities (Ardito et al., 2021; Jean and Kim, 2020). Yet, digitalization also offers opportunities for EEEs to overcome barriers by fostering global connections, providing access to new markets, and enabling resource optimization (Dam et al., 2019). By leveraging digital technologies, EEEs can identify business opportunities across industries and geographies, thereby enhancing their competitiveness and narrowing the gap with firms from developed economies (Xie et al., 2021; Shamim et al., 2020). This is particularly beneficial for EEEs that are not born global but seek cost-effective strategies, such as exports, to expand their global presence (Pergelova et al., 2019; Wamba and Queiroz, 2020). Hence, digitalization may serve as an enabler, breaking barriers and encouraging EEEs to engage in export activities (Chen and Kamal, 2016; Laplume et al., 2016; Lee and Falahat, 2019).

However, the dark side of digitalization, especially in emerging economies, should not be overlooked. These environments, characterized by pronounced information asymmetry and institutional weaknesses, can amplify the risks and costs associated with digitalization, limiting its benefits (Appiah et al., 2025; Deng et al., 2022). Verbeke and Hutzschenreuter (2021) highlight that this dark side often involves resource shortages and structural limitations in exporting, especially when resources and capabilities at both the firm and country levels fall short of meeting the demands of advanced digitalization. Adding to these challenges, Luo (2022) points out that excessive reliance on digitalization for export activities can lead to disruptions, particularly in contexts with unreliable digital infrastructure.

Thus, while digitalization enables EEEs to access external markets and reduce barriers, these firms also need to be able to leverage their limited resources effectively (Peng, 2001), navigating the challenges posed by the dark side of digitalization, especially in emerging economies (Keupp and Gassmann, 2009; Luo and Bu, 2016). As digitalization

progresses, the complexity of digital systems increases and firms may encounter difficulties in adapting, especially if their capabilities are insufficient to meet these demands. This suggests a nonlinear relationship between digitalization and export propensity, where initial boosts in propensity may eventually diminish as the challenges of advanced systems become more pronounced (Luo, 2022; Verbeke and Hutzschenreuter, 2021).

Additionally, in emerging economies, institutional environments often lack robustness, posing challenges for EEEs. One critical institutional factor that may affect export propensity is corruption. In a corrupt institutional context, formal institutions are ineffective and informal institutions could fill in the voids (Peng et al., 2008). For example, rent seeking becomes more prevalent, which enables government officials to affect business activities through various implicit policies, rules, and regulations that occur pervasively in emerging economies.

While corruption is prevalent in emerging markets due to weak regulation and frequent bribery, it serves as a double-edged sword, offering both potential benefits and drawbacks (Chen and Kamal, 2016; Lee and Falahat, 2019). Corruption can create inefficiencies and distort market dynamics, yet it may also facilitate certain transactions in environments with inadequate institutional frameworks. In this sense, two conflicting arguments about corruption exist in the literature. Anokhin and Schulze (2009) suggested that corruption can be regarded as a virtual tax, which discourages economic activities. Firms may therefore suffer from the higher costs of a more corrupt environment (Cuervo-Cazurra, 2016; Estrin et al., 2013). In contrast, firms can also obtain unique advantages through bribes to government officials to access more resources and bypass obstacles, which is regarded as the grease of the economy (Méon and Sekkat, 2005).

Overall, EEEs' ability to navigate institutional challenges such as corruption is crucial for leveraging digitalization to enhance export activities. We propose that corruption moderates the relationship between digitalization and export propensity, strengthening the positive effects of lower levels of digitalization while exacerbating the negative impacts of higher digitalization. Based on this, we subsequently develop testable hypotheses exploring the relationship between digitalization and export propensity, as well as the moderating role of corruption.

2.2. Digitalization and export propensity

EEEs often face structural and systemic constraints that hinder their ability to compete on the international stage. These constraints include small operational scale, outdated technological capabilities, limited access to resources, and a lack of experience, training, and market knowledge (Peng et al., 2008). Such challenges make it difficult for EEEs not only to establish themselves in competitive international markets but also to incorporate export activities into their operations. However, digitalization serves as a transformative tool, enabling these firms to overcome such barriers. From a resource-based perspective, it allows EEEs to better leverage their existing resources (Elia et al., 2021). By advancing their digitalization efforts from low-to-intermediate levels, EEEs can reduce information asymmetry and leverage digital tools to enhance their export potential.

Previous studies have demonstrated that digitalization reduces the information barriers, enabling firms to identify opportunities and access global markets (Johanson and Vahlne, 2009; Ojala et al., 2018). This facilitates the development of niche markets and provides firms with timely insights from a diverse range of users across countries. Digital processes sustain direct engagements with customers, resulting in relationships that are broader in size and scope. These interactions enhance the likelihood of recognizing timely opportunities and expand EEEs' decision-making capabilities (Amankwah-Amoah et al., 2019; Autio, 2017).

Additionally, digitalization fosters networks that allow firms to interact directly with a wide range stakeholders, surpassing the traditional buyer–seller relationship. This facilitates communication efficiency and helps overcome geographical and institutional barriers (Johanson and Vahlne, 2009; Monaghan et al., 2020). Legner et al. (2017) provide evidence that digital tools enable firms to share innovations, build resources quickly, and develop complementary assets, amplifying their strengths as digital barriers decrease. Moreover, platforms such as social media create an environment conducive to exporting, making EEEs more willing to go global (Pagani and Pardo, 2017). This highlights the importance of firm-specific resources, which can be leveraged through digitalization to enhance competitive advantages in international markets.

As the degree of digitalization increases beyond a certain threshold, its benefits in enhancing EEEs' export propensity may begin to diminish, potentially hindering their willingness to export. First, the inadequate country-level digital infrastructure in emerging economies - such as limited broadband penetration and frequent power shortages- poses a significant challenge. Luo (2022) highlights that digital interdependence risks—such as unexpected breakdowns, contagions, and disruptions—stem from the interconnectedness of firms and global stakeholders. This interconnectivity depends heavily on country-level digital infrastructure, which is often underdeveloped in emerging economies compared to advanced ones. Advanced markets typically invest more in ensuring stable digital connectivity. As a result, insufficient digital infrastructure can prevent EEEs from fully utilizing digital tools, especially at advanced levels of digitalization, ultimately limiting their ability to compete effectively in global markets (Ghobakhloo, 2018). This also highlights the resource-based constraints that limit EEEs' ability to adopt digitalization.

Second, increasing levels of digitalization exacerbate the need for skilled, tech-savvy human capital, which is often scarce in emerging economies. A mismatch between advanced digital technologies and the limited availability of trained labor can result in inefficient use of digital tools, thereby reducing international competitiveness (Nath et al., 2010; Ucbasaran et al., 2008). For example, the World Economic Forum (2021) stated that, in some African countries, fewer than 2 % of workers are trained in digital skills, underscoring a critical gap that hinders EEEs' ability to leverage digitalization effectively.

Third, while digitalization increases visibility in global markets, it also intensifies competition for EEEs (Ingram, 2021; Jean et al., 2020). High levels of digitalization expose these firms to intense competition with resource-rich multinational corporations, particularly in crowded digital marketplaces where differentiation is both critical and challenging for emerging enterprises. Established incumbents from advanced economies, equipped with superior technologies and extensive resources, often hold a significant advantage (Hortaçsu et al., 2009; Kahiya, 2018). For instance, firms in developed economies leverage advanced digital tools such as AI-driven analytics, cloud computing, automated supply chains, and sophisticated e-commerce platforms to optimize operations, customize products, and penetrate international markets effectively. Consequently, EEEs are at a natural disadvantage when competing internationally. Additionally, the Global Competitiveness Report (2020) highlights that emerging economies often lag in business dynamism and innovation capability, further exacerbating the challenge. As a result, the heightened competition stemming from digitalization, combined with the lack of firm internal resources, can transform its potential benefits into a burden, ultimately reducing EEEs' export propensity.

Considering these arguments, we propose that digitalization exhibits a curvilinear relationship with EEEs' export propensity. At moderate levels, digitalization facilitates the export process by reducing barriers and improving efficiency. However, beyond a certain threshold, its benefits decline, and the challenges outweigh the gains. Thus, we hypothesize:

Hypothesis 1. Digitalization has an inverted U-shaped relationship with EEEs' export propensity.

2.3. The moderating role of home country corruption

The relationship between digitalization and export propensity is also influenced by the institutional environment. Specifically, here we focus on the role of corruption, which has been extensively examined for its negative influence on economic development (Glaeser and Saks, 2006; Treisman, 2000; La Porta et al., 1999; Shleifer and Vishny, 1993). In the context of emerging economies, corruption becomes the norm (Li et al., 2008, 2021; Rodriguez et al., 2005; Uhlenbruck et al., 2006), forcing businesses to navigate complex and opaque regulatory systems that hinder their operations. This can impede their digitalization efforts and their ability to compete in international markets, limiting their capacity to mobilize internal organizational resources through digital transformation to overcome institutional barriers.

Contrary to the view that corruption primarily imposes barriers on digitalization and export propensity, it can also create opportunities for EEEs to navigate regulatory obstacles or expedite processes through informal means, facilitating their initial entry into international markets. Therefore, we argue that high corruption enhances the positive effects of digitalization on export propensity at low-to-intermediate levels of digitalization for the following reasons. First, at the country level, corruption often fosters the creation of complex informal networks and political connections. In such environments, EEEs that are able to "play the game" could potentially gain advantages at the early stages of digitalization (Chowdhury and Audretsch, 2021; Méon and Sekkat, 2005). They might receive faster approvals, better access to resources, or more favorable regulations, all of which could support their initial digitalization efforts to enter international markets (Rose-Ackerman and Palifka, 2016). Second, high corruption often leads to market distortions, with resources, opportunities, and benefits disproportionately concentrated among certain entities. In such cases, EEEs that can navigate the corrupt system could experience an accelerated digitalization process initially, thereby facilitating export propensity (Méon and Weill, 2010; Zhuang et al., 2010). While corruption is not without costs, the benefits of these political connections, informal networks, and market distortions are prominent, potentially resulting in a more pronounced positive relationship between digitalization and export propensity at low-to-intermediate levels of digitalization (Qi et al., 2020).

However, those benefits do not imply that corruption is beneficial in the long run as digitalization increases, and it is important to note that these short-term gains come with long-term costs. While it might appear to facilitate business operations at lower levels of digitalization, corruption also exacerbates the problems associated with higher levels of digitalization. Primarily, as digitalization increases, so does the requirement for robust and sound institutional quality. However, high levels of corruption at the country level often undermine the rule of law and breed a lack of transparency in society, which leads to greater uncertainty in the business environment (Belitski et al., 2016; Lee et al., 2024; Treisman, 2000). This uncertainty and unstable business environment can potentially reduce the effectiveness of digitalization efforts as a means to increase export propensity in the long run for high levels of digitalization.

Next, the marginal benefits of corruption diminish while its potential costs rise with increasing digitalization (Aidis et al., 2012; Belitski et al., 2016). EEEs may face escalating demands for bribes, excessive reliance on illicit practices, and a neglect of addressing underlying operational inefficiencies, all of which can undermine their ability to compete effectively in international markets. These challenges amplify the negative effects of advanced digitalization on export propensity (Baker et al., 2005; Tonoyan et al., 2010; Wang et al., 2018). Furthermore, as previously noted, the heightened visibility resulting from frequent use of digital technologies can make EEEs more prominent targets for corrupt officials. This increased uncertainty further exacerbates the negative impacts on EEEs' willingness to export. In addition, from the country-level perspective, high corruption contexts can also influence a country's digital infrastructure and human capital. It may, for example, lead to misallocation of resources away from public goods like education and infrastructure, including digital infrastructure (Gyimah-Brempong, 2002), which might significantly influence the EEEs' ability to leverage digital tools as digitalization increases. The negative influence of corruption could thus become greater at higher levels of digitalization.

While corruption may initially amplify the positive effects of digitalization on export propensity at low-to-intermediate levels of digitalization, unresolved issues related to corruption can become more pronounced as firms advance their digitalization efforts. This can result in diminishing returns and a potential decline in export propensity at higher levels of digitalization. The downsides stemming from home country corruption are less pronounced or offset at the low-to-intermediate digitalization stage but become critical in the high levels of digitalization stage due to variations in the acceptance of uncertainty and associated costs. Hence, an environment of corruption can also amplify the downturn in the inverted U-shape relationship between digitalization and export propensity. We propose that corruption may also exacerbate the potentially detrimental effects of high levels of digitalization on export propensity, increasing the downslope of the inverted U-shaped relationship between digitalization and export propensity. These arguments lead to the following hypothesis:

Hypothesis 2. Corruption moderates the inverted U-shaped digitalization–export propensity relationship such that the inverted U-shaped effects become steeper for EEEs located in contexts with strong corruption than for those in contexts with weak corruption.

Overall, hypotheses are summarized in Fig. 1.

3. Methods

3.1. Data collection

We primarily collected data from the WBES, which have been conducted since the 1990s by various World Bank units. The WBES provides detailed firm-level information with a worldwide scope, especially in emerging economies. The topics in the WBES also cover a wide array—including infrastructure, trade, finance, innovation, regulations, and perceptions about obstacles to doing business—through face-to-face interviews with top managers and owners. The sampling methodology for implementing enterprise surveys is stratified random sampling, which increases the precision of the estimates and lowers standard errors. Standardized questionnaires and rigorous interview protocols also ensure consistency and comparability of the data from different countries.

Due to missing information on the countries from WBES, our analysis is based on the pooled cross-sectional dataset comprising 17,265 firm-level observations covering 35 emerging economies, distributed among four regions (i.e., Africa, East Asia and Pacific, Eastern Europe and Central Asia, and Latin America and the Caribbean) globally. After cleaning the observations with missing data (for further details in Table 1), there were 3376 exporters included in the sample. Bulgaria had the greatest proportion of samples, with 5.456 %, and Indonesia had the least, with 0.539 %. The other countries account for 1 %–4 % of the total samples.

3.2. Variable measures

3.2.1. Dependent variable

Table 2 summarizes the operationalization of the variables in our analysis. Our study operationalizes export propensity by the decision of whether to be an exporter or not. Similar to previous research (Estrin et al., 2008; Ganotakis and Love, 2012), the export propensity is indicated by a dummy variable equal to 1 for exporters and 0 otherwise.

3.2.2. Independent variable

There is no common method to measure firms' digitalization, the

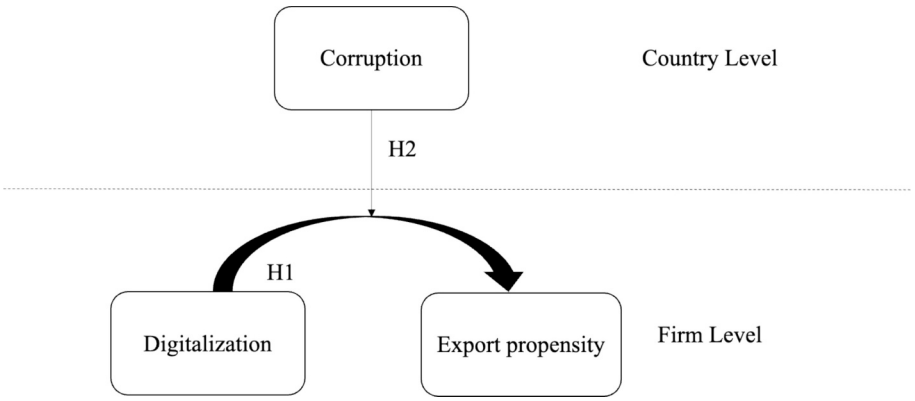

Fig. 1. Multilevel research framework.

Table 1
Sample distribution.

Regions	Countries	Frequency	Percent	Cumulative (%)
Africa	Botswana	333	1.929	1.929
	Ghana	442	2.560	4.489
	Kenya	648	3.753	8.242
	Mali	475	2.751	10.993
	Mauritania	226	1.309	12.302
	Mauritius	293	1.697	13.999
	Mozambique	419	2.427	16.426
	Namibia	321	1.859	18.286
	Senegal	459	2.659	20.944
	South Africa	935	5.416	26.360
	Tanzania	370	2.143	28.503
	Uganda	453	2.624	31.127
	Zambia	438	2.537	33.663
East Asia and Pacific	Indonesia	93	0.539	34.202
	Philippines	147	0.851	35.054
	Vietnam	98	0.568	35.621
Eastern European and Central Asia	Albania	202	1.170	36.791
	Bulgaria	942	5.456	42.247
	Croatia	509	2.948	45.195
	Georgia	208	1.205	46.400
	Kazakhstan	322	1.865	48.265
	Poland	168	0.973	49.238
	Turkey	853	4.941	54.179
	Ukraine	503	2.913	57.092
Latin America and the Caribbean	Argentina	856	4.958	62.050
	Chile	849	4.917	66.968
	Colombia	927	5.369	72.337
	El Salvador	662	3.834	76.171
	Guatemala	488	2.827	78.998
	Honduras	412	2.386	81.384
	Mexico	1242	7.194	88.578
	Nicaragua	425	2.462	91.040
	Panama	528	3.058	94.098
	Peru	562	3.255	97.353
	Uruguay	457	2.647	100.000

Table 2
Variable description.

Variables	Definition	Source
Dependent variable		
Export propensity	Dummy variable. The probability to become an exporter. Exporter = 1; Non-exporter = 0	WBES
Independent variable		
Digitalization index	Current firms' digital index constructed by a formula which integrates annual digital expenditure, digital infrastructure, and number of permanent employees	WBES
Moderating variable		
Corruption	Perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests	WGI
Control variables		
Firm size	The size of the firm, measured by the number of permanent employees	WBES
Age	The number of years since the firm was established	
Quality of workforce	Subjective assessments by the EEE managers of the obstacles posed by inadequately educated workforces, on a five-point scale (0–4)	
Foreign ownership	The percentage share of equity ownership by "private foreign individuals, companies or organizations"	
Public ownership	The percentage share of ownership by the state or government	
Institutional quality	The overall institutional quality in a given country consisting of five dimensions: voice of accountability, political stability, government effectiveness, regulatory quality, and rule of law.	WGI
Internet cover rate	Individuals using the Internet in a given country (% of population)	WDI
GDP annual growth	GDP growth (annual %) in the fiscal year	
Official currency exchange rate	Official exchange rate (local currency units relative to the U.S. dollar. Period average)	

Note: WBES – World Bank Enterprise Survey (https://www.enterprisesurveys.org/en/enterprisesurveys) for the firm-level variables. WGI – World Bank's Worldwide Governance Indicators (https://info.worldbank.org/governance/wgi/) and WDI – World Bank's World Development Indicators (https://data.worldbank.org/products/wdi) for macroeconomic data.

independent variable here, in the related literature. The most frequent metrics for its assessment relate to marketing, sales, and support (Vadana et al., 2019). For example, Ardito et al. (2021) measured it through a digital orientation proxy, which counts the areas where digital technologies have been adopted (e.g., advertising, selling, purchasing, distribution, or operations). Although this type of measure reflects the scope of use for digitalization in various business activities, the connection with the extent to firms' digitalization is still lacking. Hagsten and Kotnik (2016) suggested a four-construct measurement that contains online presence, online transactions, digital infrastructure, and digital training for employees. Measures on the integration of digital expenditures and digital capabilities remain scarce.

Following the measurement method developed by Luo and Bu (2016), we therefore adopted a composite index consisting of digital capabilities and digital expenditures to measure digitalization. As a result, firms' digitalization index can be expressed by the following formula:

$$Firm's\ Digitalization\ Index_{it} = \left(log\frac{CO_{it}}{N_{it}}\right)e^{CA_{it}}$$

where CO_{it} represents the total annual digital expenditure, such as in ICT services and digital training for employees in year *t*. In addition, CO_{it} has been uniformly converted into U.S. dollars according to the official exchange rate on the last day of year *t*. N_{it} represents the number of permanent, full-time employees in firm *i* in year *t*, as employees are likely to be trained to increase their own digital capabilities regularly. Considering digital expenditure also helps us fully understand the firm's attitudes towards digital technology and their investment in this digital area. To make digital expenditure more comparable across countries and industries and allow later combination with digital capability, we took the logarithm form of the ratio between the annual digital expenditure and the number of employees. CA_{it} represents the digital capability, which involves the use of digital infrastructure such as email or websites to sell products or services to customers. Specifically, we code this variable 2 if firms both use both email and website, 1 if the firm only uses one of them, and 0 if the firm uses neither.

The above measure of firms' digitalization first developed a highly composite index that incorporates digital capabilities and digital expenditures, which contributes to measurement of the degree of digitalization. Digital expenditure (i.e., amount in $) and digital capability (i.e., 0–2 scale) are also significantly inconsistent and asymmetric in scale. We used a logarithm function to transform digital expenditure and an exponential function to transform digital capability to combine them appropriately. $\mathrm{Log}\left(\frac{CO_{it}}{N_{it}}\right)$ normalizes the variabilities of digital expenditure and reduces its scale to an appropriate level comparable to the scale of exponentially transformed digital capability.

3.2.3. Moderating variable

Corruption originates from the Worldwide Governance Indicators (hereafter WGI), which describe the country-level institutional environments through a set of six indicators covering the process by which governments are selected, monitored, and replaced; the capabilities that governments effectively implement; and respect for civil rights (Kaufmann et al., 2009). Based on the original WGI dataset, we reverse the already established scale to capture corruption, which ultimately ranges between −2.5 and 2.5 with higher grades indicating strong corruption and vice versa.

3.2.4. Control variables

The selection of control variables was driven by prior studies. Firm- and country-level features are both controlled. Regarding the firm level, and accounting for firm heterogeneity, we include firm size and age as basic firm-related factors that are commonly controlled by the related literature (Ucbasaran et al., 2013; Wiklund et al., 2010). Size is measured by the logarithm of the number of permanent employees, given that larger firms tend to internationalize faster than smaller firms (Bernard et al., 2007), while age is measured by operating years since the EEE was founded (logarithm). Apart from the above, foreign ownership is also controlled, because foreign-own companies are known to have better technologies and market networks that can improve exporting (Krammer et al., 2018), measured by the percent of the focal firm owned by foreign capital, either individuals or organizations. Similarly, we still control for public ownership (i.e., percentage of ownership by the state or government) because of the importance of state-owned firms in emerging economies (Hoskisson et al., 2000). Workforce quality is also introduced as a control measured using EEE managers' subjective ratings on the extent of obstacles posed by inadequately educated workforces (on a scale of 0–4).

Concerning the country level, we controlled for institutional quality to reduce the potential highly correlated effects that corruption might capture from institutional environments. Institutional quality was proxied through the five governance dimensions (i.e., voice and accountability, political stability, government effectiveness, regulatory quality, and rule of law) developed by Kaufmann et al. (2009) for the WGI, as noted earlier. Our research used principal component analysis to elaborate a composite score for the institutional environment (Garrido et al., 2014), reducing five indicators to one factor and allowing us to capture institutional quality in a single variable. A higher final score indicates strong institutional quality in the home country. Three other country-level indexes are also controlled: GDP annual growth, Internet coverage rate, and official exchange rate. We argue that these three controls are associated with EEEs' export propensity.

3.3. Empirical strategy

Because of the multilevel nature of our data and the dummy dependent variable (export propensity), we use a hierarchical modeling method (i.e., multilevel logistic regression) reporting fixed effects on coefficient estimation and random effects on variant components allowing intercepts to vary randomly across countries (Amorós et al., 2019; Autio et al., 2013; Capelleras et al., 2019; Epure et al., 2024; Estrin et al., 2013, 2022). Specifically, the fixed effects in the model represent the relationships between the independent variables and the outcome variable that are consistent across all groups, while the random effects account for variations that are specific to each group. This allows for modeling of both within-group and between-group variability, which makes multilevel logistic regression suitable for analyzing hierarchical or clustered data, where observations are nested within different groups. It thus provides information about the strength and significance of the relationships between the independent variables and the outcome variable, as well as the amount of variability accounted for by random effects.

Our dataset is a cross-sectional pooled time-series, in which firms are hierarchically nested by country (Aguinis et al., 2013). Multilevel analysis allows us to address unobserved heterogeneity within the context of a cross-country and cross-time dataset (Estrin et al., 2013, 2022). We did not run standard multivariate methods, because they would impede us from assuming the independence of observations (Hofmann et al., 2000). In other words, we would be assuming that firms act homogenously but do not consider how the environment influences their decisions. In this case of institutions and export-oriented activity, we observe a similar structure where firms are Level 1 and countries are Level 2, which is similar to recent research such as Amorós et al. (2019), Estrin et al. (2022), and Epure et al. (2024) who encourage studies with two levels to use this approach. We therefore follow Aiken and West (1991)'s method. The equation is shown below.

$$Y^{*}_{ij} = \beta_0 + \beta_1 X_{ij} + \beta_2 X_{\mathrm{Square}_{ij}} + \beta_3 Z_j + \beta_4 (X_{ij} \times Z_j) + \beta_5 \left(X_{\mathrm{Square}_{ij}} \times Z_j\right) + \mathrm{Controls} + \varepsilon_{ij}$$

$$\varepsilon_{ij} \sim N(0, \sigma^2)$$

$$\begin{cases} Y_{ij} = 1 \ if\ Y^{*}_{ij} > 0 \\ Y_{ij} = 0 \ if\ Y^{*}_{ij} = otherwise \end{cases}$$

where X_{ij} indicates the digitalization of firm *i* in country *j*, and Z_j is the degree of corruption in country *j*. Y^{*}_{ij} represents the probability of firm *i* located in country *j* to export, and Y_{ij} is its observed variable. β_0 is the intercept of the multilevel logistic estimation, ε_{ij} is indicates the disturbance term with constant variance and random distribution. The predictors were entered into the regression equation in four steps. In the first step, only control variables were entered as a null model. In the second and third steps, the linear (X_{ij}) and quadratic ($X_{\mathrm{Square}_{ij}}$) terms of digitalization were successively added to detect linear and quadratic main effects. To test the moderating role of corruption on the curvilinear relationship of digitalization with export propensity, the linear

interaction between digitalization and corruption ($X_{ij} \times Z_j$) and quadratic-by-linear ($X_{Square_{ij}} \times Z_j$) terms were introduced in the final step.

To assess any potential multicollinearity bias, we check the variance inflation factors (VIF) and tolerance values for all variables included in our model. All VIF values are below the threshold of 10, indicating no significant evidence of multicollinearity concerns (Hair et al., 2006).

4. Results

4.1. Descriptive statistics

Table 3 presents the descriptive results for the variables listed above, for the entire sample from 35 countries. The average value of export propensity suggests that 19.5 % the firms in the dataset are exporters. We also conducted group mean comparisons using one-way ANOVA to test if the average values of export propensity differ significantly across sampled countries. The result indicated that export propensity differs across firms in all countries. The average export intensity among the truncated sample is 41.95 %. Table 3 still suggests the average values of corruption is 0.164. The mean digitalization index for the entire sample is 0.328.

Turning to the controls, the average firm age is 17.856, while the number of full-time permanent employees is around 79.505. In terms of ownership, the average foreign ownership is 9.113 % and public ownership accounts for 0.384 % of firms, suggesting fewer firms influenced by the government. Managers of EEEs regard an inadequately educated workforce as a moderate obstacle on average. Regarding the country-level controls, average institutional quality is 0.837 across all the countries, and average GDP annual growth is around 5.726 %. Average Internet coverage rate in the sampled countries is 15.850 %. The official exchange rate corresponding to the local currency units relative to the U.S. dollar period average is 418.816.

Table 3
Descriptive statistics.

	Observation	Mean	Std. Dev.	Min	Max
(1) Export propensity	17,265	0.195	0.397	0.000	1.000
(2) Corruption	17,265	0.164	0.586	−1.457	0.971
(3) Digitalization index	17,265	0.328	0.258	−0.081	1.266
(4) Firm size	17,265	79.505	286.588	1.000	12,000.000
(5) Age	17,265	17.856	16.500	1.000	190.000
(6) Quality of work	17,265	1.413	1.324	0.000	4.000
(7) Foreign ownership (%)	17,265	9.113	27.185	0.000	100.000
(8) Public ownership (%)	17,265	0.384	5.046	0.000	100.000
(9) Institutional quality	17,265	0.837	1.466	−0.983	4.629
(10) GDP annual growth (%)	17,265	5.726	2.631	0.845	18.333
(11) Internet cover rate (%)	17,265	15.850	12.580	0.810	58.970
(12) Official currency exchange rate	17,265	418.816	1583.406	0.933	17,065.080

Note: Complete variable definitions are provided in Table 2. and variable correlations in Table 4.

4.2. Multilevel logistic regression model results

Table 4 describes the correlation coefficients among the study variables, and it appears there is no higher correlation between independent variables, dependent variables, and controls. Table 5 reports the results of the hierarchical regression model for export propensity. Model 1 through Model 4 represent the four steps of the entered variables mentioned in the prior section. Model 1 only includes the control and moderating variables. Model 2 introduces digitalization to test the direct linear effects on export propensity. Model 3 tests the quadratic linear effects of digitalization. Model 4 examines the moderating role of corruption. The fixed effects of year and industry are controlled in all the model by dummy variables.

According to Model 2 in Table 5, the direct linear effect of digitalization on export propensity in emerging economies is positive and significant ($\beta = 2.302,\ p < 0.01$). However, when we introduce the quadratic term of digitalization in Model 3, the results support Hypothesis 1 that digitalization has an inverted U-shaped relationship with export propensity, as the main direct effect of digitalization in Model 3 is positive and significant ($\beta = 4.839, p < 0.01$) and the squared term of digitalization is negative and significant ($\beta = -2.735, p < 0.01$).

Turning to the moderating role of corruption on the curvilinear relationship between EEEs' digitalization and export propensity, our study also supports Hypothesis 2. Model 4 shows a statistically significant and positive coefficient for the linear interaction term between digitalization and corruption ($\beta = 2.091, p < 0.01$) and a statistically significant and negative coefficient for the quadratic interaction term ($\beta = -2.230, p < 0.01$). These results indicate the proposed inverted U-shaped relationship between digitalization and export propensity is moderated by corruption. The slope of curve is increased by high level of corruption (Haans et al., 2016).

To gain more insight into how corruption moderates the curvilinear relationship between digitalization and export propensity, we plotted the moderating relationships in Fig. 2 (Aiken and West, 1991). We considered one standard deviation below and above the mean to represent low and high levels of corruption. As demonstrated in Fig. 2, regardless of the contexts of corruption, the slopes at the minimum and maximum levels of digitalization are consistent with the results shown in Table 5, which confirms the existence of an inverted U shape. The interaction graph indicates that EEEs founded in contexts with a high level of corruption exhibit a more pronounced inverted U-shaped relationship between the degree of digitalization and export propensity than those in contexts with a low level of corruption, which is relatively symmetric. This indicates that the curvilinear effect of digitalization on export propensity becomes stronger as corruption grows, corroborating the expectations formulated in Hypothesis 2. Notably, a high level of corruption might strengthen the positive effects of digitalization through its greasing role, but it might also intensify the adverse effects of high levels of digitalization through greater uncertainty in the long run, as well as the costs of corruption, and misallocation of resources. For firms located in contexts with low corruption, the turning point occurs more gradually compared to contexts with high corruption. This suggests that the positive effects of digitalization last longer in low corruption environments. The uncertainty and costs of corruption thus arrive earlier in contexts of high corruption compared with in low corruption contexts, this shifting the turning point ahead.

Concerning the control variables, the effects varied in terms of two different levels. For firm-level controls, firm size and age are all significantly positively related to export propensity, which suggests that bigger and older EEEs are more willing to internationalize because of a strong ability to resist potential risk and abundant experience, in line with Krammer et al. (2018). Foreign and public ownership have positive impacts on export propensity, which is in line with the literature (Bernard et al., 2007), while workforce quality does not influence exporting willingness, which aligns with the findings of Krammer et al. (2018).

Table 4
Correlation matrix.

No.	Variable	(1)	(2)	(3)	(4)	(5)	(6)
1	Export propensity	1.000					
2	Corruption	−0.113*	1.000				
3	Digitalization index	0.246*	−0.259*	1.000			
4	Firm size (log)	0.168*	−0.153*	0.166*	1.000		
5	Age (log)	0.419*	−0.082*	0.318*	0.311*	1.000	
6	Quality of work	0.113*	−0.057*	0.157*	0.085*	0.187*	1.000
7	Foreign ownership	0.151*	−0.044*	0.126*	−0.022*	0.172*	0.015*
8	Public ownership	0.029*	0.023*	0.034*	0.065*	0.093*	0.018*
9	Institutional quality	0.054*	−0.722*	0.146*	0.048*	0.055*	0.088*
10	GDP annual growth (log)	−0.062*	0.098*	−0.036*	−0.038*	−0.056*	−0.035*
11	Internet cover rate (log)	0.159*	−0.520*	0.281*	0.192*	0.171*	0.201*
12	Official currency exchange rate (log)	−0.130*	0.254*	0.111*	−0.127*	−0.132*	−0.129*

No.	Variable	(7)	(8)	(9)	(10)	(11)	(12)
7	Foreign ownership	1.000					
8	Public ownership	−0.010*	1.000				
9	Institutional quality	0.007*	−0.013*	1.000			
10	GDP annual growth (log)	0.061*	0.019*	−0.183*	1.000		
11	Internet cover rate (log)	−0.062*	0.015*	0.494*	−0.197*	1.000	
12	Official currency exchange rate (log)	−0.010*	−0.024*	−0.246*	0.134*	−0.410*	1.000

Note: Observations: 17265. The asterisks indicate significance at the following level: * $p < 0.05$. Complete variable definitions are provided in Table 2.

As for the effects of other macro-level controls, the official exchange rate negatively influences export propensity, which suggests that the exchange rate will be the main concern when EEEs decide to export. As the exchange rate goes up, the willingness to export decreases. Internet coverage rate positively influences EEEs' willingness to go international. Neither GDP annual growth nor institutional quality appear to matter for EEEs' decision to internationalize.

4.3. Robustness checks

We performed a variety of additional tests to explore the robustness of our findings. We tested the nature of the inverted U-shaped relationship following a procedure suggested by Haans et al. (2016). To confirm the existence of an inverted U-shaped relationship, it is not sufficient for the coefficient of the quadratic term to be significant. Two additional features should occur. First, the slopes at the ends of data range should be significant and of the expected sign, which are positive slopes at the smallest value of digitalization and negative slopes at the highest value. Second, the turning point should be located within the data range. At the bottom of Table 5, we report the results of the additional analyses of the inverted U-shaped relationship and show that the slopes at the extremes of our data range are of the expected sign and significance. The turning point is situated exactly within the data range. The Fieller (1954) method was used to estimate the confidence interval of the turning point.

Apart from employing the quadratic term of the digitalization index to test curvilinear effects, we further utilize piecewise regression with a threshold approach to examine the non-linear relationship, following prior research (Meyer, 2009). Empirically, a dummy variable was created to differentiate values below and above the threshold, calculated as the turning point for the independent variable. This approach allows us to test whether the relationship changes—such as being positive below the threshold and negative above—or to confirm the inverted U-shape. Accordingly, a dummy variable was generated based on the calculated threshold for firm's digitalization obtained in previous analysis (Model 3 in Table 5) to categorize firms into those with high or low digitalization levels. The results, presented in Table 6, show that the coefficient for the interaction term is negative and statistically significant ($\beta = -3.207, p < 0.05$), indicating that the effect of digitalization diminishes as it rises above the threshold. This finding provides key evidence of a curvilinear (diminishing returns) effect: while higher digitalization initially enhances export propensity, the effect weakens after a certain point, consistent with our main findings.

The effects of digitalization on willingness to internationalize varied within countries, particularly related to country-level digitalization. To address this, we converted our firm-specific responses for digitalization into country-level averages for the sampled emerging economies. We then classified the samples into two groups based on the median of sampled country-level digitalization and ran the regression separately for the two groups (i.e., above and below the median). This conversion explicitly addressed the heterogeneity within the countries regarding country-level digitalization (Krammer et al., 2018; Yi et al., 2013). We found that the regression results of the two groups are similar to the main regression results, inverted U-shaped relationship between digitalization and export propensity shown in Table 7 (Model 1 and Model 3).

Krammer et al. (2018) identified three prominent attributes of institutional environments within EEEs' home countries that merit consideration in relation to firms' export propensity: political instability, competition from the informal sector, and the level of corruption. The focuses of these factors are motivated by the broader literature in comparative institutional theory, which characterizes emerging countries as beset by insufficient regulatory, as well as political institutions that fail to ensure market access and provide a level playing field (Schneider et al., 2010). We further investigated the other two attributes as our moderating variables. We measured informal competition based on the managers' responses to the questions: “To what extent is competition from the informal sector affects business operations” and captured political instability by the extent to which political instability is an obstacle to the current operations of the establishment. The scale of responses is the same as the alternative measure of corruption. The results are shown in Table 8, and we found informal competitors and political instability do not significantly moderate the curvilinear effects of digitalization on export propensity, which suggests these two home country institutions might not be able to alter the slopes of the curvilinear effects.

Finally, one of the main issues when using survey data for statistical analysis is common method variance (CMV). This occurs when independent and dependent variables originate from the same source, which can potentially lead to spurious correlations that arise from the way data constructs are measured. We believe that the CMV issue is not serious here for several reasons. First, WBES does not include any personal

Table 5
Multilevel logistic regression results (dependent variable: export propensity).

Dep. var.: export propensity	(1)	(2)	(3)	(4)
Firm size(log)	0.688***	0.612***	0.593***	0.592***
	(0.019)	(0.020)	(0.02)	(0.020)
Age(log)	0.189***	0.148***	0.144***	0.147***
	(0.030)	(0.030)	(0.03)	(0.030)
Foreign ownership	0.075***	0.065***	0.063***	0.062***
	(0.018)	(0.019)	(0.019)	(0.019)
Public ownership	0.009***	0.008***	0.008***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)
Quality of workforce	0.003	0.001	0.002	0.003
	(0.004)	(0.004)	(0.004)	(0.004)
Institutional quality	−0.101	−0.087	−0.084	−0.070
	(0.115)	(0.124)	(0.117)	(0.121)
GDP annual growth (log)	0.232	0.278	0.341	0.362
	(0.251)	(0.269)	(0.255)	(0.263)
Internet cover rate (log)	0.336***	0.208*	0.199*	0.197*
	(0.100)	(0.108)	(0.102)	(0.105)
Official exchange rate (log)	−0.056	−0.145***	−0.111***	−0.110**
	(0.042)	(0.045)	(0.043)	(0.044)
Corruption	−0.188	−0.102	−0.127	−0.414
	(0.250)	(0.271)	(0.255)	(0.300)
Digitalization index		2.302***	4.839***	4.606***
		(0.114)	(0.360)	(0.379)
Digitalization index_ square			−2.735***	−2.555***
			(0.366)	(0.378)
Digitalization index*Corruption				2.091***
				(0.666)
Digitalization index_ square * Corruption				−2.230***
				(0.632)
Digitalization: Slope at min			5.282***	5.022***
Digitalization: Slope at max			−2.077***	−1.862***
Turning point within the range			Yes	Yes
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Intercept	−5.075***	−5.014***	−5.483***	−5.495***
	(0.736)	(0.775)	(0.758)	(0.772)
Country-level variance	0.232***	0.275***	0.241***	0.257***
	(0.064)	(0.076)	(0.067)	(0.072)
Log likelihood	−6275.681	−6064.283	−6036.10	−6029.427
Wald Chi2	2313.47***	2495.23***	2511.75***	2509.89***
Degree of freedom	31	32	33	35
Observations	17,265	17,265	17,265	17,265
Groups	35	35	35	35

Note: Standard errors are in parentheses. The asterisks indicate significance at the following levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Fixed effects of Industry and Year are also controlled in all models.

information that could identify the respondents, and this strongly reduces the likelihood for managers toe select socially desirable answers. Our dependent variables are also not perceptual measures but based on accounting information. CMV is less likely to appear when objective data are used.

5. Discussion and conclusion

5.1. Theoretical implications

Firm digitalization has gained prominence, yet its role in the propensity to export, particularly in emerging economies, is not well understood. To our knowledge, this paper is the first effort to investigate the non-linear relationship between digitalization and EEEs export propensity. In fact, the extant literature tends to overemphasize the positive linear effects of digitalization on exporting (Jean and Kim, 2020; Brieger et al., 2022; Ojala et al., 2018), neglecting the curvilinear relationship we examine here. Our first main contribution is thus to highlight the nuanced impact of digitalization in shaping the export decision. Several researchers have found that digitalization facilitates exporting (Hagsten and Kotnik, 2016; Jean and Kim, 2020; Luo and Bu, 2016), whereas others have warned that high levels of digitalization demand higher standards of national and firm resources, which EEEs often find difficult to access, thus constraining their ability to expand internationally (Bhandari et al., 2023; Luo, 2022; Verbeke and Hutzschenreuter, 2021). Building on RBV considerations, our study offers a more balanced framework for understanding how digitalization influences export propensity. The results reveal that digitalization has an inverted U-shaped effect on exporting, which implies that low-to-intermediate levels of digitalization increase the likelihood of exporting, while higher levels are harmful to EEEs' export willingness. As such, at appropriate levels, digitalization can act as a transformative force, enabling EEEs to overcome internal resource constraints and enhance their export propensity. By reducing information asymmetries and improving operational efficiency, digital tools empower firms to navigate the complexities of exporting. These technologies also facilitate the development of international networks and knowledge, which are crucial for identifying and pursuing foreign market opportunities (Puthusserry et al., 2020).

However, as digitalization reaches higher levels, its positive effects may be offset by challenges such as inadequate digital infrastructure, a lack of skilled workers, and intense global competition, which can ultimately result in diminishing returns. This is consistent with the findings of Luo (2022) and Hadjikhani and Lindh (2020) regarding the disadvantages of digitalization. Hence, the dark side of digitalization emerges when firm and country-level resources are insufficient to meet the heightened demands and complexities associated with advanced digitalization (Verbeke and Hutzschenreuter, 2021). Thus, we extend resource-based explanations of exporting by highlighting the important role digitalization plays in enabling and constraining the export ambitions of EEEs.

Using an IBV perspective, the study has also examined how corruption moderates the curvilinear relationship between digitalization and export propensity. Specifically, our second key contribution is to demonstrate that corruption steepens the inverted U-shaped curve: it amplifies the positive effects of digitalization at low-to-intermediate levels, while intensifying the negative effects at higher levels. By incorporating an institutional lens into the analysis, we provide a more nuanced understanding of how varying degrees of digitalization affect export propensity in corrupt environments. In fact, corruption, like other institutional factors, has dual effects, both positive and negative (Belitski et al., 2016). At low-to-intermediate levels of digitalization, the benefits of corruption become salient in helping EEEs facilitate the decision to export, as described by the “grease the wheels” notion (Chowdhury and Audretsch, 2021). The positive effects of digitalization at this stage could be strengthened by corruption through the creation of informal networks and political connections, enabling EEEs to secure faster approvals and more favorable regulations (Belitski et al., 2016; Estrin et al., 2013). The benefits disproportionately concentrated among well-connected entities in highly corrupt contexts could also enhance the positive impacts on export propensity at the stage of low digitalization.

However, as digitalization intensifies, the negative effects of corruption become more pronounced and eventually outweigh its benefits. At higher levels of digitalization, EEEs already possess the basic information and knowledge needed for exporting. Yet, the costs associated with corruption, such as escalating bribery demands and institutional uncertainty, may become major obstacles. Corruption undermines trust, misallocates resources, and weakens a country's digital infrastructure and human capital, thereby exacerbating the downslope of the inverted U-shaped relationship. These challenges tend to discourage EEEs from further export efforts (Adomako et al., 2021; Belitski et al., 2016). As EEEs increase their level of digitalization, they become more exposed to these detrimental impacts, which ultimately reinforce the declining phase of the digitalization-export relationship at high levels. Therefore, this study extends the literature on the digitalization-export nexus by offering a more nuanced understanding of how digitalization influences

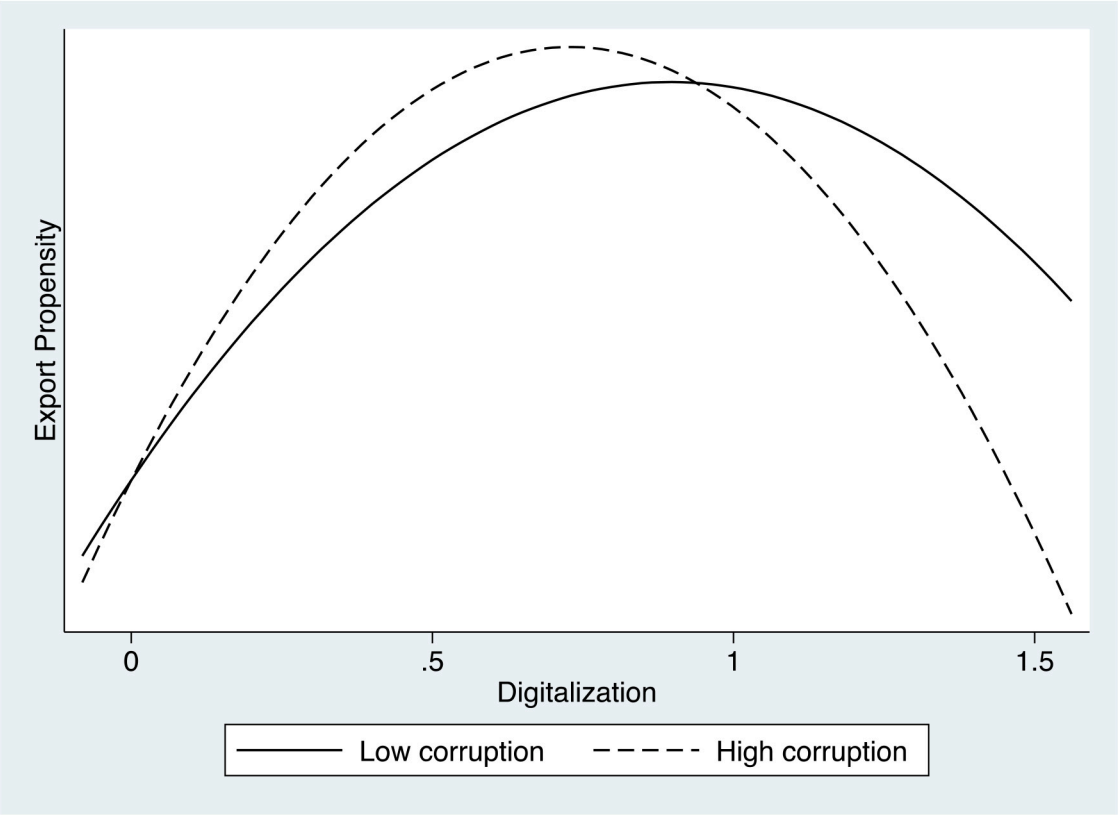

Fig. 2. Interaction graph of corruption in the curvilinear relationship between firms' digitalization and export propensity.

export propensity in emerging economies and the key role of corruption as a contextual factor. Since it amplifies the benefits of digitalization at lower levels while exacerbating its negative effects at higher levels, our results highlight the importance of a balanced approach to digitalization for EEEs.

5.2. Practical implications

The findings offer managerial insights for EEEs using digital technologies to begin exporting, as well as policy suggestions for local authorities. A key managerial implication of the study is the importance of striking a balance between the benefits and challenges of digitalization for export propensity. Using these technologies for daily operations provides many benefits to EEEs, such as reducing information asymmetries (Lee and Falahat, 2019), improving knowledge integration and sharing within and outside the organization (Alberti-Alhtaybat et al., 2019), as well as enabling the discovery of foreign market opportunities and access to stakeholders (Kim et al., 2018). EEEs should thus fully exploit the advantages of digitalization for exporting activity while recognizing its potential downsides. At higher levels of digitalization, EEEs may face diminishing returns due to unsound digital infrastructure, a lack of skilled human capital, and intense global competition, which could weaken their willingness to export. Appropriately using multiple digital technologies is a challenge for managers during the decision-making process for international expansion. Therefore, EEEs need to carefully calibrate their digital strategies to maximize the benefits of technology adoption without overwhelming their operations or becoming too reliant on digital solutions.

The findings also suggest that the curvilinear relationship is steepened by corruption in emerging economies. The implication for policymakers is that the effects of digitalization on export propensity benefit greatly from corruption yet are also damaged by its downsides at different stages of digitalization. Although corruption represents incomplete regulation, which may be beneficial for exporting to some extent, the idea behind its role recommends that policymakers make efforts to ease export formalities, provide access to resources, and create business opportunities, while exerting enough of the positive functions of corruption. To address this, local authorities could focus on creating a business environment that reduces bureaucracy, streamlines approval processes, and gradually promotes transparency to minimize uncertainty over time.

5.3. Limitations and future research

Although our study provides significant insights into the effects of digitalization on export propensity and the moderating role of corruption, it is not without limitations, which pave the way for future studies. Our research examines the decision stage of exporting, namely export propensity. However, the role of digitalization in post-entry performance (i.e., export intensity) remains underexplored, especially in the context of emerging economies. Since export propensity and intensity are distinct constructs (Ganotakis and Love, 2012; Nguyen et al., 2022), future studies could investigate whether digitalization exhibits similar or different curvilinear effects on export intensity. Some studies suggest that digitalization and social media usage positively impact export market performance in developed countries (Eid et al., 2020; Mahmoud et al., 2020). However, more nuanced studies are needed to assess these dynamics in emerging economies, where institutional challenges persist (Jean and Kim, 2020).

The study captures digitalization based on firms' use of digital tools for operations, sales, and stakeholder interactions (Luo and Bu, 2016). However, digitalization encompasses diverse technologies, such as big data, robotics, cloud systems, and additive manufacturing, that may have varied impacts on internationalization (Strange and Zucchella, 2017). Future research could disaggregate these technologies to provide a deeper understanding of their specific contributions to exporting and

Table 6
Robustness check: Digitalization as a dummy variable.

Dep. var.: export propensity	(1)	(2)
Firm size(log)	0.611***	0.608***
	(0.02)	(0.02)
Age(log)	0.147***	0.146***
	(0.03)	(0.03)
Foreign ownership	0.066***	0.065***
	(0.019)	(0.019)
Public ownership	0.008***	0.008***
	(0.001)	(0.001)
Quality of workforce	0.002	0.002
	(0.004)	(0.004)
Institutional quality	−0.086	−0.087
	(0.123)	(0.122)
GDP annual growth(log)	0.295	0.314
	(0.267)	(0.265)
Internet cover rate (log)	0.21**	0.211**
	(0.107)	(0.106)
Official exchange rate(log)	−0.14***	−0.139***
	(0.045)	(0.045)
Corruption	−0.104	−0.096
	(0.268)	(0.266)
Digitalization index	2.384***	2.422***
	(0.126)	(0.127)
High Digitalization (dummy)	−0.188	2.893**
	(0.128)	(1.254)
Digitalization index*High Digitalization (dummy)		−3.207**
		(1.301)
Industry	Yes	Yes
Year	Yes	Yes
Intercept	−5.199***	−5.245***
	(0.638)	(0.635)
Country-level variance	0.269***	0.264***
	(0.075)	(0.073)
Log likelihood	−6063.202	−6060.064
Wald Chi2	2496.89	2502.49***
Degree of freedom	33	34
Observations	17,265	17,265
Groups	35	35

Note: Standard errors are in parentheses. The asterisks indicate significance at the following levels: *** p < 0.01, ** p < 0.05, * p < 0.1. The fixed effects of Industry and Year are also controlled in all models. The high digitalization dummy variable is categorized based on the turning point for digitalization identified in Model 3 of Table 5. Specifically, firms with a degree of digitalization above the turning point are categorized as having high digitalization, while those below the turning point are categorized as low digitalization. The coefficient of the interaction term indicates whether the relationship between digitalization and export propensity follows an inverted U-shaped pattern.

Table 7
Robustness check: different country digitalization levels.

	(1)	(2)	(3)	(4)
Dep. var.: export propensity	Low country-level digitalization		High country-level digitalization	
Firm size(log)	0.669***	0.666***	0.545***	0.546***
	(0.033)	(0.033)	(0.026)	(0.026)
Age(log)	0.175***	0.177***	0.13***	0.131***
	(0.049)	(0.049)	(0.039)	(0.039)
Foreign ownership	0.052*	0.052*	0.066***	0.066***
	(0.031)	(0.031)	(0.024)	(0.024)
Public ownership	0.007***	0.007***	0.009***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)
Quality of workforce	0.006	0.006	−0.002	−0.002
	(0.005)	(0.005)	(0.006)	(0.006)
Institutional quality	−0.096	−0.081	0.397	0.368
	(0.14)	(0.14)	(0.361)	(0.38)
GDP annual growth (log)	0.232	0.241	0.807**	0.829**
	(0.374)	(0.374)	(0.325)	(0.339)
Internet cover rate (log)	0.039	0.041	0.625***	0.63***
	(0.168)	(0.169)	(0.19)	(0.2)
Official exchange rate (log)	−0.044	−0.041	−0.147***	−0.149***
	(0.066)	(0.066)	(0.049)	(0.051)
Digitalization index	5.969***	4.841***	4.406***	4.488***
	(0.596)	(0.894)	(0.484)	(0.488)
Digitalization index_ square	−4.531***	−3.606***	−2.029***	−2.123***
	(0.67)	(1.05)	(0.466)	(0.473)
Corruption	−0.12	−0.566	0.562	0.296
	(0.462)	(0.509)	(0.415)	(0.507)
Digitalization index*Corruption		2.621*		1.223
		(1.562)		(0.98)
Digitalization index_ square * Corruption		−2.217		−1.165
		(1.865)		(0.863)
Digitalization: Slope at min	6.707***	5.429***	4.736***	4.834***
Digitalization: Slope at max	−5.498***	−4.285***	−0.729***	−0.886***
Turning point within the range	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Intercept	−5.582***	−5.404***	−7.627***	−7.703***
	(0.907)	(0.911)	(0.904)	(0.942)
Country-level variance	0.216***	0.217***	0.065*	0.076*
	(0.081)	(0.081)	(0.034)	(0.039)
Log likelihood	−2462.736	−2460.283	−3541.318	−3540.384
Wald Chi2	1218.55***	1217.54***	1320.74***	1316.35***
Degree of freedom	32	34	29	31
Observations	8707	8707	8558	8558
Groups	19	19	16	16

Note: Standard errors are in parentheses. The asterisks indicate significance at the following levels: *** p < 0.01, ** p < 0.05, * p < 0.1. Fixed effects of Industry and Year are also controlled in all models.

develop more nuanced measures for digitalization (Charalabidis et al., 2015; Chen and Chen, 2015).

Since our work focuses on the moderating role of home country corruption, future research could consider the impact of host country institutions on digitalization and internationalization (Autio et al., 2013; Estrin et al., 2013). Additionally, our findings derive from emerging economies and, thus, may not fully generalize to developed countries, where advanced infrastructure, robust institutional frameworks, and digital capabilities might mitigate the negative effects of excessive digitalization. For example, Japan's high transparency and efficient regulatory systems contrast with emerging economies such as India.

The study also focuses on export activity, but firms may pursue other entry modes, such as joint ventures, or mergers and acquisitions, which could be influenced differently by digitalization. Similarly, our analysis assumes that firms make deliberate export decisions, yet some firms, particularly digitally born global in emerging markets, may internationalize from inception (Paul and Rosado-Serrano, 2019). Exploring how digitalization impacts these firms' unique pathways and other entry modes could provide additional insights.

Lastly, our research captures the current institutional dynamics of emerging economies, characterized by rapid growth, increased consumer demand, and surging foreign direct investment (Marquis and Raynard, 2015). However, as these economies mature and regulations stabilize, corruption's role may evolve, potentially diminishing its influence on the curvilinear effects of digitalization. Future studies could examine these transitions to determine whether the observed patterns hold in more stable regulatory environments.

5.4. Conclusion

In conclusion, this study contributes to the literature by enhancing our understanding of how digitalization influences the propensity of firms in emerging economies to engage in exporting. By demonstrating a curvilinear relationship, we highlight that while digitalization offers initial benefits for export activities, these may diminish beyond a certain threshold. Additionally, the study enriches our knowledge by showing that home country corruption amplifies both the positive effects of digitalization at lower levels and the negative effects at higher levels. This dual role of corruption further emphasizes the complexity of leveraging digitalization in resource-constrained environments.

Table 8
Robustness check: additional moderators.

Dep. var.: export propensity	(1)	(2)
Firm size(log)	0.593***	0.592***
	(0.020)	(0.020)
Age(log)	0.144***	0.145***
	(0.030)	(0.030)
Foreign ownership	0.062***	0.063***
	(0.019)	(0.019)
Public ownership	0.008***	0.008***
	(0.001)	(0.001)
Quality of workforce	0.002	0.003
	(0.004)	(0.004)
Institutional quality	0.011	−0.055
	(0.083)	(0.098)
GDP annual growth(log)	0.398	0.345
	(0.252)	(0.261)
Internet cover rate (log)	0.166*	0.222**
	(0.101)	(0.103)
Official exchange rate(log)	−0.125***	−0.104**
	(0.043)	(0.044)
Digitalization index	3.973**	4.764***
	(1.561)	(0.392)
Digitalization index_ square	−1.549	−2.715***
	(1.647)	(0.414)
Informal competitor	0.350	
	(0.283)	
Digitalization index*Informal competitor	0.468	
	(0.841)	
Digitalization index_ square * Informal competitor	−0.639	
	(0.880)	
Political instability		−0.225
		(0.207)
Digitalization index*Political instability		0.734
		(0.505)
Digitalization index_ square * Political instability		−0.481
		(0.449)
Industry	Yes	Yes
Year	Yes	Yes
Intercept	−6.111***	−5.547***
	(0.878)	(0.751)
Country-level variance	0.227***	0.245***
	(0.064)	(0.069)
Log likelihood	−6034.444	−6034.381
Wald Chi2	2514.36***	2511.47***
Degree of freedom	35	35
Observations	17,265	17,265
Groups	35	35

Note: Standard errors are in parentheses. The asterisks indicate significance at the following levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The fixed effects of Industry and Year are also controlled in all models. The measure of institutional quality has included corruption in both models. However, Model 2 of Table 7 has excluded political instability in the measurement of institutional quality.

CRediT authorship contribution statement

Joan-Lluís Capelleras: Writing – review & editing, Supervision, Funding acquisition, Conceptualization. **Victor Martin-Sanchez:** Writing – review & editing, Supervision, Conceptualization. **Chao Zhang:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization.

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Declaration of competing interest

The authors have no relevant financial or non-financial interests to disclose. All authors contributed equally. Author names are listed alphabetically.

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Data availability

Data will be made available on request.

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