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Article

Is digital transformation a barrier to export reduction during COVID-19? The case of a developing country

Cogent Business & Management

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Suggested Citation: Thuy, Nguyen Cam; Dat, Luong Van; Dong, Do Phu; Linh, Vu Thuy; Thang, Doan Ngoc (2023) : Is digital transformation a barrier to export reduction during COVID-19? The case of a developing country, Cogent Business & Management, ISSN 2331-1975, Taylor & Francis, Abingdon, Vol. 10, Iss. 2, pp. 1-18,
<https://doi.org/10.1080/23311975.2023.2211218>

This Version is available at:

<https://hdl.handle.net/10419/294435>

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To cite this article: Nguyen Cam Thuy, Luong Van Dat, Do Phu Dong, Vu Thuy Linh & Doan Ngoc Thang (2023) Is digital transformation a barrier to export reduction during COVID-19? The case of a developing country, Cogent Business & Management, 10:2, 2211218, DOI: [10.1080/23311975.2023.2211218](https://doi.org/10.1080/23311975.2023.2211218)

To link to this article: <https://doi.org/10.1080/23311975.2023.2211218>



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Published online: 12 May 2023.



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Received: 06 January 2023
Accepted: 03 May 2023

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MANAGEMENT | RESEARCH ARTICLE

Is digital transformation a barrier to export reduction during COVID-19? The case of a developing country

Nguyen Cam Thuy¹, Luong Van Dat¹, Do Phu Dong¹, Vu Thuy Linh¹ and Doan Ngoc Thang^{1*}

Abstract: This paper investigates the impact of digital transformation on export reduction during COVID-19 by using unique data from Vietnamese manufacturing firms. Digital transformation reflects whether firms had already introduced digital technology before the COVID-19 outbreak or started using digital technology during the COVID-19 outbreak. Meanwhile, an export reduction is a partial de-internationalization in which firms decrease overseas sales. Estimation results from the instrumental variable probit method show that digital transformation has a negative effect on the probability of export reduction. This effect becomes particularly strong for micro, small and medium enterprises. Our findings have managerial implications for firm managers.

Subjects: International Economics; Business, Management and Accounting

Keywords: export reduction; de-internationalization; digital transformation; COVID-19; developing countries



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PUBLIC INTEREST STATEMENT

This paper quantifies the effect of digital transformation on export reduction during COVID-19 by using unique data from Vietnamese manufacturing firms.

Digital transformation reflects whether firms had already introduced digital technology before the COVID-19 outbreak or started using digital technology during the COVID-19 outbreak; An export reduction is a partial de-internationalization in which firms decrease overseas sales.

The estimation result shows that digital transformation has a negative effect on the probability of export reduction.

This effect becomes particularly strong for micro, small and medium enterprises.

1. Introduction

The appearance of the coronavirus pandemic, or “COVID-19,” in short, has brought numerous negative impacts on international trade, especially in exporting activities (Hayakawa & Mukunoki, 2021). According to the OECD (2022), because of the pandemic, international exporting and importing volumes have witnessed the biggest reduction since World War II. Numerous researchers have investigated the reasons behind the reduction in exporting activity (Strange et al., 2022). For example, because of the lockdowns, firms need to reduce their workforce (Zimpelmann et al., 2021) or increase commodity hedging (Ghosh et al., 2022; Hasan et al., 2022). Moreover, because of the negative impacts of COVID-19 on the global supply chain and global logistics (Budd & Ison, 2023), demand for overseas markets fell (Jomthanachai et al., 2022). Consequently, exporting firms need to consider withdrawing fully or partially from exporting activities during the COVID-19 pandemic (Campos-García et al., 2020). Indeed, this was not the first time firms needed to downsize their exporting activities because of external factors or temporary events such as COVID-19 (Kafouros et al., 2022; Niittymies et al., 2022). That firms need to withdraw from exporting has been defined as “de-internationalization” (Benito & Welch, 1997). Because firms must change or adopt new strategic plans after executing the de-internationalization process (Cuervo-Cazurra et al., 2019), although the negative effects of the pandemic are expected to decrease gradually after reaching a peak in July 2020 (Hayakawa & Mukunoki, 2021), it is questionable whether firms will re-enter the global market (Kafouros et al., 2022).

On the other hand, during the COVID-19 pandemic, there is an increasing demand for applying digital transformation in order to maintain firms’ activities (Datta & Nwankpa, 2021; Ratten, 2022) and avoid the economic collapse because of the lockdown policies around the world (Soto-Acosta, 2020). The catalyst role of the COVID-19 context toward the transformation process has been confirmed by reports in advisory (Nations, 2020) and research papers (Fletcher & Griffiths, 2020; Soto-Acosta, 2020). Based on previous research on the positive impacts of digital transformation on firms’ performance (Du & Jiang, 2022), Hayakawa and Mukunoki (2021) suggested that the applied technologies in the digital transformation process could diminish the negative impacts of the pandemic on exporting firms. Supporting this idea, Strange et al., (2022) also pointed out the benefits of this process for firms’ exporting performances. It is expected that, during the pandemic, firms with successful digital transformations would minimize the possibility of de-internationalization.

In other words, the COVID-19 context has forced firms to face the dilemma between de-internationalization and digital transformation. However, the digital transformation perspective has not been mentioned as a direct factor in the general theory of de-internationalization (Lim & Mandrinos, 2023) or the systematic literature review of de-globalization (Gordon, 2023). Thus, this paper aims to fill this gap when examining the linkage between digital transformation and de-internationalization, especially in the pandemic context, which is considered the catalyst for both processes. Moreover, according to Rupeika-Apoga et al., (2022), the difference in the size of firms could hinder digital transformation. Indeed, large firms tend to have more advantages compared to small and medium-sized firms in applying technologies to business processes (Kretschmer & Khashabi, 2020). However, Straume et al., (2022) have concluded that, during COVID-19, large exporting firms have been impacted less negatively than smaller businesses. Therefore, it is expected that the size of firms will play a moderating role in the transmission of the effects of digital transformation on the export reduction of firms during the pandemic.

In order to figure out the relationship between digital transformation and export reduction, the data of 242 manufacturing firms from 33 provinces obtained from the Vietnam Chamber of Commerce and Industry (VCCI) in July—August 2020 has been utilized. The result of this research would contribute to the literature on de-internationalization in the context of a pandemic by examining the role of digital transformation in preventing export reduction and how the nexus between digital transformation and export reduction is moderated by firm size. To the best of our

knowledge, this is one of the first attempts to quantify the impact of digital transformation on export reduction in a developing country like Vietnam.

The rest of the paper is organized as follows: Section 2 reviews related works of literature and hypotheses, and Section 3 discusses data description. Section 4 discusses the model specification. Section 5 discusses the estimation results of export reduction and digital transformation. Section 6 is the conclusion.

2. Literature review and hypothesis development

2.1. Export reduction

The significance of international trade, especially exporting activities, is undeniable. Researchers have concluded that a high level of export intensity has positive impacts on macro- (Abegaz & Nene, 2022; Murshed, 2022), and microeconomic (Acedo et al., 2021; Massini et al., 2022), social development (Lou & Li, 2022), and even environmental problems (Deng et al., 2021; He & Huang, 2021). However, in fact, internationalization, including but not limited to exporting and foreign investment (Tang et al., 2021), is not a linear process (Dominguez & Mayrhofer, 2017). In order to reflect the withdrawing activities of firms from the global market, Benito and Welch (1997) have proposed the term “de-internationalization,” which defines the situation of export reduction or reducing the export intensity, backshoring, and exiting from investing in foreign countries. In terms of export reduction and reducing export intensity, instead of committing the whole resource to a high level of export intensity, firms tend to have an export reduction tendency for a particular period.

According to Kafouros et al. (2022), de-internationalization could be classified into two categories based on the voluntariness of withdrawing and the market share left after withdrawing. Specifically, Kafouros et al. (2022) pointed out that, based on voluntariness, firms could withdraw from exporting due to strategic plans to avoid loss in foreign markets or to focus on expanding the domestic market share (Cuervo-Cazurra et al., 2019) or due to being forced by the external factors such as, especially, foreign government policies or economic boycotts (Vissak & Francioni, 2013). Based on the current level of exporting activities, Kafouros et al. (2022) have classified the export reduction tendency into partial and full de-internationalization. While partial de-internationalization refers to the relatively reduced involvement in exporting activities, full de-internationalization implies a situation in which firms only focus on the domestic market.

Numerous hypotheses have been developed by researchers in order to explain the determinants and reasons behind the de-internationalization in order to explain the underpinning of the reducing trend. The resource-based view (Love & Roper, 2015), the knowledge-based view (Lee et al., 2019), the organizational learning theory (D’Angelo et al., 2016), and the real options theory (Chi et al., 2019) are the main literature strands used to explain the de-internationalization and export reduction trend. However, the role of time is not at the center of these explanations. Therefore, the investigation into the reasons for the decline in exports should include the events that occur during the firms’ exit from foreign markets.

Following this research, it could be concluded that the reasons behind the export reduction can be categorized into two groups: internal and external factors (Kafouros et al., 2022). In terms of internal factors, firm size is the most important factor that has been examined by researchers. However, the proxy used to calculate the firm size has not reached a consensus among experts and researchers. Using the number of full-time employees as a proxy to measure the size of a firm and a sample from 75 countries, Audretsch et al. (2022) concluded that a large number of employees has a positive impact on export intensity. In other words, firms with a higher number of full-time employees are expected to have a lower chance of reducing their exporting activities. Moreover, Campos-García et al. (2020) found that the reduction of exports by firms has a positive impact on the strategy of changing the size of the firm based on reducing the number of

employees. Although not in consensus with Audretsch et al. (2022), Pla-Barber and Alegre (2007) emphasized that the size of a firm should be calculated by both the number of employees and the total sales of this firm. Because of the difference in proxy, Pla-Barber and Alegre (2007) concluded that firm size does not play an important role in the export intensity of firms. Indeed, this research is conducted in a science-based industry, namely biotechnology. Pla-Barber and Alegre (2007) explained that, in this sector, the main competitive advantages of firms come from scientific discoveries, training, and human resources. In other words, total sales and the number of employees of a firm do not have any significant impacts on the process of withdrawing from exporting.

Following the resource-based view, innovation is the most important element of competitive advantage, especially in the global market. According to Ortigueira-Sánchez et al. (2022), in developing countries, government innovation subsidies will facilitate the ability of firms to create innovation, which leads to positive impacts on export performance. However, the effects of innovation on export activities could be adjusted by the ownership of firms. According to Dong et al. (2022), foreign ownership would be a negative factor in accelerating export activities through innovation. In contrast, the political ties of board directors can help firms increase their export performance through both technical and non-technical innovation (Lebedev et al., 2021; Dong et al., 2022). However, according to Kafouros et al. (2018), firms with developing innovations have a chance to change their strategic plan, which is to withdraw from a particular oversea market.

According to the research conducted by Kafouros et al. (2022) and Niittymies et al. (2022), external factors or temporary events are able to force firms to reduce exporting activities. The COVID-19 pandemic has posed a threat to international trade, especially in exporting countries. The magnitude of these negative effects has decreased over time after reaching a peak in July 2020 (Hayakawa & Mukunoki, 2021). Although these effects are considered controlled (Hayakawa & Mukunoki, 2021), the pandemic has impacted negatively on global logistics and the global supply chain (Budd & Ison, 2023). These logistics and supply issues have led to a decrease in export activities and a decrease in overseas demand (Jomthanachai et al., 2022). Moreover, under the pressure of the COVID-19 pandemic, the number of working hours of full-time employees has witnessed a significant decrease (Zimpelmann et al., 2021). In developing countries, employees need to face the threat of permanently losing their jobs because of the impacts of the pandemic (Ardiyono, 2022). Along with the conclusion of Campos-García et al. (2020), the downsizing phenomenon during the pandemic could directly lead to the export reduction. Although there is a direct link between the pandemic and export reduction, government policy against COVID-19 has played an important role in preventing the negative impacts of the COVID-19 pandemic on exporting activities (Boffardi et al., 2022).

2.2. Digital transformation

“Digital transformation” has been defined as the process of firms dealing with changes in their business and economic environment by adopting technologies in order to improve their performance (Vial, 2019). According to Du and Jiang (2022), there are three main determinants driving firms toward digital transformation process, which are macro environment changes (Li et al., 2016), a high level of competitive intensity (Kohli & Melville, 2019), and the changing requirements of customers (Verhoef et al., 2021). However, Skare et al. (2023) stated that although external factors such as pandemics, climate changes, customers’ requirements, and financial and business cycles could be considered the driving forces of digital transformation, the most important determinants of the process are digital technology, which could be supported by information technologies, employees’ skills, and digital strategy (Eller et al., 2020).

The impacts of digital transformation have drawn the attention of many researchers. There is a consensus among researchers on the positive impacts of digital transformation on firms’ performance (Du & Jiang, 2022). By decomposing digital transformation into normal and excess processes, Zhai et al. (2022) proved that digital transformation could help firms improve their financial performance in the short and long term. However, Zhai et al. (2022) only use the ROA and

ROE indexes to measure the financial performance of firms. Zhou *et al.* (2022) have provided a new perspective when concluding that digital transformation could help firms avoid sticky taxes and reduce the amount of tax that firms need to pay. Last but not least, customers are expected to receive more value from the digitalization process of firms (Matarazzo *et al.*, 2021).

Moreover, digital transformation has been proven to have positive impacts on business models in multiple sectors. For example, in the automotive industry, Matarazzo *et al.* (2021) have found an encouraging linkage between digital transformation and an increase in benefits, productivity, and competitiveness. In the manufacturing sector, Wen *et al.* (2022) found that digitalized firms tend to execute a different strategy to compete to gain market share rather than to compete in terms of cost and price. Wen *et al.* (2022) emphasized that the changes in strategic plans could lead to a sustainable competitive advantage for firms. Positive impacts have been found when firms apply digital transformation to marketing and increase brand recognition (Melović *et al.*, 2020). In the agricultural sector, digitalization has served as a signal of sustainable development and as a suggestion for the future of agriculture (Ancin *et al.*, 2022). In financial fields such as banking and stock markets, numerous researchers have concluded that digital transformation can help firms reduce the risk of a stock price crash (Jiang *et al.*, 2022; Wu *et al.*, 2022) or facilitate competition in the banking sector (Bejar *et al.*, 2022).

However, the adoption of digitalization processes has resulted in unanticipated risks associated with firms' data management and inappropriate customer experiences (Chouaibi *et al.*, 2022). In terms of the working environment, digitalization has been found to be the reason behind the desensitization of employees (Palumbo, 2022). The environment of a country is expected to receive the negative impact of the digitalization of firms since Ahmadova *et al.* (2022) have confirmed the inverted U-shape relationship between digital transformation process of firms and environmental performance.

2.3. Effect of digital transformation on export reduction

According to Niu *et al.* (2023), digital transformation can facilitate the transformation in two ways: by reducing financial constraints and by enhancing the effectiveness of boards of managers. Firstly, firms' innovations require numerous resources (Kelley, 2009). Meanwhile, digital transformation will facilitate the transparency of information between firms and external investors (Chen *et al.*, 2022), which leads to the fact that firms could reduce the information cost and more easily get access to investment to enhance innovations. Secondly, innovations could be hindered by the discretion of managers in accepting new ways of doing business (O'Connor and Rafferty, 2012). These problems could be addressed by digital transformation because it provides effective internal information transfer (Chen *et al.*, 2022) and precision and simplicity when executing business processes (Verhoef *et al.*, 2021). In the meantime, from the resource-based perspective, innovations could assist exporting firms in gaining a competitive advantage (Kafouros *et al.*, 2022). Therefore, firms with innovations are expected to have fewer chances to reduce exports or withdraw from foreign markets. In other words, digital transformation plays a significant role in fostering the exporting activities of firms and preventing firms from reducing exports.

Moreover, Strange *et al.* (2022) suggested that because digital transformation could help firms reduce logistics and transfer information costs, enhance brand recognition in the global market, and improve opportunities to acquire business knowledge, internalization could be easier for digitalized firms. Ren and Gao (2022) also pointed out the direct link between digital transformation toward the export dual margin of firms. The positive correlation suggested that digitalization has a direct, positive impact on the export capacity of firms.

With this discussion above, we conjecture the below hypothesis:

H1: Digital transformation has a negative effect on export reduction.

Implementing digital transformation requires firms to restructure their businesses (Ulas, 2019). However, firms tend to adopt digitalization in different ways depending on their size (Balakrishnan & Das, 2020). Using the number of employees and annual revenue, Balakrishnan and Das (2020) have classified firms into three groups, including small, medium, and large firms. Balakrishnan and Das (2020) concluded that large and medium-sized firms tend to reorganize their structures based on professionalism, while small firms have a tendency to do so based on the technology types implemented. Therefore, while large and medium firms could both implement effectively and find new markets, small firms could only focus on the process of digital innovation. According to Rupeika-Apoga et al. (2022), financing sources are one of the main barriers to digital transformation. Therefore, compared to small and medium-sized firms (SMEs), large firms are considered to have advantages in implementing digitalization in the first stage. Kretschmer and Khashabi (2020) concurred with Rupeika-Apoga et al. (2022) that SMEs have a tendency to lag behind in the implementation of new technology in business processes because of a shortage of necessary resources.

However, things changed because of the COVID-19 pandemic. Under the pressure of the pandemic, the innovation, which includes digital innovations in the digitalization process, of large firms is more vulnerable compared to that of SMEs (Hayakawa & Mukunoki, 2021). Especially in terms of ownership, state-owned firms tend to have more time to adjust their structure of the business; therefore, compared to private or foreign-owned firms, innovations at state-owned firms are expected to be implemented inflexibly and untimely. Large exporting firms are expected to respond more quickly and effectively to the negative impacts of the pandemic, despite their inflexibility, due to their larger trade network (Straume et al., 2022).

Based on this discussion, we assume that:

H2: The effect of digital transformation on export reduction is moderated by firm size.

3. Data description

This study uses firm-level data obtained from the Vietnam Chamber of Commerce and Industry (VCCI).¹ VCCI implemented a survey on the situation of digital transformation in businesses in the context of the COVID-19 epidemic in July–August 2020. We retain the data of manufacturing firms, given that the manufacturing sector matches the theory of trade. Missing observations are eliminated as a part of the data cleaning process. Finally, 242 observations remain, encompassing 33 provinces listed in Table 1.

Dependent variable: ER

ER is denoted as a dummy variable that receives the value of 1 if a firm reports a sale reduction in overseas markets and 0 otherwise.

Main independent variables: DI, DIA, and DIS

DI is a dummy variable that takes a value of 1 if a firm had already introduced digital technology before the COVID-19 outbreak or started using digital technology during the COVID-19 outbreak and 0 otherwise. *DIA* is a dummy variable that takes a value of 1 if a firm had already introduced digital technology before the COVID-19 outbreak and 0 otherwise. *DIS* is a dummy variable that takes a value of 1 if a firm started using digital technology during the COVID-19 outbreak and 0 otherwise.

3.1. Control variables

Drawing from the rich literature on the antecedents of export reduction and de-internationalization (Tang et al, 2021; Kafouros et al., 2022), we incorporate confounders to control for the confounding

Table 1. List of province surveyed

No.	Province	Freq.	Percent	No.	Province	Freq.	Percent
1	An Giang	1	0.41	17	Hai Duong	3	1.24
2	Ba Ria Vung Tau	14	5.79	18	Hai Phong	1	0.41
3	Bac Giang	11	4.55	19	Hung Yen	10	4.13
4	Bac Ninh	5	2.07	20	Kien Giang	1	0.41
5	Binh Dinh	19	7.85	21	Long An	3	1.24
6	Binh Duong	19	7.85	22	Nam Dinh	4	1.65
7	Binh Phuoc	1	0.41	23	Phu Tho	3	1.24
8	Binh Thuan	7	2.89	24	Quang Nam	4	1.65
9	Da Nang	3	1.24	25	Quang Ngai	1	0.41
10	Dak Lak	6	2.48	26	Quang Tri	1	0.41
11	Dong Nai	33	13.64	27	Tay Ninh	8	3.31
12	Dong Thap	1	0.41	28	Thai Binh	2	0.83
13	Hochiminh	28	11.57	29	Thai Nguyen	2	0.83
14	Ha Giang	1	0.41	30	Thua Thien Hue	2	0.83
15	Ha Nam	6	2.48	31	Tien Giang	2	0.83
16	Ha Noi	36	14.88	32	Tuyen Quang	1	0.41
17	Hai Duong	3	1.24	33	Vinh Phuc	3	1.24

effects on export reduction. *MSME* is a dummy that takes a value of 1 if a firm is micro, small and medium-sized firm. *Employee* reflects the number of employees that ranges from 1 to 5 if the firm has 1–50, 51–100, 101–200, 201–500, and over 501 employees, respectively. *Clients* is the number of sales clients that ranges from 1 to 5, if the firm has 1–2, 3–5, 6–10, 11–15, and over 15 clients. *Foreignown* is a dummy variable that takes a value of 1 if a firm is owned by foreigners and 0 otherwise. Foreign ownership is expected to facilitate firm survival in the foreign market due to higher capacities and resources (Tang et al., 2021). *Innovation* is a binary variable that has a value of 1 if a firm introduces a new product or process and 0 otherwise. This variable captures the outcome of innovation, in which a more innovative firm is less likely to reduce exports (Sui & Baum, 2014). Shaver and Flyer (2000) documented that firms with the best technologies tend to leave a foreign agglomeration with weak technologies.

Policy is firm’s evaluation of government actions against COVID-19 that takes a value of 1 if a firm is highly or fully satisfied and 0 otherwise. *Layoff* is a binary variable that has a value of 1 if a firm has difficulty with a temporary or permanent layoff and 0 otherwise. *Logistics* is a binary variable that has a value of 1 if a firm has delayed a procurement due to international or domestic logistics trouble and 0 otherwise. A statistical description of all variables is reported in Table 2. 79% of firms surveyed suffered an export reduction. Meanwhile, 57% of firms had already introduced digital technology before the COVID-19 outbreak, and 18% of firms started using digital technology during the COVID-19 outbreak. In our sample, 43% of firms are MSMEs, 14% of firms are owned by foreign investors, and 74% of firms have innovation activities.

4. Model specification

We follow the current literature on export performance in COVID-19 (Tang et al., 2021; Kafourous et al., 2022) to specify the benchmark model as follows:

Table 2. Statistical summary

Variable	Obs	Mean	Std. Dev.	Min	Max
ER	242	0.79	0.41	0	1
DI	242	0.75	0.43	0	1
DIA	242	0.57	0.50	0	1
DIS	242	0.18	0.39	0	1
MSME	242	0.43	0.50	0	1
Employee	242	3.55	1.48	1	5
Clients	242	3.93	1.27	1	5
Foreignown	242	0.14	0.34	0	1
Innovation	242	0.74	0.44	0	1
Policy	242	0.53	0.50	0	1
Layoff	242	0.71	0.46	0	1
Logistics	242	0.54	0.50	0	1

$$\begin{aligned} Pr(ER_{ik} = 1) &= Pr(\beta_0 + \beta_1 Digital_{ik} + \beta_2 CONTROL_{ik} + \gamma_k + \varepsilon_{ik} > 0) \\ &= \Phi(\beta_0 + \beta_1 Digital_{ik} + \beta_2 CONTROL_{ik} + \gamma_k + \varepsilon_{ik}) \end{aligned} \quad (1)$$

Where subscript i and k refer to firm and sector, respectively. γ_k stands for sector-fixed effects. ER_{ik} denotes the export reduction decision of firm i in sector k . $Digital_{ik} = \{DI_{ik}, DIA_{ik}, DIS_{ik}\}$ is a set of digital transformation variables. DI_{ik} is a dummy variable that takes a value of 1 if firm i had already introduced digital technology before the COVID-19 outbreak or started using digital technology during the COVID-19 outbreak, and 0 otherwise. DIA_{ik} is a dummy variable that takes a value of 1 if firm i had already introduced digital technology before the COVID-19 outbreak and 0 otherwise. DIS_{ik} is a dummy variable that takes a value of 1 if firm i has started using digital technology during the COVID-19 outbreak and 0 otherwise. $CONTROL_{ik}$ represents a set of control variables. ε_{ik} has a normal distribution with a zero mean and unit variance. As ES_{ik} is a dummy variable, we adopt the probit technique to estimate model (1). Pr denotes probability, and Φ represents the cumulative distribution function of the standard normal distribution. All results stated are marginal effects at the mean level. We include the sector-fixed effects γ_k to control the unobserved sector-specific factors. Cluster standard errors are reported at the sector-location level.

In our model specification, a simultaneous relationship may exist between digital transformation and export reduction decisions that causes our estimation results to be biased. As export reduction has an adverse effect on firms' performance, they have fewer resources to implement digital transformation.

To deal with the estimation bias caused by the endogeneity issue, we apply Fisman and Love's (2003) sector-location average approach. Specifically, we divide digital transformation induced by firm i in the k -th sector ($Digital_{ik}$) into two components:

$$Digital_{ik} = DIGITAL_{ik} + DIGITAL_k, \quad (2)$$

where $DIGITAL_{ik}$ signifies an idiosyncratic element and $DIGITAL_k$ is the average value of digital transformation i , which is the same for all firms operating in the k -th sector. The main assumption is that the sector's average digital transformation is not correlated to the firms' export reduction decisions. After that, we employ the sector average of the digital transformation variable as our instrument. Hence, employing the instrumental variable approach, our model can be presented as follows:

$$Pr(ER_i = 1) = Pr(\beta_0 + \beta_1 DIGITAL_i^{IV} + \beta_2 CONTROL_i + \gamma_k + \varepsilon_i > 0) \\ = \Phi(\beta_0 + \beta_1 DIGITAL_i^{IV} + \beta_2 CONTROL_i + \gamma_k + \varepsilon_i), \quad (3)$$

where $DIGITAL_i^{IV}$ represents the fitted value computed from the first-step regression in which we regress a digital transformation on the average of export reduction at the sector level along with the set of control variables.

We first investigate the digital transformation-export reduction decision nexus without considering the endogeneity bias. After that, we apply the sector-location average approach to correct the endogeneity concern. Moreover, we re-regress Equation (3) with sub-samples by firm size to examine the moderating role of resources and capabilities. Finally, we consider the effects of digital tools that a firm had already introduced before COVID-19 or had introduced during COVID-19.

5. Empirical results

5.1. Baseline result

Table 3 illustrates the baseline results of our estimation, in which Column 1 describes the regression results of export reduction on the variable *DI*, while the results on *DIA* and *DIS* are shown in columns (2) and (3), respectively. There is statistically significant evidence in columns (1) and (3) that *DI* and *DIS* are negatively correlated with export reduction. When a firm had already

Table 3. Baseline result without endogeneity control

	(1)	(2)	(3)
VARIABLES	ER	ER	ER
<i>MSME</i>	1.274** (0.644)	1.237* (0.681)	1.365** (0.659)
<i>Employee</i>	0.510*** (0.190)	0.472** (0.189)	0.485*** (0.178)
<i>Clients</i>	-0.00296 (0.0573)	-0.0210 (0.0607)	-0.0196 (0.0705)
<i>Foreignown</i>	-2.309*** (0.579)	-2.297*** (0.589)	-2.363*** (0.666)
<i>Innovation</i>	0.543 (0.345)	0.502 (0.327)	0.538 (0.345)
<i>Policy</i>	0.0764 (0.434)	0.0243 (0.417)	0.0370 (0.448)
<i>Layoff</i>	0.862*** (0.326)	0.797*** (0.294)	0.842** (0.352)
<i>Logistics</i>	0.416** (0.181)	0.430** (0.174)	0.535*** (0.176)
<i>Digital</i>	-0.695*** (0.216)	0.0656 (0.159)	-0.715** (0.338)
Constant	-1.645 (1.025)	-1.931* (1.075)	-2.052** (1.039)
Observations	184	184	184
Pseudo R2	0.423	0.407	0.428

Note: Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

introduced digital technology before COVID-19 or started using digital technology during COVID-19, the possibility of a reduction in overseas sales decreases by 0.695%. Similarly, the probability of export reduction drops by 0.715% when digital technology is used during COVID-19. These results are aligned with the findings of Strange et al. (2022), Ren and Gao (2022), and Kafouros et al. (2022). On the other hand, column (2) shows no statistically significant relationship between *ER* and *DIA*. This result suggests that the digital technology that firms introduced before COVID-19 may not be relevant to firms in the context of COVID-19.

In the subsequent analysis, the IV method is deployed to resolve the endogeneity issue. We conduct endogeneity tests to validate our instrumental variables, as illustrated in Table 4. First, the results of the Hausman tests of endogeneity show a statistically significant χ^2 in the model incorporating the export reduction variables (*DI*). The results reveal that the endogeneity of export reduction and digital transformation may be a problem in our data sample. Next, the results of the LM statistics for the under-identification tests show that χ^2 is statistically significant, meaning that our instrumental variables are appropriate. Lastly, we observe a statistically significant Cragg-Donald Wald F-statistic, signifying that the instrumental variables used in our paper are strong enough to alleviate the endogeneity problem. These tests provide evidence to validate our instrumental variables.

Taking into account the endogeneity bias, we describe the regression results in Table 5. Similar patterns in terms of the signs and statistically significant results are found in Table 5; however, the effects of *DI* and *DIS* on export reduction have become particularly strong. Specifically, the introduction of digital technology before COVID-19 or starting to use digital technology during COVID-19 (*DI*) decreases the possibility of export reduction by 1.23%, while the likelihood of reducing export value goes down by 1.71% in the case of starting to use digital technology during COVID-19 (*DIS*). These results confirm our prediction in Hypothesis H1 that digital transformation has a negative effect on export reduction and are aligned with the findings of Freund and Weinhold (2004), Lin (2015), and Rodríguez-Crespo and Martínez-Zarzoso (2019).

Moving to the analysis of control variables, foreign ownership negatively affects a firm's export reduction possibility. On the one hand, a foreign network assists firms in overcoming entry barriers and boosts their export possibilities (Doan et al., 2020). On the other hand, foreign investors with higher capacities and resources and better governance may support firms' internalization, thereby preventing export reduction (Tang et al., 2021). By contrast, delays in procurement (*Logistics*) are positively related to export reduction. In particular, if firms experience a delay in the supply of materials or acquisition of goods due to international or domestic issues, the export reduction probability increases by 0.43% in column (1) of Table 4. This result is confirmed by Marti et al., (2014), who found that efficient logistics activities have a positive effect on export performance. The coefficient estimate of *Layoff* is also positive and statistically significant, suggesting that a company's difficulty in implementing a temporary or permanent layoff could lead to a reduction in exports. One possible explanation is that the social distance policy implemented

Table 4. Endogeneity test

ER (First stage model)	Coefficient
	DI
Hausman test of endogeneity (χ^2)	20.34 (0.000)
Leiberg-Paap rk LM statistic (Under-identification test)	27.21 (0.000)
Cragg-Donald Wald F-statistic	39.64 (0.000)

Note: we portray endogeneity tests of *DI* on *ER* from the specification using 2SLS. p-values are in brackets.

Table 5. Baseline result with endogeneity control

	(1)	(2)	(4)	(5)	(7)	(8)
VARIABLES	ER	DI	ER	DIA	ER	DIS
<i>MSME</i>	0.69 (0.473)	-0.01 (0.108)	0.70 (0.480)	-0.03 (0.124)	0.73 (0.464)	0.02 (0.101)
<i>Employee</i>	0.35** (0.159)	0.02 (0.037)	0.37** (0.156)	0.03 (0.043)	0.28 (0.173)	-0.01 (0.035)
<i>Clients</i>	0.04 (0.106)	0.05*** (0.020)	0.01 (0.114)	0.07*** (0.023)	-0.07 (0.096)	-0.01 (0.019)
<i>Foreignown</i>	-1.97*** (0.389)	-0.01 (0.083)	-2.11*** (0.361)	-0.21** (0.097)	-1.66*** (0.567)	0.20** (0.079)
<i>Innovation</i>	0.54** (0.233)	0.07 (0.057)	0.49** (0.235)	0.06 (0.066)	0.42* (0.234)	0.01 (0.054)
<i>Policy</i>	0.05 (0.224)	0.06 (0.051)	-0.02 (0.225)	0.02 (0.059)	0.01 (0.216)	0.03 (0.047)
<i>Layoff</i>	0.60** (0.235)	0.02 (0.056)	0.65*** (0.230)	0.07 (0.065)	0.49* (0.269)	-0.05 (0.052)
<i>Logistics</i>	0.43* (0.227)	0.05 (0.053)	0.39 (0.248)	-0.02 (0.062)	0.59*** (0.223)	0.07 (0.050)
<i>DIGITAL</i>	-1.23** (0.544)		-0.64 (0.627)		-1.71** (0.739)	
<i>DIGITAL^{IV}</i>		0.99*** (0.154)		0.99*** (0.187)		1.00*** (0.244)
Constant	-0.60 (0.918)	-0.38 (0.242)	-1.02 (0.900)	-0.41 (0.262)	-0.56 (0.938)	0.02 (0.205)
Observations	242	242	242	242	242	242

Note: Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0$.

during COVID-19 gives rise to insufficient workers to conduct transactions and negotiate with trading partners. Furthermore, innovation has a positive impact on export reduction. This finding is consistent with Shaver and Flyer (2000), who indicated that firms with the best technologies tend to leave foreign markets with weak technologies. However, the firm size has a positive effect on export reduction that is contrary to Bernini et al. (2016) prediction. Finally, the effects of *MSME* and *Policy* are muted, whereas those of *Employees* and *Clients* are mixed.

5.2. Further analysis

In this part, we examine the moderating effect of firm size on the nexus between digital transformation and export reduction. Firm size is viewed as a proxy for resources and capabilities. Table 6 shows the results of MSMEs in columns (1–6) and large firms in columns (7–12). While digital transformation has no impact on export reduction in large firms, it does prevent export reduction in MSMEs. Moreover, the effects of *DI* and *DIS* become more pronounced in MSMEs. Balakrishnan and Das (2020) found that, in terms of digital transformation, large enterprises focus on reorganizing their structures, while small firms tend to improve their operational processes. As a consequence, large firms need to have more time to adjust their business structure in a period of crisis such as COVID-19; therefore, compared to small firms, technological innovations in big companies are expected to be implemented inflexibly and untimely (Hayakawa & Mukunoki, 2021). Besides, Love and Ganotakis (2013) contend that large and small- and medium-sized firms de-internationalize in various ways. During a crisis, large firms do not need to close a foreign branch to recover slack resources, but small

Table 6. Estimation results by firm size

VARIABLES	MSMEs					Large-sized firms						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Employee	0.15 (0.204)	0.03 (0.045)	0.18 (0.204)	0.04 (0.049)	0.12 (0.218)	-0.01 (0.044)	0.69* (0.356)	-0.03 (0.070)	0.75** (0.352)	-0.00 (0.083)	0.70 (0.451)	-0.04 (0.061)
Clients	0.15 (0.183)	0.06* (0.034)	0.12 (0.241)	0.14*** (0.037)	-0.10 (0.183)	-0.07** (0.033)	-0.04 (0.170)	0.05* (0.025)	-0.05 (0.161)	0.04 (0.030)	-0.11 (0.169)	0.01 (0.022)
Foreignown	-2.51*** (0.661)	0.01 (0.096)	-2.69*** (0.536)	-0.30*** (0.106)	-2.12** (1.056)	0.34*** (0.095)	-0.61 (0.901)	-0.08 (0.221)	-0.44 (0.880)	-0.01 (0.264)	-0.58 (0.984)	-0.09 (0.194)
Innovation	0.21 (0.442)	0.04 (0.091)	0.05 (0.443)	-0.01 (0.098)	0.25 (0.424)	0.04 (0.089)	0.93*** (0.333)	0.06 (0.075)	1.00*** (0.332)	0.11 (0.090)	0.79* (0.468)	-0.05 (0.066)
Policy	0.14 (0.361)	0.09 (0.081)	0.09 (0.404)	0.17* (0.087)	-0.10 (0.372)	-0.08 (0.079)	0.08 (0.346)	0.03 (0.066)	-0.03 (0.329)	-0.05 (0.079)	0.04 (0.400)	0.08 (0.057)
Layoff	-0.17 (0.387)	-0.08 (0.089)	0.01 (0.393)	0.03 (0.096)	-0.18 (0.391)	-0.12 (0.087)	1.12*** (0.345)	0.09 (0.072)	1.13*** (0.339)	0.11 (0.086)	1.01** (0.461)	-0.03 (0.064)
Logistics	1.31*** (0.476)	0.12 (0.085)	1.22** (0.588)	-0.05 (0.092)	1.69*** (0.528)	0.16* (0.080)	0.13 (0.336)	0.01 (0.068)	0.08 (0.329)	-0.00 (0.081)	0.16 (0.346)	0.02 (0.059)
DIGITAL	-1.39* (0.786)		-0.49 (1.103)		-1.88* (0.959)		-1.21 (0.864)		-1.20 (0.817)		-0.78 (2.319)	
DIGITAL ^{IV}		1.20*** (0.264)		1.04*** (0.286)		1.40*** (0.398)		0.91*** (0.188)		0.94*** (0.244)		0.66** (0.294)
Constant	0.71 (0.903)	-0.57** (0.276)	0.13 (0.924)	-0.72*** (0.262)	1.03 (0.986)	0.19 (0.209)	-2.22 (1.848)	-0.08 (0.384)	-2.63 (1.776)	-0.15 (0.438)	-2.66 (2.253)	0.13 (0.321)
Observations	105	105	105	105	105	105	137	137	137	137	137	137

Note: Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

ones may have to do so (Bernini et al., 2016). Hence, digital transformation aids MSMEs in preventing export shrinkage. This supports hypothesis H2.

Lastly, we disentangle the impacts of digital tools that a firm had already introduced before COVID-19 or had recently introduced during COVID-19. Digital tools are classified into six groups based on firm activities: First, intra-company management (*Intra*) includes either remote employee management, web-based meeting systems (i.e., Zoom, Google Meet), cloud services, an internal approval system, or e-learning; Second, procurement (*Procu*) includes either Electronic Data Exchange or e-Payment; Third, Logistics (*Logis*) includes either document or cargo delivery applications or storage management systems; Fourth, Production (*Prod*) includes either an IoT device, robotics or line automation, a Manufacturing Execution System, or Enterprise Resource Planning; Fifth, Marketing (*Market*) includes either web-based meeting systems (e.g., Zoom, Skype, Google Meet), SNS (e.g., Facebook), or e-Commerce; and Sixth, Sales (*Sales*) includes Electronic Data Exchange, SNS (e.g., Facebook), e-Commerce, or e-Payment.

In Table 7, we report the coefficients of digital tool variables only. In each regression, we use the same set of control variables as in Equation (3). Panel A of Table 7 shows that the adoption of digital tools in Logistics, Production, and Sales before COVID-19 prevents the export reduction. It is clear that public demand for food, medical equipment, and consumer goods increases significantly in the context of lockdown and social distancing (Parveen, 2020), which makes firms struggle to keep up with demand. Hence, manufacturers have already adopted digital tools in Logistics, Production, and Sales to accommodate increased demand while avoiding export reduction (Chitrakar et al., 2021; Shen et al., 2020). Meanwhile, Panel B indicates that the adoption of digital tools in Marketing during COVID-19 prevented export shrink. The pressure of high demand for consumer goods eases over time due to the impact of online transactions (Collinson, 2020). The introduction of e-commerce or web-based meetings plays a vital role in helping firms facilitate trade, negotiate, and allocate resources to meet requirements from foreign partners (Abdelrhim & Elsayed, 2020). When considering already or newly adopted digital instruments, Panel C shows that those adopted for intra-company management, Logistics, and Sales help to lower the export reduction.

We report the coefficients of digital tools variables only. In each regression, we use the same set of CONTROL variables as in Equation (3).

6. Conclusion and managerial implications

In this paper, we examine whether the digital transformation has an impact on firms' export reduction. We use data from the Vietnam Chamber of Commerce and Industry, covering 33 provinces in Vietnam from July to August 2020. Our empirical results show that digital transformation negatively impacts firms' reduction in overseas sales. Whether businesses implemented digital transformation before or at the beginning of the pandemic, the possibility of export reduction decreases. This effect becomes more pronounced in the case of micro, small and medium enterprises, while digital transformation has no impact on export reduction in large firms as they do not need to close foreign branches to recover scarce resources.

The COVID-19 pandemic, which began in late 2019 and early 2020 worldwide, has had a huge impact on global economies in terms of supply chain disruptions and international trade. Digitization is helping companies overcome challenges caused by the pandemic. Especially small and medium-sized companies are encouraged to find suitable technologies in order to provide new digital products and services to their customers. The sooner the digital transformation is implemented, the more benefit the digitized companies will gain. However, when adopting these technologies, they should carefully consider the following challenges: First, the impact of digital transformation will foster new ways of working regardless of people's geographical location (Almeida et al., 2020). Second, it is imperative to investigate how labor is valued both socially and financially and its impact on the company's performance, particularly for those involved in international trade and those with branches

Table 7. Estimation results of digital tools

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	ER	Intra	ER	Procu	ER	Logis	ER	Prod	ER	Market	ER	Sales
Panel A: Already adopted												
Adoption	-0.29 (0.819)		0.05 (0.615)		-1.13*** (0.410)		-1.16** (0.570)		1.01** (0.440)		-1.24*** (0.456)	
Adoption_iv		1.02*** (0.199)		1.08*** (0.168)		1.05*** (0.161)		0.95*** (0.210)		1.00*** (0.135)		1.01*** (0.176)
Panel B: Newly adopted												
Adoption	-0.01 (0.696)		-0.98 (0.825)		-0.87 (0.990)		1.53 (1.700)		-1.63*** (0.616)		1.59 (0.996)	
Adoption_iv		1.00*** (0.199)		1.02*** (0.168)		0.99*** (0.155)		0.98*** (0.218)		1.00*** (0.148)		0.97*** (0.169)
Panel C: Already or newly adopted												
Adoption	-1.90*** (0.375)		0.20 (0.689)		-1.34*** (0.363)		-0.88 (0.732)		0.81 (0.573)		-1.15** (0.529)	
Adoption_iv		0.99*** (0.198)		1.14*** (0.188)		1.06*** (0.155)		0.89*** (0.218)		0.99*** (0.148)		1.02*** (0.169)

Note: Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

in foreign countries. Moreover, when implementing or adopting a new digital tool, managers should carefully consider its impact on work and employment related to issues of control, surveillance, and resistance (Hodder, 2020), which contribute to the success of introducing new technology.

Overall, the results of this paper have contributed to both theoretical and practical perspectives. The paper has proven the direct impacts of digital transformation on export reduction, which has not drawn the attention of researchers in this field. Based on the results, this paper has suggested management practices to help firms avoid de-internationalization. However, this paper still has limitations. Firstly, the data was collected in July and August 2020. Thus, the paper could not examine the impacts of the pandemic on the exporting activities of firms in 2021, when the Delta variant will have spread (Yu et al., 2021). Future research should extend the research period to verify the results. Secondly, the data was only collected in Vietnam. Therefore, the results might not represent other developing countries. The authors suggest that the results should be tested in different geographical contexts.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Citation information

Cite this article as: Is digital transformation a barrier to export reduction during COVID-19? The case of a developing country, Nguyen Cam Thuy, Luong Van Dat, Do Phu Dong, Vu Thuy Linh & Doan Ngoc Thang, *Cogent Business & Management* (2023), 10: 2211218.

Note

1. Due to privacy concerns, the data are not publicly available.

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