COVID-19 PANDEMIC AND MANUFACTURING SECTOR: AN EVALUATION OF COPING STRATEGIES

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Abstract

This study investigates the adoption and impact of coping strategies within the manufacturing sector in the context of pandemic disruptions. Utilizing the multinomial endogenous treatment effects model, we accounted for potential selection biases in our analysis of a comprehensive dataset comprising 29,443 Vietnamese manufacturing firms. The most prevalent coping strategy was the pursuit of new markets, adopted by approximately 27.9 percent of the firms surveyed. Notably, a significant proportion of firms had not yet implemented any coping strategies to mitigate the effects of the pandemic. Our findings indicate a varied degree of effectiveness among the coping strategies in enhancing revenue outcomes. Strategies such as the promotion of e-commerce and the exploration of new output markets yielded positive impacts on firm performance, with increases of 7.82 percent and 0.16 percent, respectively. Conversely, other strategies demonstrated relatively lower effectiveness. This underscores the necessity for additional research to elucidate the role of government support programs and policies in facilitating the adoption of effective coping strategies (Huang et al., 2021), thereby enabling manufacturing firms to maintain operational resilience in the face of potential future disruptions.

Keywords: Effectiveness, Coping Strategies, COVID-19 Pandemic, Manufacturing Sector, Vietnam

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1. INTRODUCTION

As of September 2021, the Vietnam Ministry of Health reported 766,051 COVID-19 cases and 18,758 deaths since the pandemic's onset (Vietnam Government, 2021). Consequently, the COVID-19 pandemic has precipitated an unprecedented crisis, profoundly impacting public health, industry, and socioeconomic aspects (Boyacı-Gündüz et al., 2021; Tan & Tran, 2020; Rathi et al., 2024). Key sectors including agriculture, construction, transportation, healthcare, finance, retail, tourism, and manufacturing all felt the repercussions of this outbreak (Wicaksono & Rinaldi, 2021; Naseer et al., 2023).

The manufacturing sector is a cornerstone of the Vietnamese economy, encompassing various industries such as textiles, garments, footwear, electronics, and automobile manufacturing. This sector contributed approximately 16% to the gross domestic product (GDP) and provided employment for around 8.2 million individuals, solidifying its position as one of the largest employers in the nation (General Statistics Office [GSO], 2020). Unfortunately, the COVID-19 pandemic has affected all areas, including Vietnamese businesses. The manufacturing industry, a significant contributor to Vietnamese GDP, has been hit hard due to global supply chain disruptions and reduced demand for products. As a result, there has been a significant decline in the country's economy, particularly in manufacturing, due to its dependence on exports. Sectors such as transportation, processing, assembly, and production, which are part of the manufacturing process, have suffered the most. In 2020, the Vietnamese government confirmed that the outbreak affected a staggering 84.8% of businesses, impacting nearly five million workers (GSO, 2020).

The recent focus is on coping techniques for manufacturing businesses during epidemics. Zaazou and Salman (2022) identified four strategies that improved sales and profitability in Egyptian manufacturing. Farooq et al. (2021) highlighted three strategies that enhanced financial performance and creativity in Chinese firms. Liu et al. (2023) found supply chain management as a key predictor of pandemic performance. Jin et al. (2022) and Kalogiannidis et al. (2022) showed that research and development (R&D) expenditures and digitalization respectively had positive impacts on company performance during the pandemic. In Vietnam, various studies have delved into the repercussions of the COVID-19 pandemic on the manufacturing sector, proposing coping strategies for companies. Butt (2022) investigated the pandemic's effects across four South Asian countries including Vietnam and concluded that companies investing in digital technologies and diversifying their supply chains were better equipped to handle disruptions caused by the pandemic. Nguyen (2023) advocated for companies in the textile and garment industry to prioritize investments in automation and digital technologies to enhance their resilience to future pandemics. However, there remains a dearth of studies examining the decision-making process behind a company's choice of pandemic coping strategies and the subsequent outcomes associated with those decisions. Additionally, no prior study has investigated the effects of the pandemic and its coping strategies using a large-scale dataset encompassing businesses from all manufacturing sectors and regions in Vietnam.

Previous studies provide insights into the impact of coping strategies on manufacturing companies during COVID-19. However, gaps exist in the literature. Many studies focus on the pandemic's immediate effects, neglecting long-term impacts and the ripple effects on companies' response strategies and performance. Most research is conducted in developed countries, leaving a gap in understanding coping strategies in emerging economies. There is also limited research on the relationship between coping strategies and specific performance metrics. This study aims to fill these gaps by investigating the adoption and impact of coping strategies in the manufacturing sector of a developing country like Vietnam.

The rest of the paper is structured as follows. Section 2 offers a comprehensive literature review. Section 3 outlines the materials and methods employed in the study. Section 4 presents and discusses the results. Finally, Section 5 concludes the investigation and delves into its implications.

2. LITERATURE REVIEW

The COVID-19 pandemic has had a significant impact on manufacturing companies globally, including those in Vietnam. The impacts can be categorized into four main areas: 1) supply chain disruptions, 2) changes in demand and production, 3) workforce changes, and 4) financial burdens (Mehta et al., 2020; Xu et al., 2020; Castañeda-Navarrete et al., 2021; Chowdhury et al., 2021; Koutoupis et al., 2022; Nnaji et al., 2022; Oudat, 2022; Saura et al., 2022). Studies such as Xu et al. (2020) and Castañeda-Navarrete et al. (2021) found that the pandemic caused significant disruption in global supply chains, affecting manufacturers' ability to source raw materials and components. The pandemic has led to changes in consumer demand, with a shift toward essential goods and changes in production, with companies focusing on products that are in high demand (Mehta et al., 2020). The pandemic has significantly affected the workforce, with companies implementing various strategies to protect workers and ensure business continuity. For example, Nnaji et al. (2022) found that companies implemented strategies to promote worker safety, such as providing personal protective equipment and implementing social distancing strategies. Saura et al. (2022) found that the pandemic has led to changes in work arrangements with an increase in remote work and the use of digital technologies to maintain communication and collaboration. Besides, Nguyen and Dinh (2021) highlight the financial burdens as the consequences of the pandemic on these companies, reporting a decrease in revenue and profitability.

Despite the challenges posed by the pandemic, companies in the manufacturing sector have implemented various strategies for adapting and innovating (Hanelt et al., 2021; Huang et al., 2021; Farooq et al., 2021; Zaazou & Salman, 2022). These strategies can be categorized into four main areas: 1) product and process innovation, 2) supply chain

management, 3) financial management, and 4) workforce management. Irfan et al. (2022) found that companies implemented various strategies to improve their resilience, such as diversifying their supply chains and investing in digital technologies. Zaazou and Salman (2022) and Chen et al. (2023) identified supply chain management as a key response strategy. Zaazou and Salman (2022) also highlighted financial management as a response strategy. The study found that companies implemented workforce management strategies, such as promoting worker safety and changing work arrangements.

Several studies examined the impact of specific coping strategies on company performance (Hussen, 2020; Farooq et al., 2021; Kalogiannidis et al., 2022; Dike & Tuffour, 2023; Liu et al., 2023). For example, Zastempowski (2023) confirmed R&D spending as a push factor for company performance during a pandemic, whereas Zeng et al. (2022) found that digitalization was associated with better company performance. However, some studies have found that certain response strategies, such as decreasing work hours and laying off workers temporarily, have little or no impact on company performance during a pandemic (Xiong et al., 2020).

The COVID-19 pandemic has had a significant impact on companies in Vietnam's manufacturing sector (Castañeda-Navarrete et al., 2021; Nguyen, 2023; Hadian & Rezayatmand, 2022; Akbari et al., 2023). Recent studies investigated the consequences associated with the pandemic outbreaks on various aspects of these companies, highlighting the need for strategic responses to manage disruptions caused by the pandemic (Nguyen, 2023). Castañeda-Navarrete et al. (2021) found that the pandemic has led to a decrease in production output and caused significant supply chain disruptions. Hadian and Rezayatmand (2022) reported that the pandemic has negatively impacted workforce management, with increased absenteeism, reduced productivity due to workplace closures, and lack of workforce availability. Nguyen and Dinh (2021) highlight the financial burdens as the consequences of the pandemic on these companies, reporting a decrease in revenue and profitability. Other studies, such as Akbari et al. (2023), Akbari and Hopkins (2022), and Le and Nhieu (2022), have focused on the impact of the pandemic on supply chain management in the manufacturing sector in Vietnam. These studies found that the pandemic has led to supply chain disruptions, increased supply chain risk, and the need for new strategies to manage supply chain disruptions. Furthermore, studies by Akbari et al. (2023) investigated the adoption of Industry 4.0 technologies in the manufacturing sector. The study indicates that COVID-19 outbreaks have facilitated the adoption of these technologies, particularly digital transformation in supply chains, as a means to mitigate the negative effects of the pandemic. Akbari and Hopkins (2022) also highlighted the importance of government support in facilitating the adoption of digital technologies in response to the pandemic.

While the studies mentioned offer valuable insights into the links between coping strategies and manufacturing company performance amid the COVID-19 pandemic, there are several noteworthy gaps in the existing literature. Limited attention has been given to understanding the long-term effects of the pandemic on manufacturing companies and the effectiveness of their coping strategies over time. Moreover, there is a scarcity of studies focusing on coping strategies and performance in manufacturing companies within emerging economies, which may face unique challenges and opportunities. Importantly, studies exploring the relationship between specific coping strategies and performance metrics associated with companies' decisions to adopt these strategies are limited in the literature. Further investigation is needed to assess the role of government support programs and policies in facilitating the implementation of coping strategies and their subsequent impact on company performance in the context of the COVID-19 pandemic. Therefore, addressing these gaps in the literature is crucial for providing evidence-based insights into the interplay between coping strategies and company performance.

3. RESEARCH METHODOLOGY

3.1. Data

Data for this study were obtained from a nationwide survey of all 63 provinces (Figure 1), types of businesses, and company size. The General Statistics Office (GSO) conducted the rapid survey to assess the impact of the COVID-19 pandemic on businesses in April 2020 in response to requests for timely information to aid government intervention. The survey collected information on the impact of the pandemic, responses from companies, and government support programs. The outputs of the survey provide policymakers and governments with evidence-based information to propose forthcoming intervention policies to deal with current and future shocks (GSO, 2020).

The survey covered the entire country and all economic sectors, including the manufacturing sector. However, in this study, we extracted data from the manufacturing sector for further analysis. The total sample of the survey is 162,738 firms, of which 29,443 firms work in the manufacturing sector. The survey gathered data on crucial companies, business activities, and pandemic impacts. The GSO also studied the strategies used by companies in response to the pandemic and evaluated the effectiveness of government support in overcoming challenges and mitigating damage caused by the pandemic. The survey content was divided into five basic information groups:

1) Identification of the survey unit: company name, address, phone number, tax code, economic type, main business sector.

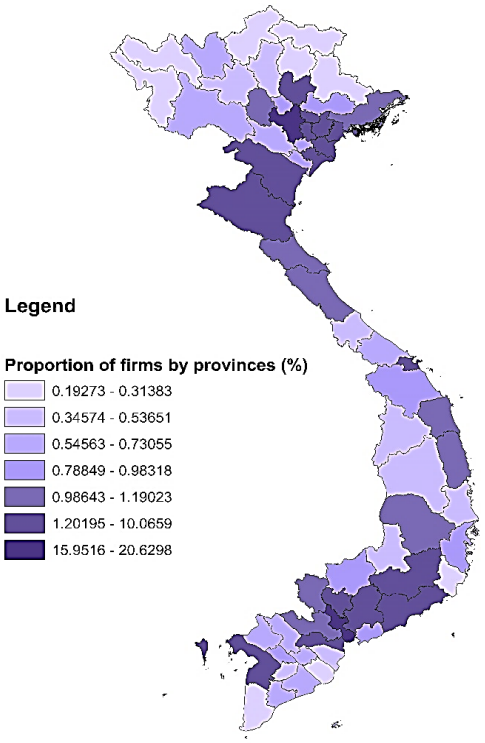
2) The business situation of the company.

3) The company's coping solutions in response to the impact of the COVID-19 pandemic.

4) Evaluation of the effectiveness of government solutions to support businesses in overcoming difficulties and reducing damage due to the COVID-19 pandemic.

5) Some questions about the competitiveness of the company.

Figure 1. Percentage of companies surveyed across regions of Vietnam (%)



3.2. Empirical model

The objective of this study is to model the relationship between manufacturing companies' adoption of coping strategies and their impact on company performance, specifically company revenue, in the face of external shocks such as the COVID-19 pandemic. To achieve this, we employ a multinomial endogenous switching treatment regression (MESR) framework.

The MESR approach involves two stages. In Stage 1, we estimate the multiple-choice coping strategies employed by manufacturing companies using a Multinomial Logit Selection (MNLS) model. This model captures the decision-making process of manufacturing companies in selecting different coping strategies. The multinomial logit model is a type of regression analysis that models the probability of choosing one of several possible outcomes, making it appropriate for our research question.

In Stage 2, we use Inverse Mill Ratios (IMR) as additional variables to control for selection bias, and ordinary least squares (OLS) to assess the degree to which a connection exists between each adoption decision and its effect on the outcomes (revenue changes in 2020 vs. 2019). This stage examines the relationship between the selected coping strategies and their impact on company performance, specifically on company revenue. OLS is a commonly used regression technique to estimate the linear relationship between two variables. The inverse Mills ratio is a correction term that accounts for the selection bias that occurs when the decision to adopt a coping strategy relates to unobserved factors that also affect company performance.

The *STATA* command *mlogit* is used for Stage 1, and the *selmlog* command is used for Stage 2 (Bourguignon et al., 2002). This modelling approach provides a robust analytical framework for examining the relationship between coping strategies and their impact on company performance. By modelling both the adoption decision and the impact of the outcome simultaneously, this study can account for the complex interactions between these factors and provide insight into the factors that influence the success of coping strategies in the face of external shocks such as the COVID-19 pandemic.

Stage 1: Identify the factors related to the choice to implement response strategies.

The multinomial logit model used in Stage 1 is a widely used approach to model the decision-making process of individuals facing multiple alternatives. In this step, we identified the factors influencing the adoption of the following strategies applied by the surveyed companies: 0) non-adoption, 1) promoting e-commerce, 2) transforming key products/services, 3) training employees to improve professional qualifications/skills, 4) finding new input markets, 5) finding new output markets, 6) producing/providing new products/services, and 7) other strategies. The model assumes that each company faces a combination of decisions to choose coping strategies and that a company's decision is based on the utility associated with each choice. Because utility is unobservable, the model assumes that the observed choice reflects the choice with the highest utility for the company, denoted by:

$$Y = Z'\beta + \varepsilon = \begin{cases} 1 \; if \; Y_{ji}^{*} > (Y_{mi}^{*}) \; with \; m1 \\ j \; if \; Y_{ji}^{*} > (Y_{mi}^{*}) with \; mj \end{cases} \text{for all m\#j} \quad (1)$$

where Y_{ji}^{*} is the latent response formulation of the observed decisions that a company either adopted or did not adopt certain response strategies, Z includes a set of explanatory variables, and ε denotes the difference between the two random errors (unobserved factors). The IMRs were calculated using $IMR = \phi(F(Z'\beta))/\Phi(F(Z'\beta))$, where ϕ (probability density function) and Φ (cumulative distribution function), Z are explanatory variables, and β is a vector of parameters to be estimated. Stage 1 is liked to Stage 2 by adding IMRs to prevent biased estimation.

Stage 2: Estimate the treatment effects of adopting coping strategies using the MESR framework.

We first estimated the relationship between the outcome variables and explanatory variables (Z) for each of the seven response strategies. The welfare outcome equation for each regime (j) is.

$$\begin{cases} Regime\ 1: W_{1j} = X_{1i}'\beta_1 + \widehat{IMR_{ji}}\lambda_1 + \varepsilon_{1i} \; if \; Y = 1 \\ Regime\ j: W_{ji} = X_{1i}'\beta_j + \widehat{IMR_{ji}}\lambda_j + \varepsilon_{ji} \; if \; Y = j \end{cases} \quad (2)$$
$$\text{j} = 1, 2, 3 \ldots, 7$$

where, W_{1j} is the outcome variable (revenue change over the 2019–2020 periods in log form) of the ith company in regime j.

This study used the same measure to estimate the impact of coping strategies on changes in company revenue. To obtain the average effect of attributable to the treatment (ATT), the coefficients of the MESR model were used by comparing the expected outcomes of companies that adopted coping strategies with those that did not in both

the actual and counterfactual scenarios, as presented below.

In the MESR framework, ATT is calculated by subtracting Eq. (3) and (4):

Adopters with adoption (actual):

$$E(W_{ji}|Y=j,Z,\widehat{IMR}) = Z'_{ji}\beta_j + \widehat{IMR}_{j\iota}\lambda_j + \varepsilon_{ji} \quad (3)$$

Adopters had decided not to adopt (counterfactual):

$$E(W_{1i}|Y=1,Z,\widehat{IMR}) = Z'_{1i}\beta_1 + \widehat{IMR}_{j\iota}\lambda_1 + \varepsilon_{1i} \quad (4)$$

ATT compares the expected outcomes of the treatment group (adopters) with those of the control group (non-adopters) under both the actual and counterfactual scenarios. By subtracting the expected outcomes of the control group from the treatment group in both scenarios, the formula calculates the difference in the expected revenue changes attributable to the treatment (ATT) between the two groups. This allowed us to estimate the causal impact of the treatment on the outcome of interest.

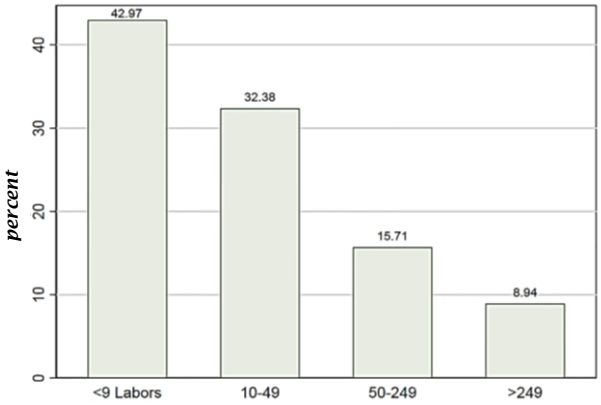
$$ATT = E(W_{ji}|Y=j,Z,\widehat{IMR}) - E(W_{1i}|Y=1,Z,\widehat{IMR}) = X'_{1i}(\beta_j-\beta_1) + IMR_{ji}(\lambda_1-\lambda_1) \quad (5)$$

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Descriptive statistics

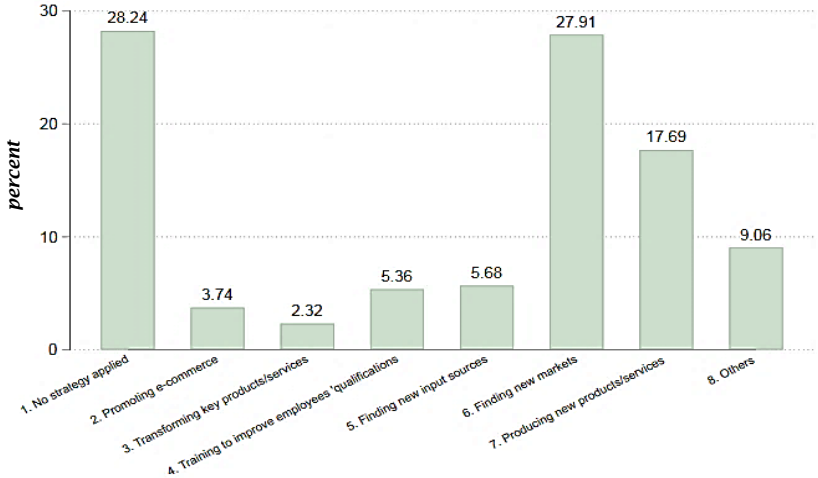
The survey was conducted online, using a web-based questionnaire. It is worth noting that small business households and SMEs comprised the highest proportion of 29,443 manufacturing companies surveyed, accounting for more than 90% (Figure 2). The manufacturing sector, including various industries, plays a crucial role in the Vietnamese economy. In this study, we used classifications from the Vietnamese government for the manufacturing sector, which include export and food processing, beverage production, tobacco product manufacturing, textile production, clothing production, food processing and manufacturing, paper production, refined petroleum products, chemical products, chemical products, metal production, and the production of electronic products, computers, and optical products.

Figure 2. Classifications of surveyed companies by size



A large-scale national survey provides a comprehensive and representative sample of manufacturing companies in Vietnam, which allows for robust statistical analysis and generalization of the findings to the broader population of manufacturing companies in the country. This data source also allows the identification of specific coping strategies adopted by manufacturing companies in response to the pandemic, which can inform future policy decisions and interventions to support businesses during crises.

Figure 3. Coping strategies applied by surveyed companies



A significant proportion of manufacturing companies have not adopted any coping strategies in response to the COVID-19 pandemic. Approximately 28.2% of the companies surveyed reported that they did not adopt any coping strategy, which was the second most frequently reported response after finding new markets. Findings from the literature suggest that the reasons why some companies did not adopt any coping strategies could include factors such as lack of resources, lack of information, or the belief that their current business model was already sufficiently resilient to withstand the pandemic. Companies that do not adopt any coping strategies may experience a decline in revenue compared with companies that adopt one or more response strategies. As a result, it is essential for businesses to take preventative strategies and implement reaction strategies to lessen the damaging effects of shocks from the outside world, such as the COVID-19 pandemic, on their operations.

Table 1. Descriptive statistics

Variables	*Mean*	*S.D*	*Min*	*Max*
Dependent variables				
Coping strategies	3.563	2.572	0	7
Revenue change 2020 vs 2019 (log)	7.881	2.456	-4.605	18.438
Independent variables				
Company size (scaled 1-5)	2.003	1.042	1	4
Employees on unpaid leave (persons)	2.141	38.995	0	3.300
Employees on leave/rotational leave (persons)	6.423	191.55	0	23.171
Overall self-assessment on the impact of pandemic (1 = negative, 2 =neutral, 3 = positive)	2.077	0.368	1	3
Impact assessment on source of domestic raw materials (1 = decreased, 2 = unchanged, 3 = increased)	1.645	0.547	1	3
Impact assessment on domestic consumption market (1 = decreased, 2 = unchanged, 3 = increased)	1.294	0.495	1	3
Impact assessment on export market (1 = decreased, 2 = unchanged, 3 = increased)	1.371	0.534	1	3
Government assistance (yes =1)	0.192	0.394	0	1

Among the coping strategies by manufacturing companies in response to the pandemic, "Finding new output markets" could be seen as the key approach (Figure 3). The study found that approximately 27.9% of the surveyed companies adopted this measure, which was the most commonly adopted among the surveyed companies. The coping strategy to find new markets was particularly important for companies heavily reliant on exports, as the pandemic reduced the demand for goods and services in many traditional markets. By finding new markets, companies were able to diversify their customer bases and reduce their reliance on key markets. This measure may be associated with a positive impact on company revenue, as companies that adopt this measure are more likely to experience revenue growth than companies that do not adopt it.

The dependent variable of Stage 1 is "*Coping strategies*", which refers to the different coping strategies adopted by manufacturing companies to cope with the pandemic outbreaks. The dependent variable of interest, company response strategies, has been classified into seven categories, as previously mentioned. The mean of this variable was 3.563 with a standard deviation of 2.572. The dependent variable for Stage 2 is "*Revenue changes 2020 versus 2019 (log)*" which measures the change in company revenue from 2019 to 2020. The mean of this variable was 7.881, with minimum (-4.605) and maximum (18.438) values. It is important to note that the average value of 2.001 indicates that the majority of Vietnamese manufacturing businesses are small and medium-sized. The pandemic has affected the workers of companies at different levels. The studied companies reported a decline in accessing inputs, exports, and local markets due to intervention strategies such as social isolation, travel restrictions, and lockdowns. Government assistance to the companies was modest (19.2%). To help affected companies deal with the pandemic, the Vietnamese government directed banks to provide additional credit, reduce interest rates, and extend tax deadlines. The government has implemented a range of policies to support both employers and employees during the pandemic. For example, the government has provided financial support to employers to help them retain workers and has implemented policies to encourage employers to reduce working hours rather than lay off workers. The government has also provided financial support to employees who have lost their jobs or been furloughed. However, owing to budget constraints, not all companies have been able to implement these policies.

4.2. Estimated results of the MESR model

4.2.1. Factors associated with the choice to implement response strategies: First-stage MESR model

Table 2 reports the estimated coefficients that indicate the likelihood of falling into a given group (0–7). Overall, the findings indicate that three key variables drive companies' decisions to adopt all coping strategies related to the pandemic. The first variable is the "*Overall self-assessment of the impact of the pandemic*", with a scale of 1 to 3, where 1 means negative, 2 means neutral, and 3 means positive. The coefficient for this variable is negative and statistically significant for all response strategies, indicating that businesses that believe COVID-19 has a negative effect are more likely to adopt all types of response strategies. The second variable is the "*Impact assessment of the source of domestic raw materials*", with a scale of 1 to 3, where 1 means decreased, 2 means unchanged, and 3 means increased. The coefficient of this variable was negative and statistically significant for all response strategies. This indicates

that companies with a more negative assessment of the impact of COVID-19 on their sources of domestic raw materials are more likely to adopt all types of response strategies, with the aim of minimizing the adverse impacts associated with the pandemic. The variable "*Government assistance*" strategies whether companies received any kind of support from the government during the pandemic. Coefficient estimates the effect of receiving such support on the decision to adopt. The coefficient estimates range from 0.136 to 0.638 depending on the coping strategy applied. In all strategies, the coefficients were positive, indicating that government support is linked to an increased likelihood of adopting certain coping strategies. However, the significance levels varied between strategies, with some coefficients not significant at conventional levels ($p > 0.05$) and others significant at $p < 0.001$.

For the remaining variables, such as company size, several studies have highlighted that company size usually has an impact on the choice of coping strategies during a pandemic. Huang et al. (2020) found that larger companies are more likely to adopt cost-cutting strategies, whereas smaller companies focus on workforce adjustments. Our findings only found a statistically significant relationship between company size and the probability of adopting Coping strategies 1, 5, and 7. Access to government support (Coping Strategy 7) has played a crucial role in enabling companies to cope with the pandemic. Companies with access to financial assistance, such as loans and grants, have been able to adopt a wider range of coping strategies (Nawaz et al., 2021). We found evidence for companies working in the manufacturing sector in Vietnam, except for the Coping strategy 1. In addition, variables that indicate labour reduction during the pandemic (number of employees temporarily taking unpaid leave and number of employees on leave/rotational leave) show a weak effect on the decision to adopt coping strategies.

Table 2. Factors associated with the choice to implement response strategies: First-stage MESR model

Variables	*Coping strategy 1*	*Coping strategy 2*	*Coping strategy 3*	*Coping strategy 4*	*Coping strategy 5*	*Coping strategy 6*	*Coping strategy 7*
Company size (scaled 1–5)	-0.229*** (0.084)	-0.116 (0.089)	0.110 (0.095)	0.062 (0.101)	0.232*** (0.083)	0.186** (0.072)	-0.040 (0.069)
Employees on unpaid leave (persons)	-0.002 (0.006)	0.001*** (0.001)	0.000 (0.001)	-0.001 (0.002)	-0.001 (0.001)	0.000 (0.001)	-0.000 (0.001)
Employees on leave/rotational leave (persons)	-0.004 (0.007)	-0.003 (0.005)	0.004 (0.003)	0.000 (0.003)	0.003 (0.003)	0.004 (0.003)	0.003 (0.003)
Overall self-assessment on the impact of pandemic (1 = negative, 2 = neutral, 3 = positive)	-1.266*** (0.267)	-0.991*** (0.263)	-0.371*** (0.133)	-0.725*** (0.161)	-0.734*** (0.114)	-0.713*** (0.131)	-0.533*** (0.141)
Impact assessment on source of domestic raw materials (1 = decreased, 2 = unchanged, 3 = increased)	-0.580*** (0.111)	-0.389** (0.164)	-0.369* (0.169)	-1.074*** (0.124)	-0.245*** (0.077)	-0.503*** (0.087)	-0.330*** (0.125)
Impact Assessment on domestic consumption market (1 = decreased, 2 = unchanged, 3 = increased)	-0.094 (0.105)	-0.059 (0.214)	-0.098 (0.120)	0.011 (0.169)	-0.570*** (0.103)	-0.259*** (0.101)	-0.351*** (0.110)
Impact assessment on export market (1 = decreased, 2 = unchanged, 3 = increased)	-0.067 (0.157)	-0.097 (0.202)	0.110 (0.102)	-0.180* (0.107)	-0.331*** (0.106)	-0.295* (0.133)	-0.268* (0.149)
Government assistance (yes = 1)	0.136 (0.230)	0.466* (0.239)	0.481*** (0.172)	0.398*** (0.128)	0.585*** (0.101)	0.638*** (0.136)	0.520*** (0.149)

*Note: Coping strategies: Base = Non-adoption, 1 = promoting e-commerce, 2 = transforming key products/services, 3 = training employees to improve professional qualifications/skills, 4 = finding new input markets, 5 = finding new output markets, 6 = producing/providing new products/services, and 7 = other strategies. The command mlogit in STATA 17 is used for Stage 1. *, **, *** denote significance at 10%, 5%, 1%, respectively*

4.2.2. Factors related with company performance indicators: Stage 2 of the MESR model

In the Stage 2 of MESR, company revenue changes are regressed by other variables for each of the seven Coping strategies 1-7, separately. The estimated results for the remaining variables are presented in Appendix. The coefficients of company size represent the statistically significant effects of company size on revenue changes for each coping measure.

On the one hand, the results show that company size has a significant positive effect on revenue changes for all coping strategies and that larger companies experience greater increases in revenue. The coefficients ranged from 1.238 to 2.307 depending on the coping measure and were statistically significant at the 1% level. Overall, these results suggest that larger companies are better able to cope with the negative effects of the COVID-19 pandemic and implement strategies that lead to increased revenue. On the other hand, the coefficient for "Employees on unpaid leave" is very small and not statistically significant in all seven response strategies.

Additionally, other variables also have moderate effects on revenue changes depending on the coping measure used, such as the number of employees on leave/rotational leave, companies' overall assessment of the impact of COVID-19, impact assessment on the source of domestic raw materials, impact assessment on the domestic consumption market, impact assessment on the export market, and received government assistance. There exists significant evidence of positive relationships between government support to deal with the pandemic and revenue changes for Coping strategies 2, 6, and 7. Transforming key products/services to respond to the pandemic is

important for businesses to remain competitive and meet the changing needs of consumers. This could include adapting existing products or services to the new reality of the pandemic or developing entirely new products or services that address pandemic-related challenges. The Vietnamese government has provided financial assistance, regulatory and policy changes, and other forms of support to incentivize businesses to develop new products or services that address the challenges posed by the pandemic. During the pandemic, companies have paid special attention to new technologies and delivery models to serve customers who are now working remotely or avoiding in-person interactions.

Table 3. Determinants of company revenue changes by coping strategies: Second-stage MESR estimation

Variables	*Coping strategy 1*	*Coping strategy 2*	*Coping strategy 3*	*Coping strategy 4*	*Coping strategy 5*	*Coping strategy 6*	*Coping strategy 7*
Company size (scaled 1–5)	2.307*** (0.226)	1.238*** (0.341)	1.858*** (0.153)	1.791*** (0.260)	1.827*** (0.090)	1.883*** (0.103)	2.060*** (0.129)
Employees on unpaid leave (persons)	-0.014 (0.027)	-0.001 (0.026)	0.001 (0.005)	0.003 (0.025)	-0.003 (0.003)	0.001 (0.001)	0.002 (0.003)
Employees on leave/rotational leave (persons)	0.005 (0.012)	-0.024* (0.011)	0.001 (0.002)	-0.002 (0.005)	-0.000 (0.001)	0.000 (0.001)	.003*** (0.001)
Overall self-assessment on the impact of pandemic (1 = negative, 2 = neutral, 3 = positive)	0.404 (0.704)	-1.432* (1.080)	-0.092 (0.605)	0.759 (0.653)	0.065 (0.165)	-0.399 (0.297)	-0.674* (0.404)
Impact assessment on source of domestic raw materials (1 = decreased, 2 = unchanged, 3 = increased)	-0.333 (0.877)	-0.077 (1.356)	0.708* (0.514)	-0.300 (0.796)	-0.208 (0.278)	-0.425*** (0.147)	0.284 (0.325)
Impact Assessment on domestic consumption market (1 = decreased, 2 = unchanged, 3 = increased)	-0.161 (0.727)	-0.461 (0.742)	-0.041 (0.277)	0.527 (0.483)	-0.175* (0.109)	-0.277** (0.165)	-0.288 (0.254)
Impact assessment on export market (1 = decreased, 2 = unchanged, 3 = increased)	0.888* (0.544)	-0.223 (0.593)	-0.635* (0.397)	-0.024 (0.345)	-0.229* (0.123)	-0.419 (0.353)	-0.533*** (0.211)
Government assistance (yes = 1)	-0.016 (0.910)	0.596* (0.409)	0.273 (0.303)	-0.009 (0.412)	0.018 (0.214)	0.510*** (0.128)	0.330* (0.205)

*Note: Coping strategies: Base = non-adoption, 1 promoting e-commerce, 2 transforming key products/services, 3 training employees to improve professional qualifications/skills, 4 finding new input markets, 5 finding new output markets, 6 producing/providing new products/services, and 7 other strategies. The user-written command selmlog in STATA 17 is used for Stage 2 (Bourguignon et al., 2002). *, **, *** denote significance at 10%, 5%, 1%, respectively.*

4.2.3. Estimated results of the treatment effects

Table 4 shows estimates of the multinomial endogenous switching regression (MESR) analysis, which is used to estimate the unconditional average treatment effects (ATT) of adopting coping strategies on company revenue change. The Table 4 shows the adoption status of each coping strategy (j = 1,...,7), the change in the outcome for the companies that adopted a coping strategy (a), the change in the outcome for the companies that did not adopt the measure (b) and the ATT (c), which is the difference between (a) and (b). The final column shows the percentage change in revenue associated with each coping strategy.

Table 4. MESR-based unconditional average treatment effects of adoption of coping strategies on company revenue change

Coping strategies	*Adoption status*			*Change in outcome*
	Adoption (j = 1,...,7) (a)	*Non–adoption (j = 0) (b)*	*ATT (c) = (a)-(b)*	*(%)*
Coping strategy 1	8.14	7.54	0.59***	7.82
Coping strategy 2	8.06	8.31	-0.25	-3.01
Coping strategy 3	8.41	8.76	-0.35	-4.00
Coping strategy 4	8.58	8.73	-0.15	-1.72
Coping strategy 5	9.20	9.19	0.015***	0.16
Coping strategy 6	8.83	9.02	-0.19	-2.11
Coping strategy 7	8.49	8.68	-0.18	-2.07

*Note: a) Coping strategies: Base= non-adoption, 1 = promoting e-commerce, 2 = transforming key products/services, 3 = training employees to improve professional qualifications/skills, 4 = finding new input markets, 5 = finding new output markets, 6 = producing/providing new products/services, and 7 = other strategies. b) *, **, *** denote significance at 10%, 5%, 1%, respectively.*

We found that strategies 1 and 5 boosted the revenue by 7.82% and 0.16%, respectively. Our findings are consistent with those of other studies that have found a positive relationship between coping strategies and company performance during the pandemic. For example, Farooq et al. (2021) found that the adoption of digital transformation strategies, such as e-commerce and online sales channels, significantly improved revenue outcomes for companies in the United Arab Emirates. The COVID-19 pandemic has highlighted the importance of e-commerce for coping with disruptions caused by the pandemic. Businesses must adopt e-commerce to adapt to the new normal and maintain business continuity while ensuring social distancing strategies. One way e-commerce

was promoted during the pandemic is through the use of online marketplaces. According to a study by Pantano and Willems (2022), online marketplaces such as Amazon, eBay, and Alibaba experienced a surge in demand during the pandemic as consumers turned to online shopping to avoid crowded stores and reduce their risk of infection. These marketplaces also provide platforms for small businesses to reach a wider audience and sell their products online. Another way e-commerce has been promoted during the pandemic is through the use of social media. Social media platforms such as Facebook, Instagram, and Twitter have become increasingly popular among businesses as a means of promoting their products and services, as well as communicating with customers. Yusoff and Azmel (2022) found that social media was an essential tool for companies during the pandemic, allowing them to reach customers and maintain their brand image. One measure adopted by companies to find new markets for their products is to explore opportunities outside traditional markets. With lockdowns and social distancing strategies, consumers have increasingly moved to online shopping. This has led to a surge in demand for online platforms that offer a wide range of products to consumers (Modgil et al., 2022). Businesses have also used social media platforms, such as Facebook, Instagram, and Twitter, to reach consumers and promote their products (Devereux et al., 2020).

Adopting strategies 2, 3, 4, 6, and 7 is not significantly associated with positive changes in revenue. The percentage change in revenue associated with each coping strategy ranged from -4.0% to -1.72%. It is worth noting that the percentage changes are based on unconditional average treatment effects and may differ across companies depending on their specific circumstances. The COVID-19 pandemic has caused significant disruptions to global supply chains, resulting in economic losses and operational challenges for businesses worldwide. To address these challenges, many companies have adopted various coping strategies including transforming key products/services, improving employee qualifications and skills, finding new markets for input materials, and exploring new distribution channels.

Although some strategies are expected to enhance a company's resilience and competitiveness during crises, their effectiveness in generating positive revenue outcomes remains unclear. Several recent studies investigated the relationship between coping strategies and company performance during the COVID-19 pandemic. Shen et al. (2020) examined the role of strategic adjustments in company business outcomes in China's manufacturing sector during the pandemic. This study found that the adoption of product and service transformation strategies is not significantly associated with improved revenue outcomes. In general, the literature suggests that the effectiveness of coping strategies for improving revenue during the COVID-19 pandemic is mixed as confirmed in our findings. While some strategies such as digital transformation may have positive impacts on company performance, others such as product and service transformation, training and development, and finding new markets for input materials may not be as effective.

5. CONCLUSION

The manufacturing sector, a significant contributor to Vietnam's GDP, faced substantial challenges due to disruptions in global supply chains, reduced consumer demand, and temporary factory closures stemming from the pandemic. This study investigates the strategies employed by Vietnamese manufacturing companies during this period and their economic implications.

Data from 29,443 manufacturing companies nationwide was analyzed using a multinomial endogenous treatment effects model. The companies demonstrated adaptability and innovation despite the pandemic-related hurdles. Response strategies included promoting e-commerce, transforming core products/services, enhancing employee skills through training, seeking new input and output markets, and introducing new products/services.

Among these strategies, finding new output markets was the most widely adopted, with nearly 28% of companies opting for this approach. This strategy was particularly crucial for export-reliant companies due to disruptions in traditional markets. However, a significant proportion of companies did not implement specific coping strategies in response to the pandemic. The effectiveness of these strategies in bolstering revenue varied. Promoting e-commerce and exploring new output markets had a positive impact on company performance (7.82% and 0.16%, respectively), while other strategies may not have been as effective.

This study underscores the economic significance of investigating the role of government support programs and policies in facilitating the implementation of response strategies. It also emphasizes the critical role of coping strategies in enabling manufacturing companies to endure future shocks. These insights offer valuable guidance for policymakers and business leaders in formulating effective strategies and policies to support the manufacturing sector during times of crisis.

The study focused on a specific set of manufacturing companies in Vietnam, which may not fully represent the diversity of the entire sector. Future research could conduct longitudinal studies to analyze how coping strategies evolve over time and their long-term impact on company performance. Conducting longitudinal studies would allow for a more in-depth analysis of how coping strategies evolve over time and their long-term impact on company performance. Subsequent studies may benefit from employing a broader and more diverse sample in dynamic settings to gain a comprehensive understanding of how firms cope with shocks and uncertainty. This would provide more robust findings of the economic implications of these strategies and enhance our understanding of firm resilience to future shocks and uncertainties.

REFERENCES

1. Akbari, M., & Hopkins, J. L. (2022). Digital technologies as enablers of supply chain sustainability in an emerging economy. *Operations Management Research, 15*(3–4), 689–710. https://doi.org/10.1007/s12063-021-00226-8
2. Akbari, M., Kok, S. K., Hopkins, J., Frederico, G. F., Nguyen, H., & Alonso, A. D. (2023). The changing landscape of digital transformation in supply chains: Impacts of industry 4.0 in Vietnam. *The International Journal of Logistics Management*. Advance online publication. https://doi.org/10.1108/IJLM-11-2022-0442
3. Bourguignon, F., Fournier, M., & Gurgand, M. (2007). Selection bias correction based on the multinomial logit model: Monte Carlo comparisons. *Journal of Economic Surveys, 21*(1), 174–205. https://doi.org/10.1111/j.1467-6419.2007.00503.x
4. Boyacı-Gündüz, C. P., Ibrahim, S. A., Wei, O. C., & Galanakis, C. M. (2021). Transformation of the food sector: Security and resilience during the COVID-19 pandemic. *Foods, 10*(3), Article 497. https://doi.org/10.3390/foods10030497
5. Butt, A. S. (2022). Understanding the implications of pandemic outbreaks on supply chains: An exploratory study of the effects caused by the COVID-19 across four South Asian countries and steps taken by firms to address the disruptions. *International Journal of Physical Distribution & Logistics Management, 52*(4), 370–392. https://doi.org/10.1108/IJPDLM-08-2020-0281
6. Castañeda-Navarrete, J., Hauge, J., & López-Gómez, C. (2021). COVID-19's impacts on global value chains, as seen in the apparel industry. *Development Policy Review, 39*(6), 953–970. https://doi.org/10.1111/dpr.12539
7. Chen, L., Li, T., Jia, F., & Schoenherr, T. (2023). The impact of governmental COVID-19 strategies on manufacturers' stock market valuations: The role of labor intensity and operational slack. *Journal of Operations Management, 69*(3), 404–425. https://doi.org/10.1002/joom.1207
8. Chowdhury, P., Paul, S. K., Kaisar, S., & Moktadir, M. A. (2021). COVID-19 pandemic related supply chain studies: A systematic review. *Transportation Research Part E: Logistics and Transportation Review, 148*, Article 102271. https://doi.org/10.1016/j.tre.2021.102271
9. Devereux, E., Grimmer, L., & Grimmer, M. (2020). Consumer engagement on social media: Evidence from small retailers. *Journal of Consumer Behaviour, 19*(2), 151–159. https://doi.org/10.1002/cb.1800
10. Dike, V. O., & Tuffour, J. K. (2023). Corporate governance practices and firm performance: The moderating effect of female directors. *Corporate Governance and Sustainability Review, 7*(1), 8–20. https://doi.org/10.22495/cgsrv7i1p1
11. Farooq, M. U., Hussain, A., Masood, T., & Habib, M. S. (2021). Supply chain operations management in pandemics: A state-of-the-art review inspired by COVID-19. *Sustainability, 13*(5), Artcle 2504. https://doi.org/10.3390/su13052504
12. General Statistics Office (GSO). (2020). *Report on the impact of the COVID-19 on labor and employment situation in Viet Nam.* https://www.gso.gov.vn/en/data-and-statistics/2020/07/report-on-the-impact-of-the-covid-19-on-labour-and-employment-situation-in-viet-nam/
13. General Statistics Office (GSO). (2021). *COVID-19 impacts on labour and employment situation in quarter IV of 2020.* https://www.gso.gov.vn/en/data-and-statistics/2021/01/covid-19-impacts-on-labour-and-employment-situation-in-quarter-iv-of-2020/
14. Hadian, S. A., & Rezayatmand, R. (2022). Economic impact of acute respiratory disease pandemics: A scoping review. *Journal of Research in Medical Sciences, 27*(1), Article 88. https://doi.org/10.4103/jrms.jrms_870_21
15. Hanelt, A., Bohnsack, R., Marz, D., & Antunes Marante, C. (2021). A systematic review of the literature on digital transformation: Insights and implications for strategy and organizational change. *Journal of Management Studies, 58*(5), 1159–1197. https://doi.org/10.1111/joms.12639
16. Huang, A., & Farboudi Jahromi, M. (2021). Resilience building in service firms during and post COVID-19. *The Service Industries Journal, 41*(1–2), 138–167. https://doi.org/10.1080/02642069.2020.1862092
17. Hussen, M. S. (2020). Exploring the impact of various typologies of human capital on firms' productivity. *World Journal of Entrepreneurship, Management and Sustainable Development, 16*(3), 231–247. https://doi.org/10.1108/WJEMSD-12-2019-0095
18. Irfan, I., Sumbal, M. S. U. K., Khurshid, F., & Chan, F. T. S. (2022). Toward a resilient supply chain model: Critical role of knowledge management and dynamic capabilities. *Industrial Management & Data Systems, 122*(5), 1153–1182. https://doi.org/10.1108/IMDS-06-2021-0356
19. Jin, G., Xu, J., Liu, F., Haris, M., & Weqar, F. (2022). Does R&D investment moderate the relationship between the COVID-19 pandemic and firm performance in China's high-tech industries? Based on DuPont components. *Technology Analysis & Strategic Management, 34*(12), 1464–1478. https://doi.org/10.1080/09537325.2021.1963699
20. Kalogiannidis, S., Kalfas, D., Chatzitheodoridis, F., & Kontsas, S. (2022). The impact of digitalization in supporting the performance of circular economy: A case study of Greece. *Journal of Risk and Financial Management, 15*(8), Article 349. https://doi.org/10.3390/jrfm15080349
21. Koutoupis, A. G., Belesis, N. D., & Kampouris, C. G. (2022). Tax and COVID-19 pandemic effects on the financial performance and risk of the hotel industry. *Corporate & Business Strategy Review, 3*(2), 125–137. https://doi.org/10.22495/cbsrv3i2art11
22. Le, M.-T., & Nhieu, N.-L. (2022). A novel multi-criteria assessment approach for post-COVID-19 production strategies in Vietnam manufacturing industry: OPA–fuzzy EDAS model. *Sustainability, 14*(8), Article 4732. https://doi.org/10.3390/su14084732
23. Liu, R., Long, J., & Liu, L. (2023). Seeking the resilience of service firms: A strategic learning process based on digital platform capability. *Journal of Services Marketing, 37*(3), 371–391. https://doi.org/10.1108/JSM-04-2022-0124
24. Mehta, S., Saxena, T., & Purohit, N. (2020). The new consumer behaviour paradigm amid COVID-19: Permanent or transient? *Journal of Health Management, 22*(2), 291–301. https://doi.org/10.1177/0972063420940834
25. Modgil, S., Dwivedi, Y. K., Rana, N. P., Gupta, S., & Kamble, S. (2022). Has Covid-19 accelerated opportunities for digital entrepreneurship? An Indian perspective. *Technological Forecasting and Social Change, 175*, Article 121415. https://doi.org/10.1016/j.techfore.2021.121415
26. Naseer, S., Khalid, S., Parveen, S., Abbass, K., Song, H., & Achim, M. V. (2023). COVID-19 outbreak: Impact on global economy. *Frontiers in Public Health, 10*, Article 1009393. https://doi.org/10.3389/fpubh.2022.1009393

27. Nguyen, L. T. M., & Dinh, H. P. (2021). Ex-ante risk management and financial stability during the COVID-19 pandemic: A study of Vietnamese firms. *China Finance Review International, 11*(3), 349–371. https://doi.org/10.1108/CFRI-12-2020-0177
28. Nguyen, M. T. (2023). Impacts of digital transformation on manufacture in Vietnam. *VNU Journal of Science: Policy and Management Studies, 39*(2), 34–45. https://doi.org/10.25073/2588-1116/vnupam.4375
29. Nnaji, C., Jin, Z., & Karakhan, A. (2022). Safety and health management response to COVID-19 in the construction industry: A perspective of fieldworkers. *Process Safety and Environmental Protection, 159*, 477–488. https://doi.org/10.1016/j.psep.2022.01.002
30. Oudat, M. S. (2022). The COVID-19 pandemic and the performance of the stock exchange market: Evidence from the Bahrain Stock Exchange indexes. *Corporate & Business Strategy Review, 3*(1), 19–28. https://doi.org/10.22495/cbsrv3i1art2
31. Pantano, E., & Willems, K. (2022). Pandemic acceleration of retail phygitalization. In *Retail in a New World: Recovering from The Pandemic That Changed the World* (pp. 57–75). Emerald Publishing Limited. https://doi.org/10.1108/978-1-80117-846-420221008
32. Rathi, S., Majumdar, A., & Chatterjee, C. (2024). Did the COVID-19 pandemic propel usage of AI in pharmaceutical innovation? New evidence from patenting data. *Technological Forecasting and Social Change, 198*, Article 122940. https://doi.org/10.1016/j.techfore.2023.122940
33. Saura, J. R., Ribeiro-Soriano, D., & Saldaña, P. Z. (2022). Exploring the challenges of remote work on Twitter users' sentiments: From digital technology development to a post-pandemic era. *Journal of Business Research, 142*, 242–254. https://doi.org/10.1016/j.jbusres.2021.12.052
34. Shen, H., Fu, M., Pan, H., Yu, Z., & Chen, Y. (2020). The impact of the COVID-19 pandemic on firm performance. *Emerging Markets Finance and Trade, 56*(10), 2213–2230. https://doi.org/10.1080/1540496X.2020.1785863
35. Tan, S., & Tran, T. (2020). *Impact of COVID-19 on firms in Vietnam: Report No. 1: Results from the first round of COVID-19 business pulse survey*. World Bank, Washington, DC. https://hdl.handle.net/10986/34580
36. Vietnam Government. (2021). *Socio-economic situation in September and first nine months of 2021.* https://vietnam.gov.vn/2021-70686/socio-economic-situation-in-september-and-first-nine-months-of-2021-12067467
37. Wicaksono, R. M. T. A. D., & Rinaldi, R. P. (2021). Economic determinants of growth acceleration during Covid-19 pandemic: A comparative study between Indonesia, Thailand and Vietnam. *Journal of Developing Economies, 6*(1), 12–46. https://doi.org/10.20473/jde.v6i1.20834
38. Xiong, H., Wu, Z., Hou, F., & Zhang, J. (2020). Which firm-specific characteristics affect the market reaction of Chinese listed companies to the COVID-19 pandemic? *Emerging Markets Finance and Trade, 56*(10), 2231–2242. https://doi.org/10.1080/1540496X.2020.1787151
39. Xu, Z., Elomri, A., Kerbache, L., & El Omri, A. (2020). Impacts of COVID-19 on global supply chains: Facts and perspectives. *IEEE Engineering Management Review, 48*(3), 153–166. https://doi.org/10.1109/EMR.2020.3018420
40. Yusoff, S. M., & Azmel, A. A. M. A. (2022). Brand awareness: The influence of social media during the Covid-19 Pandemic. *BASKARA: Journal of Business and Entrepreneurship, 5*(1), 68–82. https://doi.org/10.54268/baskara.v5i1.14045
41. Zaazou, Z. A., & Abdou, D. S. (2022). Egyptian small and medium sized enterprises' battle against COVID-19 pandemic: March–July 2020. *Journal of Humanities and Applied Social Sciences, 4*(2), 94–112. https://doi.org/10.1108/JHASS-09-2020-0161
42. Zastempowski, M. (2023). Analysis and modeling of innovation factors to replace fossil fuels with renewable energy sources — Evidence from European Union enterprises. *Renewable and Sustainable Energy Reviews, 178*, Article 113262. https://doi.org/10.1016/j.rser.2023.113262
43. Zeng, H., Ran, H., Zhou, Q., Jin, Y., & Cheng, X. (2022). The financial effect of firm digitalization: Evidence from China. *Technological Forecasting and Social Change, 183*, Article 121951. https://doi.org/10.1016/j.techfore.2022.121951

APPENDIX

Table A.1. Estimated results for Stage-2 for each coping strategy (remaining variables)

	ln_diff1		ln_diff2		ln_diff3		ln_diff4		ln_diff5		ln_diff6		ln_diff7	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	-0.555	0.689	-1.704	1.353
_m0	-1.147	1.899	-3.454	3.444	-0.161	2.910	1.974	2.586	-0.235	1.318	-3.079*	1.576	-2.313	2.035
_m2	-10.791*	6.304	0.509	5.436	-2.067	2.737	-3.645	3.196	-1.769	1.195	-0.261	1.076	1.876	2.372
_m3	12.857*	6.031	-5.459	9.475	-1.251	3.559	5.423	5.123	-0.208	1.252	0.363	3.464	0.964	2.104
_m4	6.684	7.526	-0.294	7.946	1.930	2.479	0.882	3.738	1.803***	0.604	3.542***	1.254	-0.495	1.911
_m5	-0.426	2.753)	0.455	7.279	1.140	1.453	-2.972	3.340	2.036	1.695	0.359	1.462	-0.614	1.096
_m6	-0.076	4.517)	4.472	6.042	1.663	2.725	1.388	3.756	1.726**	0.684	-1.532	1.957	2.642	1.486
_m7	-7.261*	4.150)	1.968	3.873	-1.982	3.623	-3.584	3.993	-3.359***	0.998	4.582***	1.138	6.708	1.736
_cons	1.216	(2.816)	3.449	3.393	2.568	3.038	0.174	2.738	5.532***	0.644	16.079*	8.967	15.081*	7.750
Sigma2	187.111	132.563	44.845	174.786	12.854	26.137	40.203*	28.570	17.492**	6.055	-0.177	0.185	-0.563	0.381
rho0	-0.107	0.246	-0.662*	0.288	-0.058	0.538	0.399	0.382	-0.072	0.445	-0.985*	0.513	-0.764	0.533
rho2	-1.012	0.631	0.097	0.716	-0.739	0.597	-0.737*	0.467	-0.542	0.302	-0.084	0.352	0.620	0.613
rho3	1.206*	0.527	-1.046*	0.691	-0.448	0.798	1.097*	0.655	-0.064	0.378	0.116	0.884	0.319	0.546
rho4	0.627	0.708	-0.056	0.645	0.690	0.545	0.178	0.600	0.553	0.183	1.133***	0.304	-0.164	0.513
rho5	-0.040	0.319	0.087	0.575	0.408	0.357	-0.601	0.525	0.624	0.475	0.115	0.404	-0.203	0.327
rho6	-0.007	0.433	0.856*	0.527	0.595	0.590	0.281	0.544	0.529	0.183	-0.490	0.576	0.873*	0.428
rho7	-0.681*	0.286	0.377	0.428	-0.709	0.737	-0.725	0.599	-1.030	0.283	0.359	1.462	-0.614	1.096