

ERIA Discussion Paper Series**No. 485****Global Value Chain Disruptions and Firm Survival During
COVID-19: An Empirical Investigation****Sasidaran GOPALAN***

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Abstract: *Despite the rapid acceleration of countries participating in global value chains (GVCs) over the last three decades, global GVC participation rates have plateaued since the global financial crisis (GFC) and worsened with the onset of the coronavirus disease (COVID-19) pandemic. The massive supply chain disruptions induced by the pandemic not only appeared to expose the vulnerabilities of GVCs, largely because of concentration risks, but also contributed to a dramatic decline in trade flows globally. As countries around the world emerge from the shadows of the pandemic, there is growing academic and policy interest in deciphering how countries should build effective strategies that facilitate firm survival, especially viewed from the lens of resilience and robustness. Considering this background, in this paper, we propose to make a twofold contribution to this literature. First, we undertake a comprehensive firm-level investigation (in a cross-country setting) to ascertain whether firms engaged in GVCs relative to non-GVC firms exhibited better survival instincts during the COVID-19 pandemic. Second, we uncover the heterogeneity of the shock across sectors and industries, considering the varied sectoral/industrial exposure to the COVID-19 pandemic. We document that GVC firms showcased greater robustness and resilience during the pandemic phase compared with other firms. Our results also show that the degree of resilience and robustness varies significantly by industry.*

Keywords: Global value chains; firm survival; resilience; COVID-19

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1. Introduction and Motivation

One of the stylised facts about modern trade flows between countries is their intrinsic connection to global value chains (GVCs). The central idea behind GVCs is that the production process is fragmented across multiple countries, which implies that a product is ‘made in the world’, as opposed to just one country (Santacreu and LaBelle, 2021). A more formal definition can be found in Antràs (2020: 543), who defined a GVC as ‘...a series of stages involved in producing a product or service that is sold to consumers, with each stage adding value, and with at least two stages being produced in different countries. A firm participates in a GVC if it produces at least one stage in a GVC’.²

GVCs have become increasingly prevalent globally over the last three decades. Available data on GVC participation³ from the United Nations Conference on Trade and Development (UNCTAD) show that about 60% of global trade today comprises trade in intermediate goods and services that are incorporated at multiple levels of production networks for final consumption. The increasing relevance of production fragmentation in international trade has broadly coincided with the information and communication technology revolution, along with a general fall in transportation costs which allowed multinational firms to outsource complex production activities across borders. Recent firm-level empirical evidence has also documented how digitalisation by firms has not only positively influenced GVC deepening but also benefitted financially constrained firms (Gopalan, Reddy, and Sasidharan, 2022).

Despite the rapid acceleration of countries engaging in GVCs over the last three decades, global GVC participation rates have plateaued since the global financial crisis (GFC) and worsened with the onset of the coronavirus disease (COVID-19) pandemic. In fact, the massive supply chain disruptions induced by the pandemic not only appeared to expose the vulnerabilities of GVCs, largely because of concentration risks, but also contributed to a dramatic decline in trade flows globally (IMF, 2022).

As countries exit the pandemic, it is natural for policymakers to search for viable ways to build effective strategies that will allow firms integrated in global supply chains to weather similar future shocks better. Such strategies for firm survival can be viewed from

² The 2020 World Development Report by the World Bank offers the following example to illustrate the idea of a GVC: ‘For example, a bike assembled in Finland with parts from Italy, Japan, and Malaysia and exported to the Arab Republic of Egypt is a GVC’ (World Bank, 2020: 17).

³ GVC participation at the country level is measured as the sum of the indirect value added and foreign value added of a country. For more details on the measurement, see the UNCTAD–Eora GVC Database (UNCTAD, n.d.).

the lens of both ‘resilience’ and ‘robustness’. The related supply chain management literature defines resilience as whether or not a firm can move back to normalcy after the shock. While the notion of resiliency captures the ability to transition to pre-shock times, robustness focuses on a firm’s ability to survive and withstand the shock (Miroudot, 2020). In other words, this reflects whether a firm can sustain its operations during a shock. Given this context, the question of interest is how countries can build more resilient and robust GVCs to handle similar future shocks?

Two central issues are of importance here. First, what is the degree to which firms plugged into GVCs are vulnerable to such shocks? Second, if they are vulnerable, then what are the specific channels through which they can mitigate such vulnerabilities? Both issues are empirical questions that assume immense policy significance in the post-pandemic world.

A handful of studies has started empirically examining these related questions in various country-/region-specific settings. In one of the first studies on this topic, focusing on a larger cross-country setting (133 countries), Borino et al. (2021) found that trading firms were more vulnerable to shocks arising from constraints in obtaining inputs relative to domestic firms and they also suffered from a reduction in sales resilience (relative to domestic firms), although the study concluded that trading firms were better equipped to handle such vulnerabilities by adopting mitigation strategies that included promoting teleworking and online sales along with substituting sourcing from newer suppliers.

Using novel survey data on the Association of Southeast Asian Nations (ASEAN) economies and India, Todo et al. (2022) examined the characteristic features of firm resilience with specific reference to the COVID-19 pandemic. They found that the supply chain links of a foreign-owned firm with strong home ties (with a home supplier or customer) were less likely to be disrupted during the pandemic. They also found that geographic diversity of suppliers and customers facilitated a firm’s resilience to supply chain disruptions.

Despite some early evidence of nearshoring and reshoring after firms started relocating their production activities, the long-term feasibility and viability of such a strategy has been questioned in the literature (Panwar, Pinkset, and De Marchi, 2022). Some studies, such as Abidi, El Herradi, and Sakha (2022), have noted that firms’ digitalisation attempts turned out to be a hedge in terms of weathering output losses from the pandemic.

Despite growing interest, this budding literature is relatively new and several research gaps remain unaddressed. Considering this background, in this paper, we propose to make a twofold contribution to this growing literature. First, we undertake a comprehensive firm-level investigation (in a cross-country setting) to ascertain whether firms engaged in GVCs relative to non-GVC firms exhibited better survival instincts from the point of view of resilience and robustness during the COVID-19 pandemic.⁴ Second, we go a step further by uncovering the heterogeneity of the pandemic shock across sectors and industries, considering the varied sectoral/industrial exposure. To the best of our knowledge, neither of these dimensions have been addressed in the extant literature.

Our primary contributions are thus empirical and can be linked to two broad strands of literature. The first strand relates to the set of studies understanding whether GVCs propagate or help absorb shocks. The second strand relates to the literature exploring the determinants of firm resilience/robustness, with specific reference to the COVID-19 pandemic. The international trade literature at the macro level has highlighted how economies integrated deeply in international trade tend to be more sensitive to global shocks. As summarised by Kramarz, Martin, and Mejean (2020), in theory, at the macro level, intense trade participation can result in sectoral concentration which in turn amplifies a country's exposure to supply shocks, but at the same time, higher diversification can also moderate output volatility by shielding the country from domestic demand shocks. For instance, di Giovanni and Levchenko (2009) illustrated how trade openness contributes to higher output volatility. Evidence to the contrary is presented by Caselli et al. (2015), who showed that countries which are exposed to large domestic shocks can benefit from reduced aggregate volatility if they diversify their sources of demand and supply through international trade. While this debate has its roots in the literature examining the relationship between trade openness and output volatility, studies at the firm level are largely restricted to selected advanced Organisation for Economic Co-operation and Development (OECD) countries (see, for instance, Kramarz, Martin, and Mejean, 2020).

A natural question that becomes relevant here from the COVID-19 pandemic experience is to what extent firms that were integrated in GVCs (at varying degrees of intensity) were exposed to vulnerabilities during the COVID-19 pandemic as captured by

⁴ We would like to note that our usage of the word 'survival' should not be misconstrued with its empirical equivalent of 'survival analysis'. Although the issue of firm resilience and robustness is about firm survival at its core, and hence any survival analysis would be an invaluable complement, our data limitations constrain us from performing such an analysis. In particular, the lack of systematic panel data results in the absence of information on the entry and exit of firms, which is pivotal for undertaking survival analysis.

measures of resilience and robustness? While it is obvious from macro data that GVCs were severely disrupted during the pandemic, there is relatively sparse firm-level empirical evidence comparable across countries that can shed light on whether GVC firms have a greater likelihood (relative to non-GVC firms) of being less resilient and robust. Although this scarcity could be largely attributable to data unavailability, we attempt to overcome this constraint in a unique way using unique firm-level data from the World Bank that allows us to find representative indicators capturing both resilience and robustness at the firm level during the pandemic phase.

To preview our key empirical findings, we document that GVC firms showcased greater robustness and resilience during the pandemic phase compared with other firms. Our results also show that the degree of resilience and robustness varies significantly by industry. At a very broad level, although we find GVC firms from both the services and manufacturing sectors showcasing resilience, the results are stronger for the services sector. However, within industries, we observe notable variations as well, with GVC firms within publishing and printing, for instance, showcasing greater resilience compared with those from transport equipment. With respect to the services sector, we observe that firms from construction and wholesale trade, and computer & related activities exhibited greater resilience compared with GVC firms in air transport and hotels & restaurants.

The remainder of the paper is structured as follows: Section 2 lays out the data and empirical strategy adopted in this paper. In doing so, we also offer a discussion of the metrics employed in our paper to measure GVCs and their resilience as well as robustness, drawing on the firm-level literature. Section 3 presents the empirical findings and the results of sensitivity checks. Section 4 concludes with a summary of our findings and highlights avenues for future research.

2. Data and Empirical Strategy

2.1. Data Sources

To empirically address the proposed research questions outlined in section 1, we draw information from two sources. Our primary source of data is the COVID-19 Follow-up Enterprise Surveys (CFES) compiled by the World Bank. These surveys are follow-ups of the World Bank Enterprise Surveys (WBES). For the CFES, the World Bank re-contacted the firms surveyed in previous rounds of the WBES to obtain COVID-19 related information on the operations and adjustments brought about by the firms. Hence, we merge the CFES

database with the WBES database to obtain a detailed data set on 33 economies, containing information on aspects of COVID-19 and other standard information collected in the WBES. The merged data set provides rich and firm-level information on firm-specific indicators such as firm age, firm size, ownership affiliation, international trade status, and financial constraints, along with information on the impacts of COVID-19. The final analysis is conducted on a cross-sectional sample of 6,891 firms from 33 economies across the world. Table 1 presents the economies covered in our analysis. It is important to note that the choice of countries is driven by the data available in the CFES database.

Table 1: Country Profile

Country	Observations	Country	Observations
Albania	256	Malta	175
Belarus	509	Moldova	115
Bosnia & Herzegovina	219	Mongolia	126
Chad	16	Montenegro	126
Croatia	160	Morocco	173
Cyprus	75	Mozambique	209
El Salvador	243	Nicaragua	164
Estonia	111	Niger	54
Georgia	152	North Macedonia	122
Greece	225	Poland	253
Guatemala	161	Portugal	253
Guinea	71	Russia	1,061
Honduras	106	Serbia	273
Italy	109	Slovenia	65
Kazakhstan	700	Togo	24
Latvia	77	Zimbabwe	444
Lithuania	64		

Source: Compiled from the World Bank Enterprise Survey and COVID-19 Follow-up Enterprise Surveys. World Bank (n.d.), Enterprise Surveys, <http://www.enterprisesurveys.org> (accessed 20 March 2022).

2.2. Empirical Model

Our empirical strategy is to estimate the following model, which attempts to explain firm survival from the perspective of their resilience and robustness for both GVC and non-GVC firms during the pandemic phase, controlling for other firm-level and country-level determinants of a firm's survival.

$$Firm\ Survival_{ict} = \Phi(\alpha + \beta_1 GVC_{ict} + \beta_2 Firm\ factors_{ict} + \gamma_t + \omega_j + \zeta_c + \mu_{ict}) \quad (1)$$

where subscripts i , c , and t denote the firm, country, and year in which the survey was conducted, respectively.

First, with regard to our dependent variable, we follow the existing studies in capturing firm survival through two specific ways: the first is to capture survival in terms of firm resilience, which reflects the ability of a firm to bounce back after a shock; the second is through a firm's robustness, which typically reflects the ability of a firm to withstand the shock. Put differently, this can be measured by the firm's operating status during the pandemic. Considering the above definitions, we specifically proxy firm resilience using its sales response, where we create a dichotomous variable which identifies a firm to be resilient if its sales performance either remained the same or improved since the onset of the pandemic. Similarly, a firm is considered robust if the firm continued its operations, and not robust if it experienced closure. Hence, the equation above will be estimated using a probit model considering the binary nature of our dependent variables.

One of the aims of our empirical strategy is to capture the dynamic effects by identifying firms' resilience during the pandemic relative to before the pandemic. We achieve this by relying on how our dependent variable is measured. More specifically, the data we use from the CFES allow us to capture *changes in a firm's sales due to the pandemic* as the dependent variable. This implies that a firm is resilient if its sales in the survey month (e.g. in 2022) remained the same or increased in comparison to what they were during the same month in 2019/2020. In essence, then, our measure leverages the survey question to draw out information based on the change in sales. Hence, it is important to reiterate that our measure of resilience is not static in nature, and provides insight into how the pandemic specifically impacted firms.

The only caveat that needs to be borne in mind is that this still leaves us with a pseudo panel because we can only extract information on sales resilience for previous years but not the other firm characteristics because they are not matches between the WBES and the CFES. While this is admittedly a limitation of data availability, we believe that this does not take away the novelty of our proposed analysis considering how our findings still hold valuable lessons for policymakers about whether firms plugged into GVCs experienced greater resilience or vulnerability when confronted with the pandemic.

Our key explanatory variable of interest is that of firm integration in GVCs. We capture GVC firms as simultaneous exporters and importers following the literature. The existing literature has resorted to multiple ways of defining what constitutes a GVC firm.

For instance, according to Harvie, Narjoko, and Oum (2010), a firm participates in a GVC if it supplies to any tier of the supply chain and if the firm either imports intermediates or exports. Wignaraja (2013) identified a GVC firm as a sustained exporter with at least 40% of its sales exported directly. While both indicators place a higher emphasis on firms' exporting aspects compared with their importing activities, the recent literature on GVCs defines a GVC firm as one that is involved in international markets (either importing or exporting or as two-way traders). It is pertinent to note that the definition of GVCs cannot merely concern only exporters as it is inconsistent with the idea that a firm producing a good under the GVC framework involves the participation of at least two countries, thereby making them two-way traders, i.e. firms that export and import simultaneously (Antràs, 2020; Reddy, Sasidharan, and Thangavelu, 2023; Colovic, Misganaw, and Assefa, 2022; Gopalan, Reddy, and Sasidharan, 2022; Reddy, Chundakkadan, and Sasidharan, 2021; Urata and Baek, 2020; Rigo, 2021; DAVIS and Zaki, 2020; Ehab and Zaki, 2020; World Bank, 2020). To that end, we define a firm to be a GVC firm if it is a simultaneous exporter and importer (see Gopalan, Reddy, and Sasidharan, 2022 for a discussion).

Our model also captures various firm-specific factors that contribute to firm resilience and robustness to include variables such as the formal bank financing available to a firm, firm size, firm experience proxied by its age, a firm offering training to its employees, firm ownership (sole proprietor vs others), agglomeration-based location classification, and whether the firms are foreign-owned or domestic.⁵ The firm-level control variables employed in our analysis are in line with recent studies on resiliency. For instance, Todo et al. (2022) also controlled for the age, size, and ownership of the firm while exploring the supply chain resiliency of firms from ASEAN and India. Finally, we also account for sectoral/industrial, survey year, and country fixed effects that capture the changes in firm resilience/robustness during the first and second waves of the pandemic across sectors/countries. Table 2 summarises the definitions of variables used in the empirics.

⁵ We thank Professors Kimura and Urata for this valuable suggestion.

Table 2: Definitions of Variables

Variable	Definition	Source
Robustness	=1 if the establishment did not close temporarily during the pandemic & 0 otherwise	CFES
Sales resilience	=1 if after the onset of the pandemic, firm sales increased or remained the same; 0 if the sales decreased	CFES
Financial access	=1 if firm has a line of credit & 0 otherwise	WBES
Age	Number of years firm has been in incorporation	WBES
Capital city	=1 if firm is in the capital city; 0 otherwise	WBES
GVC	=1 if firm exports & imports simultaneously; 0 otherwise	CFES
Size	Log of number of workers in the firm	WBES
Training	=1 if firm provides training to its employees; 0 otherwise	WBES
Sole	=1 if firm is solely owned; 0 otherwise	WBES
Foreign	=1 if firm is foreign owned; 0 otherwise	WBES

CFES = COVID-19 Follow-up Enterprise Surveys, GVC = global value chain, WBES = World Bank Enterprise Surveys.

Source: Authors, based on World Bank (n.d.), Enterprise Surveys, <http://www.enterprisesurveys.org> (accessed 20 March 2022).

Based on the foregoing discussion, it is unclear whether we can expect firms that are more engaged in GVC-oriented trade to be more or less resilient/robust, as the effect could go in either direction. With regard to the other explanatory variables, we expect firms (i) having greater access to finance, (ii) that are older and larger, (iii) providing training to their employees, and (iv) belonging to business groups and smaller agglomerates, to be more resilient/robust to the disruptions caused by the pandemic.

3. Empirical Results

3.1. Summary Statistics

Table 3 presents the descriptive statistics of the variables used in this study. From the table, we can observe that close to 58% of the firms in our sample were robust to the pandemic shock, i.e. they did not close temporarily during the pandemic. However, only 31% of the firms showed resilience, i.e. only 31% of the firms were able to maintain or increase their level of sales compared with pre-pandemic levels. The high level of robustness and low level of resilience indicates that although many firms in our sample were able to sustain the pandemic shock in terms of business closure, they were not resilient enough to withstand the global economic slowdown. We can also note that only 38% of the firms have access to finance from a bank or other financial institution.

Table 3 also highlights that the average age of the sample firm is 22 years, and about one-quarter of them operate from capital cities. In terms of our measure of GVCs, we find that, by our broader metric of GVCs, about 15% of the firms can be characterised as GVC firms. We can also note that about 35% of the sample firms provide training to their workers. In terms of ownership, we observe that in our sample, less than 2% of the firms are sole proprietor firms and close to 7% of the firms are foreign-owned, with most of the firms in the sample being domestic firms.

Table 3: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Source
Robustness	6,891	0.582	0.493	0	1	WBES Follow-up Surveys
Sales resilience	6,824	0.312	0.463	0	1	WBES Follow-up Surveys
Financial access	6,891	0.389	0.488	0	1	WBES
Age	6,891	22.045	16.672	2	207	WBES
Capital city	6,891	0.253	0.435	0	1	WBES
GVC	6,891	0.149	0.356	0	1	WBES Follow-up Surveys
Size	6,891	3.388	1.309	.693	10.309	WBES
Training	6,891	0.345	0.475	0	1	WBES
Sole	6,891	0.013	0.113	0	1	WBES
Foreign	6,891	0.068	0.252	0	1	WBES

GVC = global value chain, Std. Dev. = standard deviation, WBES = World Bank Enterprise Surveys.

Source: Authors, based on World Bank Enterprise Surveys, <http://www.enterprisesurveys.org> (accessed 20 March 2022).

3.2. Baseline Results

Tables 4 and 5 show the baseline results from the probit estimates. We start by showing results for how GVC firms compare with respect to non-GVC firms when it comes to robustness, followed by a discussion of the results for firm resilience. From the table, we observe a positive and significant coefficient on our baseline measure of GVCs, highlighting a positive association between GVC integration and firms' robustness. Put differently, the likelihood of a firm being more robust is higher if it is a GVC firm than otherwise. Interpreting the results in terms of marginal effects, we can say that GVC firms were 5%–15% more likely to be robust to the pandemic shock compared with non-GVC firms, which is a striking result from a policy perspective, considering its economic significance.

Table 4: Baseline Results – Robustness and GVC Participation

Variables	(1) Robustness	(2) Robustness	(3) Robustness	(4) Robustness
GVC	0.150*** (0.0175)	0.154*** (0.0175)	0.0509*** (0.0169)	0.0509*** (0.0169)
Financial access	0.0497*** (0.0121)	0.0485*** (0.0121)	0.00970 (0.0115)	0.00970 (0.0115)
Age	0.000564 (0.000367)	0.000718* (0.000368)	0.000768** (0.000376)	0.000768** (0.000376)
Size	0.0208*** (0.00501)	0.0207*** (0.00500)	0.0319*** (0.00478)	0.0319*** (0.00478)
Training	0.0231* (0.0129)	0.0238* (0.0128)	0.00891 (0.0123)	0.00891 (0.0123)
Sole	-0.349*** (0.0594)	-0.335*** (0.0593)	0.00755 (0.0562)	0.00755 (0.0562)
Foreign	0.0312 (0.0237)	0.0288 (0.0236)	-0.000150 (0.0219)	-0.000150 (0.0219)
Capital city	-0.0439*** (0.0134)	-0.0383*** (0.0134)	-0.0466*** (0.0135)	-0.0466*** (0.0135)
Log private credit to GDP				0.309*** (0.0540)
Industry FE	Yes	Yes	Yes	Yes
Survey year FE	-	Yes	Yes	Yes
Country FE	-	-	Yes	Yes
Observations	6,891	6,891	6,891	6,891

FE = fixed effects, GDP = gross domestic product, GVC = global value chain.

Note: Marginal effects are reported. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors.

In terms of financial variables, we observe that firms having access to finance showed more robustness. We can also note that more experienced firms showed greater robustness during the pandemic shock relative to younger firms. In terms of size, we can see that larger firms turned out to be more robust. With regard to ownership, both sole proprietorship and foreign ownership have insignificant results,⁶ highlighting that ownership heterogeneity amongst firms did not appear to play a major role in influencing firms' robustness. Finally, we note that firms from small agglomerates exhibit greater robustness compared with firms operating in larger agglomerates (i.e. the capital city). Our baseline results thus document various factors associated with firm robustness, in addition to underlining the point that

⁶ The insignificant coefficient of foreign ownership could be attributed to a lower sample representation of foreign firms, as less than 7% of our sample firms are foreign firms.

GVC firms showcased greater robustness during the pandemic phase compared with firms not plugged into GVCs.

Next, we examine the resiliency aspect of firms and estimate our baseline model with firm resilience as the dependent variable. Table 5 documents these results of our probit estimation. From the table, we can yet again note a positive coefficient on GVCs, highlighting the important point that firms with a high probability of being more resilient and robust turned out to be GVC firms relative to non-GVC firms. However, interestingly, the coefficient turns statistically insignificant in the presence of industry, year, and country fixed effects. These results, as shown in columns 1, 2, and 3, highlight the possibility of industry and country heterogeneity playing a key role in firms' resilience. As a result, we probe this deeper to uncover the heterogenous impacts, mainly in terms of industries/sectors.

Table 5: Baseline Results – Resilience and GVC Participation

Variables	(1) Resilience	(2) Resilience	(3) Resilience	(4) Resilience
GVC	0.0758*** (0.0157)	0.0819*** (0.0156)	0.0255 (0.0160)	0.0255 (0.0160)
Financial access	0.0121 (0.0115)	0.0104 (0.0114)	-0.00135 (0.0115)	-0.00135 (0.0115)
Age	- 0.00101*** (0.000348)	-0.000782** (0.000347)	-0.000192 (0.000370)	-0.000192 (0.000370)
Size	0.0337*** (0.00465)	0.0336*** (0.00462)	0.0316*** (0.00470)	0.0316*** (0.00470)
Training	-0.00783 (0.0122)	-0.00693 (0.0121)	-0.00273 (0.0123)	-0.00273 (0.0123)
Sole	-0.164*** (0.0634)	-0.142** (0.0628)	0.0723 (0.0662)	0.0723 (0.0662)
Foreign	0.0295 (0.0219)	0.0257 (0.0217)	0.0394* (0.0212)	0.0394* (0.0212)
Capital city	-0.101*** (0.0132)	-0.0932*** (0.0132)	-0.0336** (0.0140)	-0.0336** (0.0140)
Log private credit to GDP				0.234*** (0.0645)
Industry FE	Yes	Yes	Yes	Yes
Survey year FE	-	Yes	Yes	Yes
Country FE	-	-	Yes	Yes
Observations	6,824	6,824	6,824	6,824

FE = fixed effects, GDP = gross domestic product, GVC = global value chain.

Note: Marginal effects are reported. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors.

Before we do so, it is also useful to note from Table 5 that the remaining results appear to be broadly consistent with what we found in our baseline results shown in Table 4. For instance, similar to firm robustness, we also observe that larger firms and firms from small agglomerates performed better in terms of resilience compared with smaller firms and firms operating in big agglomerates.

3.3. Accounting for Sectoral Heterogeneity

3.3.1. Heterogeneity Across Sectors: Manufacturing vs Services

As discussed earlier, our sample encompasses firms from different industries. At a broader level, these firms can be characterised as firms operating in the manufacturing and services sectors. In this regard, the modus operandi of firms in manufacturing and services differ substantially. As a result, incorporating industry heterogeneity while examining the resilience and robustness dynamics becomes essential. Hence, in the following subsections, we examine how firms from manufacturing and services performed in terms of their resilience and robustness, and how GVC dynamics played a part in it.

Table 6 documents the findings of our empirical analysis, examining the robustness of firms from manufacturing and services. From the table, we observe that the coefficient of GVC, though positive, turns insignificant in our full model specification. In terms of finance, we observe a positive coefficient, although it remains insignificant – indicating that access to finance is not significantly associated with robustness of either manufacturing or services firms. In terms of firm size, we note that larger firms were more robust and firms from small agglomerates also showcased more robustness.

Table 6: Robustness and GVC Participation – Manufacturing vs Services

Variables	Manufacturing				Services			
	(1) Robustness	(2) Robustness	(3) Robustness	(4) Robustness	(5) Robustness	(6) Robustness	(7) Robustness	(8) Robustness
GVC	0.0490** (0.0197)	0.0552*** (0.0195)	0.00730 (0.0206)	0.00730 (0.0206)	0.118*** (0.0271)	0.121*** (0.0270)	0.0392 (0.0278)	0.0392 (0.0278)
Financial access	0.0217 (0.0164)	0.0215 (0.0163)	0.00274 (0.0167)	0.00274 (0.0167)	0.00630 (0.0166)	0.00298 (0.0165)	0.00142 (0.0163)	0.00142 (0.0163)
Age	-0.00121*** (0.000449)	-0.000952** (0.000446)	-0.000545 (0.000492)	-0.000545 (0.000492)	-0.000834 (0.000560)	-0.000631 (0.000558)	0.000402 (0.000581)	0.000402 (0.000581)
Size	0.0452*** (0.00633)	0.0492*** (0.00627)	0.0499*** (0.00670)	0.0499*** (0.00670)	0.0301*** (0.00686)	0.0267*** (0.00687)	0.0198*** (0.00673)	0.0198*** (0.00673)
Training	0.00340 (0.0179)	0.00144 (0.0177)	0.00170 (0.0182)	0.00170 (0.0182)	-0.0152 (0.0170)	-0.0119 (0.0169)	0.00317 (0.0171)	0.00317 (0.0171)
Sole	-0.205** (0.0965)	-0.170* (0.0954)	0.0603 (0.0997)	0.0603 (0.0997)	-0.229*** (0.0824)	-0.212*** (0.0819)	0.0408 (0.0879)	0.0408 (0.0879)
Foreign	0.0301 (0.0313)	0.0299 (0.0310)	0.0432 (0.0307)	0.0432 (0.0307)	0.0243 (0.0313)	0.0183 (0.0312)	0.0448 (0.0303)	0.0448 (0.0303)
Capital city	-0.118*** (0.0202)	-0.107*** (0.0201)	-0.0356 (0.0219)	-0.0356 (0.0219)	-0.0978*** (0.0176)	-0.0909*** (0.0177)	-0.0347* (0.0185)	-0.0347* (0.0185)
Log private credit to GDP				0.104 (0.111)				0.276*** (0.0853)
Industry FE	-	-	-	-	-	-	-	-
Survey year FE	-	Yes	Yes	Yes	-	Yes	Yes	Yes
Country FE	-	-	Yes	Yes	-	-	Yes	Yes
Observations	3,464	3,464	3,433	3,433	3,360	3,360	3,360	3,360

FE = fixed effects, GDP = gross domestic product, GVC = global value chain.

Notes: All columns report marginal effects. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors.

Having explored the across-sector heterogeneity between manufacturing and services in terms of robustness, we now proceed by examining it in terms of resilience. Table 7 documents the results of this analysis, where firm resilience becomes our dependent variable. Interestingly, we find that at a very broad level, GVC firms from both services and manufacturing have a greater likelihood of being resilient compared with non-GVC firms. However, the results are stronger for the services sector in terms of statistical significance, possibly highlighting that GVC firms in the services sector were likely to be more resilient to the pandemic shock relative to their counterparts in manufacturing. Clearly, this could mask potential within sectoral variations, which we check in the next subsection.

The results also reveal the relative insignificance of the financial constraint variable across both manufacturing and services firms. Further, across both subsets of firms, we observe that larger firms and firms from smaller agglomerates exhibited greater resilience, similar to the findings reported in our baseline estimation. Hence, from our analysis, we observe that trade integration in the form of GVC participation is a key differentiating factor between manufacturing firms' resilience and services firms' resilience.

Table 7: Manufacturing vs Services – Resilience and GVC Participation

Variables	Manufacturing				Services			
	(1) Resilience	(2) Resilience	(3) Resilience	(4) Resilience	(5) Resilience	(6) Resilience	(7) Resilience	(8) Resilience
GVC	0.128*** (0.0215)	0.130*** (0.0215)	0.00667 (0.0213)	0.00667 (0.0213)	0.166*** (0.0318)	0.170*** (0.0316)	0.0870*** (0.0306)	0.0870*** (0.0306)
Financial access	0.0874*** (0.0172)	0.0873*** (0.0172)	0.0246 (0.0164)	0.0246 (0.0164)	0.0210 (0.0177)	0.0176 (0.0176)	0.000823 (0.0169)	0.000823 (0.0169)
Age	0.00134*** (0.000483)	0.00141*** (0.000484)	0.000647 (0.000503)	0.000647 (0.000503)	0.000283 (0.000583)	0.000551 (0.000584)	0.00157*** (0.000599)	0.00157*** (0.000599)
Size	0.00700 (0.00683)	0.00796 (0.00685)	0.0387*** (0.00668)	0.0387*** (0.00668)	0.0466*** (0.00746)	0.0422*** (0.00749)	0.0402*** (0.00710)	0.0402*** (0.00710)
Training	0.0457** (0.0190)	0.0452** (0.0190)	0.0143 (0.0181)	0.0143 (0.0181)	0.0110 (0.0181)	0.0153 (0.0181)	0.0172 (0.0175)	0.0172 (0.0175)
Sole	-0.303*** (0.0862)	-0.296*** (0.0863)	0.0667 (0.0791)	0.0667 (0.0791)	-0.420*** (0.0804)	-0.397*** (0.0799)	-0.0731 (0.0782)	-0.0731 (0.0782)
Foreign	0.0456 (0.0346)	0.0457 (0.0346)	-0.0166 (0.0322)	-0.0166 (0.0322)	0.0131 (0.0339)	0.00393 (0.0336)	0.0112 (0.0316)	0.0112 (0.0316)
Capital city	-0.0642*** (0.0203)	-0.0614*** (0.0204)	-0.0421** (0.0206)	-0.0421** (0.0206)	-0.0298 (0.0185)	-0.0202 (0.0184)	-0.0540*** (0.0187)	-0.0540*** (0.0187)
Log private credit to GDP				0.342*** (0.0879)				0.237*** (0.0727)
Industry FE	-	-	-	-	-	-	-	-
Survey year FE	-	Yes	Yes	Yes	-	Yes	Yes	Yes
Country FE	-	-	Yes	Yes	-	-	Yes	Yes
Observations	3,498	3,498	3,482	3,482	3,393	3,393	3,393	3,393

FE = fixed effects, GDP = gross domestic product, GVC = global value chain.

Notes: All columns report marginal effects. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors.

3.3.2. Heterogeneity Within Sectors

In the previous section, we showed how GVC firms in the services sector turned out to be more resilient compared with GVC firms in the manufacturing sector in terms of statistical significance. We believe that these results should be dissected further to unmask the variations within each sector. Against this backdrop, in the present section, we delve deeper into within-sector heterogeneity.⁷ Specifically, we look at the GVC resilience and robustness nexus at the two-digit International Standard Industrial Classification of All Economic Activities (ISIC) 3.1 level, thereby providing deeper insights at the industry level – going beyond the manufacturing and services dichotomy.

Table 8 presents the results for firm robustness at the two-digit industry level. Given the differentiation impact of GVCs observed in the previous section, we restrict our focus to the GVC variable.⁸ We can observe that GVC firms from food & beverages, wearing apparel, fabricated metals, machinery & equipment, electrical machinery, and medical equipment exhibited greater resilience from the manufacturing sector.⁹ Further, we observe that GVC firms from other transport equipment experienced less robustness, and we also see an insignificant coefficient for motor vehicles. From a services viewpoint, we find that GVC firms from construction, services related to automotives, and land transportation showed greater robustness. Tourism, which is captured by hotels & restaurants and air transport, both yield an insignificant coefficient, yet again highlighting that being integrated in global trade did not benefit firms in terms of robustness.

⁷ We thank Prof. Kimura, and Prof. Urata for this valuable suggestion.

⁸ Results for other variables are available upon request to the authors.

⁹ For brevity, we report only the results for a few selected industries. Results for other industries that are not reported in the table are available upon request to the authors.

Table 8: Robustness at the Two-Digit Industry Level

Manufacturing		Services	
Industry	GVC	Industry	GVC
Food & beverages	0.102**	Construction	0.179*
Textiles	0.161	Sale, maintenance & repair of motor vehicles	0.325**
Wearing apparel	0.131**	Wholesale trade & commission trade	0.181***
Fabricated metals	0.186***	Hotels & restaurants	0.210
Machinery & equipment	0.125*	Land transport	0.314**
Electrical machinery	0.212*	Air transport	-0.038
Medical equipment	0.267*	Post & telecommunication	-0.119
Other transport equipment	-0.223		

GVC = global value chain.

Notes: All columns report marginal effects. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors.

Table 9 documents the results for firm resilience at the two-digit industry level. The results are broadly comparable. From the table, we can observe that firms from the basic and fabricated metals sector showcased greater resilience compared with non-GVC firms in the same sector. In contrast, GVC firms from other transport equipment experienced less robustness – this could be attributed to supply chain shocks in the chip system, which brought the global automotive industry to a standstill. Along similar lines, we observe an insignificant coefficient for motor vehicles as well. With respect to services, we observe that firms from construction and wholesale trade, and computer & related activities, showed more resilience, while as expected, the likes of air transport and hotels & restaurants do not, consistent with the fact that firms from the tourism sector were deeply affected and trade integration did not aid their operations during the pandemic period.

Table 9: Resilience at the Two-Digit Industry Level

Manufacturing		Services	
Industry	GVC	Industry	GVC
Food & beverages	-0.026	Construction	0.131
Textiles	0.131	Sale, maintenance & repair of motor vehicles	0.126
Wearing apparel	0.074	Wholesale trade & Commission trade	0.184***
Basic metals	0.297**	Hotels & restaurants	0.103
Fabricated metals	0.132*	Land transport	0.066
Other transport equipment	-0.203	Air transport	-0.024
		Computer & related activities	0.359**

GVC = global value chain.

Notes: All columns report marginal effects. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors.

3.4. Accounting for Firm Heterogeneity

In the preceding sections, we explored the heterogeneity between the manufacturing and services sectors before taking a detailed look at differences within both sectors. Taking this a step further, we explore heterogeneities at a more granular level, i.e. at the firm level, and examine aspects of firm survival. To this end, we explore firm heterogeneity across three dimensions.

First, having established a robust positive association between GVC participation, firm resilience, and robustness, we delve deeper into this association to understand how different modes of GVC participation, i.e. direct and indirect participation, have implications on the resilience and robustness of firms during the pandemic. To this end, with GVC firms, we identify direct GVC firms as firms that undertook direct exports and imported inputs simultaneously. Similarly, indirect GVC firms are firms that imported inputs, but did not export directly. Both our measures of a direct and indirect GVC firm are binary in nature.

Table 10 presents the results of our probit regressions. From the table, we can observe that direct GVC firms demonstrate a significant positive association between direct GVC participation and firm survival in terms of resilience and robustness. The coefficient turns insignificant, however, for the case of indirect GVC participation. The results indicate that the positive association documented in the baseline results is driven by direct GVC participation of firms, whereas indirect GVC integration does not appear to correlate with firm performance during the pandemic. This could be attributed to greater dependence of the firm-on-firm

performance of the partnering firm in the case of indirect GVC participation. As a result, if the partner firm does not showcase resilience and robustness, the same would likely hold for the primary firm.

Table 10: Resilience and Robustness – Direct vs Indirect GVC Participation

Variables	(1) Robustness	(2) Robustness	(3) Resilience	(4) Resilience
Direct GVC	0.0511*** (0.0185)		0.0382** (0.0171)	
Indirect GVC		0.0270 (0.0250)		-0.0246 (0.0243)
Financial access	0.00986 (0.0115)	0.0106 (0.0115)	-0.00158 (0.0115)	-0.000639 (0.0115)
Age	0.000764** (0.000376)	0.000775** (0.000376)	-0.000201 (0.000370)	-0.000173 (0.000370)
Size	0.0320*** (0.00479)	0.0338*** (0.00473)	0.0311*** (0.00470)	0.0331*** (0.00465)
Training	0.00896 (0.0123)	0.00937 (0.0123)	-0.00286 (0.0123)	-0.00214 (0.0123)
Sole	0.00646 (0.0562)	0.00690 (0.0563)	0.0722 (0.0662)	0.0698 (0.0663)
Foreign	-0.000163 (0.0219)	0.00398 (0.0218)	0.0383* (0.0212)	0.0421** (0.0212)
Capital city	-0.0464*** (0.0135)	-0.0472*** (0.0135)	-0.0335** (0.0140)	-0.0340** (0.0140)
Log private credit to GDP	0.308*** (0.0540)	0.313*** (0.0540)	0.232*** (0.0645)	0.232*** (0.0646)
Industry FE	Yes	Yes	Yes	Yes
Survey year FE	-	Yes	Yes	Yes
Country FE	-	-	Yes	Yes
Observations	6,891	6,891	6,824	6,824

FE = fixed effects, GDP = gross domestic product, GVC = global value chain.

Notes: All columns report marginal effects. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

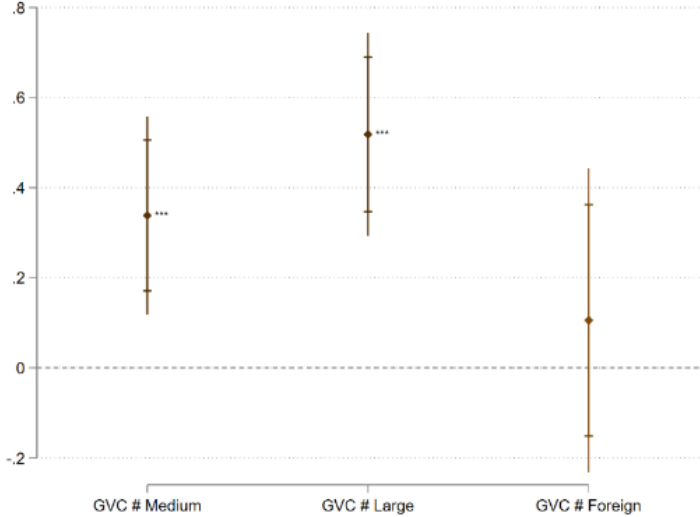
Source: Authors.

Second, we differentiate between small firms, medium-sized firms, and large firms; and examine how the GVC association with resilience and robustness fares when accounting for heterogeneity in firm size. In this regard, it is important to account for differences in firm size, since larger firms have a greater pool of resources compared with smaller firms. These differences play a key role in shaping the resilience and robustness of firms. In our baseline estimates, we observed a positive coefficient on firm size, indicating a positive association between larger firms and resilience and robustness. Consequently, from Figure 1, we observe that medium-sized and large firms that are integrated in GVCs showcase a greater probability

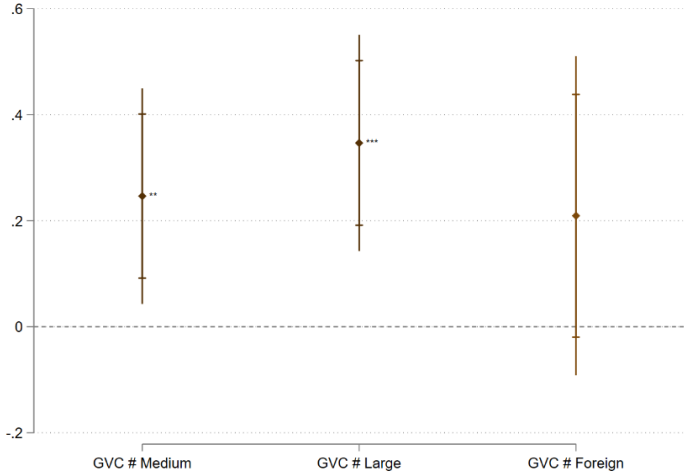
of resilience and robustness compared with smaller GVC firms. The findings reinforce the notion of scale in shaping resilience and robustness during times of unpredictable external shocks. Third, multinationals as lead firms are fundamental in a GVC set-up. However, foreign presence by itself yields insignificant results for firm resilience and robustness. Hence, we interact foreign presence in firms with their GVC participation and find that the impact remains insignificant (Figure 1). From our analysis, we observe that heterogeneity in terms of GVC integration and firm size are important channels associated with greater probability of resilience and robustness amongst our sample firms.

Figure 1: Role of Firm Heterogeneity

(a) Robustness



(b) Resilience



GVC = global value chain.
Source: Authors.

3.5. Sensitivity Checks

A key finding of the present study is the positive association between GVC integration and the survival of firms during the COVID-19 pandemic. To highlight that our results are not sensitive to our identification of GVC firms, we employ an alternative measure to proxy for the supply chain integration of firms. Our alternative measure, analogous to our baseline measure, is binary in nature, but differs with respect to additional restrictions imposed on the baseline measure. More specifically, our alternative measure (GVC-R) is coded as 1 if the firm, in addition to being a simultaneously exporting and importing firm, has an internationally recognised quality certification; and 0 otherwise. Our measure of GVC-R is more restrictive than our baseline measure, as evidenced by the fall in GVC firms in the sample from 14.9% for the baseline measure to 6.0% for the GVC-R. Table 11 reports the results of Equation (1) with the GVC-R as the key explanatory variable. From the table, we note that, similar to our baseline estimates, we continue to observe a significant and positive association between supply chain integration and the resilience and robustness of firms.

Further, we also acknowledge that the COVID-19 pandemic had differential impacts across economies, with varied degrees of lockdown policies, workplace closures, and travel bans, amongst other restrictions, which hampered the domestic operations of firms. We factor this in using the Oxford Stringency Index (Our World in Data, n.d.), which is a composite measure of nine metrics. The index is computed at a daily frequency and ranges from 0 to 100, with a higher score suggesting a stricter response to the pandemic. Given that our sample consists of yearly data, we aggregate the stringency index to arrive at a yearly measure for each country. Countries with a stringency index above average are identified as economies with higher stringency levels and others are grouped into the lower basket. Table 12 documents the results of this subsample analysis. From the table, we observe that the coefficient of GVC remains statistically significant and positive for both firm resilience and robustness, irrespective of the extent of stringency, suggesting that our results are not sensitive to the level of stringency or restrictions faced by an economy during the pandemic.¹⁰

¹⁰ Alternatively, we interact our measure of GVC with the stringency index (yearly) and find that higher stringency was negatively associated with firm resilience and robustness. However, GVC firms showcased greater resilience compared with other firms. The empirical results are available upon request from the authors. We thank Prof. Ghodsi for this valuable suggestion.

Table 11: Sensitivity Check – Alternative Measure of GVC Participation

Variables	(1) Robustness	(2) Robustness	(3) Robustness	(4) Robustness	(5) Resilience	(6) Resilience	(7) Resilience	(8) Resilience
GVC-R	0.219*** (0.0269)	0.220*** (0.0269)	0.107*** (0.0256)	0.107*** (0.0256)	0.0861*** (0.0220)	0.0889*** (0.0218)	0.0397* (0.0218)	0.0397* (0.0218)
Financial access	0.0513*** (0.0121)	0.0503*** (0.0121)	0.00921 (0.0115)	0.00921 (0.0115)	0.0133 (0.0115)	0.0119 (0.0115)	-0.00151 (0.0115)	-0.00151 (0.0115)
Age	0.000501 (0.000368)	0.000650* (0.000369)	0.000715* (0.000376)	0.000715* (0.000376)	- (0.000350)	- (0.000348)	-0.000212 (0.000370)	-0.000212 (0.000370)
Size	0.0198*** (0.00503)	0.0198*** (0.00502)	0.0305*** (0.00480)	0.0305*** (0.00480)	0.0337*** (0.00468)	0.0338*** (0.00465)	0.0312*** (0.00472)	0.0312*** (0.00472)
Training	0.0214* (0.0129)	0.0221* (0.0129)	0.00743 (0.0123)	0.00743 (0.0123)	-0.00792 (0.0122)	-0.00690 (0.0121)	-0.00337 (0.0123)	-0.00337 (0.0123)
Sole	-0.353*** (0.0593)	-0.340*** (0.0591)	0.00588 (0.0561)	0.00588 (0.0561)	-0.168*** (0.0634)	-0.147** (0.0629)	0.0708 (0.0662)	0.0708 (0.0662)
Foreign	0.0357 (0.0237)	0.0339 (0.0237)	-0.000257 (0.0219)	-0.000257 (0.0219)	0.0319 (0.0219)	0.0287 (0.0218)	0.0395* (0.0212)	0.0395* (0.0212)
Capital city	-0.0418*** (0.0134)	-0.0366*** (0.0134)	-0.0452*** (0.0135)	-0.0452*** (0.0135)	-0.100*** (0.0132)	-0.0929*** (0.0132)	-0.0331** (0.0140)	-0.0331** (0.0140)
Log private credit to GDP				0.303*** (0.0540)				0.231*** (0.0645)
Industry FE	-	-	-	Yes	-	-	-	Yes
Survey year FE	-	Yes	Yes	Yes	-	Yes	Yes	Yes
Country FE	-	-	Yes	Yes	-	-	Yes	Yes
Observations	6,891	6,891	6,891	6,891	6,824	6,824	6,824	6,824

FE = fixed effects, GDP = gross domestic product, GVC = global value chain.

Notes: All columns report marginal effects. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors.

Table 12: Resilience and Robustness – Country Level Stringency Index

Variables	High Stringency Index		Low Stringency Index	
	(1) Robustness	(2) Resilience	(3) Robustness	(4) Resilience
GVC	0.118*** (0.0220)	0.0774*** (0.0220)	0.0819*** (0.0270)	0.0649*** (0.0224)
Financial access	0.0372** (0.0164)	0.0173 (0.0174)	0.0193 (0.0175)	-0.00964 (0.0154)
Age	0.00440*** (0.000606)	-7.32e-05 (0.000580)	-0.000950** (0.000484)	-0.000437 (0.000436)
Size	-0.00939 (0.00657)	0.0296*** (0.00683)	0.0467*** (0.00733)	0.0249*** (0.00650)
Training	0.0804*** (0.0180)	0.0358* (0.0187)	-0.00745 (0.0177)	-0.0120 (0.0157)
Sole	-	-		
Foreign	0.0205 (0.0322)	0.00238 (0.0333)	0.0412 (0.0325)	0.0573** (0.0276)
Capital city	-0.0773*** (0.0202)	-0.0898*** (0.0215)	-0.0405** (0.0188)	-0.0468*** (0.0175)
Log private credit to GDP			-0.185*** (0.0619)	0.00634 (0.0580)
Industry FE	Yes	Yes	Yes	Yes
Survey year FE	-	Yes	Yes	Yes
Country FE	-	-	Yes	Yes
Observations	3,280	3,257	3,611	3,565

FE = fixed effects, GDP = gross domestic product, GVC = global value chain.

Notes: All columns report marginal effects. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors.

4. Conclusions and Directions for Future Research

To what extent were firms plugged into GVCs relative to non-GVC firms resilient and robust during the COVID-19 pandemic? How heterogenous were these shocks across sectors and industries, considering the varied levels of exposure to the COVID-19 pandemic? While the consensus is that GVCs have been severely disrupted during the pandemic, there is hardly any firm-level empirical evidence comparable across countries that can shed light on whether GVC firms have a greater likelihood (relative to non-GVC firms) of being less resilient and robust. Using the World Bank's COVID-19 Follow-up Enterprise Survey data, we found representative indicators capturing both resilience and robustness at the firm level during the pandemic phase to empirically test if GVC firms withstood the shock better than non-GVC firms. We also shed light on other important firm-level determinants of robustness and resilience.

Our empirical results have shown that GVC firms showcased greater robustness and resilience during the pandemic phase compared with other firms. We also find notable variations in terms of the degree of resilience and robustness across and within industries. At a very broad level, although we find GVC firms from both the services and manufacturing sectors showcasing resilience, the results turned out to be stronger for the services sector. However, within the industries, we find that GVC firms within sectors like publishing and printing revealed greater resilience compared with those from transport equipment, while in the services sector, firms from construction and wholesale trade showed greater resilience compared with GVC firms in air transport and hotels & restaurants.

Despite a robust set of empirical exercises, our study is not free from limitations. First, the absence of panel data restricts us from establishing causal links between GVC participation and the resilience and robustness of firms. Second, we are unable to undertake survival analysis due to lack of panel data, resulting in the absence of information on the entry and exit of firms, which is pivotal for undertaking survival analysis. With greater data availability, both these options represent promising avenues for future research which could hold significant policy implications.

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