Supply Chain Disruptions, Firm Strategies, and Resilience: Evidence from European Firms

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Abstract

This paper leverages detailed firm-level survey responses matched with balance sheet data to examine the impact of supply chain disruptions on firm performance and the strategic responses of managers to adverse shocks. The findings indicate that proactive management significantly reduces the magnitude and persistence of supply chain shocks. Strategies such as inventory stockpiling, digitalization, and trade openness and near-shoring – rather than reshoring – are among the most effective in enhancing firm resilience. However, financial constraints not only limit firms' ability to implement these strategies but are also exacerbated by supply chain disruptions, underscoring the need for policies that support supply chain adaptation and investment in resilience-enhancing measures.

Keywords: Supply Chain Disruptions, Firm Resilience, Managerial strategy, Global Value Chains, Financial Constraints, COVID-19

JEL classification: F14, F23, L25, L60, D22

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1 Introduction

The fragmentation of production across borders has reshaped global trade, allowing firms to specialize in core competencies and source goods from the most efficient producers worldwide (Antràs, 2020).

Global value chains (GVCs) offer significant efficiency gains but also introduce new vulnerabilities. Firms embedded in international supply networks face heightened exposure to trade disruptions, transportation bottlenecks, and macroeconomic volatility (Baldwin and Freeman, 2022). Indeed, supply chain (SC) disruptions have become the new normal (Grossman et al., 2021). The COVID-19 pandemic and subsequent geopolitical shocks have further highlighted these risks, triggering widespread supply chain disruptions that have forced firms to re-assess their sourcing strategies, financial resilience, and operational flexibility.

In response to these events, a fast-growing literature has started investigating global supply chains, mostly from a theoretical point of view and focusing on macroeconomic efficiency and optimal policy (e.g., Kopytov et al., 2024, Grossman et al., 2024, and Grossman et al., 2024). However, very little is known about the specific strategic responses taken by managers in response to these shocks and how these actions affect performance and resilience. This creates an important knowledge gap, as existing work might be of limited guidance for managers and practitioners interested in learning about concrete strategies to face supply chain disruptions.

This paper is an attempt at filling this gap by leveraging confidential firm-level data from the latest waves of the European Investment Bank General Survey (EIBGS), matched to ORBIS, from Bureau van Dijk. We focus on an unbalanced panel constructed from the survey of approximately 12,000 EU firms per year in manufacturing, construction, services, and utilities between 2017 and 2024.

Based on these data, the paper investigates the relationship between SC disruptions, managerial responses, and firm-level resilience to shocks. Specifically, we examine how firms navigate SC shocks since the COVID-19 pandemic, the specific actions they undertake to mitigate these shocks, and the long-term implications for their business activities

and financial performance.

The analysis employs a multi-stage empirical approach in order to maximize the exploitation of the data. First, we present the results of an event study regression in Section 3, which we use to estimate the impact the COVID-19 shock on firm turnover and employment. The main message from this part of the analysis is that while on average the COVID-19 shock had a negative and persistent impact on firm performance, firms that took actions aimed at transforming their supply chain managed to reduce the magnitude and persistence of the shock.

Next, in Section 4 we examine more in detail the relationship between different kinds of supply chain shocks and firms' strategic responses. The evidence from this part of the analysis suggests that firms experiencing supply chain shocks responded by increasing inventory stockpiling and investing in digital inventory and inputs tracking, albeit with a dampening effect from supplier price shocks. Moreover, they remained committed to international trade, with some indications of a shift toward both near-shoring and diversification, rather than reshoring.

In Section 5, we turn to evaluating the consequences of the actions taken by managers in terms of firm resilience to shocks. We find that firms taking action to face supply chain shocks by increasing inventory stockpiling and digitalize were more likely to be resilient, but these actions did not involve near-shoring or diversification efforts. Instead, we find that increasing the number of exporting destinations in the EU, thus relying more on the single market, also contributed significantly to firm resilience.

Finally, Section 6 examines what firm characteristics correlate with proactive supply chain management, specifically in terms of firm size and financial constraints, and how supply chain shocks impact firms. We find that firms that experienced supply chain disruptions were more likely to report financial constraints, and that there is a cumulative effect when firms experience multiple types of supply chain shocks. Yet there is no evidence of an impact on firm turnover, suggesting the prioritization of performance over financial health in the face of supply chain obstacles. The relationship between supply chain actions and financial constraints is more nuanced.

The remainder of this paper is structured as follows: Section 1.1 discussed the related literature; Section 2 presents the data sources and variables used in our analysis. The main analysis is in Sections 3, 4, 5, and 6. Section 7 concludes with a discussion of the implications of our findings for managers and policymakers.

1.1 Related Literature

Previous contributions from the management literature have examined the role of systematic risk in supply networks (Osadchiy et al., 2016). Ho et al. (2015) review research on supply chain risk management, while Kamalahmadi and Parast (2016) focuses explicitly on the business literature.

However, existing work does not capture the recent technological and policy developments that took place in the context of the latest wave of supply chain disruption induced by the COVID-19 pandemic.

The contribution of this paper is re-examining the issue in light of the current economic and policy outlook, as well as the new possibilities offered by new technologies.

El Baz et al. (2023) reviews more recent contributions and provides a novel quantitative assessment. The World Economic Forum has also published a 'resiliency compass' (WEF, 2021), based on a survey of 400 operations and supply chain executives to develop an updated framework for resilience building.

However, the more recent work focuses on narrow industries and is based on small survey samples, which casts doubts on the external validity of the findings. This paper contributes to filling this gap by examining the managerial responses of managers to supply chain shocks in a much larger survey covering manufacturing and non-manufacturing industries.

2 Data

2.1 EIB Surveys

The EIBGS dataset comprises an unbalanced panel of approximately 12,000 firms across the EU per year since the 2016 survey wave, along with 800 US firms included from the 2019 wave onward. Firms are matched to ORBIS using data from the year preceding each survey wave, though some survey questions pertain more directly to the wave year itself. The sectoral composition remains relatively stable over time, with around 30% of firms in manufacturing (NACE C), 26% in services (NACE G/I), 20% in construction (NACE F), and 23% in other sectors (NACE D/E/H/J), with year-to-year variation of approximately 1%.

We are primarily interested in the 2020, 2021, and 2022 EIBGS questions on the impact of COVID and firms' supply chain responses, a more detailed set of questions on supply chain disruptions included in EIBGS since the 2022 wave, and questions on the strategies used to address them included since the 2023 wave.

Each wave of the EIBGS also collects data on firm turnover, employment, assets, wage bill, profit margin, investment, and various constraints or market perceptions, some of which are discussed and utilized in the analysis below.

Since 2023 there is also a new questionnaire on supply chains (SUCH survey) conducted by the EIB on a smaller sample of 1,811 firms, with one year of data avialable as of now. This survey expands on the supply chain questions in the EIBGS, adding questions on top source and export countries, concerns when finding new suppliers, export activity, and more. While 546 firms appear in both surveys, the SUCH survey does not include broader EIBGS questions beyond those directly related to supply chains in that year. Although the EIBGS remains the primary focus of this study, insights from the SUCH survey are briefly incorporated into the discussion where relevant.

2.1.1 EIBGS Results of SC relevant questions

2020 shocks (specifying since 2020 or due to COVID-19): 54% of firms reported reducing employment due to COVID-19 (q64, 2020 wave), while 16% expected a permanent reduction in employment (q65_4, 2020 & 2021 waves). 31% of firms anticipated long-term impacts on their supply chains, such as changes in organizational structure (q65_2, 2020 & 2021 waves). Specifically, 38% of firms reported this expectation in 2020, compared to 33% in 2021. Additionally, 48% of firms cited a COVID-induced sales shock leading to decreased sales since 2020 (q65a, 2021 wave). In response to the crisis, 15% of firms transformed their supply chains (q70_2, 2021 & 2022 waves), with 11% reporting such adjustments in 2021 and 17% in 2022. The question on supply chain transformation is asked as "And as a response to the Covid-19 pandemic, have you taken any actions or made investments to ...?" which has the sub-question: "transform your supply chain (bring more stages to the same location or closer to your business's home country)." This question will be used to identify a subset of firms that took proactive supply chain action in response to the COVID-19 shock.

2021, 2022, and 2023 SC obstacles and SC actions: Since the 2022 wave, questions have been asked each year on supply chain disruptions across multiple dimensions, including logistics, materials, and regulatory barriers (q75_1/2/3, 2022 wave; q75_4/5/6/7/8/9, 2023 & 2024 waves). Beginning in the 2023 wave, the survey introduced questions on firms' sourcing strategy adjustments (q76a_1/2/3/4/5, 2023 & 2024 waves). Table 1 provides a detailed summary of these survey questions. Notably, in the 2022 wave, the three questions on material shortages were consolidated into a single item, as were the two questions on regulatory and customs-related barriers.

2.2 Matching with ORBIS

For each survey year of the EIBGS, around 5,000 firms are included in the following year, a few thousand in the year after that, and diminishing from there, as shown in figure 1. This structure allows for both cross-sectional analysis, maximizing the number of firms available for any given survey question, and panel analysis, leveraging firms observed

Table 1: Key Survey Results

The impact of COVID-19 has been:			**since 2020**
q64. a reduction in employment			54%
q65_4. an expected permanent reduction in employment			16%
q65a. decreased sales or turnover			48%
q65_2. an expected long term impact on supply chain (e.g. different organizations, not necessarily negative)			31%
q70_2. actions to transform your supply chain (e.g. bring more stages to the same location or closer to home country)			15 %
q75. Since the beginning of... were any of the following an obstacle?	**2021**	**2022**	**2023**
Access to commodities or raw materials (e.g., steel, copper, fossil fuels, lithium, etc.)		51%	36%
Access to semiconductors and microchips		26%	18%
Access to other components, semi-finished products, services, or equipment		47%	33%
Access to materials (any of the above)	68%	63%	48%
Disruptions of logistics and transport	68%	53%	44%
Compliance with new regulations/certifications	35%	45%	46%
Changes in customs & tariffs (importers and exporters)		41%	40%
Any (of the above) shock	78%	80%	73%
q76a. Since the beginning of... has or the firm is planning to:		**2022**	**2023**
increase stocks and inventory		27%	21%
invest in digital inventory and inputs tracking		19%	17%
reduce share of goods or services imported (importers)		10%	8%
reduce imports from outside the EU and substitute with EU imports (importers)		15%	15%
diversify or increase the number of source countries (importers)		26%	20%
Any (of the above) action		46%	39%

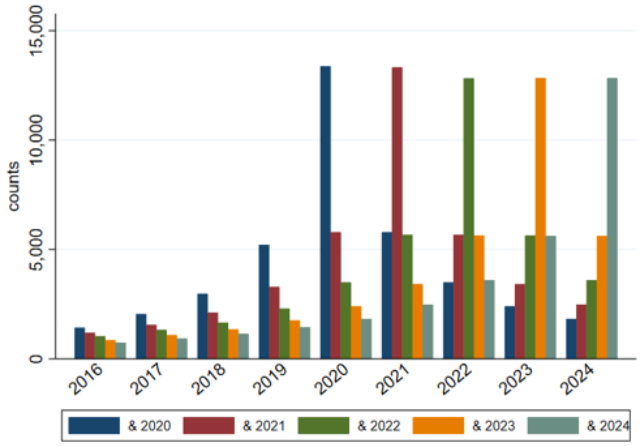
Note: Percentage out of all firms that answered, numbering around 12,000 per year (or around 6,000 to 7,000 if specifying importers and exporters). Questions are not industry specific.

across multiple years. Since some EIBGS questions capture shocks tied to specific years, the EIB has merged the survey data with ORBIS, enabling the incorporation of complementary financial metrics and an assessment of firms' financial positions before and after their inclusion in the EIBGS.

Various panels can be created depending on the EIBGS wave of interest and the matched ORBIS data that has been made available to us by the EIB. For the 2023 wave of EIBGS, mostly corresponding to the firm-year 2022, we have access to a balanced ORBIS panel spanning 2017 to 2022 for 7,521 matched firms. For firms in the 2021 wave

of EIBGS, mostly corresponding to the firm-year 2020, we have access to a balanced ORBIS panel spanning 2017 to 2022 for 2,389 matched firms (a lower number due to recent years not yet updated for firms only in previous waves).

Figure 1



Note: The counts are of how many firms are in both the year indicated in the legend as well as the year indicated on the x-axis. For example, the blue line on the x-axis for 2022 indicates the total number included in both the 2022 wave and the 2020 wave.

2.3 Firm Performance and Financial Stress

In this study, we are interested in analyzing the effects of the COVID-19 shock, as well as the subsequent supply chain shocks and firm strategies, on firm performance, specifically measured by log turnover.

Table 2: Summary Statistics of Key Variable from OBIRS

	Median	Mean	SD	Max	Min
Turnover	3.18E+06	5.50E+07	7.72E+08	1.20E+11	0
Turnover (log)	15	15.127	2.231	25.511	0
Working Capital / Assets	0.206	0.227	0.254	0.872	-0.51
Cash and Equivalents / Assets	0.08	0.151	0.178	0.797	0
EBIT / Assets	0.052	0.066	0.167	0.632	-0.715
Shareholder Funds / Assets	0.417	0.395	0.37	0.965	-1.506
Turnover / Assets	1.5	1.86	1.497	8.656	0.006
Observations	375,551				

Note: Negative values for turnover replaced with zeros. The ratios are winsorized at the 1st and 99th percentile.

The EIBGS survey data also contains questions on financial constraints. These include "Do you think that each of the following will improve, stay the same, or get worse over

the next 12 months?" for both availability of internal finance (q23_1) and availability of external finance (q23_2), as well as "Thinking about your investment activities in [ADD COUNTRY OF INTERVIEW], to what extent is each of the following an obstacle? Is it a major obstacle, a minor obstacle or not an obstacle at all?" where one sub-question is "availability of finance" (q38_8). Note that these questions are more of a t+1 response, or a one-year lag relative to the questions on shocks and actions that refer to the previous year. Table 3 contains counts of each response for these questions for the waves 2018 to 2024, simplified to binary variables equal to 1 if "improve" or "stay the same" and equal to 0 if "get worse" for both availability of external finance and availability of internal finance, and for the availability of finance, equal to 1 if "not an obstacle at all" and 0 if "a major obstacle" or "a minor obstacle". This allows a directional interpretation similar to Z-score or turnover.

Table 3: Financial Constraints EIBGS Questions

wave:	2018	2019	2020	2021	2022	2023	2024
q23_1 Internal fin. (improve or same)	92%	92%	67%	89%	82%	85%	88%
q23_2. External fin. (improve or same)	91%	90%	72%	86%	75%	77%	87%
q38_8 Availability of fin. (not an obstacle)	52%	52%	50%	49%	51%	52%	53%

Note: Percentage out of all firms that answered, numbering around 12,000 per year.

3 Shocks and Managerial Responses

As a starting point, we assess the impact of the COVID-19 shock on firm performance and how proactive supply chain action by managers mitigated the shock.

3.1 Empirical Strategy

The survey data identify whether COVID led to a permanent reduction in employment through a question (q65_4) asked in both the 2020 and 2021 waves. We focus on this question because the term “permanent” indicates a persistent shock, making it a stronger indicator than the included sales-related questions.

Log turnover from ORBIS serves as the primary outcome variable, enabling a panel-

based event study approach. An event study allows estimating the immediate and persistent effects of the COVID-19 shock on firm turnover.

The event study is based on a two-way fixed effects estimator:

$$Y_{it} = \alpha_i + \gamma_t + \sum_{k \neq 0} \beta_k D_{it}^k + \epsilon_{it}, \tag{1}$$

where Y_{it} is log turnover or employment for firm i at time t; α_i firm fixed effects; γ_t: year fixed effects; D_{it}^k is a dummy variable indicating event time k relative to treatment (e.g., $k = -2, -1, 0, 1, 2, 3$), where $k = 0$ is the baseline year, set to 2019. The parameters β_k are the event study coefficients, measuring the effect of the shock at each period k. The error term is denoted by ϵ_{it}.

To assess whether firms that took action to transform their supply chain were better able to mitigate the negative effects of the COVID-19 shock, we extend the estimator to a difference-in-differences (DiD) model with two-way fixed effects. Specifically, we introduce interaction terms between the COVID shock indicator and a dummy variable indicating whether a firm reported transforming its supply chain in direct response to COVID (q70_2), which was surveyed in both the 2021 and 2022 waves. The full specification is:

$$Y_{it} = \alpha_i + \gamma_t + \sum_{g=1}^{4} \beta_g G_{ig} \times \text{Post}_t + \epsilon_{it}, \tag{2}$$

where G_{ig} denotes the four categories of firms created from the interaction term; firms that reported both the COVID-19 shock and SC action (G_1), firms that reported the shock but no SC action (G_2), firms that reported no shock but SC action (G_3), and firms that reported no shock and no SC action (G_4). The variable Post_t is an indicator equal to 1 for the years 2020, 2021, and 2022, and 0 otherwise.

We use a balanced sample based on ORBIS turnover data to ensure a consistent set of firms on both sides of the shock. This will also allow for a cleaner comparison between firms that took supply chain action and those that did not.

3.2 Results

Figure 2 presents point estimates and 95% confidence intervals from estimating equation 1, examining the impact of the event on firms' log turnover (Panel (a)) and log employment (Panel (b)). In each panel, the estimates in blue are based on the full sample, while those in red refer to a subsample of firms that reported taking action to transform their supply chains in response to the shock.

The results indicate that, on average, the COVID shock had a persistent negative impact on firms' revenue. Notably, the permanent employment shock exhibits no pre-trends for either outcome variable.

Focusing on the full sample, firms experiencing the shock suffered a near 20% decline in log turnover in the first year of COVID, and they did not recover relative to unaffected firms by 2021 or 2022. For employment, impacted firms experienced a 6.3% decline in the number of employees during the first year of COVID, worsening to 12% in the second year and with no signs of recovery by 2022.

But the average effect hides important heterogeneity. As shown by the estimates in red, firms that reported to have taken action to transform their supply chains experienced smaller and temporary shocks. This suggests that firms that actively adapted their supply chains were able to mitigate the longer-term impact of the shock. Notably, the negative impact is not statistically significant by 2022.

To further assess whether firms that took supply chain action were better able to mitigate the negative effects of the COVID-19 shock, we estimate the difference-indifference model specified in equation 2.

Table 4 presents the average effects of the employment shock on log turnover (columns 1 to 5) and log employment (columns 6 to 10). Columns 1 and 6 correspond to the average effects of the event study estimates in figure 2 for the full sample. Firms reporting a permanent employment shock saw a 15.3% decrease in turnover and a 10.3% decrease in employment relative to firms that did not report the shock.

The results from estimation of equation 2 suggest that the entire negative COVID effect, both on turnover and employment, comes from firms that did not give attention

to transforming their supply chain.

In terms of magnitude, columns 2 and 7 suggest that idle firms impacted by the COVID shock (G_2 :) experienced a 17.7% decline in turnover and 11.4& in employment relative to firms that were not impacted by COVID and did not transform their supply chain (G_4 :). As expected, this aligns with the event study estimates.

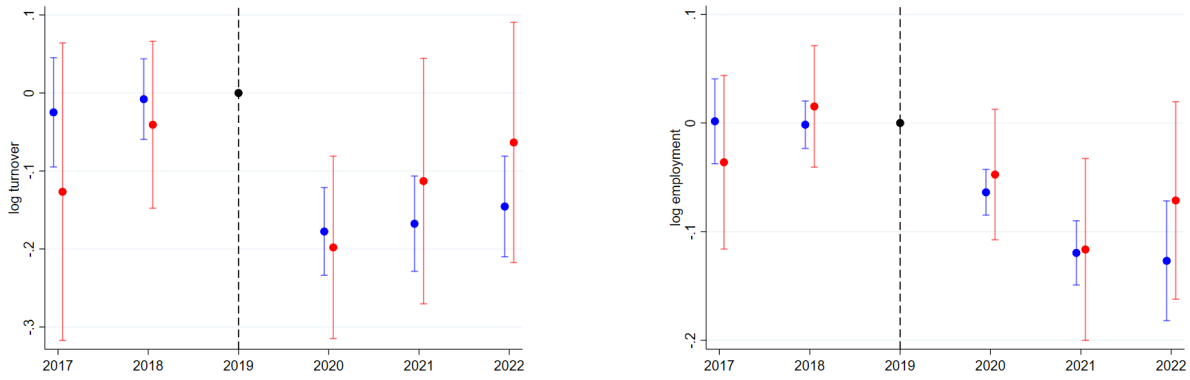
There are 63 firms that report both a negative employment shock and supply chain transformation (G_1 :).[1] To test if this relatively small group indeed performs better than G_2, the reference group is changed to G_2 : in columns 3 and 8 of table 4. Results show that firms taking action to transform their supply chain were able to mitigate the negative employment shock, with a 11.9% relative improvement in turnover compared to G_2 firms, despite still losing a similar number of employees (column 8).

41 of the firms in G_1 : additionally report that COVID will have a long-term impact on their supply chain (q65_2). This allows us to test whether our results are driven only by comparing relatively sophisticated firms that are increasingly exposed with firms that do not have supply chains or are less exposed. By restricting the sample to firms that experienced a supply chain impact, we compare those that report both an employment shock and taking action to transform their supply chain to a more similar control group of firms with at least a minimal level of supply chain complexity. Columns (4) and (9) show that all explanatory power is concentrated within this small subsample, reinforcing our main findings. For this sub-sample, G_1 firms see a 16.7% boost in turnover and a 9.7% boost relative to G_2 firms.

Results are robust to increasing the fixed effects in as many dimensions as possible. These include (in addition to firm fixed effects) year-industry (2 digit NACE codes) fixed effects that control for sector-specific shocks that might affect firms within the same industry differently than others, year-country fixed effects that account for country-specific macroeconomic conditions, and year-sector-country (for the four sectors manufacturing, services, construction, and other) fixed effects that capture how broad sectoral trends in-

[1] Of these, 25 are in manufacturing, 15 in services, 7 in construction, and 16 in other. This distribution makes it difficult to analyze sectoral heterogeneity by splitting the sample, as the resulting groups are very small compared to the other three groups in equation 2.

Figure 2: Event study: impact of the COVID-19 employment shock



(a) log turnover (b) log employment

Note: Estimates for the full sample in blue, and the sub-sample of firms that took action to transform their supply chain in red.

Table 4: DiD: The role of supply chain action in mitigating the COVID-19 shock

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
post2020 = 1 #										
CV emp = 1	-0.153***					-0.103***				
	(0.022)					(0.017)				
G_1 : CV emp = 1 # SC trans = 1		-0.059	0.119**	0.167***	0.036		-0.054	0.060	0.097*	-0.022
		(0.050)	(0.055)	(0.062)	(0.109)		(0.041)	(0.045)	(0.057)	(0.071)
G_2 : CV emp = 1 # SC trans = 0		-0.177***					-0.114***			
		(0.025)					(0.021)			
G_3 : CV emp = 0 # SC trans = 1		0.010	0.188***	0.215***	0.172***		0.017	0.131***	0.139***	0.126***
		(0.017)	(0.028)	(0.045)	(0.032)		(0.014)	(0.024)	(0.035)	(0.031)
G_4 : CV emp = 0 # SC trans = 0			0.177***	0.188***	0.173***			0.114***	0.101***	0.119***
			(0.025)	(0.041)	(0.032)			(0.021)	(0.033)	(0.028)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17096	15182	15182	3744	1432	16462	14594	14594	3646	10942
R-Sq.	0.132	0.135	0.135	0.168	0.127	0.016	0.017	0.017	0.017	0.018

Note: DV: log turnover (ORBIS) in columns (1) to (5), log employment (ORBIS) in columns (6) to (10). CV emp = 1 if COVID caused a permanent negative employment shock (q65_4, '20 & '21). SC trans = 1 if firm responded to COVID by transforming its supply chain (q70_2, '21 & '22). Sample balanced on ORBIS firm turnover availability. EU firms only. (4) and (9) reduce the sample to firms reporting a long-term impact of COVID on their SC (q65_2, '20 & '21), and (5) and (10) the opposite. Robust errors; * p < 0.10, ** p < 0.05, *** p < 0.01.

teract with country-level policies. These are shown in Appendix Table A3 of the appendix for re-estimates of the last 3 columns of table 4.

4 Unpacking Managers' Responses to Supply Chain Disruption

We leverage multiple years of survey data to examine the relationship between supply chain shocks and firms' strategic responses.

4.1 Empirical Strategy

Specifically, we analyze whether experiencing a supply chain shock increases the likelihood of firms adopting specific supply chain actions based on logit regressions.

We first estimate a baseline model where the independent variable is a dummy equal to 1 if the firm experienced any supply chain shock, providing a broad assessment of how disruptions influence firms' responses.

Next, we refine the analysis by replacing this with specific indicators for different types of shocks, including logistics disruptions, raw material shortages, and customs and tariff changes.

To account for firm-specific heterogeneity, we employ a balanced panel over two years and include both firm and year fixed effects as we are only interested in the within-firm variation in this case. The conditional fixed-effects logit model is specified as follows:

$$Pr(\text{SCAction}_{it} = 1 \mid \text{SCShock}_{it}, \alpha_i, \gamma_t, \boldsymbol{\beta}) = \frac{1}{1 + \exp(-\alpha_i - \gamma_t - \text{SCShock}_{it}\boldsymbol{\beta})} \quad (3)$$

where SCAction_{it} is a binary variable equal to 1 if firm i took a specific supply chain action in year t (e.g., increasing inventory, diversifying suppliers); SCShock_{it} is a inary variable indicating whether firm i experienced a supply chain shock in year t; α_i is firm fixed effect; γ_t is year fixed effect. The parameters $\boldsymbol{\beta}$ are the coefficients capturing the impact of supply chain shocks on the probability of taking a supply chain action.

4.2 Results

As 5,157 firms are in both 2023 and 2024 waves, which is the only two years so far that the complete set of these questions has been asked, we are able to effectively employ firm fixed effects to isolate within-firm variation, despite working with binary variables.

The percentage of firms that take each action conditional on experiencing a shock or not are presented in Appendix Table A1. It is not only firms that report to experience SC shocks that take action. While 61% of firms that experienced a SC shock took at least one SC action, 34% of firms that did not experience any SC shock also took at least one SC action.

Figure 3 presents results from regressing each supply chain action on (a) a dummy variable indicating whether a firm experienced any supply chain shock that year (figure 3a), (b) dummy variables for the number of shocks a firm experienced in a given year (figure 3b), (c) each of the three main categories of supply chain shocks separately (figure 3c), (d) each of the three types of materials shocks separately (figure 3d), which were consolidated into one materials shock in the above. Results for the sub-sample of manufacturing firms are reported in Figure A2 and are mostly in line with the full sample.

The only supply chain action that never achieves statistical significance is reducing the share of goods or services imported. This suggests that firms experiencing trade shocks do not respond by cutting their overall reliance on imports. Instead, they exhibit strong correlations with other supply chain adaptation strategies. Rather than reducing imported inputs, firms prioritize insulating themselves through increased inventory stockpiling, digitization efforts, and diversifying their suppliers.

While firms are not reshoring, they actively substitute extra-EU imports with intra-EU imports when faced with a SC shock, suggesting a shift toward near-shoring. Notably, the likelihood of pursuing near-shoring increases as firms experience multiple trade shocks. They also actively expand the number of countries they import from with the same pattern, indicating that diversification becomes a more urgent strategy as disruptions accumulate.

Figure 3c highlights how the three main SC shocks relate to these SC actions sep-

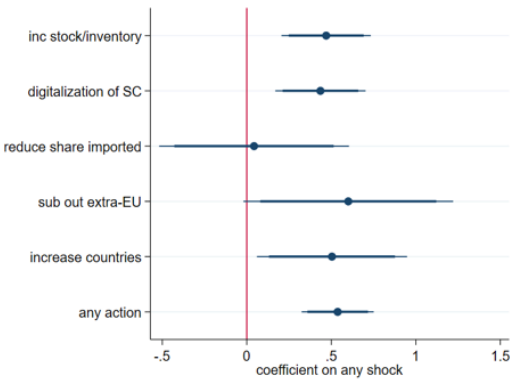
arately. Experiencing a logistics shock makes firms most likely to increase stock or inventory as a SC strategy, which aligns with firms seeking resilience against shipping or procurement delays. Experiencing customs and materials shocks also correlates with stockpiling. Digitization efforts correlate with experiencing logistics and materials shocks. All shocks correlate with efforts to substitute out extra-EU imports, while logistics and material shocks correlate with diversification efforts more generally (increasing countries).

Figure 3d shows the disaggregation of the materials shocks into commodity shocks, chip shortages, and other materials disruptions. We find that commodity and chip shocks in particular lack correlation with reducing the share imported, unlike other materials. This is intuitive, as commodities are typically resources that a country either has or does not, while chips require massive capital investments, making them difficult to source domestically. Other materials, however, may be obtainable domestically. A similar logic applies to the decision to diversify suppliers more generally, as commodities and chips may not have as many alternatives. However, experiencing commodities shocks correlates specifically with efforts to substitute extra-EU imports with intra-EU imports.

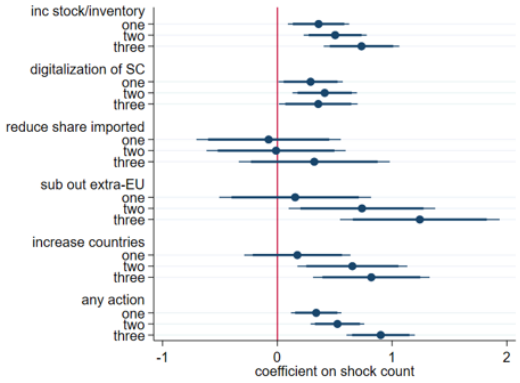
Additional insight from the SUCH survey on what firms look for when finding new suppliers is relevant here. Since there is only one year of data from the SUCH survey available now, we drop firm fixed effects and add an exporter dummy, sector dummy (manufacturing, services, construction, or other), and a region dummy (north EU, south EU or east EU). Logit regressions show that firms looking to substitute extra-EU imports with intra-EU imports and firms looking to increase the number of countries they source from are concerned most about the business environment of the country of the new supplier, customs and tariffs, and geopolitical risk and security of supply. Firms looking to increase the countries they source from are also the most likely to say it would be difficult to find an alternative supplier in their home country.

Moreover, the SUCH survey asks about costs and prices. A question used to identify firms experiencing a greater than 25% supplier price increase is particularly relevant. Appendix Table A2 details a dampening effect of such a supplier price shock on a firm's ability to increase inventory in response to logistics and materials shocks. There is also a

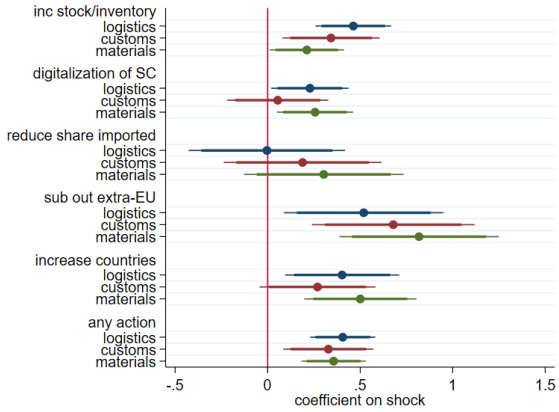
Figure 3: Panel Analysis: Supply Chain Shocks and Actions



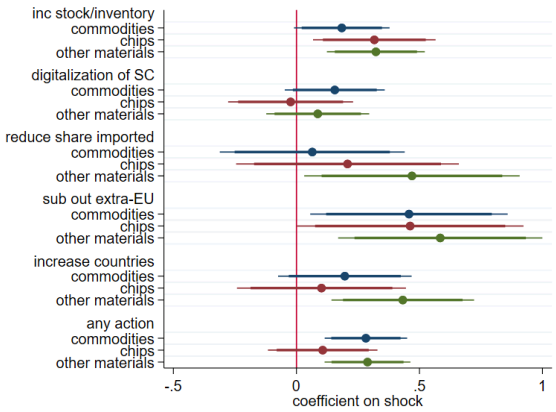
(a) any shock



(b) shock count



(c) shocks categories



(d) materials

Note: Conditional fixed effect logit regressions corresponding to equation 3. All include year and firm fixed effects. All but each grouping of the 3 count dummies for shocks are separate regressions. The bars indicate 90% (thick) and 95% (thin) confidence intervals for standard errors.

dampening effect of supplier price shocks on firms' investment in digitalizaion in the face of logistics shocks. On the other hand, there is a significant multiplying effect of supplier price shocks on firms' efforts to find new source countries in the face of customs shocks.

To conclude, firms experiencing supply chain shocks primarily respond by insulating themselves through increased inventory stockpiling and digitization. However, they remain committed to international trade, with some indications of a shift toward both near-shoring and diversification rather than reshoring.

5 Evaluating Managerial Responses to Disruption

Understanding the micro-mechanisms underlying firms' resilience to the COVID shock is crucial from both a managerial and policy perspective. Therefore, we leverage the richness of our data to examine which factors correlate with firms' likelihood of being relatively resilient.

5.1 Empirical Strategy

After investigating the mitigating effect of supply chain action on the COVID shock, we aim to assess systematic differences between firms that were relatively resilient to the COVID-19 shock and those that were less resilient. Specifically, we examine how firms' supply chain strategies relate to their resilience. The goal is to establish an empirical method to connect the recovery of firms from COVID-19 to the SC proactiveness identified from the survey data detailed in table 1.

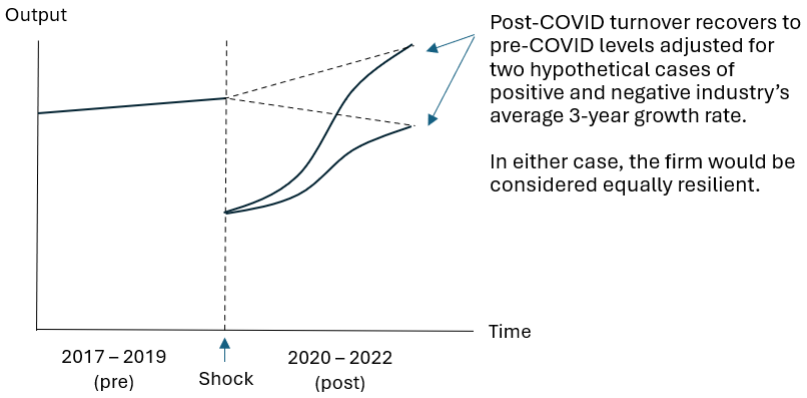
To achieve this, we compute a COVID-19 resiliency index based on firms' post-COVID sales performance relative to pre-COVID levels, adjusted for the average growth rate of their 2-digit NACE industry over the three post-COVID years. Figure 4 illustrates this approach, showing two hypothetical firms that, while ending at different absolute levels post-COVID, are considered equally resilient.

Firms with a resiliency index above the median firm in the sample are classified as relatively resilient, simplifying the analysis to an indicator variable. The details are presented in Appendix B.

Our approach systematically compares firms based on their resilience to the COVID-19 shock and examines how their strategic decisions relate to their post-pandemic recovery. Adjusting for post-COVID industry growth rates helps isolate firm-level performance from broader industry trends and external shocks, providing a more accurate comparison across firms.

Focusing the resiliency dummy on 2022 allows us to assess how the post-rebound year of the COVID shock shaped firms' long-term impact while maximizing observations

Figure 4: Defining firm resiliency



by including more of the roughly 12,000 firms in this wave. Additionally, this approach allows us to maximize the sample of firms answering these rich survey questions while still tying back to the COVID shock and discussing sectoral heterogeneity. As our resiliency measure is a dummy variable, we employ logit regression to estimate the probability of ending 2022 as a firm that was relatively resilient to the COVID shock based on the 3 years prior to 2020 and 3 years since 2020 conditional on each supply chain strategy.

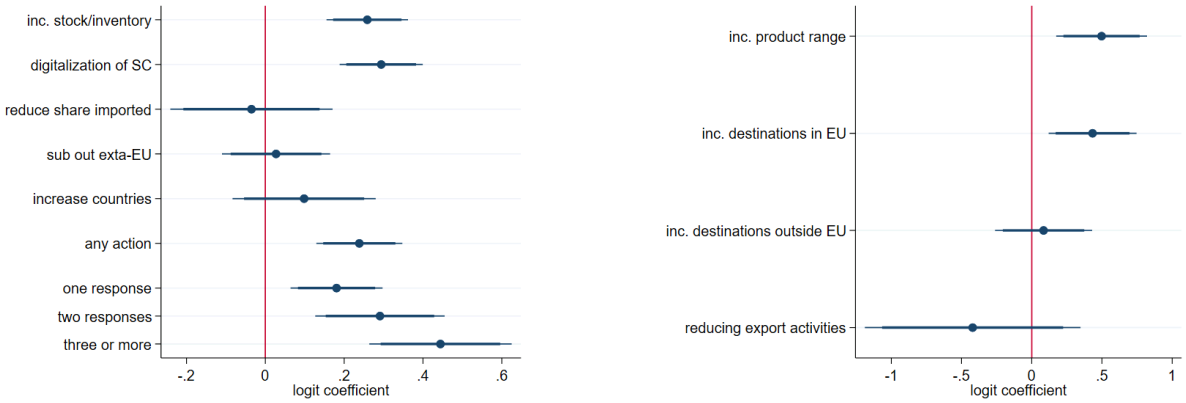
The probability of a firm being relatively resilient is given by:

$$Pr(\text{ResilientFirm}_i = 1 \mid SC_i, \boldsymbol{Z}_i, \lambda_n, \delta_j, \boldsymbol{\beta}, \boldsymbol{\gamma}) = \frac{1}{1 + \exp(-\lambda_n - \delta_j - SC_i\beta - \boldsymbol{Z}_i\boldsymbol{\gamma})} \quad (4)$$

where ResilientFirm_i is a binary indicator as defined above; SC_i is a binary supply chain-related variable taken from the survey responses for the year 2022; $\boldsymbol{Z}_i$ is a vector of firm-level controls, including pre-COVID average log turnover (captures firm size and market presence), pre-COVID average turnover-to-assets ratio (reflects capital efficiency), and pre-COVID average inventory-to-assets ratio (indicates supply chain management strategies), where the averages are over the years 2017 to 2019; λ_n is country fixed effect, and δ_j is a 2-digit industry fixed effect.

We investigate each independent variable separately, meaning SC_i represents any of the relevant survey questions detailed in table 1.

Figure 5: Firm Resilience Post-COVID: Supply Chain Shocks and Actions in 2022



(a) SC actions

(b) export actions (SUCH)

Note: Logit regressions corresponding to equation 4. Controls are 2-dig industry FE, Country FE, exporter, avg pre log turnover, avg pre turnover to assets, and avg pre stock to assets. All but the 3 count dummies for responses are separate regressions. The bars indicate 90% (thick) and 95% (thin) confidence intervals for robust errors clustered on 2-dig industry codes. The samples include 7,251 firms for the SC actions regressions or 3,880 firms for the actions specific to importers, and 678 exporters with sufficient matched ORBIS data for the SUCH questions.

5.2 Results

Figure 5 presents results from equation 4, estimating the relationship between supply chain actions in 2022 and firms' long-term recovery in the three years following the onset of the pandemic.

Across all sectors, firms that took supply chain management action in 2022 were more likely to be relatively resilient to the COVID-19 shock, particularly if increasing stock and inventory levels or digitalizing supply chain and input tracking. However, this is not true for engaging in broader restructuring efforts by reducing the share of goods imported, near-shoring, or increasing the number of sourcing countries. Still, firms that undertook three or more supply chain actions exhibited the strongest association with turnover resilience.

As mentioned above, the EIB also conducts an annual survey dedicated to supply chain questions (SUCH). Despite the smaller sample, interesting results are found when looking at a new questions in the survey on export activities. Panel (b) of Figure 5 highlights that resilient firms (by turnover) tend to expand by increasing their product

range and destinations within the EU, reinforcing reliance on the single market, while no clear relationship is observed for destinations outside the EU. Additionally, reducing exports is negatively correlated with firm resiliency, though not statistically significant.

6 What Firms Take Action?

This section examines if firms are more likely to experience shocks and take specific actions depending on size (in terms of turnover) and financial conditions.

6.1 Empirical Strategy

This section relies entirely on survey data, allowing us to retain all firms present in multiple waves rather than losing observations when merging with ORBIS, particularly in recent years.

We estimate both logit regressions for financial condition outcomes and linear regressions for turnover.

The key explanatory variables are supply chain shock and action dummies, iterated through in separate regressions. We employ multiple fixed effects specifications to account for time-invariant firm characteristics, macroeconomic conditions, and sectoral trends, ensuring robust inference regarding the role of supply chain dynamics in shaping firms' financial and operational resilience.

Log turnover proxies for size. For financial conditions, we estimate logit and conditional fixed-effects logit models to assess the probability that a firm reports stable or improving (a) availability of internal financial (q23_1), (b) availability external financial (q23_2), or that there are no obstacles with the (c) availability of finance for investment activities (q38_8). These variables equal 0 if the firms report that the availability of finance is indeed worsening or is an obstacle, thus giving negative coefficients the interpretation of correlation with financial constraints. These survey questions, described in section 2.3, allow us to investigate whether financial constraints are exacerbated by disruptions or mitigated by strategic firm actions.

For all four outcome variables, we iterate through different supply chain shocks and response dummies using standard logit or linear regressions. Each relationship is estimated under three fixed effects specifications: first with year, industry, and country fixed effects, then with industry-year and country fixed effects, and finally with year and firm fixed effects. The first two specifications are an unbalanced panel including all firms in each corresponding wave while the last specification with firm fixed effects is balanced. Standard errors are clustered at the firm level to account for within-firm correlation over time.

6.2 Results

The results are presented in Figure 6. Firms that experienced supply chain disruptions were more likely to report financial constraints.

The availability of finance for investment appears particularly sensitive to SC shocks (Figure 6d), where this relationship holds across all types of SC shocks in the conditional fixed effects logit model.[2] Additionally, there is a strong cumulative effect on the availability of finance, with firms experiencing all three types of supply chain shocks being the most likely to report this as an obstacle. This finding underscores the financial vulnerability imposed by supply chain disruptions, as affected firms struggle to access liquidity, especially funds for investment activities.

The relationship between supply chain actions and financial constraints is more nuanced. Generally, firms taking SC action are more likely to report these financial constraints, especially when looking at the cross-section results on external finance and availability of finance for investment. Most of these associations cannot be differentiated from time-invariant firm characteristics, as they do not remain statistically significant when introducing firm fixed effects (right columns), though this may owe simply to the fact that we only have two years of data as of now.

Firms intending to increase the number of countries they import from were more likely

[2]While the four firm fixed effects models in the right columns of figure 6 do not include industry-year fixed effects due to conditional fixed-effects logit models estimation limitations, adding these fixed effects alongside firm fixed effects in a linear regression does not alter statistical significance levels for any outcome variable.

to report financial constraints, a relationship that holds at the 90% confidence level for internal finance when firm fixed effects are included (right column of figure 6b). This may be indicative of the direct discovery costs of sourcing from new countries that comes from internal financing. This suggests that as firms look to diversify they may be unable to rely solely on internal financing.

Digitization of supply chain management follows a similar pattern, with statistically significant effects on the availability of finance for investment when firm fixed effects are included (right column of figure 6d). This is logical, as digitization represents a direct investment effort. However, firms that invest in digitization are less likely to report external financing obstacles. This may be a benefit of increased transparency with external financiers that comes with digitization.

More broadly, firms that diversify their SC tend to be those firms that anticipate constraints in external finance and availability of finance for investment, as indicated by the zeroing out of the coefficients when firm fixed effects are included. This may reflect an urgency to re-optimize the supply chains of firms that operate in a changing macroeconomic environment, despite the liquidity concerns that re-optimization can cause.

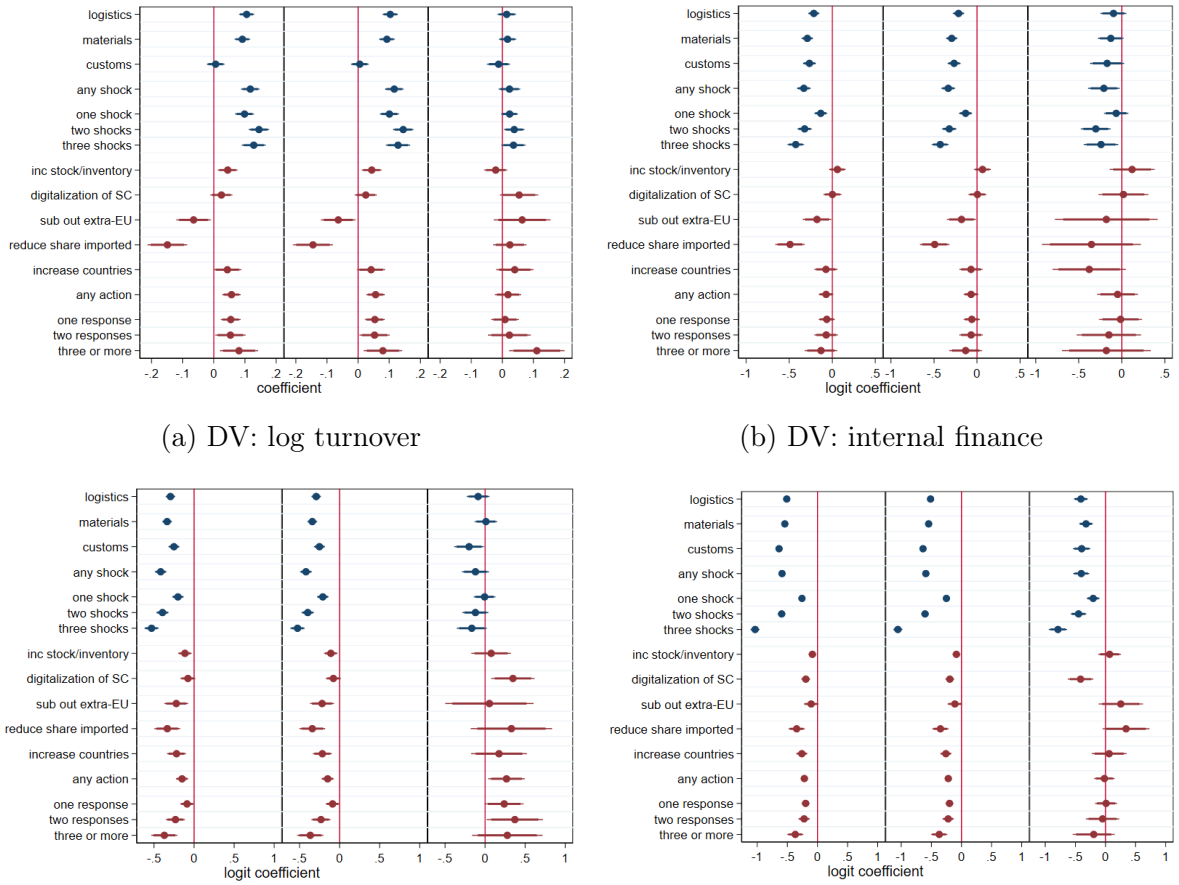
In contrast, firms reporting supply chain shocks and actions tend to be larger in terms of turnover. However, experiencing shocks or taking actions has little impact on firm turnover when firm fixed effects are included.[3] The fact that supply chain shocks and actions generally correlate with stable turnover but are accompanied by a deterioration in firms' financial health shows that firms' prioritization of maintaining turnover comes at the expense of financial health.

Figure 7 highlights industry heterogeneity in the regression results examining the availability of finance under different types of supply chain shocks, with firm fixed effects. The results indicate that firms in industries such as food manufacturing (10), textiles (13), paper (17), printing (18), chemicals (20), plastics (22), metal products (25), machinery (28), waste management (38), construction (41, 42), wholesale (46), retail (47), trans-

[3]An exception is found when looking at the subsample of manufacturing firms for inventory stockpiling, where increasing stock and inventory is negatively associated with firm turnover when firm fixed effects are introduced. This suggests that firms creating an inventory buffer tend to experience setbacks in turnover.

portation (52), accommodation (55), and publishing (58) drive the increased likelihood of reporting financial constraints under at least one type of shock.

Figure 6: Panel Analysis: Firm Performance and Supply Chains



(a) DV: log turnover

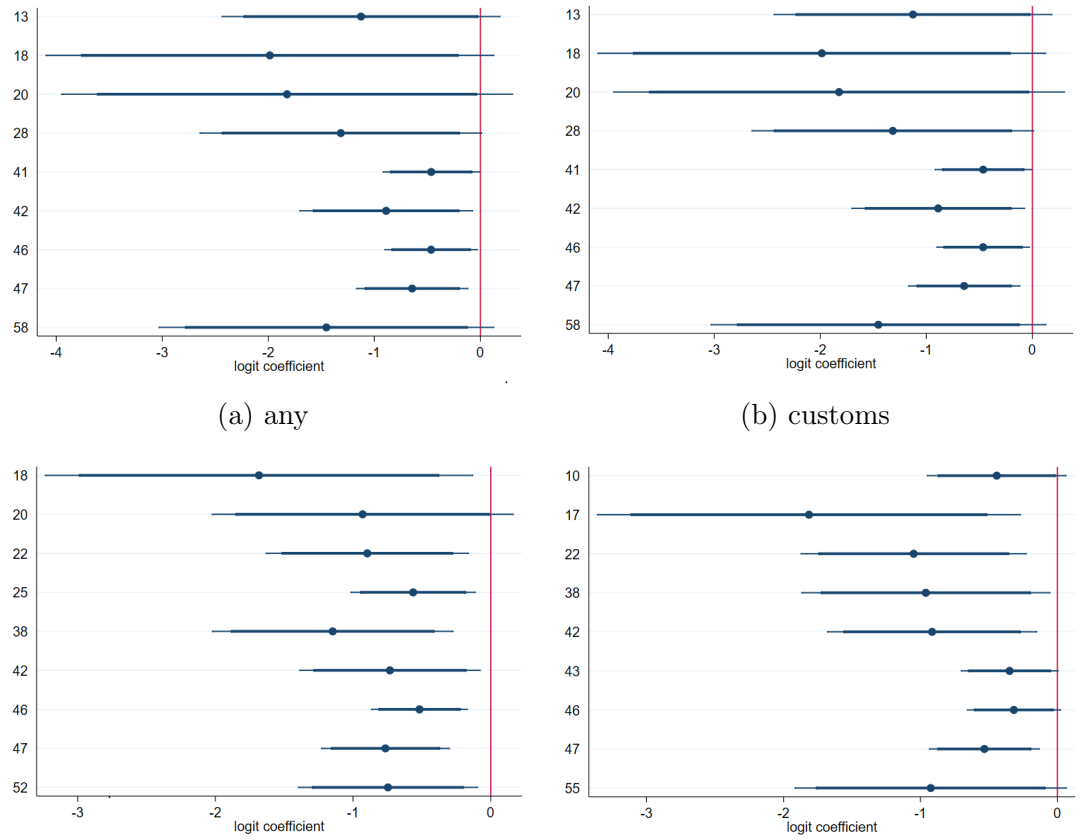
(b) DV: internal finance

(c) DV: external finance

(d) DV: availability of finance

Note: (a) employs linear regressions for log turnover while (b), (c), and (d) employ logit regressions where negative coefficients have a financial constraint interpretation. The left columns include year, industry, and country fixed effects. The middle columns include industry-year and country fixed effects. The right column includes year and firm fixed effects. Other controls are an exporter dummy and the 3-year lag number of employees. All but each grouping of the 3 count dummies for shocks are separate regressions. The bars represent 90% (thick) and 95% (thin) confidence intervals for the standard errors. The samples include approximately 1,850 firms for SC shocks and 900 firms for SC actions with sufficient variation to remain in the conditional fixed-effects regressions, except for those specific to importers, where the number of firms with sufficient variation is 1,060 for the customs shock and from 222 to 358 for the SC actions.

Figure 7: Panel Analysis: Availability of Finance and Supply Chains, Industry Interactions



(a) any (b) customs

(c) logistics (d) materials

Note: Negative coefficients have a financial constraint interpretation. The figure reports statistically significant coefficients past the 90% confidence level on $\text{Industry}_j \times \text{Shock}_{it}$ from a single regression that includes all corresponding interaction terms, firm and year fixed effects, an exporter dummy, and the three-year lagged number of employees. The bars represent 90% (thick) and 95% (thin) confidence intervals for the standard errors.

7 Conclusion

This paper examines how firms navigated supply chain disruptions during and after the COVID-19 pandemic, the strategic responses they adopted, and the long-term implications for financial performance and resilience. Using firm-level survey data from the European Investment Bank General Survey (EIBGS) matched to ORBIS balance sheet data, we provide new empirical evidence on the relationship between supply chain shocks, managerial decisions, and firm outcomes. Our findings highlight that proactive supply chain management, particularly through inventory stockpiling, digitalization, and trade openness, played a critical role in mitigating the adverse effects of disruptions.

Our event study results show that firms affected by the COVID-19 shock suffered persistent declines in turnover and employment, but those that took action to transform their supply chain in response to the shock were able to limit the severity and duration of these negative impacts. Further analysis demonstrates that firms that took supply chain management action in 2022 were more likely to be relatively resilient to the COVID-19 shock. Notably, additional results from the new SUCH survey conducted by the EIB since 2023 suggest that increasing product ranges and the number of export destinations within the EU contributed significantly to firm resilience.

Building on these findings, our analysis of more recent supply chain shocks in 2022 and 2023 reveals that firms have continued to adapt their supply chain strategies in response to ongoing disruptions. A key response has been an increased reliance on inventory stockpiling and investments in digital tracking of inventory and inputs, suggesting that firms are prioritizing greater visibility and supply chain buffers. However, the effectiveness of these adaptations appears to be moderated by supplier price shocks, which may limit firms' ability to fully insulate themselves from volatility. Importantly, we find that firms take effort to remain engaged in international trade, showing a preference for nearshoring in the EU as well as wider source country diversification rather than full reshoring. This suggests that rather than retreating from global markets, firms are restructuring their supply chains to enhance resilience while maintaining the benefits of international trade.

Finally, our analysis of firm characteristics and supply chain management highlights

the financial pressures firms face when navigating disruptions. Firms experiencing supply chain shocks were more likely to report financial constraints, with cumulative effects for those facing multiple disruptions. However, despite these financial pressures, we find no significant impact on firm turnover, suggesting that firms prioritize maintaining operational performance even under financial strain. The relationship between supply chain actions and financial constraints remains complex, but, generally speaking, companies actively taking supply chain actions are also the most likely to report obstacles in obtaining finance for investment and external finance more broadly.

Beyond firm-level outcomes, this study has broader implications for policymakers and supply chain practitioners. The evidence suggests that fostering international trade relationships and enabling firms to invest in digital supply chain solutions can enhance overall resilience, but that trade shocks may induce financial constraints and hardships beneath surface level turnover volumes. Policymakers should therefore consider how regulatory frameworks and financial support mechanisms can encourage firms to adopt more adaptive and flexible supply chain strategies.

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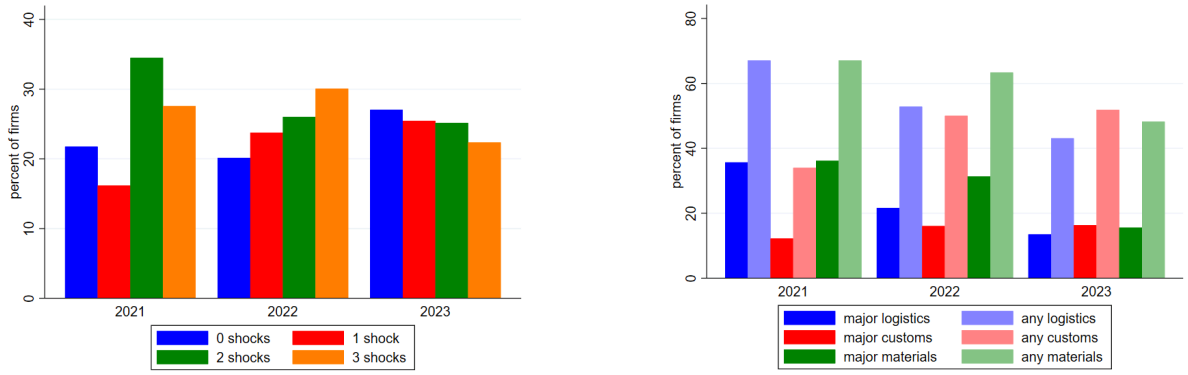
A Figures and Tables Appendix

Figure A1: Summary States: Percent of Firms Experiencing Shocks



(a) counts (b) shocks

Note: Percent out of the total number of firms answering the question. "Any" includes firms reporting either a major obstacle or a minor obstacle. The counts are based on either major or minor obstacle for each of the 3 main categories of shocks.

Table A1: Supply Chain Shocks and Supply Chain Actions in 2022 and 2023

	any shock		logistics		customs		materials	
	Yes	No	Yes	No	Yes	No	Yes	No
inc stock/inventory	34%	17%	37%	24%	38%	29%	36%	21%
digitalization of SC	26%	14%	28%	19%	29%	23%	27%	18%
reduce share imported	11%	6%	12%	7%	13%	8%	11%	7%
sub out extra-EU	18%	10%	20%	13%	20%	15%	20%	12%
increase countries	29%	15%	33%	19%	34%	22%	31%	19%
any action	61%	34%	66%	45%	70%	54%	64%	42%

Note: Comparison of the percentage of manufacturing firms taking each action, between those that experienced the indicated supply chain shock and those that did not in the 2-year cross-section.

Table A2: Responses to supply chain and supplier price shocks

DV:	Inc. Stock/Inventory			SC Digitalization			Increase Countries		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
price increase	0.732**	0.649***	0.389*	-0.515	0.580**	0.304	-0.025	-0.132	-0.418
	(0.303)	(0.244)	(0.210)	(0.407)	(0.276)	(0.227)	(0.452)	(0.382)	(0.296)
materials shock	0.928***			0.290*			0.580***		
	(0.150)			(0.162)			(0.201)		
# price increase	-0.890***			0.686			0.297		
	(0.339)			(0.441)			(0.493)		
logistics shock		0.647***			0.648***			0.611***	
		(0.132)			(0.157)			(0.181)	
# price increase		-0.883***			-0.741**			0.440	
		(0.294)			(0.332)			(0.432)	
customs shock			0.239*			0.217			0.422***
			(0.139)			(0.154)			(0.163)
# price increase			-0.493			-0.511			1.004***
			(0.312)			(0.344)			(0.387)
Observations	1642	1651	1262	1642	1651	1262	1105	1115	1064

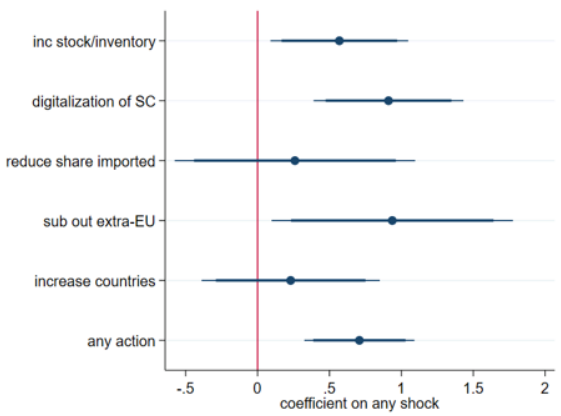
Note: price increase is an indicator equal to 1 if the firm reported experiencing a price increase from its suppliers of greater than 25% since 2022 (SUCH survey). Standard errors; * p < 0.10, ** p < 0.05, *** p < 0.01.

Table A3: DiD: The role of supply chain action in mitigating the COVID-19 shock; different fixed effects

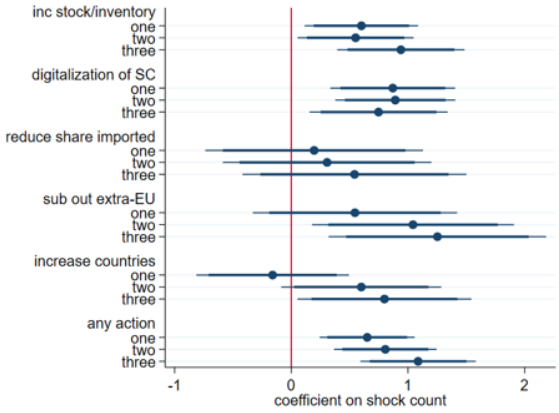
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
post2020 = 1 #									
CV emp = 1 # SC trans = 1	0.127***	0.163**	0.074	0.102**	0.164**	0.036	0.088	0.180***	-0.014
	(0.048)	(0.065)	(0.089)	(0.049)	(0.064)	(0.090)	(0.056)	(0.066)	(0.112)
CV emp = 0 # SC trans = 1	0.148***	0.186***	0.135***	0.158***	0.198***	0.143***	0.183***	0.196***	0.174***
	(0.025)	(0.045)	(0.032)	(0.025)	(0.044)	(0.032)	(0.025)	(0.044)	(0.032)
CV emp = 0 # SC trans = 0	0.162***	0.213***	0.137***	0.168***	0.218***	0.145***	0.194***	0.218***	0.181***
	(0.029)	(0.049)	(0.037)	(0.029)	(0.049)	(0.037)	(0.029)	(0.050)	(0.038)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Industry	Yes	Yes	Yes	No	No	No	No	No	No
Year-Country	No	No	No	Yes	Yes	Yes	No	No	No
Year-Sector-Country	No	No	No	No	No	No	Yes	Yes	Yes
Observations	15,176	3,744	11,426	15,176	3,744	11,426	14,921	3,680	11,238
R-Sq.	0.197	0.260	0.199	0.218	0.308	0.222	0.206	0.298	0.212

Note: Reproduces columns (9) (10) and (11) of table 4 with additional fixed effects. Robust errors; * p < 0.10, ** p < 0.05, *** p < 0.01.

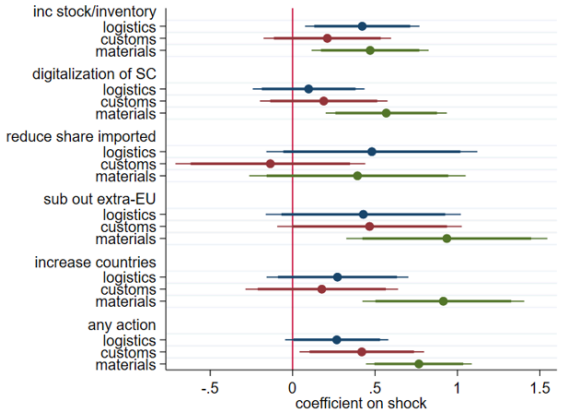
Figure A2: Panel Analysis: Supply Chain Shocks and Actions (manufacturing)



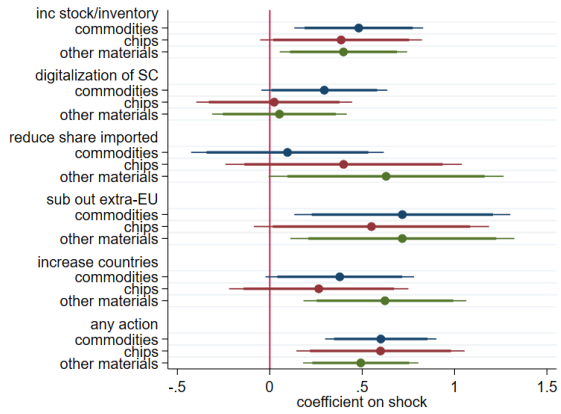
(a) any shock



(b) shock count



(c) shocks categories



(d) materials

Note: Conditional fixed-effects logit regressions corresponding to equation 3, including year and firm fixed effects. All but each grouping of the 3 count dummies for shocks are separate regressions. The bars represent 90% (thick) and 95% (thin) confidence intervals for the standard errors. There are 1,546 firms in the manufacturing sector surveyed in both years. The final samples include between 500 and 530 manufacturing firms with sufficient variation remaining in the conditional fixed-effects regressions, except for those specific to importers, where the sample size is around 300 firms.

B Defining Resilience

$$\text{PreAvg}_i = \frac{1}{3} \sum_{t=2017}^{2019} \text{Turnover}_{i,t}$$

$$\text{PostAvg}_i = \frac{1}{3} \sum_{t=2020}^{2022} \text{Turnover}_{i,t}$$

$$\text{PostCOVIDIndAvgGrowth} = \frac{1}{3} \sum_{t=2020}^{2022} \frac{\text{IndTurnover}_t - \text{IndTurnover}_{t-1}}{\text{IndTurnover}_{t-1}}$$

$$\text{Resiliency}_i = \frac{\text{PostAvg}_i - (\text{PreAvg}_i \times (1 + \text{PostCOVIDIndAvgGrowth}))}{\text{PreAvg}_i}$$

$$\text{ResilientFirm}_i = \begin{cases} 1, & \text{if Resiliency}_i > \text{median(Resiliency)} \\ 0, & \text{otherwise} \end{cases}$$