Supply Chain Shocks, Managerial Responses, and Resilience: Evidence from European Firms

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Abstract

This paper leverages detailed firm-level survey responses from the European Investment Bank and ORBIS balance sheet data to examine the impact of supply chain disruptions on firm performance and the strategic responses of managers to adverse shocks. Using a multi-stage empirical approach, we find that proactive managerial strategies significantly reduce the magnitude and persistence of supply chain shocks. Strategies focused on enhancing internal management, such as inventory stockpiling and supply chain digitalization, are more effective in boosting firm resilience than a broad reorientation of sourcing strategies. We also find that supply chain shocks exacerbate financial constraints and, in turn, limit firms' ability to implement these strategies.

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

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

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This research utilizes a confidential European Investment Bank (EIB) survey. The views expressed in this paper are those of the authors and do not necessarily reflect those of the affiliating institutions.

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 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, little is known about the specific strategic responses taken by managers and how these actions affect performance and resilience. This creates an important knowledge gap, as existing work may offer limited guidance to managers and practitioners seeking concrete strategies to address 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 Group 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.

Using these data, the paper investigates the relationship between supply chain disruptions, managerial responses, and firm-level resilience. Specifically, we examine how firms navigated the COVID-19 pandemic and a multi-year panel of recurring supply chain obstacles through 2024, focusing on the specific supply chain actions undertaken to mitigate these shocks and how those responses influenced resilience and financial outcomes.

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 in more detail the relationship between different kinds of supply chain disruptions and firms' strategic responses. The evidence from this part of the analysis suggests that firms experiencing supply chain obstacles responded by increasing inventory stockpiling and investing in digital inventory and inputs tracking, with a dampening effect observed from supplier price shocks. Moreover, firms remained committed to international trade, with some indications of a shift toward both near-shoring and broader 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 that pursued supply chain strategies to increase inventory stockpiling and digitalize their supply chain management were more likely to demonstrate resilience. In contrast to the responses described above, these resilience-enhancing strategies did not include near-shoring or sourcing country diversification efforts, despite the prominence of such measures in policy and managerial debates. On the export side, resilience was associated with expanding the product range overall and increasing the number of exporting destinations within the EU, reinforcing reliance on the single market, with no such results found for increasing destinations outside of the EU.

Finally, Section 6 examines the role of financial constraints. We find that firms that experienced supply chain shocks were more likely to report financial constraints. Additionally, there are cases where supply chain actions associate with financial constraints separately from that of any contemporaneous supply chain shock, indicating that some mitigation strategies entail greater costs to the firm than others.

Taken together, these findings underscore the critical role of managerial decision-making in shaping firm resilience in the face of global supply chain disruptions. They highlight the importance of both operational flexibility, particularly through digitalization and inventory strategies, and financial capacity in enabling firms to adapt effectively. By documenting these patterns across a large and diverse sample of EU firms, this paper provides empirical insights that complement theoretical work on global value chains and offer practical guidance for firms and policymakers confronting continued supply chain volatility.

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, and there is no consensus on the most effective resilience strategy.

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 in all EU members.

Recent supply chain shocks have unfolded in an environment of elevated inflation, raising questions about how price dynamics interact with firms' operational decisions. Papadakis (2006) show that price shocks in upstream markets disproportionately affect firms that maintain low inventory levels. Complementing this, Moosavi and Hosseini (2021) find that firms can mitigate supply chain disruptions through strategies such as inventory stockpiling or supplier diversification, though these approaches involve trade-offs between resilience and cost. This paper builds on these insights by examining how supplier price shocks may weaken a firm's ability to implement certain supply chain strategies and accelerate efforts for others.

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 actions: In the 2022 wave, firms were asked three questions about supply chain obstacles related to logistics, materials, and trade restrictions (q75_1/2/3, 2022 wave). For each category, firms could indicate whether they experienced a major obstacle, a minor obstacle, or no obstacle. Unless otherwise specified in this paper, we combine responses indicating a minor or major obstacle and use these to proxy for supply chain shocks in each category. Since 2023, the materials question was expanded into three subcategories and the trade restrictions question into two (q75_4/5/6/7/8/9, 2023 & 2024 waves). This allows for a three-year panel if the expanded questions are recombined back to a total of three. Additionally, starting in 2023, 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 for the full sample of firms in each wave.

Approximately 3,000 firms responded to the SC obstacles questions in all three years. Among these firms, 93% reported experiencing at least one minor or major SC obstacle at some point during this period, 81% in two of the three years, and 55% in all three years. These numbers remain substantial for firms reporting major obstacles, at 67%, 40%, and 16%, respectively. On average, a firm faced at least one minor or major SC obstacle in 2.3 out of the 3 years, and at least one major SC obstacle in 1.2 out of the 3 years.

Table B1 reports the average number of the three main supply chain obstacles per firm, broken down by industry. The values range from 0 (no reported obstacles) to 3 (all three categories affected). The table also provides the number of observations per industry and the total turnover for each industry, offering an overview of the sample composition. Industries with the highest average number of reported obstacles include *motor vehicles & trailers manufacturing*, *computers, electronics, and optical products manufacturing*, *machinery & equipment manufacturing (n.e.c.)*, *construction*, and *retail trade*. However, the most affected industries vary across years. Figure B1 illustrates this variation, showing turnover-weighted industry averages for both reported supply chain shocks and the number of strategies firms employed in response.

As shown in table 1, 46% of the full sample reported adopting a sourcing strategy in 2022, and 39% in 2023. Approximately 5,000 of these firms participated in the survey in both years. Among these firms, 45% of the firms that pursued at least one strategy in 2022 pursued zero strategies in 2023, while 21% of firms that pursued zero strategies in 2022 went on to pursue at least one strategy in 2023.

There is even less persistence when looking at each of the sourcing strategies separately. For instance, 66% of firms that increased inventory/stock in 2022 did not continue doing so in 2023. Similarly, 59% no longer invested in digitalization. 78% of firms that aimed to substitute out extra EU imports with intra EU imports in 2022 did not in 2023, while 85% of firms that planned to reduce the share of goods imported did not in 2023. Lastly, 65% of firms with the strategy in 2022 to increase the number of countries they source from did not continue to in 2023. It is unclear whether this low persistence is because goals were achieved or goals were changed.

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 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.

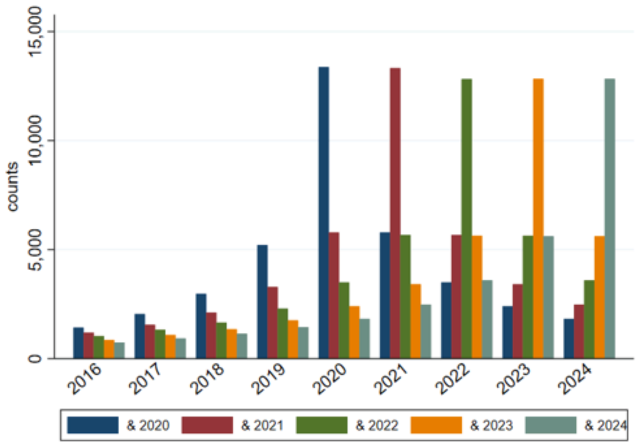
Various panels can be created depending on the EIBGS wave of interest and the matched ORBIS data that has been made available to us by the EIB. For the 2023 wave of EIBGS, mostly corresponding to the firm-year 2022, we have access to a balanced ORBIS panel spanning 2017 to 2022 for 7,521 matched firms.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

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			49%
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)			14 %
q75. Since the beginning of ... were any of the following an obstacle (either minor or major):	**2021**	**2022**	**2023**
access to materials (or any of the below 3)	67%	64%	49%
commodities or raw materials (e.g., steel, copper, fossil fuels, lithium, etc.)		51%	36%
semiconductors and microchips		26%	18%
components, semi-finished products, services, or equipment		47%	33%
disruptions of logistics and transport	67%	54%	44%
trade restrictions (or any of the below 2)	34%	50%	52%
compliance with new regulations/certifications		45%	46%
changes in customs & tariffs (importers and exporters)		40%	40%
Any shock (of the above)	78%	80%	73%
q76a. Since the beginning of ... has or is the firm planning to make these changes in sourcing strategy:		**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 action (of the above)		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). EU firms only. Questions are not industry specific and are paraphrased to save space. See figure A1 for more details on firms that experience multiple supply chain obstacles in a given year and the split between firms specifying a minor obstacle vs a major obstacle.

Figure 1: EIBGS Total and Repeat Observations



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, subsequent supply chain shocks, and firm strategies on firm performance, specifically measured by log turnover.

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 relative to the questions on shocks and actions that refer to the previous year. Table 2 shows firm responses for these questions from 2018 to 2024, simplified into binary variables where 0 indicates a financial constraint.[1] This allows for a directional interpretation where a more positive value indicates a better outcome, similar to turnover.

[1]For both the availability of external and internal finance, the binary variable equals 1 if the response is "improve" or "stay the same," and 0 if the response is "get worse." For the availability of finance, the binary variable equals 1 if the response is "not an obstacle at all," and 0 if the response is "a major obstacle" or "a minor obstacle."

Table 2: 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 of table 1) 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 the following fixed effects specification:

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

where Y_{it} is log turnover or employment for firm i at time t; α_i captures firm fixed effects; $\gamma_r st$ are region-sector-year fixed effects,[2] accounting for time-varying shocks at the region and sector level; 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

[2]Defined over three EU macro-regions (North, South, East) and four sectors (manufacturing, services, construction, and other).

able to mitigate the negative effects of the COVID-19 shock, we extend the estimator to a fixed effects difference-in-differences (DiD) model. 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:

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

where α_i and γ_{rst} are defined as above,[3] 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 that experienced the shock suffered a 17% relative decline in log turnover in the first year of COVID, controlling for firm-specific factors

[3] We also estimate variants of this specification using alternative fixed effects structures, discussed below.

and time-varying shocks common to firms in the same region and sector. This decline persisted, with no recovery observed in 2021 or 2022. For employment, impacted firms experienced a 6.3% relative decline in the number of employees during the first year of COVID, worsening to 11.9% 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-in-difference (DiD) model specified in equation 2.

Table 3 presents the average DiD 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 event study in figure 2 for the full sample. Firms reporting a permanent employment shock saw a 15.2% decrease in turnover[4] and a 10.3% decrease in employment relative to firms that did not report the shock, while controlling for firm fixed effects and time-varying region-sector shocks.

The remaining columns show results from variations of equation 2 that allow treatment effects to differ by supply chain response. The estimates suggest that the negative COVID-19 effect on both turnover and employment is concentrated among firms that did not report 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 17.6% decline in turnover and 11.7& 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 :).[5] To test if this relatively small group indeed performs better than

[4]There is a similar 15.7% decrease in EBITDA and a 12.0% decrease in operative EBIT.

[5]Of these, 25 are in manufacturing, 15 in services, 7 in construction, and 16 in other. This distribution

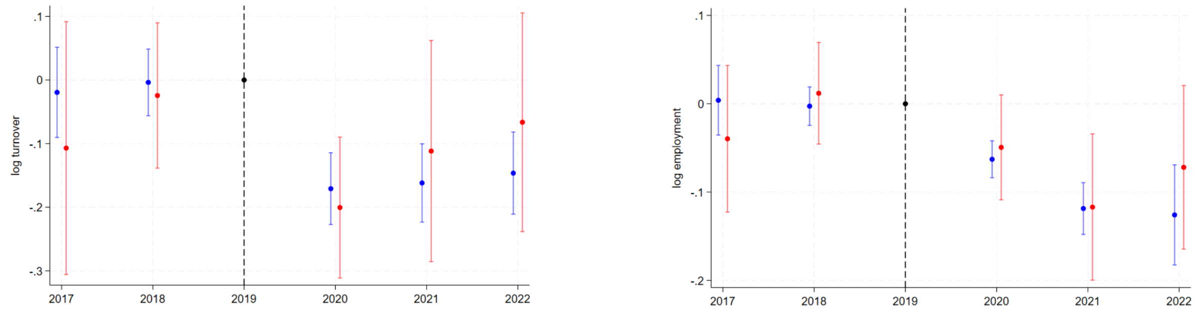
G_2, the reference group is changed to G_2 : in columns 3 and 8 of Table 3. Results show that firms taking action to transform their supply chain were able to mitigate the negative employment shock, with a 11.9% relative improvement in turnover compared to G_2 firms, despite still losing a similar number 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 17.4% boost in turnover and a 12.8% boost in employment 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 interact with country-level policies. These are shown in Appendix Table A3 of the appendix for re-estimates of the columns 3, 4, and 5 of table 3.

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

DV:	log turnover					log employment				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
post2020 = 1 #										
CV = 1	-0.152***					-0.103***				
	(0.022)					(0.017)				
G_1 : CV = 1 # SC tr = 1		-0.055	0.122**	0.174***	0.037		-0.038	0.080*	0.128**	-0.008
		(0.050)	(0.055)	(0.063)	(0.107)		(0.040)	(0.044)	(0.057)	(0.071)
G_2 : CV = 1 # SC tr = 0		-0.176***					-0.117***			
		(0.025)					(0.021)			
G_3 : CV = 0 # SC tr = 1		0.014	0.190***	0.219***	0.180***		0.018	0.135***	0.156***	0.129***
		(0.018)	(0.029)	(0.046)	(0.037)		(0.014)	(0.024)	(0.037)	(0.032)
G_4 : CV = 0 # SC tr = 0			0.176***	0.186***	0.171***			0.117***	0.107***	0.122***
			(0.025)	(0.041)	(0.032)			(0.021)	(0.033)	(0.028)
Firm Fixed Effects (FEs)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Region-Sector FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16830	14921	14921	3680	11238	16199	14336	14336	3582	10751
R-sq.	0.147	0.151	0.151	0.185	0.147	0.026	0.028	0.028	0.049	0.031

Note: DV: log turnover (ORBIS) in columns (1) to (5), log employment (ORBIS) in columns (6) to (10). CV = 1 if COVID caused a permanent negative employment shock (q65_4, '20 & '21). SC tr = 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; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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:

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

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 binary variable indicating whether firm i experienced a supply chain shock in year t; α_i is a firm fixed effect; and γ_t is a year fixed effect. The parameters $\boldsymbol{\beta}$ capture the impact of supply chain shocks on the probability of taking a supply chain action.[6]

[6]While estimation of equation 3 converges reliably, it fails if adding high-dimensional fixed effects. As a robustness check, results for the sub-sample of manufacturing firms are included in the appendix.

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 supply chain (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 SC action on (a) a dummy variable indicating whether a firm experienced any SC 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 SC shocks separately (figure 3c), and (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.

Estimated coefficients are in log-odds units and can be exponentiated (i.e., $\exp(\beta)$) to yield multiplicative effects. For example, the first coefficient in Figure 3a (≈ 0.5) implies that the odds of increasing stocks and inventory are about 65% higher when a firm reports any SC obstacle, holding firm and year fixed effects constant.

The only SC 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 SC 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 shock, suggesting a shift toward near-shoring. This likelihood of pursuing near-shoring increases as firms experience multiple trade shocks. They also 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 shocks relate to managerial actions separately. 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 is available at the time of writing and it is for a much smaller sample, 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 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

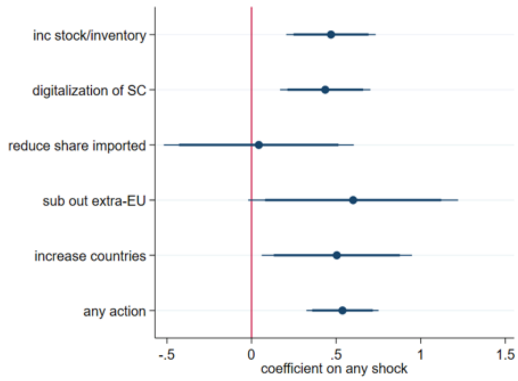
Understanding the micro-mechanisms underlying firms' resilience to the COVID shock is crucial from both a managerial and policy perspective. Therefore, we leverage the richness of our data to examine which factors correlate with firms' likelihood of being relatively resilient.

5.1 Empirical Strategy

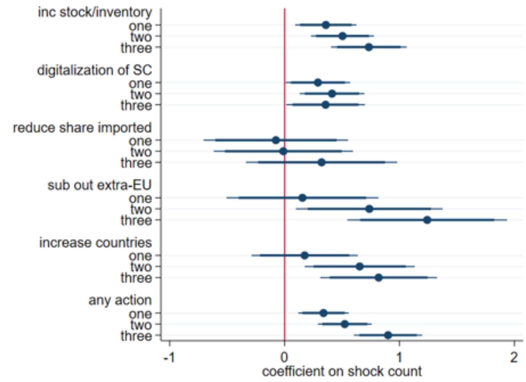
After investigating the mitigating effect of supply chain action on the COVID shock, we aim to assess systematic differences between firms that were relatively resilient to the COVID-19 shock and those that were less resilient. Specifically, we examine how firms' supply chain strategies relate to their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

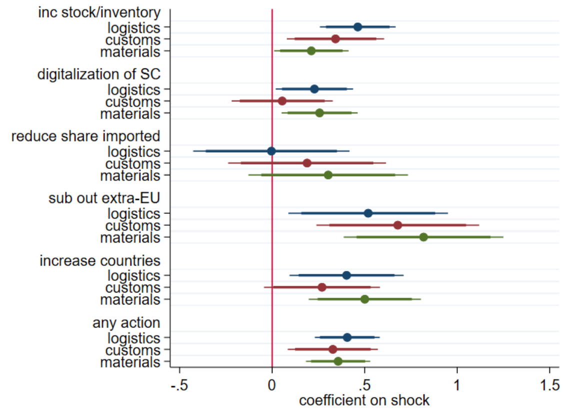
Figure 3: Panel Analysis: Supply Chain Shocks and Actions



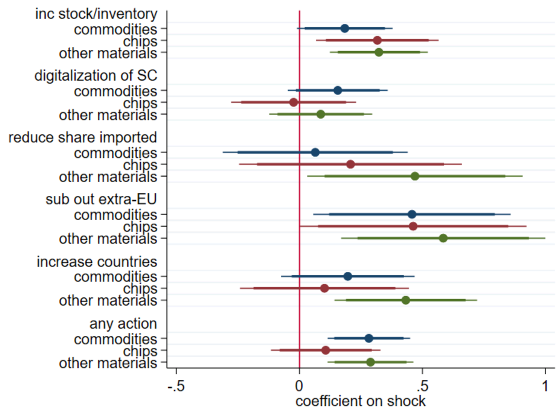
(a) any shock



(b) shock count



(c) shocks categories



(d) materials

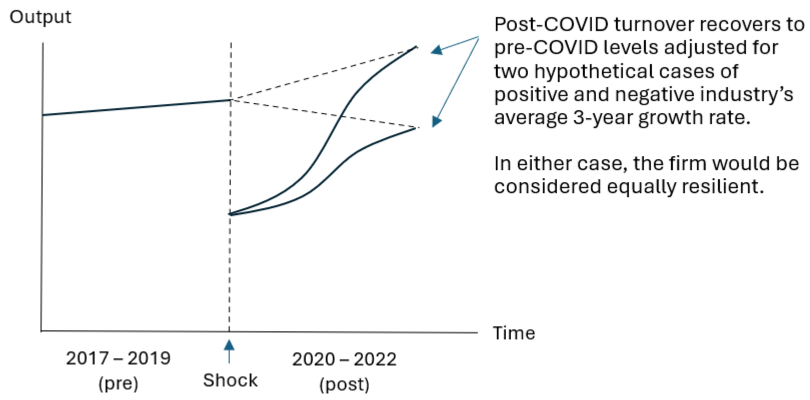
Note: Conditional fixed effect logit regressions corresponding to equation 3. All include year and firm fixed effects. All but each grouping of the 3 count dummies for shocks are separate regressions. The bars indicate 90% (thick) and 95% (thin) confidence intervals for standard errors.

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.

Figure 4: Defining firm resiliency



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 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.

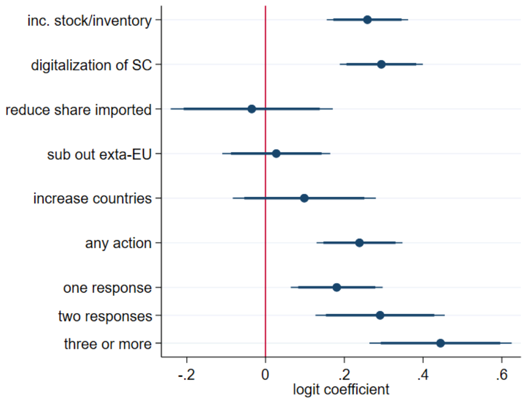
The probability of a firm being relatively resilient is given by:

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

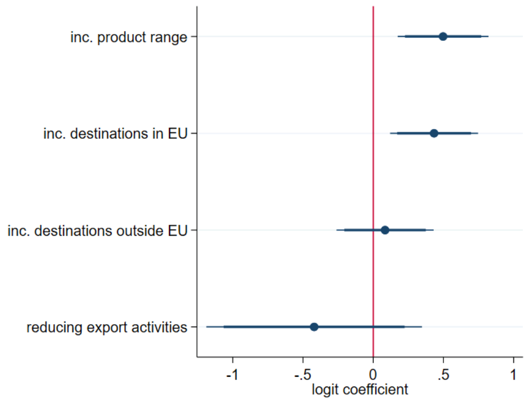
where ResilientFirm_i is a binary indicator as defined above; SC_i is a binary supply chain-related variable taken from the survey responses for the year 2022; $\boldsymbol{Z}_i$ is a vector of firm-level controls, including pre-COVID average log turnover (captures firm size and market presence), pre-COVID 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 denotes country fixed effects; and δ_j denotes 2-digit NACE Rev. 2 industry fixed effects.

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 The Role of Financial Constraints

This section examines whether firms that experience supply-chain shocks or undertake specific supply-chain actions differ in terms of firm size and reported financial constraints.

6.1 Empirical Strategy

This section relies entirely on survey data, allowing us to retain all firms observed in multiple waves, rather than losing observations due to ORBIS matching, particularly in recent years.

We estimate a series of linear and logit regressions using an unbalanced panel, exploiting both between- and within-firm variation in survey responses.[7] The key explanatory variables are supply chain shock and action dummies, each included in separate regressions.

We examine the relationship between each explanatory variable and four outcome variables: firm turnover and three proxies for financial constraints. These financial constraint measures correspond to three survey questions (see section 2.3): (1) firms' expectations regarding changes in the availability of internal finance (q23_1), (2) expectations regarding changes in the availability of external finance (q23_2), and (3) reported obstacles to the current availability of finance for investment (q38_8). Question q38_8 offers the most direct measure of current financial constraints, while questions q23_1 and q23_2 inherently describe within-firm variation in $t + 1$ expectations. Each response is coded as a dummy equal to 0 if the firm expects a worsening in availability or reports obstacles and 1 otherwise. This coding provides a similar directional interpretation as turnover, where higher values indicate better outcomes.

[7] As of now, we have only two years of data on supply chain strategies. Therefore, the within-firm analysis is based on a smaller sample.

Each relationship is estimated under three fixed effects specifications: (model 1) year, industry, and country fixed effects; (model 2) industry-year and country fixed effects; and (model 3) year and firm fixed effects. These correspond to the left, middle, and right columns in each panel of Figure 6. Standard errors are clustered at the firm level to account for within-firm correlation over time.

6.2 Results

Figure 6 presents the estimated relationships across all models. The blue estimates refer to the supply chain shocks, while the red estimates refer to actions.

The evidence strongly suggests that firms reporting being hit by the shocks are also more likely to be financially constrained, irrespective of the variable used.

The availability of finance for investment in panel (d) appears particularly sensitive to SC shocks (Figure 6d), where this negative relationship holds across all types of SC shocks in the conditional fixed effects logit model.[8] 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 also clear. 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 on these supply chain strategies as of now.

Nevertheless, introducing firm fixed effects (right column of figure 6b) shows that firms intending to increase the number of countries they import from were increasingly

[8]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.

reporting constrained internal financing, a relationship that holds at the 90% confidence level. This may be indicative of the direct discovery costs of sourcing from new countries that come from internal financing. This suggests that as firms look to diversify they may be unable to solely rely on internal financing.

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

More broadly, firms that diversify their SC by increasing the countries they source from 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 moving to the conditional fixed effects model. 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. It is similar for firms reporting to look inward by substituting out extra-EU imports for intra-EU imports or reducing the share of goods and services imported. These firms tend to be financially constrained regardless of variation in these strategies.

Our specifications do not allow to make statements on the direction of causality, but nonetheless suggests that financial constraints have either been an impediment to implement effective responses to disruptions, or the actions have been financially costly to firms taking action. Further analysis is needed to elucidate these relationships.

Table B2 shows further results when interacting supply chain shock dummies with supply chain response dummies for explaining the three types of financial constraints. This additional analysis is important to distinguish the relationship of the supply shocks with firm financial constraints from distinct relationships between financial constraints and supply chain action.

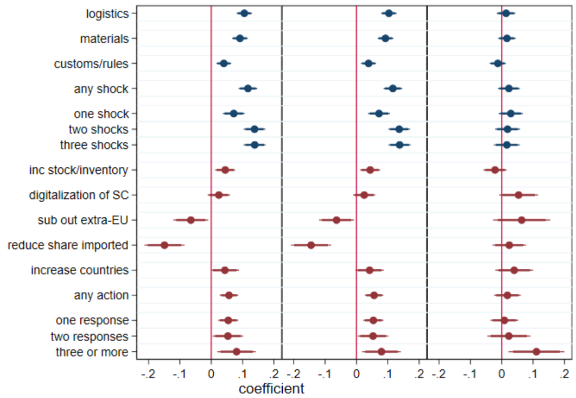
For example, reducing the share of imported goods and services is associated with a higher likelihood of reporting internal financing constraints (columns on the left), but the nature of this association depends on whether firms are simultaneously experiencing specific types of supply chain shocks. In a regression including logistics shocks, import reduction, and their interaction, it is only the logistics shock and the interaction term that are statistically significant, indicating that reducing import reliance becomes financially burdensome specifically in the context of logistics disruptions. In contrast, when the included shock is a materials shortage, the main effect of reducing imported inputs is significant at the 1% level, while the interaction is not. This suggests that firms that reduce their dependence on imported inputs tend to face financial constraints regardless of whether they are directly experiencing the shock. Taken together, these findings imply that only logistics disruptions amplify the financial strain of reducing the share of imported goods and services and only in terms of internal finance.

For the most part, the association with financial constraints is coming from the supply chain shocks much more so than from the supply chain actions. However, there are other cases besides reducing the share of goods and services imported where supply chain actions associate with financial constraints separately from that of any supply chain shocks, such as the association of supply chain digitization and increasing the countries firms source from with constraints on access to finance for investment.

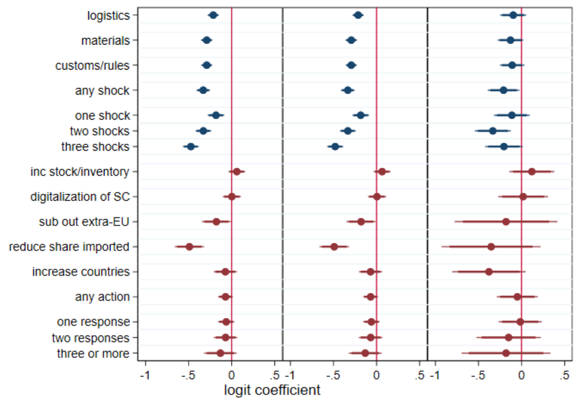
6.3 Industry Heterogeneity

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

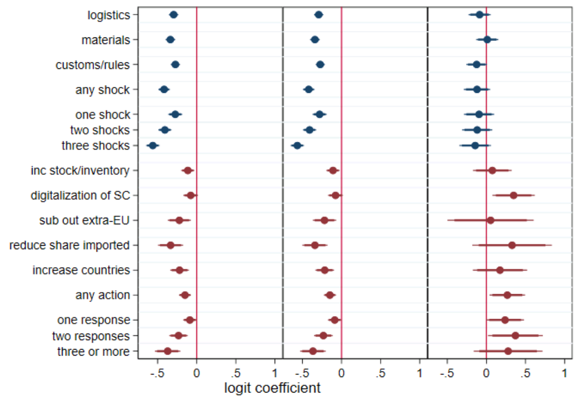
Figure 6: Panel Analysis: Firm Performance and Supply Chains



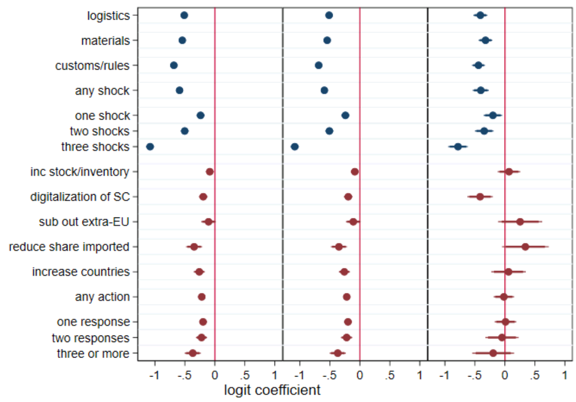
(a) DV: log turnover



(b) DV: internal finance (next 12 months)



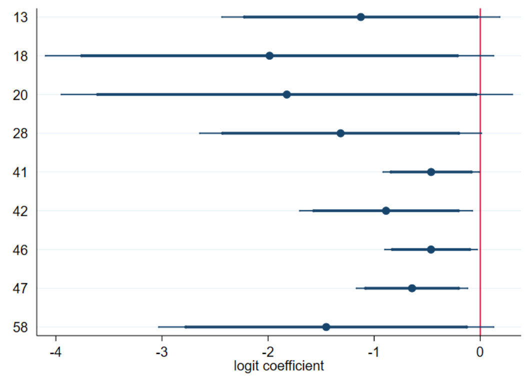
(c) DV: external finance (next 12 months)



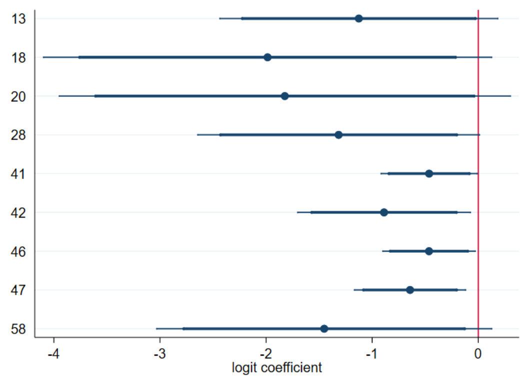
(d) DV: availability of finance (now)

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.

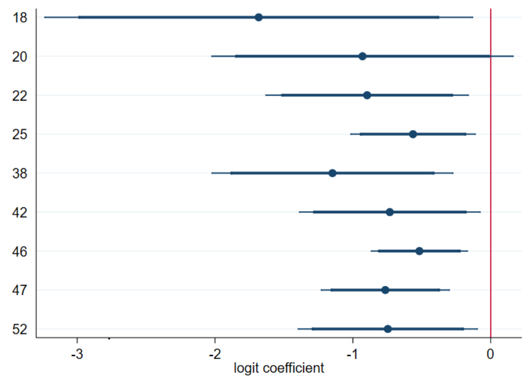
Figure 7: Panel Analysis: Availability of Finance and Supply Chains, Industry Interactions



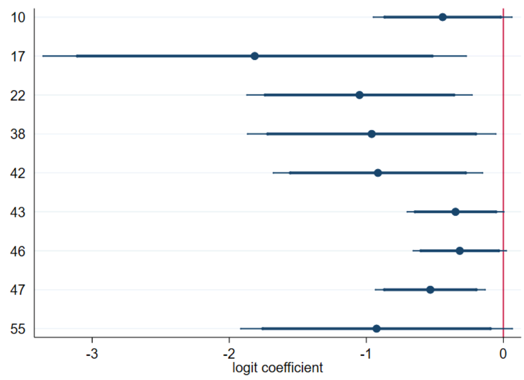
(a) any



(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 Industry$_j$ $\times$ 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. Note that the main effect of the SC shock is omitted so to avoid need of a reference group for the Industry$_j$ $\times$ Shock$_{it}$ interaction. The bars represent 90% (thick) and 95% (thin) confidence intervals for the standard errors.

7 Conclusions and Policy Implications

This paper examines how firms navigated supply chain shocks 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 Group 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.

Companies actively taking supply chain actions are also the most likely to report obstacles in obtaining finance for investment and external finance more broadly. Shedding further light on the role of financial constraints in shaping managerial responses and the direction of causality is the next item on our research agenda.

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, even for firms that maintain healthy sales figures throughout periods of turbulence.

To enable greater resilience of EU firms, policymakers should specifically focus on reducing the financial and institutional barriers that constrain firms' ability to adapt. This includes improving access to finance for investments in inventory buffers and digital supply chain tools, and reinforcing the EU single market as a stable platform for trade and market expansion. Policies that simplify cross-border sourcing and exporting within the EU, rather than focusing narrowly on protecting home markets or promoting full reshoring, could be especially effective. While digitalizing supply chains is associated with improvements in firms' outlook on external finance, it appears to impose immediate costs on the availability of investment financing, underscoring the need for public support. Policymakers should therefore prioritize dedicated financing tools for supply chain upgrades, including targeted grants for SMEs to help them overcome upfront investment hurdles.

Because firms respond differently to similar shocks depending on internal characteristics, targeted support tools such as diagnostics or conditional subsidies may be needed to enable adaptive strategies where capabilities are limited. Ultimately, the findings suggest that resilience is not about retreating from global markets, but about equipping firms with the flexibility and support to navigate them more effectively.

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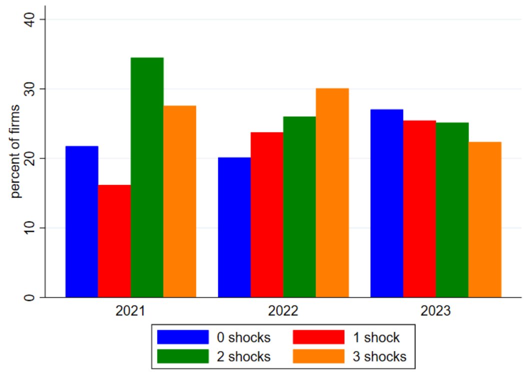
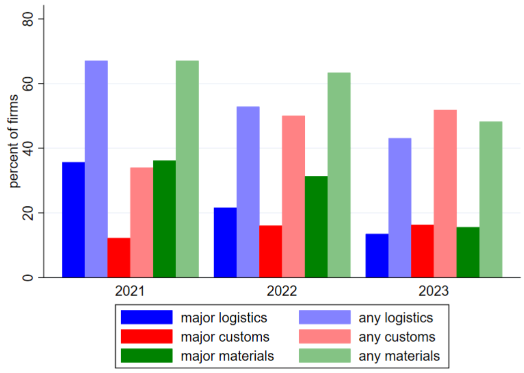
A Figures and Tables Appendix

Figure A1: Summary States: Percent of Firms Experiencing Shocks



(a) counts



(b) shocks

Note: Panel (a) shows the breakdown of firms by the number of different categories of shocks they experience in each year (reporting either a major or minor obstacle for logistics, materials, or customs/regulation for a maximum count of 3). Panel (b) shows the percentage of firms reporting each main category of obstacles, with the light color bars the percent reporting either a major or minor obstacle.

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

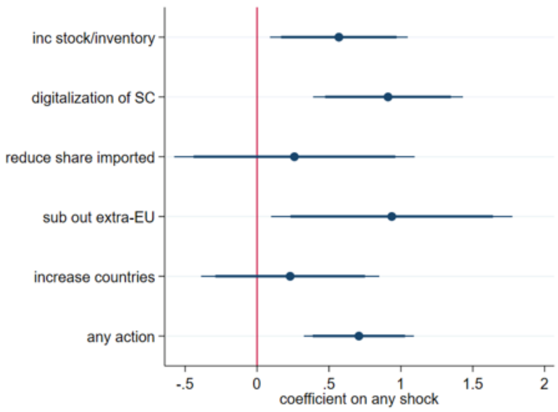
Note: price increase is an indicator equal to 1 if the firm reported experiencing a price increase from its suppliers of greater than 25% since 2022 (SUCH survey). Standard errors; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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

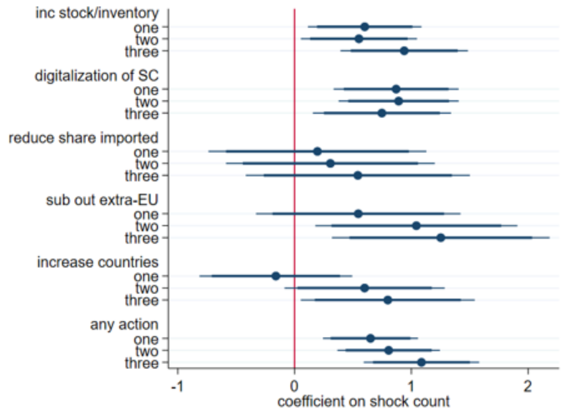
DV:	log turnover								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
post2020 = 1 #									
CV = 1 # SC tr = 1	0.127***	0.163**	0.074	0.102**	0.164**	0.036	0.088	0.180***	-0.014
	(0.048)	(0.065)	(0.089)	(0.049)	(0.064)	(0.090)	(0.056)	(0.066)	(0.112)
CV = 0 # SC tr = 1	0.148***	0.186***	0.135***	0.158***	0.198***	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 = 0 # SC tr = 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: Each 3 columns reproduce columns (3) (4) and (5) of table 3 for alternative fixed effects specifications. Robust errors; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

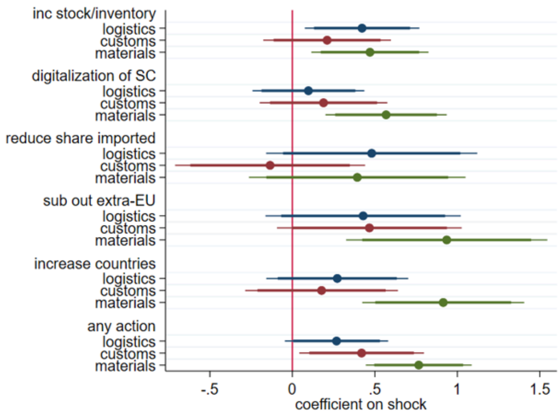
Figure A2: Panel Analysis: Supply Chain Shocks and Actions (manufacturing)



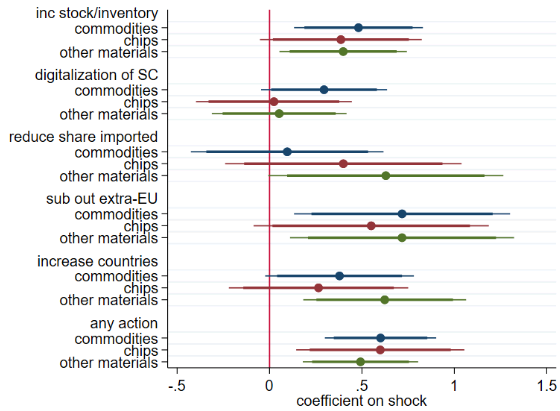
(a) any shock



(b) shock count



(c) shocks categories



(d) materials

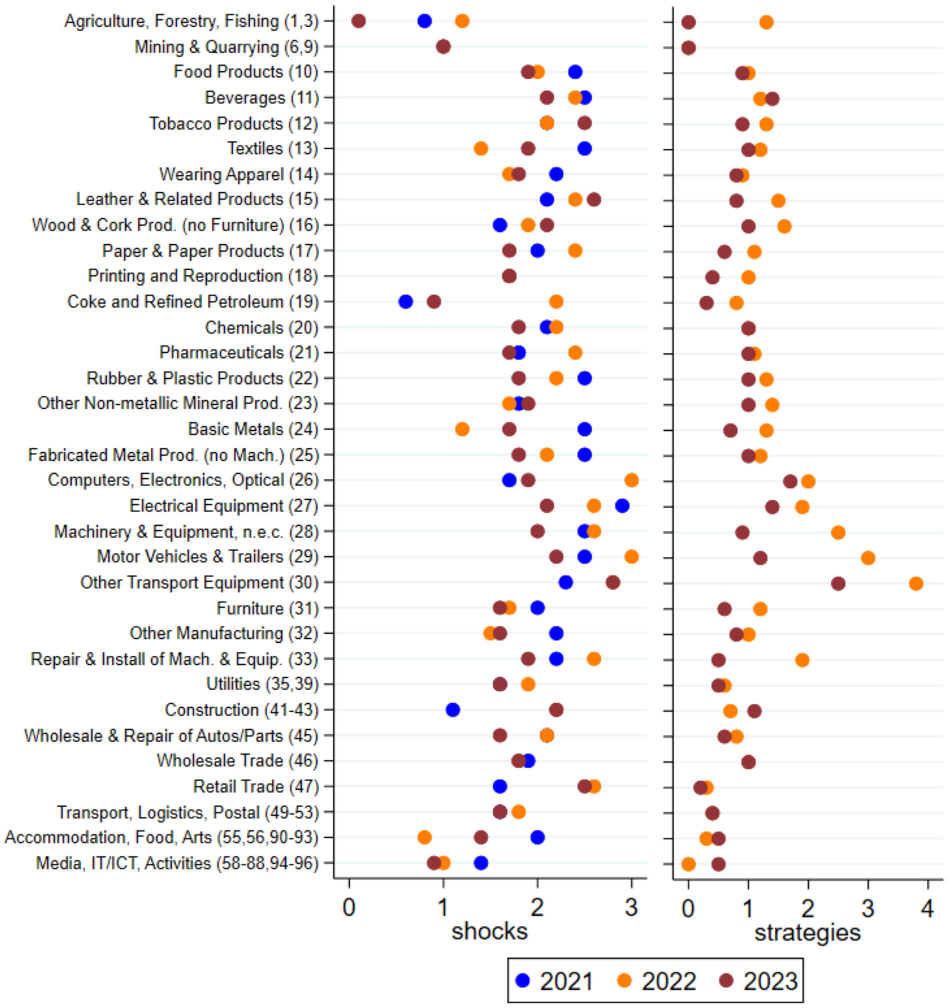
Note: Conditional fixed-effects logit regressions corresponding to equation 3, including year and firm fixed effects. All but each grouping of the 3 count dummies for shocks are separate regressions. The bars represent 90% (thick) and 95% (thin) confidence intervals for the standard errors. There are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

Table B1: Turnover-weighted average shocks per industry

	2021				2022				2023			
Industry	**w**	**u**	**obs**	**turn**	**w**	**u**	**obs**	**turn**	**w**	**u**	**obs**	**turn**
Agriculture, Forestry, Fishing (1,3)	.8	2	9	0	1.2	1.9	9	0	.1	1	6	0
Mining & Quarrying (6,9)	1	1	3	0	1	1	1	0	1	.5	2	0
Manufacturing:												
Food Products (10)	2.4	1.7	423	44	2	1.7	432	30	1.9	1.6	436	24
Beverages (11)	2.5	2.1	52	4	2.4	1.7	58	4	2.1	1.5	51	5
Tobacco Products (12)	2.1	2.2	6	1	2.1	1.7	6	1	2.5	2.8	4	0
Textiles (13)	2.5	2.2	118	3	1.4	1.6	117	3	1.9	1.7	127	4
Wearing Apparel (14)	2.2	1.7	111	1	1.7	1.3	110	1	1.8	1.3	97	1
Leather & Related Products (15)	2.1	1.6	39	1	2.4	1.7	35	1	2.6	1.7	38	1
Wood & Cork Prod. (no Furniture) (16)	1.6	1.7	185	7	1.9	1.7	202	9	2.1	1.5	199	9
Paper & Paper Products (17)	2	2	116	12	2.4	1.8	99	13	1.7	1.4	86	7
Printing and Reproduction (18)	1.7	1.8	106	2	1.7	1.8	108	2	1.7	1.5	124	1
Coke and Refined Petroleum (19)	.6	1.7	9	16	2.2	1.9	11	4	.9	1.2	9	4
Chemicals (20)	2.1	2.2	160	22	2.2	2.1	131	12	1.8	1.9	146	18
Pharmaceuticals (21)	1.8	2	41	4	2.4	2	45	13	1.7	1.6	41	4
Rubber & Plastic Products (22)	2.5	2.2	270	38	2.2	1.9	262	8	1.8	1.7	270	10
Other Non-metallic Mineral Prod. (23)	1.8	1.7	162	9	1.7	1.7	185	13	1.9	1.5	177	13
Basic Metals (24)	2.5	2	99	18	1.2	1.8	97	34	1.7	1.6	96	14
Fabricated Metal Prod. (no Mach.) (25)	2.5	1.9	643	26	2.1	1.7	635	16	1.8	1.5	663	12
Computers, Electronics, Optical (26)	1.7	2.1	116	6	3	2.1	136	241	1.9	1.6	115	7
Electrical Equipment (27)	2.9	2.1	143	153	2.6	2.1	144	9	2.1	1.7	169	14
Machinery & Equipment, n.e.c. (28)	2.5	2.2	357	26	2.6	2.1	327	31	2	1.8	341	22
Motor Vehicles & Trailers (29)	2.5	2.2	86	12	3	2.2	102	308	2.2	1.8	86	14
Other Transport Equipment (30)	2.3	2	38	6	2.8	2.4	34	5	2.8	2	46	5
Furniture (31)	2	2	144	2	1.7	1.8	139	4	1.6	1.2	141	3
Other Manufacturing (32)	2.2	2	103	2	1.5	1.8	112	3	1.6	1.5	111	3
Repair & Install of Mach. & Equip. (33)	2.2	1.8	123	2	2.6	1.8	113	2	1.9	1.6	133	2
Utilities (35,39)	1.6	1.1	674	85	1.9	1.5	607	41	1.6	1.2	625	47
Construction (41-43)	1.1	1.7	2509	151	2.2	1.6	2416	67	2.2	1.4	2393	60
Wholesale & Repair of Autos/Parts (45)	2.1	1.9	374	12	2.1	1.8	369	12	1.6	1.7	333	10
Wholesale Trade (46)	1.9	1.9	1403	82	1.8	1.8	1487	79	1.8	1.6	1448	149
Retail Trade (47)	1.6	1.6	830	35	2.6	1.5	835	105	2.5	1.3	793	104
Transport, Logistics, Postal (49-53)	1.6	1.4	1336	37	1.8	1.6	1345	34	1.6	1.4	1300	37
Accommodation, Food, Arts (55,56,90-93)	2	1.3	441	5	.8	1.3	440	8	1.4	1.1	486	7
Media, IT/ICT, Activities (58-88,94-96)	1.4	1.1	737	30	1	1.2	797	668	.9	1	861	27
All	2.0	1.7	11987	857	2.0	1.7	12001	1786	1.9	1.4	11984	636

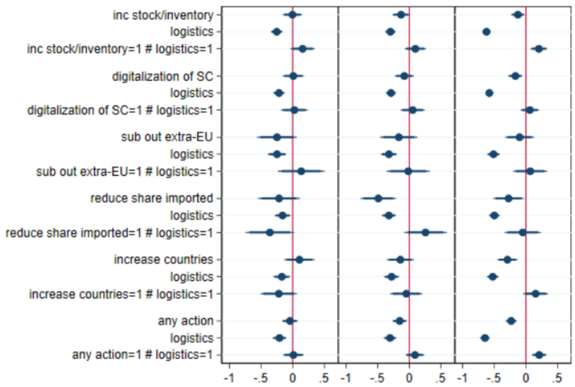
Note: "w" is the turnover-weighted industry average shock count. "u" is the unweighted average. The 3 shocks are logistics, the combined materials categories, and the combined customs/regulations categories. "obs" is the number of firms in the sample for that industry-year. "turn" is the industry's total turnover in the sample in billions euros (among surveyed firms - not actual industry totals).

Figure B1: Turnover-weighted average SC shocks and SC strategies per industry

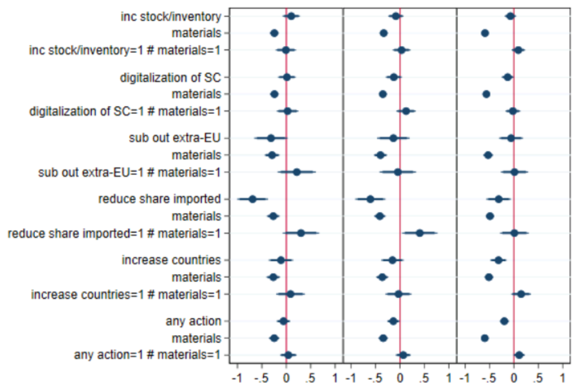


Note: Turnover-weighted industry average shock count (max 3) and strategies count (max 5). The 3 main shocks are logistics, materials, and customs/regulation.

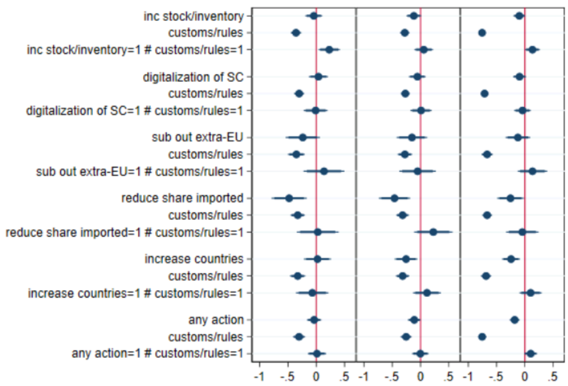
Figure B2: Panel Analysis: Firm Performance and Supply Chains: Interactions



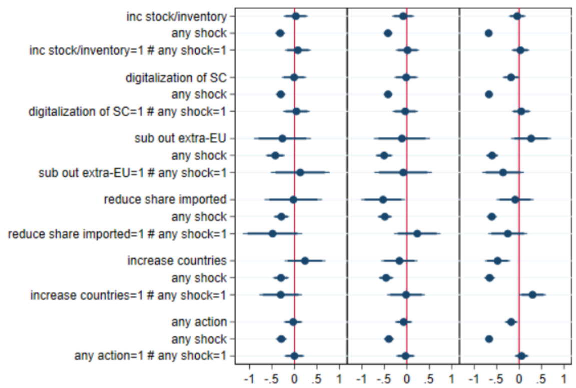
(a) logistics



(b) materials



(c) customs



(d) any shock

Note: DV in left comlumns is internal finance (next 12 months). DV in middle columns is external finance (next 12 months). DV in right columns is availability of finance (now). All employ logit regressions where negative coefficients have a financial constraint interpretation. All regressions include industry-year and country 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.

B Defining Resilience

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

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

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

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

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