Rapport 2025:03

Global Supply Risks and Resilience

Lessons from Swedish Firms

Tillväxtanalys
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Preface

The mission of the Swedish Agency for Growth Policy Analysis is to evaluate the impact of government policies on sustainable growth at regional and national levels. We also provide data and recommendations for the development, review and streamlining of government policies.

The ability of the business sector to withstand and recover from economic shocks has become increasingly important amid rising geopolitical tensions and global market uncertainty. In this report, we evaluate various resilience strategies using data from 1,828 Swedish industrial companies from 2017 to 2023. Our statistical analysis shows that geographical diversification of supply chains and increased stockpiling of inputs help reduce the sector's vulnerability, while the effects of so-called 'friendshoring' must be assessed on a case-by-case basis.

This study is part of a broader project on supply chain resilience in an uncertain global economy. The project is led by Håkan Nordström in collaboration with Josefin Videnord.

We are grateful to all those who have contributed to this report, including conference participants at ETSG 2024 in Athens, SNEE 2024 in Lund, and the Swedish Conference in Economics 2024 in Lund, as well as seminar participants at the University of Groningen Department of Global Economics and Management, Örebro University School of Business, the National Board of Trade Sweden, and the Swedish National China Centre.

A special thanks is extended to our external reviewer Olga Lark, researcher at The Swedish National Road and Transport Research Institute (VTI) and Lund University, and our internal reviewer Ismail Ouraich, analyst at the Swedish Agency for Growth Policy Analysis, who have both provided feedback that has greatly improved the report.

Östersund, February 2025

Sverker Härd
Director-General, Swedish Agency for Growth Policy Analysis

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Summary

The ability of the business sector to withstand and recover from economic shocks has become increasingly important amid rising geopolitical tensions and global market uncertainty. In this report, we evaluate various resilience strategies using data from 1,828 Swedish industrial companies from 2017 to 2023. Our statistical analysis shows that geographical diversification of supply chains and increased stockpiling of inputs help reduce the sector's vulnerability, while the effects of so-called 'friendshoring' must be assessed on a case-by-case basis.

Stylized facts about sourcing

Swedish companies primarily rely on regional EU/EEA suppliers due to their low trade costs and reduced delivery risks. Less frequent and intermittent suppliers often come from more distant regions, reflecting a diversification strategy. Adaptation to changing global market conditions occurs gradually, suggesting that switching suppliers entails relatively high costs.

Resilience Strategies: Combining Stockpiling and Diversification may be the best option

Our statistical analysis shows that both diversification and stockpiling effectively reduce firms' vulnerability to global supply disruptions. Combining these strategies may be the most effective approach, as the marginal benefit of each individual measure diminishes. However, each company must weigh its options based on its specific circumstances.

Friendshoring is not a panacea

The potential benefits of relocating sourcing to allied countries are assessed through an analysis of historical supply disruptions for various inputs. The results are mixed: random friendshoring reduces supply risks in 40% of cases but increases them in 60%. Therefore, friendshoring is not a universal solution but rather a strategy that must be evaluated on a case-by-case basis with careful consideration of future risks.

Adaptation to a more uncertain global economy has primarily occurred through more stockpiling—not friendshoring

Adjustments to a riskier global economy have primarily been made through increased stockpiling. Significant friendshoring has yet to take place, except for a shift away from Russia due to war-related sanctions. Instead, procurement has been redirected to other rival and non-aligned countries—including China, which the EU highlights in its strategy for "strategic autonomy." This underscores the challenge of decoupling from China and other rivals, as businesses remain dependent on sourcing inputs where they are available and competitively priced.

Small firms stockpile, large firms diversify

Resilience strategies vary by company size and industry. Smaller firms primarily rely on stockpiling, while larger firms focus on diversification—reflecting differences in costs and capacity. Primary industries that source raw materials from organized markets diversify less than those dependent on customized parts and components.

Policy conclusions

If the private sector underinvests in resilience, public intervention may be warranted to strengthen the economy's ability to withstand shocks. Many argue that this is the case, citing the collapse of supply chains during the pandemic and rising geopolitical tensions. Confirming this hypothesis would require a comprehensive cost-benefit analysis, which falls outside the scope of this study. What we do observe is that companies are investing more in resilience than before, primarily by increasing their inventories of inputs to bridge temporary disruptions. Whether these investments are optimal from a broader societal perspective remains uncertain.

If further analysis concludes that government intervention is necessary, efforts should focus on addressing the root causes of rising global market risks. Many supply risks are political, as highlighted by the measures imposed by Donald Trump following his reinstatement as U.S. president in January 2025. The most effective way to mitigate these risks is to restore a rules-based global trading system under the WTO. Retreating into rival trade blocs would not only restrict firms' market access but also hinder their ability to diversify risk.

If this is not feasible in today's geopolitical climate—which currently appears to be the case—the key political challenge will be to design defensive measures without further escalating tensions in the global economy. Determining the specific actions to be taken, both nationally and within the EU framework, is a task for policymakers.[1]

[1] In the next report in this series, we will take a closer look at the issue of critical raw materials for the green transition and the measures the EU has taken to strengthen strategic autonomy.

1. Introduction

Economic resilience is defined as the ability to withstand and recover from economic shocks. In this report, we evaluate various strategies that companies can use to strengthen their supply chains—something that has become increasingly urgent due to the geopolitical situation and unpredictable trade conditions, particularly concerning import tariffs and export restrictions on critical raw materials from countries such as China, which holds an almost monopolistic position in rare earth elements, essential for the green transition.

Our evaluation is based on microdata from 1,828 Swedish industrial firms, covering the period from the first quarter of 2017 to the last quarter of 2023. It examines three key strategies for reducing vulnerability:

- Diversification of the supplier base
- Stockpiling of raw materials and intermediate inputs
- Increased sourcing from allied countries ("friendshoring").

These three strategies address supply chain risks in different ways. The first aims to reduce the risk by engaging alternative suppliers as backups. The second strategy focuses on mitigation. By keeping inventories of critical inputs, production can continue and, if carefully calibrated, sustain operations until supply resumes. The third strategy seeks to minimize risks as much as possible by choosing reliable suppliers, a practice that has been equated in the current geopolitical debate with increasing purchases from allied nations, commonly referred to as *friendshoring*.

As Swedish industrial firms use different strategies, they can be evaluated empirically. This study builds on Tillväxtanalys (2023), which examined supply chain disruptions during the pandemic, as well as Lafrogne-Joussier et al. (2023) and de Lucio et al. (2023), who analyse resilience strategies using French and Spanish microdata.

1.1 Disposition

This report summarizes the findings of a longer working paper with the same title.[2] We begin by presenting the analytical framework and data, followed by a description of methods for measuring supply risks. Next, we analyze how these risks influence sourcing decisions and how diversification and stockpiling strengthen firms' resilience to global supply disruptions. The effects of friendshoring are addressed in a separate section. We then examine how companies have adapted to an increasingly uncertain global economy in recent years, as well as differences across industries and firms of various sizes. The report concludes with a brief summary and policy discussion

[2] Tillväxtanalys (2025). Global Supply Risks and Resilience - Lessons from Swedish firms. WP 2025:01

2. Framework and data

2.1 Data

The study covers 1,828 manufacturing firms in Sweden over the period from the first quarter of 2017 to the last quarter of 2023. The firms are categorized into 23 industries at the main level of the Swedish Standard Industrial Classification and into four size classes based on the average number of employees per firm during the study period: micro (1–9), small (10–49), medium-sized (50–249), and large (250+). Table 1 presents the distribution of firms by industry and size class.

Table 1. The distribution of firms across industries and size classes

Sector (ISIC)	Micro	Small	Medium	Large	Total
10. Food	14	30	43	15	102
11. Beverages		1	3	4	8
12. Tobacco			3	2	5
13. Textiles	5	13	13	1	32
14. Apparel	3	5	2		10
15. Leather	4	5	2		11
16. Wood	6	21	27	11	65
17. Paper	4	25	19	20	68
18. Printing and reproduction	12	14	4		30
20. Chemicals	13	36	34	16	99
21. Pharmaceuticals		7	9	7	23
22. Rubber and plastics	23	75	61	4	163
23. Mineral products	9	14	18	14	55
24. Basic metals	6	22	20	15	63
25. Fabricated metal	64	125	92	15	296
26. Computers and electronics	34	55	33	8	130
27. Electrical equipment	12	35	33	6	86
28. Other machinery	40	110	112	32	294
29. Motor vehicles	25	28	42	21	116
30. Other transport equipment	8	13	12	5	38
31. Furniture	1	10	22	5	38
32. Other manufacturing	14	20	13	5	52
33. Repair and installation.	23	10	9	2	44
Total	320	674	626	208	1828

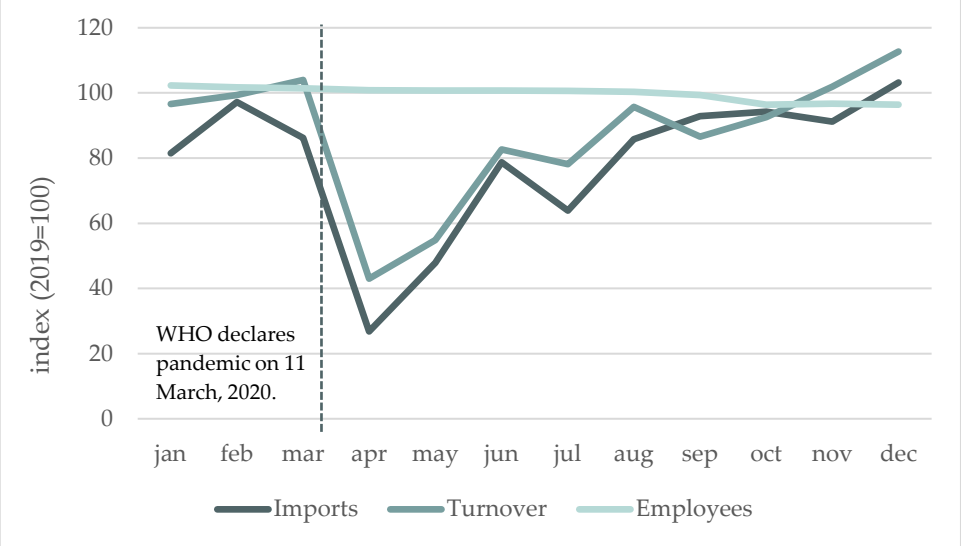
2.2 Model

2.2.1 A simple sourcing model with Leontief technology

The analysis is based on a model in which firms produce output using fixed proportions of various inputs, a standard assumption in analyses of global supply chains. A key characteristic of the Leontief technology is that production is constrained by input shortages. This creates a direct link between disruptions and production, which we leverage to study the effects of inventory management and diversification.

Figure 1 illustrates an example of this connection, drawn from the Swedish automotive industry during the COVID-19 pandemic. At the peak of the crisis in April 2020, imports of parts and components had fallen to just 25 percent of normal levels, while revenue—partially sustained by sales of finished vehicles from inventory—declined to 40 percent. After a production halt of approximately six weeks, operations gradually resumed, reaching full recovery by the end of the year, followed by a post-pandemic boom as backlogged orders were fulfilled. Employment was only marginally affected, as the costs of the production stoppage were shared with the state.

Figure 1. Imports of production inputs, turnover and number of employees in the Swedish automotive industry in 2020, compared to the same month in 2019 (2019 = 100)



2.2.2 Sourcing in a risk-free world

In a risk-free world without supply shocks, firms buy their supplies from the country offering the best price for each input, factoring in transportation margins, tariffs, and other trade costs. In this context, splitting an order between two or more suppliers would not be rational unless the required volume exceeds the supply capacity of the lowest-cost supplier. Therefore, in general, the full order will go to the supplier that offers the best overall conditions.

2.2.3 Risk management in an uncertain global economy

If there is a risk that a company may be unable to deliver the agreed volume, it can be rational to distribute orders among multiple independent suppliers that can cover for

each other, even if this results in a slightly higher total cost. In the working paper, we demonstrate that the most effective strategy is to combine suppliers whose production tends to be negatively correlated. Under optimal conditions, this can reduce the risk of running out of inputs to near zero.

Since resilience comes at a cost, companies must weigh the benefits and costs of different measures. The supply chain management literature recommends selecting primary

suppliers based on cost while engaging secondary (backup) suppliers to ensure stability. This can be achieved through a two-part contract, where a fixed share of the volume is allocated to each supplier, with an option to purchase additional units if needed at a slightly higher price as compensation for the added flexibility.

For customized inputs, such as tailor-made microchips that are not readily available off-the-shelf on the open market, it is particularly important to secure alternative suppliers in advance to minimize the risk of production stoppages.

2.2.4 Diversification versus stockpiling

An alternative to diversifying the supplier base is to stockpile inputs to create a buffer against temporary disruptions. Depending on the circumstances, a company may choose to diversify, stockpile, combine both strategies, or rely on a single supplier per input. The choice of strategy varies across industries and company sizes, suggesting that there is no universal solution (see Section 7 for further discussion).

2.2.5 Data limitations

Although Sweden has better microdata than many other countries, it is not possible to measure all dimensions of firms' risk diversification. We cannot assess risk diversification between suppliers within the same country or between domestic and foreign suppliers, as Statistics Sweden (SCB) does not provide transaction data for confidentiality reasons. For the same reason, we cannot identify imports conducted via domestic wholesalers, which is likely a common sourcing strategy for smaller firms to avoid costs associated with direct imports. Finally, there is a risk that goods cleared through customs in another EU country before being shipped onward to Sweden are incorrectly classified as originating from the EU, even if they were manufactured in, for example, China (the 'Rotterdam effect').

These sources of error are unfortunately unavoidable, limiting the analysis to measuring only geographical risk diversification between suppliers in different countries, with the caveat of the so-called Rotterdam effect. Therefore, the study includes only companies that import input materials directly, which typically means larger firms. Micro and small enterprises are included only if they import input materials themselves rather than sourcing them through domestic wholesalers.

2.3 Supply disruptions

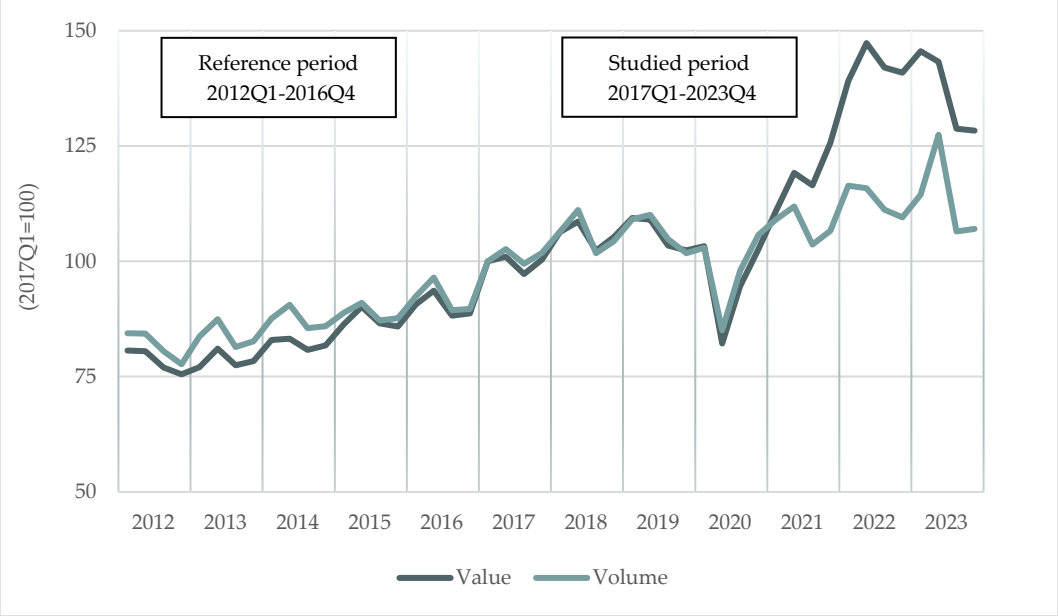
To evaluate different resilience strategies, data on import disruptions experienced by each company is required. These disruptions are defined as the difference between the ordered and delivered quantities in a given quarter. Unfortunately, we lack data on ordered quantities and can only observe actual deliveries.

Supply Disruption = Ordered Quantity – Actual Delivery

In a previous study focusing on the COVID-19 pandemic, we estimated the disruptions by assuming that orders for 2020 corresponded to actual deliveries in the same quarter of 2019. This method is based on the assumption that demand remained, on average, unchanged compared to the previous year—a reasonable assumption for 2020, as forecasts had predicted stagnant growth before the pandemic changed the landscape.

If the same method is applied in a more dynamic business environment, where some companies are growing while others are shrinking, it may become misleading. Therefore, we will use a more advanced instrumental variable (IV) method, in which we estimate disruptions for each individual input based on EU data and aggregate them into a unique, import-weighted disruption index for each company.

Figure 2. EU imports of production inputs, excluding Sweden and the UK (2017Q1=100)



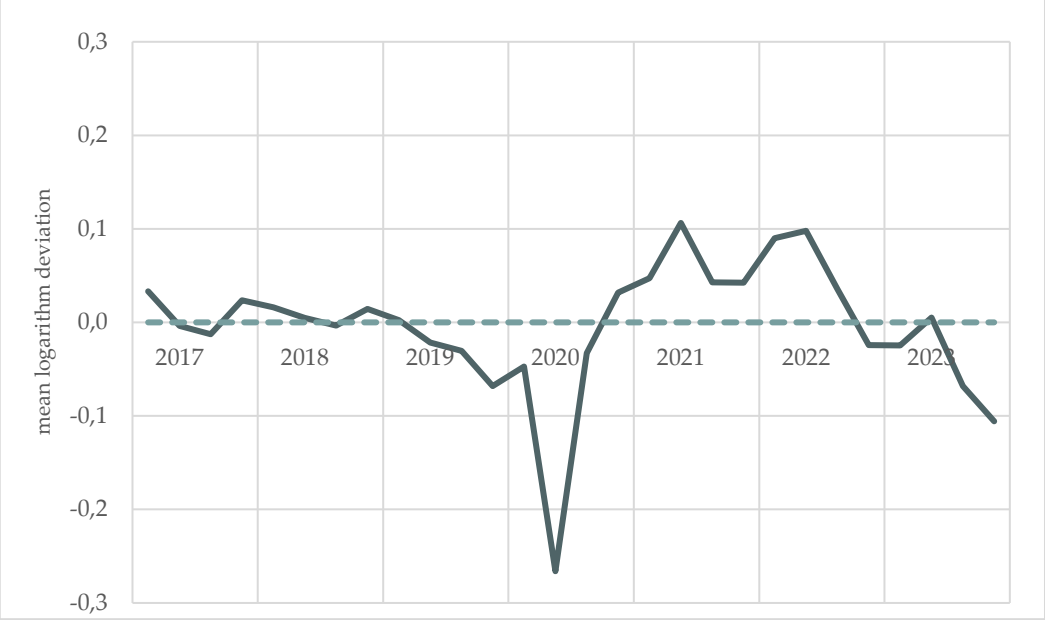
To illustrate our reasoning, we can look at Figure 2, which shows the import of inputs into the EU, excluding Sweden (to avoid endogeneity) and the United Kingdom (due to Brexit). We use import data instead of export data from partner countries, as EU data is available on a quarterly basis and provides a more detailed product-level breakdown.

The time series, which extends back to 2012, shows a positive trend with seasonal fluctuations but also clear disruptions linked to the COVID-19 pandemic in 2020, followed by an inflation-driven recovery phase and a new downturn after Russia's invasion of Ukraine in February 2022. The rise in inflation is clearly reflected in the difference between the value and volume of imports during the recovery phase.

For each input good and partner country, we estimate a log-linear, seasonally adjusted import trend based on EU data (excluding Sweden and the United Kingdom), using quarterly data from the past five years. This trend is then projected one quarter ahead to calculate the current deviation, which serves as an instrument (or proxy variable) for measuring supply disruptions in the Swedish market.

The calculations are based on real time series (volume indices) rather than import values, as the focus is on real supply shocks and how these can be mitigated through various resilience strategies. In the final step, disruptions for each input good and partner country are aggregated into an import-weighted disruption index, which is unique toeach company depending on the specific input goods it uses and the country (or countries) from which they are imported.

Figure 3. The evolution of general supply conditions over time (measured as the mean logarithm deviation from the projected supply across all inputs)



By aggregating the index for all input goods (Figure 3), we obtain a general overview of supply conditions during the studied period. The index fluctuates around zero until mid-2019, followed by a sharp decline during the COVID-19 pandemic in 2020, a strong recovery in 2021, and another drop triggered by Russia's invasion of Ukraine in February 2022. A further decline occurred in the second half of 2023 as geopolitical tensions escalated globally.

In other words, the index appears to reflect global events, reinforcing its validity as an instrument for measuring disruptions in the Swedish market.

2.4 Individual supplier risks

Using this framework, we can calculate the supply risk for each product and country as the standard deviation of disruptions over the past 20 quarters divided by the mean:

(2) $CV_{jk,t} = \frac{STD_{jk,t}}{MEAN_{jk,t}}$.

The Coefficient of Variation $(CV_{jk,t})$ is a size-neutral measure of supplier risk that can be compared across products, supplier countries, and time. As a complementary measure, adapted from the finance literature (CAPM model), we calculate the covariance between the individual suppliers and the overall market supply $(COV_{jkM,t})$, normalized by the market variance $(VAR_{jM,t})$:

(3) $\beta_{jk,t} = \frac{COV_{jkM,t}}{VAR_{jM,t}}$.

The β-measure is relevant when adding new suppliers to the "portfolio" for stabilization purposes, where values below one are stabilizing and values above one are destabilizing. Suppliers with negative β-values are particularly valuable from a stabilization perspective.

3. Does risk matter in practice?

To what extent do companies take supplier risks into account? To statistically examine this question, we estimate a risk-adjusted logit gravity model. More specifically, we assess the probability that a company chooses country k over alternative countries supplying the same input good j. Separate regressions are conducted for core suppliers, intermittent suppliers, and new suppliers to evaluate whether decision-making differs depending on the supplier's role, as suggested by the theoretical model. Core suppliers are selected based on cost considerations, while intermittent and new suppliers are chosen for stabilization purposes.

The following definitions are used to categorise suppliers:

- ***Core*:** Suppliers engaged in all of the last four quarters.
- ***Intermittent*:** Suppliers engaged in at least one of the last four quarters.
- ***New*:** Suppliers not engaged in the last four quarters.

The definition is dynamic. Core suppliers become intermittent if not used consecutively, and vice versa for intermittent suppliers. Similarly, new suppliers are moved to the intermittent category if they are used a second time during a four-quarter interval, after which they can graduate to core suppliers if used consecutively. Finally, suppliers not used for four quarters are treated as discontinued and are classified as new if re-engaged at a later stage.

3.1 Results

3.1.1 Size, distance and trade costs

We first examine the influence of standard gravity variables on sourcing decisions, including exporter size (measured by total exports to the world market), geographical distance, and other trade cost factors. These include EU and EEA membership, contiguity (shared borders), the World Bank's Ease of Doing Business Index (where a higher score indicates fewer restrictions), and indicators of business group relationships (such as parent companies or foreign subsidiaries). Additionally, we include a dummy variable to capture the effects of EU sanctions on Russia following its invasion of Ukraine. The regression results appear in the lower section of Table 2 under the heading 'Gravity.'

The first column ('Total') presents the results without distinguishing between core, intermittent, and new suppliers. As expected, firms prefer larger exporters over smaller ones and favour nearby suppliers over distant ones. Low trade costs—linked to EU/EEA partners, neighbouring countries, or countries with high Ease of Doing Business scores—also positively influence sourcing decisions. Additionally, business group ties with the exporting country further strengthen trade.

The novel aspect of the regressions is the distinction between supplier types. Notably, the EU dummy is positive for core suppliers but negative for intermittent and new suppliers. This suggests that core suppliers, used consistently, are more likely to be from the EU (or EEA), while intermittent and new suppliers, which fill gaps, are often from other regions. This is supported by the finding that distance matters less for alternative suppliers.

Explanatory variables	(Total)	(Core)	(Intermittent)	(New)
Risk:				
$ln(Supply\ shock_{jkt})$	0.017** (0.003)	0.004 (0.004)	0.025** (0.004)	0.029** (0.006)
CV_{jk}	-3.116** (0.063)	-4.419** (0.100)	-4.220** (0.105)	-0.975** (0.134)
β_{jk}	-0.002 (0.001)	-0.001 (0.001)	0.002 (0.002)	-0.006** (0.002)
Gravity:				
$ln(Size\ exporter_{jk})$	0.226** (0.001)	0.262** (0.001)	0.171** (0.001)	0.101** (0.002)
$ln(Distance_{jk})$	-0.403** (0.003)	-0.530** (0.004)	-0.261** (0.005)	-0.159** (0.008)
EU_{jkt}	0.179** (0.005)	0.390** (0.007)	-0.035** (0.008)	-0.241** (0.015)
EEA_{jkt}	0.122** (0.010)	0.238** (0.013)	0.063** (0.016)	-0.004 (0.027)
$Contiguity_{jk}$	0.186** (0.006)	0.120** (0.007)	0.193** (0.009)	0.207** (0.017)
$ln(Doing\ business_{jk})$	3.783** (0.027)	3.820** (0.040)	3.720** (0.041)	2.964** (0.063)
$Business\ group_{i}$	0.232** (0.008)	0.293** (0.011)	0.147** (0.012)	0.182** (0.023)
$Subsidiary_{ijkt}$	0.831** (0.011)	0.746** (0.015)	0.799** (0.017)	0.708** (0.029)
$Mother_{ijkt}$	1.503** (0.007)	1.537** (0.008)	1.040** (0.011)	0.630** (0.024)
Sanctions agains Russia	-4.659** (0.334)	-4.448** (0.448)	-4.407** (0.500)	
Observations	8,954,969	8,954,969	8,954,969	8,937,548
Pseudo R2	0.112	0.140	0.056	0.027
Industry & Size	Yes	Yes	Yes	Yes

Note: One star (*) indicates that the coefficient is statistically significant at the 5% level, while two stars (**) indicate statistical significance at the 1% level.

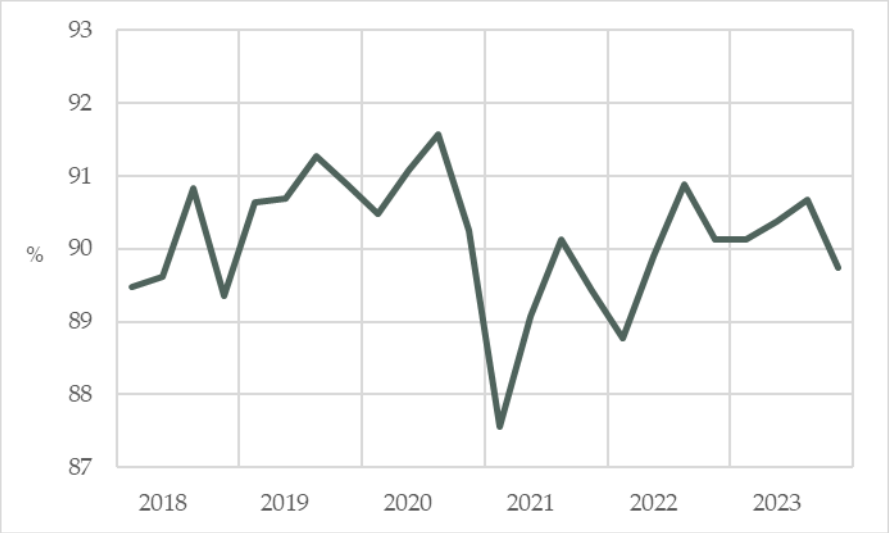
3.1.2 Suppliers are combined to manage risks

Turning to the risk parameters, note first that current supply conditions have little impact on the selection of core suppliers, which are chosen for their long-term advantages in cost and supply risk. In contrast, the current supply capacity is important for intermittent and new suppliers, who fill gaps, while the coefficient of variation is less important for them. Note, finally, that the β-coefficient is negative for new suppliers and insignificant for the other groups. This suggests that new suppliers are chosen for their stabilization merits.

The results align with portfolio theory, which suggests combining suppliers to improve supply security. To our knowledge, these findings are new to the trade literature, though they may be familiar in supply chain management studies, a field we know less about.

However, the model's explanatory power, as reflected in the pseudo R^2, is low, indicating that it is incomplete. A key missing factor is persistence in the supplier set, suggesting that finding and integrating new suppliers is costly. Indeed, as shown in Figure 4, about 90 percent of suppliers are retained from one year to the next, implying an annual turnover of approximately 10 percent. roups. This suggests that new suppliers are chosen for their stabilization merits.

Figure 4. Share of suppliers retained over an annual cycle (%)



Overall, the data suggest that firms adopt a portfolio risk management approach, balancing costs and risks while making gradual adjustments to changes in the global market. This approach involves prioritizing long-term costs and stability for core suppliers while employing more flexible, short-term strategies for intermittent and new suppliers, considering both current supply conditions and long-term risk factors.

4. Resilience

As outlined in the introduction of this paper, the resilience toolbox includes three primary tools to mitigate the effects of global supply disruptions:

- Diversifying the supply base,
- Stockpiling inputs, and
- Sourcing from nearby and allied countries (friendshoring).

In this section, we evaluate the first two strategies, which are often used together. The question of whether friendshoring can avoid risks is deferred to Section 5, along with the complex issue of defining friends and foes, a prerequisite for testing the friendshoring hypothesis.

We begin by presenting stylized facts about supply diversification and stockpiling in the Swedish manufacturing industry, including measurement issues. Using this data, along with the estimated supply disruptions from Section 2.3.1, we will evaluate how well these strategies mitigated global supply shocks during the covered period and, therefore, their potential to withstand future disruptions.

4.1 Diversification and stockpiling

4.1.1 Diversification

With the available data, we can only measure diversification across countries, as we lack information on the supplying firms. The simplest diversification measure is the average number of supplying countries per input. For example, if a firm uses two inputs, where the first input is imported from one country and the second input is imported from two countries, the average is 1.5.

We will use a slightly more sophisticated measure that also accounts for market shares, based on the assumption that the effective risk diversification is greater when the shares are equal. For instance, a 50-50 split between two suppliers is more effective than a 90-10 split, which seems like a reasonable assumption.

Specifically, the effective risk diversification is measured by the complement to the Herfindahl-Hirschman index of market concentration.[3] This index ranges from 0 to 1, where a higher value indicates a more diversified supply chain across countries. We refer to the index as the Geographical Risk Diversification (GRD).

[3] $GRD_{it} = 1 - \sum_j \sum_k w_j s_{jk}^2$, where s_{jk}^2 is the squared market share of supplier k for input j, weighted by the share of j (denoted w_j) in the input basket of firm i in period t.

Figure 5. The geographical risk distribution of the Swedish industry in 2017 and 2023

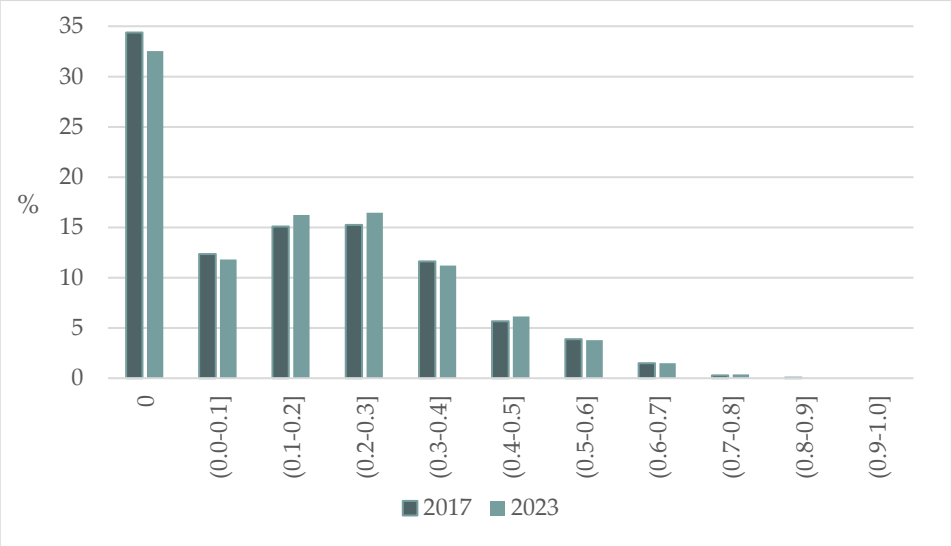


Figure 5 illustrates the GRD for the Swedish industry. The distribution is skewed to the right, with an average of 0.166 in 2017, rising to 0.171 in 2023. This corresponds roughly to a 90/10 split between two suppliers. That is, a firm imports 90 percent of an input from a main supplier and 10 percent from a backup supplier. Note that approximately one-third of firms do not diversify risks at all; they rely on a single supplier for each input. This is particularly true for smaller firms, likely due to administrative costs, whereas larger firms tend to be more diversified. Detailed data, broken down by size and industry, is provided in Section 7.1 of the paper.

4.1.2 Inventories

The stocks of inputs and finished goods are surveyed quarterly by Statistics Sweden with focus on medium-sized and large industrial enterprises. For smaller firms we only have intermittent data. The panel is therefore unbalanced.

Inventory data exhibit a seasonal pattern, with a peak in the first quarter of each year, except for 2021. This pattern is similar for inputs and finished products, though for different reasons that are not entirely clear. For inputs, it may reflect the annual planning process (repeated each year) and the advantages of bulk purchases. For outputs, it likely reflects low first-quarter demand, with firms building inventory for later sales. The exception in the first quarter of 2021 is likely a lingering effect of the pandemic, during which inputs could not be stocked in the usual manner because of remaining supply constraints, while back-logged orders were delivered directly from the production line. Detailed data, broken down by size and industry, is provided in Section 7.2 of the paper.

4.2 How effective are diversification and stockpiling as resilience strategies?

Against this background, we evaluate how well diversification and stockpiling were able to mitigate the supply shocks during the covered period and, therefore, their potential to withstand future disruptions of similar kind.

4.2.1 Deviation from trend as supply shocks

Our primary supply shocks are the deviations from the seasonally adjusted import trend in the EU, excluding Sweden and the UK (see section 2.3.1 for details). As these shocks are measured at the product level, they must be weighted to the firm level. In the spirit of Bartik (1991) shift-share instruments, we combine the country-product-period level shocks with firm-level trade exposure weights.[4]

4.2.2 Both diversification and stockpiling reduce firms' vulnerability to global supply disruptions

The regression results in Table 3 show that both diversification and stockpiling reduce firms' vulnerability to global supply disruptions, but a combination may be the most effective approach. Determining the optimal degree of resilience requires a thorough cost-benefit analysis, which is beyond the scope of this paper and likely varies across industries and firm size classes.

Since we lack quarterly production data, we use the turnover as a proxy. This proxy is not ideal since the turnover includes revenues earned from current production as well as inventory sales. We therefore include the inventories of finish products as an additional control variable.

To avoid reversed causality, that is, that turnover may influence imports, we use a two-stage instrumental variable (IV) approach. In the first stage, we estimate the relationship between imports, the supply shocks, and geographical risk diversification, and in the second stage the knockdown effects on the production, controlling for the inventories held by each firm. Firms that use both resilience strategies have, in principle, the best chances to ride out a storm.

Table 3 presents the results of the instrumental variable regressions. The first stage regression for the full sample of firms, without stockholding data, is shown in column (1), followed by the second stage regression in column (2). The supply shock and GRD are positive (+) and statistically significant. The negative coefficient of GRD_{iT}^2 shows a diminishing effect of GRD (-), suggesting that there is some optimal level of GRD after which the positive effect weakens, similar to our findings in Tillväxtanalys (2023).

Turning to the knockdown effect of imports on production in column (2), we find, as expected, that higher imports lead to increased turnover.[5] Since all of our specifications include industry-size fixed effects, the estimated changes are driven by differences in responses within industry and firm-size combinations that are not explained by the overall trends for each group.

[4] Detailed information about the supply shock instrument and firm-level weights, as well as robustness tests, are provided in the full working paper version: Tillväxtanalys (2025).

[5] A one percent increase in imports yields an 0.2 percent increase in turnover.

Table 3. Resilience: Instrumental Variable regressions

	(1) $ln(Import_{it})$	(2) $ln(Turnover_{it})$	(3) $ln(Import_{it})$	(4) $ln(Turnover_{it})$
$ln(Supply\ shock_{it})$	0.19** (0.02)		0.16** (0.03)	
GRD_{iT}	7.43** (0.15)		6.73** (0.22)	
GRD_{iT}^2	-6.07** (0.25)		-5.24** (0.34)	
$ln(Import_{it})$		0.20** (0.01)		0.14** (0.01)
$ln(Stocks\ of\ inputs_{i,t-1})$			0.20** (0.01)	0.13** (0.00)
$ln(Stocks\ of\ finished\ goods_{i,t-1}$			0.04** (0.00)	0.02** (0.00)
Observations	38,148		15,270	
Adj. R²	0.22		0.27	
First stage F-value	1 562		842	
*Industry*FirmSize FE*	Yes		Yes	

Notes: $ln(Supply\ shock_{it})$ is the shift-share instrument for the supply shocks facing producer i in period t, weighted by the lagged input shares over the previous year. GRD_{iT} measures the average Geographic Risk Diversification of firm i over the last four quarters (denoted by index T). Robust standard errors in parenthesis. A Sargan overidentification test verifies the validity of the instruments. * p<0.05, ** p<0.01.

4.2.3 Firms with relatively more inventories are more resilient

To assess the effects of inventory on turnover, we have fewer observations at our disposal since inventory data is only available for firms that have responded to the inventory surveys of Statistics Sweden. The first stage results of the smaller stockholding sample in column (3) are similar to those of the full sample in column (1) in sign, but are slightly smaller in magnitude. In column (4), we find that, given a supply shock, both inputs and finished goods have positive effects on turnover (+), although the impact is much larger for input inventories.[6]

4.2.4 Input inventories serve as a buffer to hold up production

In the short run, input inventories serve as a buffer to hold up production in case of a negative inventory supply shock. On the other hand, stocks of finished goods mainly serve as a control variable for the difference in production and turnover. Without a stock of finished goods, sales would be determined only by what you can produce here and now. However, holding a stock of finished goods enables the firm to keep up sales during a negative supply shock, at least until they run out of stocks. As an example, stockholding was the main reason the drop in sales was considerable smaller compared to the drop in imports when the Covid-19 pandemic hit.

[6] To interpret the coefficients, given a supply shock, a ten percent increase in input inventories yields a 1.3 percent increase in production, and an import increase of similar magnitude yields a 1.4 percent increase in production.

4.2.5 A combination of stockpiling and diversification may be the most effective resilience strategy

We conclude that increased geographical risk diversification has a positive impact on imports, but the effect is diminishing as GRD grows lager. It may be that firms spreading their buys too thin across suppliers lose in terms of priority. Large customers are often prioritized by suppliers in case of shortages, and this should be considered when firms decide on the degree of risk diversification. Furthermore, we conclude that both GRD and stockholding contribute positively to firm-level production through separate channels. Given a supply shock, firms diversifying and spreading risks, and firms holding more stocks, are better off in terms of production compared to other firms. Overall, our results suggest that firms may need to consider multiple dimensions when deciding on the optimal resilience strategy. We will return to this discussion in Section 7.

5. Friendshoring

5.1 Background

Friendshoring refers to the strategic relocation of supply chains to safer and more reliable “shores”, which, in the current geopolitical landscape, has become synonymous with sourcing from allied nations.

The term was introduced by former U.S. Treasury Secretary Janet Yellen in April 2022 during a speech at the Atlantic Council, an independent think tank based in Washington, D.C., where she emphasized the need to reduce U.S. dependence on Russia and China. The first concrete measure was implemented by President Joe Biden under the Inflation Reduction Act (IRA), which provided significant incentives to boost domestic production of electric vehicles and green technology at the expense of other countries. However, the fundamental idea of strengthening U.S. independence from China and other geopolitical rivals dates back to the first Trump administration (2017–2021) and has been sharpened rhetorically during his second term (2025–) as part of the America First policy.

The European Union has pursued a similar path to strengthen its 'strategic autonomy,' following one step behind the U.S. EU policy aims to reduce dependence on external forces without compromising multilateral trade principles. Two key legislative instruments—the Critical Raw Materials Act (CRMA) and the Net-Zero Industry Act—set to take effect in 2024—underscore this strategy.

China does not have an official friendshoring policy, but for over a decade, it has been building strategic alliances with developing countries worldwide through the Belt and Road Initiative (BRI), launched in 2013. This initiative aims to promote trade, infrastructure, and investment across the Global South, thereby reducing reliance on the Global North. Unlike the EU's approach, which is based on ideological alignment, China follows a pragmatic strategy focused on economic interests regardless of political systems—emphasizing advantageous deals, a strategy the new Trump administration has also adopted.

5.2 Friends and foes

The first challenge in analysing the resilience effects of friendshoring is the absence of an official list categorizing countries as either friends or foes. For the purposes of this paper, we utilize a three-tier classification system—allies, non-aligned, and rivals—based on five criteria: (1) UN votes on Russia’s aggression in Ukraine; (2) NATO status; (3) Freedom House Index of Political Rights and Civil Liberties; (4) EU free trade agreements; and (5) OECD membership. Countries are scored -1, 0, or 1 on each criterion, and the scores are then summed to classify countries into one of the three groups:

- Allies: Total score of 3 or higher.
- Rivals: Total score of -3 or lower.
- Non-Aligned: Total score between -2 and 2 (inclusive).

Classification of allied, non-aligned and rival countries

1. Voting Record in the UN General Assembly on Resolutions Regarding Russia's Aggression Against Ukraine (2022-2024).

Six resolutions (ES 11/1–11/6) calling, inter alia, for cessation of hostilities, peaceful settlement in line with the UN Charter, and reparations:

- **1:** Voted in favour of at least four resolutions.
- **0:** Abstained or were absent for the majority, or are non-members of the UN.
- **-1:** Voted against the majority of the resolutions.

2. Relationship with NATO (2024):

- **1:** NATO members.
- **0:** NATO partners, including the Partnership for Peace, the Mediterranean Dialogue, the Istanbul Cooperation Initiative, and Partners Across the Globe.
- **-1:** Countries without a formal relationship with NATO.

(Note: Russia and Belarus are scored -1 due to their suspension from the Partnership for Peace.)

3. Freedom House Index of Political Rights and Civil Liberties (2024):

- **1:** Countries classified as "free."
- **0:** Countries classified as "partly free" or unclassified.
- **-1:** Countries classified as "not free."

4. EU Free Trade Agreements (2024).

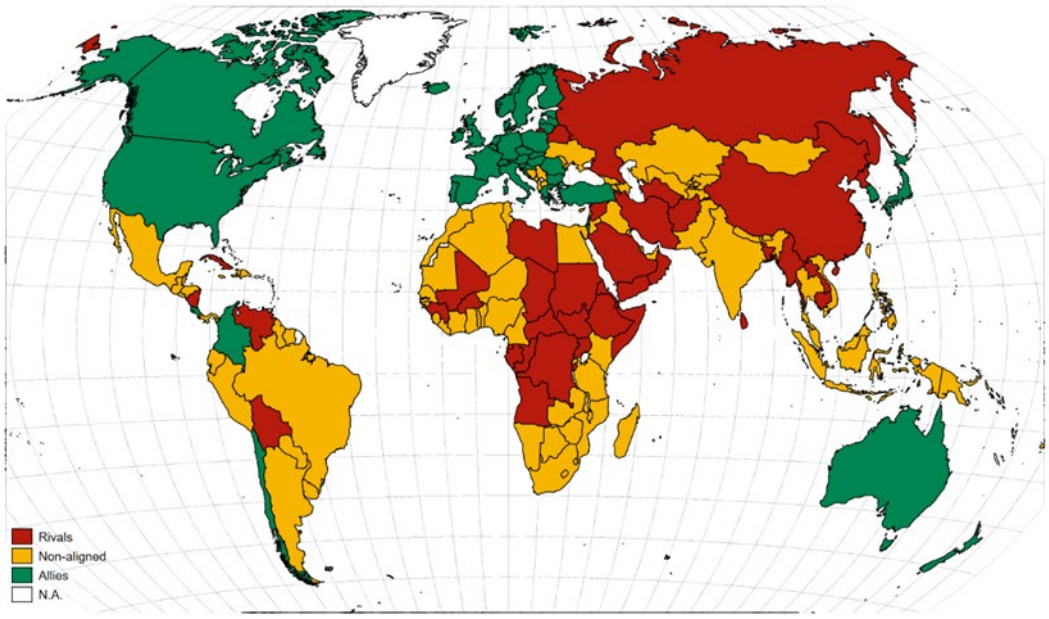
- **1:** Members of the EU, EEA, or countries with ratified bilateral free trade agreements.
- **0:** Countries with non-ratified agreements or ongoing trade negotiations.
- **-1:** All other countries, including those covered by EU preferential trade agreements for former colonies and least developed countries.

5. Relationship with the OECD (2024):

- 1: OECD members.
- **0:** OECD partners.
- **-1:** Non-members.

The classification is presented in Figure 6, with allies in green, non-aligned countries in amber, and rivals in red. While some classifications may be subject to debate, the map effectively illustrates the dynamics of a multipolar world. This global landscape highlights a clear divide between the 'Global West' and the 'Global East,' while the 'Global South' largely remains non-aligned. The classification reflects the situation as of 2024 and does not account for subsequent events, including policy shifts under the second Trump administration.

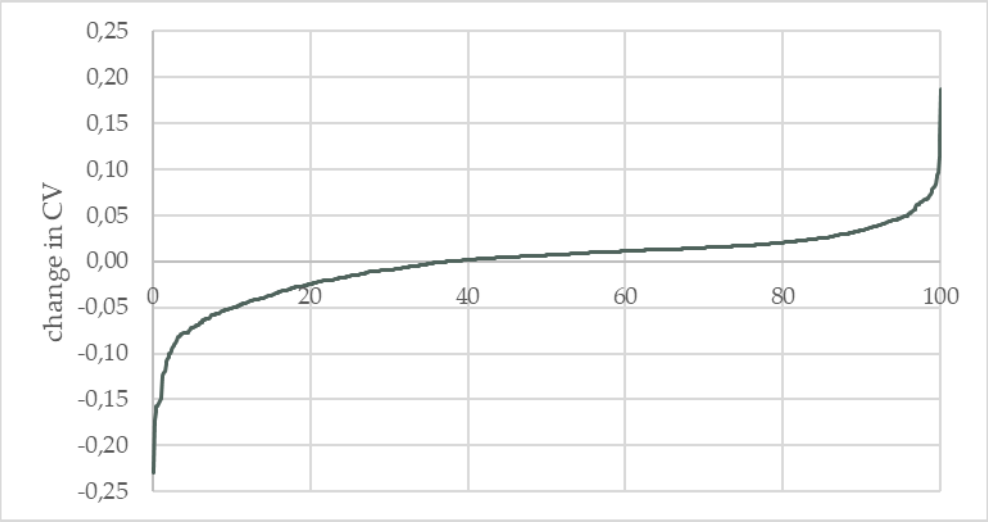
Figure 6. Allies, non-aligned and rival countries



5.3 Friendshoring is not a panacea

We analyze the effects of friendshoring by examining whether deliveries from allied countries have been more stable than those from rivals during the studied period. The results are presented in Figure 7. On the x-axis, input materials are indexed from 0 to 100, while the y-axis shows the change in the coefficient of variation when shifting from an average rival to an average allied country. Note that random friendshoring reduces delivery risk in only about 40% of cases but increases it in approximately 60%. Therefore, general claims about the benefits of friendshoring should be avoided, as the outcome depends on specific circumstances.

Figure 7. The resilience effect from friendshoring



6. Adaptations to a more uncertain world

Firms can use a number of different strategies to build resilience. Some of the available tools discussed in this paper are diversification, friendshoring, and stockpiling. Each figure below shows the average change within firm-product combinations from the baseline period (2017Q1) for a given resilience strategy.[7]

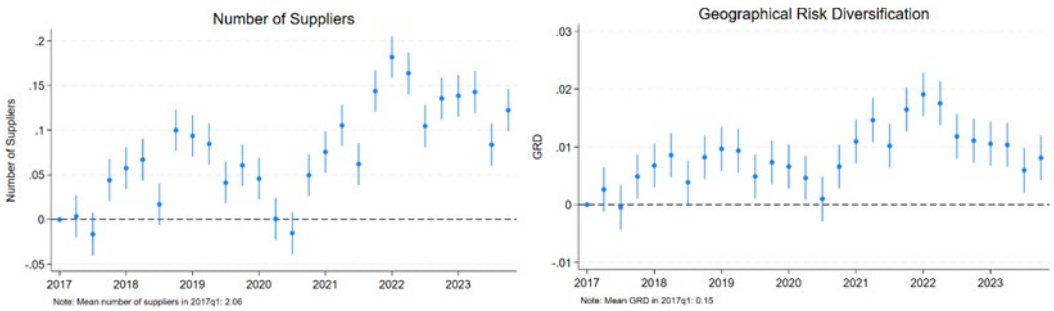
6.1 Rise in diversification after the pandemic

We measure diversification at the firm-product level in two different ways. The first is the number of countries from which a given firm-product combination is sourced. The second is geographic risk diversification (GRD).

Figure 8 shows increased diversification relative to the 2017Q1 reference point. Both the average number of suppliers (left panel) and GRD (right panel) increase, implying more geographically diversified sourcing within a given firm-product combination.

There is a sudden downward shift in both diversification measures when the Covid-19 pandemic hit in mid-2020. In addition, we find a decline in the number of suppliers, and even a clear decline in GRD from mid-2022 onward - leaving open the question for future research whether this is the beginning of a declining trend or just another temporary downturn.[8]

Figure 8. Diversification: Number of Suppliers and Geographical Risk Diversification with 95% CI:s.



[7] Inspired by de Lucio et al. (2023),[7] we run the following regression for each resilience strategy:

$$Y_{ikt} = \sum_{t=2017q1}^{2023q4} \beta_t D_t + \gamma_{ik} + \epsilon_{ikt}$$

Where D_t are time dummies, γ_{ik} represents fixed effects for each firm-product combination, and ϵ_{ikt} is the error term. The reference period is the first quarter of 2017.

[8] A Chow test for structural breaks in the time series shows that the downward shift in GRD is statistically significant, meaning that the trend after 2022Q2 is different from the one preceding it.

6.2 No rise in friendshoring

Do Swedish firms increase their share of imports from allied countries in response to geopolitical concerns? Figures 9-11 show the average sourcing from allies, non-aligned, and rivals at the product-firm level as a share of total sourcing.

Figure 9 shows the share of imports from allied countries. As can be seen, there is a significant decline in most periods starting as early as mid-2018. In other words, the share of imports from allied countries is lower compared to the first quarter of 2017, drops further in mid-2021, and then stabilizes around this lower level. The downward pattern is probably part of a trend in a longer time series where European countries, including Sweden, increasingly source from markets further away from Europe. On the other hand, the halt in the downward trend and stabilization around a new level could be due to the current geopolitical situation and political calls for increased friendshoring.

It is also important to keep in mind that less friendshoring, if detected, could be a mechanical effect of firms diversifying. Given that the firm's main supplier is already located in an allied country, adding one or more additional supplier as a diversification strategy may lead to less friendshoring if the additional supplier is located in a non-aligned or rival country.

Turning to the share of imports from non-aligned countries in Figure 10, we find that it has increased in most periods after the reference period. Interestingly, the same is true for imports from rivals in Figure 11, where the share is higher relative to the reference period in most periods, and significantly so in all periods but the final one after 2021.

Figure 9. Friendshoring: Share of imports from Allies with 95% CI:s.

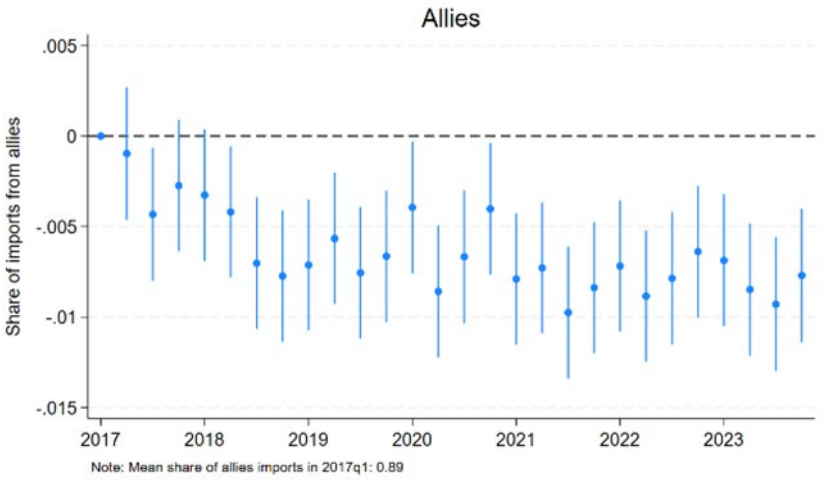


Figure 10. Friendshoring: Share of imports from Non-aligned with 95% CI:s.

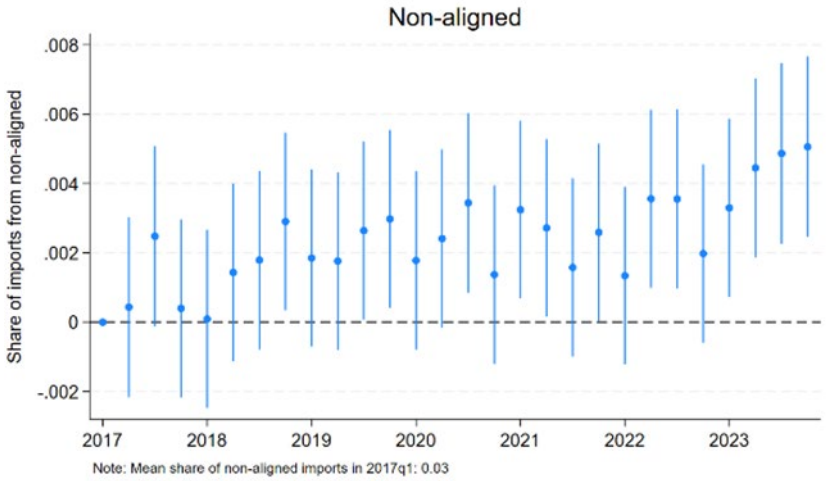
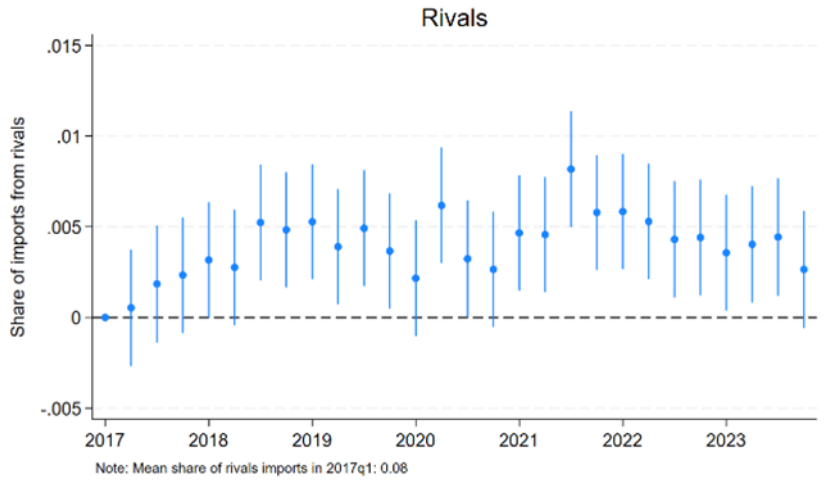


Figure 11. Friendshoring: Share of imports from Rivals with 95% CI:s.



Many large sourcing countries are included in rivals, for example China and Russia. We find that increased sourcing from China is driving the pattern for rivals. China is also by far the largest source country in the rival group, accounting for about 85 percent of total rival-shoring. However, given the policy calls for decoupling and friendshoring, and threats of higher import tariffs on Chinese goods, it seems more likely that the average share of imports from China will start to decline, or at least not increase, in the near future.

Shoring inputs from Russia has indeed declined right after Russia's invasion of Ukraine in the first quarter of 2022. Economic sanctions, including import bans, have caused the average import share from Russia to gradually decline and almost reach zero by the end of 2023.

6.3 Increased stockpiling to hedge against future supply shocks

For inventory stocks, our data are at the firm level. We measure stock intensity as detrended inputs or finished goods stock divided by reported turnover or number of employees. All stockholding data is deflated with the same PPI-deflator as for turnover.

Figure 12 shows the detrended inventory-to-sales ratio for inputs (blue dots) and finished goods (red dots). Here we find evidence of an upward trend in the data, followed by an abrupt drop in both input and finished goods inventory stock intensity after the Covid-19 pandemic - a result that could be due to rapidly decreasing inputs and/or rapidly increasing turnover. However, from the second quarter of 2022 and onwards, the input inventory stock intensity returns to the baseline level and then starts to increase again. Similar observations are made for finished goods, although only the drop in early 2021 is statistically significant. After the downturn, finished goods stock intensity seems to immediately return to levels comparable to the reference point.

Dividing stocks with number of employees yields a clear upward trend for both inputs and finished goods stock intensities right after the downturn in the aftermath of the Covid-19 pandemic. These results are displayed in Figure 13. Again, the patterns for inventory-to-employees for inputs and finished goods stocks are comparable, although the magnitude is larger for inputs. The number of employees can be seen as more slow moving compared to turnover, and thus changes in this figure are more likely due to actual changes in stockholding.

Overall, the input and finished goods stock intensities seem to follow similar patterns over the period studied. From a resilience perspective, one interpretation of the findings when we divide stocks with number of employees is that firms may have started to hold more stocks in recent periods to hedge against future supply chain disruptions.

Figure 12. Detrended stockholding: inventory-to-sales ratio with 95% CI:s.

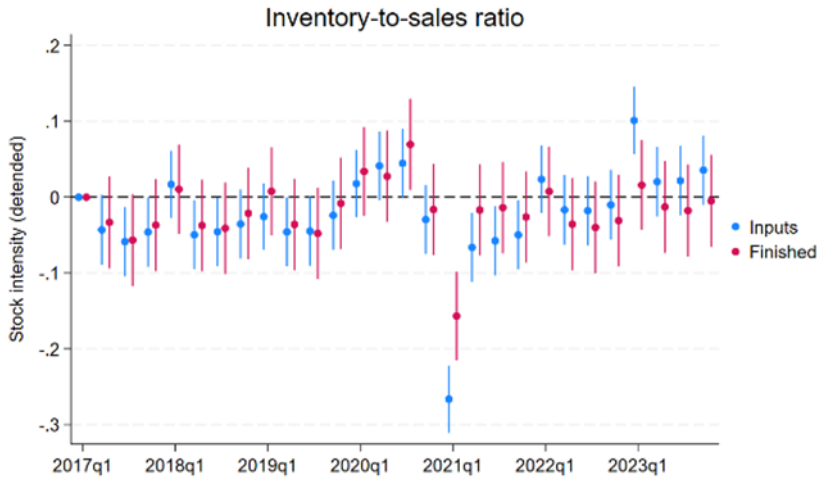
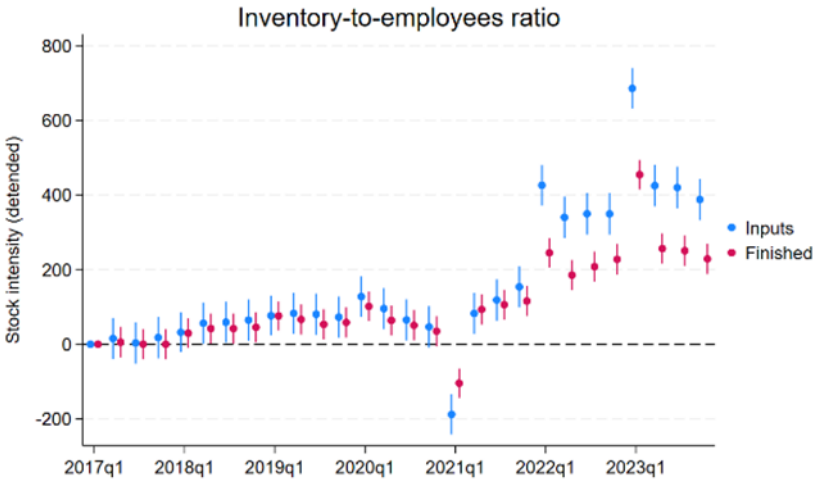


Figure 13. Detrended stockholding: inventory-to-employees ratio with 95% CI:s.



7. Resilience strategies by industry and size

In this final section of the paper, we document resilience strategies by industry and firm size. We show that smaller firms primarily rely on stockpiling as their key resilience tool, whereas larger firms allocate more resources to diversifying their supply base, likely due to differing opportunity costs.

7.1 Diversification across sizes and industry

First, consider the geographical risk diversification (GRD), broken down by sector and size class in Table 4. The table uses color-coding for clarity: blue shades represent below-average GRD, while red shades indicate above-average GRD. On average, micro firms have a GRD of 0.06, compared to 0.14 for small firms, 0.20 for medium-sized firms, and 0.25 for large firms. This pattern is consistent across sectors. These findings suggest that the scope for diversification depends on import volumes, administrative capacity, and other size-related factors.

Table 4. Geographical Risk Diversification by industry and size (average 2017Q1-2023Q4)

Sector (ISIC)	Micro	Small	Medium	Large	Total
10. Food	0,06	0,08	0,14	0,18	0,11
11. Beverages			0,19	0,22	0,15
12. Tobacco			0,18		0,15
13. Textiles	0,09	0,15	0,23		0,16
14. Apparel		0,05			0,03
15. Leather		0,09	0,02		0,04
16. Wood	0,04	0,12	0,07	0,09	0,08
17. Paper	0,07	0,17	0,19	0,18	0,16
18. Printing and reproduction	0,08	0,15	0,23		0,15
20. Chemicals	0,04	0,14	0,25	0,21	0,16
21. Pharmaceuticals		0,08	0,09	0,22	0,13
22. Rubber and plastics	0,12	0,19	0,26	0,32	0,22
23. Mineral products	0,03	0,17	0,25	0,21	0,17
24. Basic metals	0,06	0,19	0,22	0,18	0,16
25. Fabricated metal	0,05	0,11	0,19	0,25	0,15
26. Computers and electronics	0,08	0,16	0,29	0,45	0,25
27. Electrical equipment	0,04	0,13	0,21	0,35	0,18
28. Other machinery	0,09	0,20	0,34	0,42	0,26
29. Motor vehicles	0,11	0,17	0,22	0,36	0,22
30. Other transport equipment	0,06	0,20	0,32	0,32	0,23
31. Furniture	0,00	0,14	0,25	0,15	0,13
32. Other manufacturing	0,03	0,10	0,18	0,30	0,15
33. Repair and installation.	0,07	0,15	0,20		0,18
Total	0,06	0,14	0,20	0,25	0,16

Note: Dashed fields contain less than three units and are not shown separately for reasons of confidentiality.

Diversification across industries is more nuanced. Specifically, blue shades are more common in the primary industries listed at the top of the table, while red shades are more prevalent in the manufacturing industries at the bottom. This finding indicates that the incentive to diversify risk is stronger for producers of heterogeneous products requiring customized parts and components. In contrast, primary producers face less risk, as many raw materials are traded on organized markets and are therefore less reliant on individual suppliers.

7.2 Stockpiling across sizes and industry

A breakdown of the stockpiling data is presented in Table 5. The distribution across industries closely resembles that of GRD, reinforcing the hypothesis that industries dependent on customized parts and components have the strongest incentives to invest in resilience. The main difference is rather between size classes of firms, where smaller firms hold relative more inventories than larger firms.

Table 5. Inventory-to sales ratio of inputs (average 2017Q1-2023Q4)

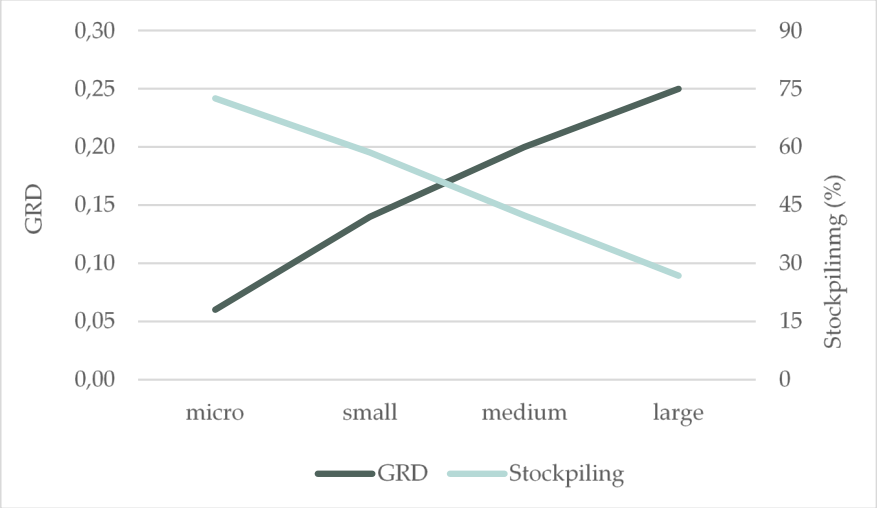
Sector (ISIC)	Micro	Small	Medium	Large	Total
10. Food		52,7	29,5	11,6	30,9
11. Beverages			29,0	8,0	16,7
12. Tobacco			41,5		30,2
13. Textiles	8,3	47,3	46,7		41,9
14. Apparel		52,4			81,7
15. Leather		50,5	52,1		48,8
16. Wood	96,9	84,6	26,5	11,2	35,6
17. Paper		54,4	25,3	13,1	21,6
18. Printing and reproduction		26,3	6,4		18,5
20. Chemicals	106,3	38,0	30,9	22,6	33,3
21. Pharmaceuticals			1,2	26,4	21,3
22. Rubber and plastics	0,0	42,4	26,8	15,5	30,5
23. Mineral products	128,8	44,8	23,2	16,2	27,1
24. Basic metals		71,4	41,1	45,0	45,6
25. Fabricated metal	79,1	48,0	41,9	45,9	46,6
26. Computers and electronics	30,8	76,7	60,0	58,4	64,3
27. Electrical equipment		72,9	48,2	32,7	52,0
28. Other machinery	0,0	76,0	50,2	35,2	52,1
29. Motor vehicles		129,2	29,3	20,6	36,7
30. Other transport equipment		73,9	70,6	52,0	65,7
31. Furniture		34,1	35,1	13,6	30,9
32. Other manufacturing	75,5	85,1	141,9	34,5	95,1
33. Repair and installation.	41,2	23,9	39,8	31,2	34,1
Total	72,5	58,6	42,3	26,8	44,0

Note: Dashed fields contain less than three units and are not shown separately for reasons of confidentiality.

7.3 Small firms stockpile, large firms diversify

The choice of resilience strategy varies by firm size. Smaller firms favor stockpiling, while larger firms prefer supply chain diversification. Medium-sized firms, however, often blend both approaches, as shown in Figure 14. These differences likely stem from varying opportunity costs. Small firms, with lower trade volumes, have fewer opportunities to diversify due to higher administrative costs and the risk of losing valuable volume discounts, making stockpiling a more practical option for them.

Figure 14. Stockpiling (IRS) versus geographical risk diversification (GRD)



The key takeaway is that there is no one-size-fits-all resilience strategy for firms. This underscores the importance of policymakers adopting a nuanced and flexible approach when designing a national resilience strategy, ensuring it caters to the diverse needs and capacities of firms across various sectors and sizes.

8. Policy implications

Summary

This report provides new insights into firms' sourcing patterns and risk management strategies, highlighting differences across industries and company sizes. Our findings indicate that while businesses consider supplier risks, they adopt different mitigation strategies. Small businesses primarily rely on stockpiling critical inputs, whereas larger companies focus on diversifying their supplier base. Both approaches help reduce vulnerability to global supply disruptions, but a combination of the two may be the most effective.

In response to rising global market risks, companies have slightly shifted their focus from just-in-time supply management to a just-in-case approach with higher inventories of inputs. By contrast, friendshoring remains uncommon despite political attention, likely due to limited availability or higher costs.

Policy conclusions

If the private sector underinvests in resilience, public intervention may be warranted to strengthen the economy's ability to withstand shocks. Many argue that this is the case, citing the collapse of supply chains during the pandemic and rising geopolitical tensions. Confirming this hypothesis would require a comprehensive cost-benefit analysis, which falls outside the scope of this study. What we do observe is that companies are investing more in resilience than before, primarily by increasing their inventories of inputs to bridge temporary disruptions. Whether these investments are optimal from a broader societal perspective remains uncertain.

If further analysis concludes that government intervention is necessary, efforts should focus on addressing the root causes of rising global market risks. Many supply risks are political, as highlighted by the measures imposed by Donald Trump following his reinstatement as U.S. president in January 2025. The most effective way to mitigate these risks is to restore a rules-based global trading system under the WTO. Retreating into rival trade blocs would not only restrict firms' market access but also hinder their ability to diversify risk.

If this is not feasible in today's geopolitical climate—which currently appears to be the case—the key political challenge will be to design defensive measures without further escalating tensions in the global economy. Determining the specific actions to be taken, both nationally and within the EU framework, is a task for policymakers.[9]

[9] In the next report in this series, we will take a closer look at the issue of critical raw materials for the green transition and the measures the EU has taken to strengthen strategic autonomy.

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