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Trade Intermediation and Resilience in Global Sourcing
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Oscar PERELLO

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L'intermédiation commerciale et la résilience dans l'approvisionnement mondial

Oscar PERELLO[1]

Résumé : Les perturbations des chaînes d'approvisionnement entravent les gains de la mondialisation et nécessitent des investissements coûteux pour renforcer la résilience. Cette étude examine comment l'approvisionnement en intrants via des intermédiaires spécialisés aide les entreprises à atténuer les perturbations dans les marchés à risque. En combinant les dossiers douaniers et fiscaux du Chili, l'auteur documente que la part des importations intermédiaires augmente avec le risque de perturbation de la chaîne d'approvisionnement, les intermédiaires maintenant des réseaux d'approvisionnement plus diversifiés et robustes. Ces faits motivent un modèle d'approvisionnement mondial avec des coûts de mise en relation avec les fournisseurs, des relations d'approvisionnement incertaines et l'accès à des intermédiaires. Les producteurs hétérogènes équilibrent les prix des intrants et les probabilités de perturbation entre les différentes localisations pour minimiser les coûts de production attendus. Les entreprises plus productives choisissent plusieurs fournisseurs par localisation, tandis que les entreprises moins productives se tournent vers des intermédiaires, payant des marges plus élevées pour un réseau plus résilient que celui qu'elles pourraient construire directement. Malgré la double marginalisation, l'intermédiation atténue le compromis entre efficacité et risque grâce à une meilleure opérabilité du réseau d'approvisionnement. La quantification du modèle révèle des pertes importantes en profits dues aux perturbations, que les intermédiaires réduisent de moitié pour les producteurs de taille moyenne qui n'ont pas la capacité de diversifier. L'intermédiation est donc essentielle pour la résilience des chaînes d'approvisionnement, suggérant un rôle pour des politiques visant à rendre ces services plus accessibles.

Mots-clés : Commerce international, conflit, sanctions, biens à usage dual

Trade Intermediation and Resilience in Global Sourcing

Abstract: Supply chain disruptions hamper the gains from globalization and require costly investments in resilience. I study how input sourcing through specialized intermediaries helps firms to mitigate disruptions in risky markets. Combining customs

[1]University College London.oscar.perello.19@ucl.ac.uk.. I am grateful to Kalina Manova, Kirill Borusyak, Jonas Hjort, and Andreas Moxnes for their generous support, and to coauthors on related projects, Javier Boncompte, Hanwei Huang, and Frank Pisch, for insightful discussions. This paper benefited from conversations with Lorenzo Caliendo, Samuel Kortum, and seminar participants at Yale; Treb Allen, Andrew Bernard, Davin Chor, Teresa Fort, Matthew Grant, Robert Staiger, Nathan Zorzi, and other members of the Dartmouth Globalization Cluster; Pol Antràs and Yuhei Miyauchi. I also appreciate the discussion by Veronica Rappoport at the LSE-Warwick Junior Trade Workshop. I thank the Ministry of Finance and the Customs Service of Chile for data access. All errors are my own.

and tax records from Chile, I document that the share of intermediated imports rises with supply chain risk, as intermediaries maintain more diversified and robust supply networks. These facts motivate a model of global sourcing with costly supplier matching, insecure supply relationships, and access to intermediaries. Heterogeneous producers balance input prices and disruption probabilities across locations to minimize expected production costs. More productive firms match with multiple suppliers per location, while less productive firms contract with intermediaries, paying higher markups for a more resilient network than they could build directly. Despite double marginalization, intermediation relaxes the efficiency-risk trade-off due to greater supply network operability. Model quantification reveals sizable profit losses from disruptions, which intermediaries halve for mid-size producers that lack the scale to diversify. Intermediation is thus instrumental for supply chain resilience, suggesting a role for policies that make these services more accessible.

Keywords : Tglobal value chains, supply chain risk, trade intermediation, diversification

JEL Codes: F10, F12, F14, L14

1. Introduction

Global markets provide access to a variety of inputs for production that enhance firm and aggregate productivity, but they also expose producers to disruptions overseas. Although these concerns intensified after the Great Recession and the COVID-19 pandemic, contributing to the backlash against globalization, firms report frequent disturbances in their supply chains even outside crisis episodes. Examples range from strikes and industrial accidents to supplier bankruptcies, transportation failures, regulatory changes, and natural disasters (Baldwin and Freeman 2022; Elliott and Golub 2022). Producers can in principle protect themselves by diversifying their supplier base (Blaum et al. 2023; Castro-Vincenzi et al. 2024). However, evidence on firm networks suggests that maintaining multiple suppliers is often prohibitive for all but the largest producers (Bernard and Moxnes 2018; Bernard et al. 2018a). Alternative approaches to supply chain resilience have thus become focal to debates on sustainable growth, reshoring, and deep economic integration.

This paper examines for the first time the role that trade intermediaries play in managing supply chain risk. Intermediaries offer firms an indirect mode of input sourcing by specializing in buying, reselling and distributing goods. They mediate a large share of international trade (Blum et al. 2009; Bernard et al. 2010; Ahn et al. 2011), and are believed to reduce sourcing costs by exploiting economies of scale (Grant and Startz 2022; Ganapati 2024). At the same time, they are blamed for charging steep markups that may hinder local producers, particularly in less developed contexts (Antràs and Costinot 2011). Yet, little is known about intermediaries' supply networks and their role for resilience downstream. Anecdotal evidence, however, suggests that intermediaries advertise their expertise in managing supply chain risk, with producers favoring indirect sourcing from riskier locations.[1]

Can producers effectively protect from supply chain disruptions by using intermediation services? I use data on the supply networks of Chilean importers to show that intermediation increases with measures of supply chain risk, and that intermediaries maintain a larger and more robust supplier portfolio. I then develop a model where producers select global sourcing strategies in the expectation of supply link disruptions. More productive firms optimally incur higher matching costs to diversify suppliers in risky markets, while less productive firms rely on intermediaries. When producers face an efficiency-risk trade-off in sourcing, intermediaries can relax it by offering a more resilient network than firms could build on their own, despite

[1] A leading chemicals intermediary, Univar, claims that *"safety and compliance are the foundation of our supply chain network"*, while Li & Fung in apparel *"focus on managing complexity and risk to maximize profitability"*. Interviews with clothing supply chain actors suggest that firms use intermediaries in riskier markets (Vedel and Ellegaard 2013). As stated by one respondent, *"life goes on in these countries despite repeated riots and crises...but we don't establish ourselves"*. See Appendix A for details.

double marginalization. Leveraging the rich microdata to estimate the model, I find a substantial mitigation role of intermediaries, especially for mid-size producers that offshore inputs but lack the scale to diversify. Counterfactual analysis underscores the scope for resilience gains through policies that lower brokerage fees in the intermediation sector.

My first contribution is to establish four facts on input sourcing under risk. I use Chilean customs data on the universe of import transactions from 2005 to 2019, matched with tax records that report firms' business activities. This enables me to distinguish between Chilean producers and intermediaries, and to identify their foreign suppliers for each HS 6-digit product and origin country. Specifically, I focus on wholesalers that mediate firm-to-firm transactions as opposed to firm-to-consumer retailers. Wholesalers are prominent in global sourcing, representing only 7% of firms but around 40% of imports and operating across a wide range of sectors.

Fact 1 documents that the share of intermediated imports by origin country and product increases with supply chain risk. This holds for three indices capturing different risk dimensions: *Geopolitical Risk* (Caldara and Iacoviello 2022), *Economic Policy Uncertainty* (Baker et al. 2016), and *Trade Volatility*, which I construct by residualizing trade flows to capture fluctuations within origin-product over time. Analysis of five-year long differences shows that exogenous changes to risk factors abroad shape the sourcing mode of Chilean firms: a one standard deviation increase in any index raises the intermediation share by nearly one percentage point.

Fact 2 unpacks differences in the supply networks of producers and intermediaries that inform this pattern: intermediaries maintain more suppliers and less concentrated input purchases within origin-products. Fact 3 reveals that the supply links of intermediaries are also more stable than those of producers. Finally, Fact 4 shows that, under direct sourcing, both the average number of suppliers and separation rates with suppliers are higher in riskier markets. Taken together, these findings suggest that producers actively seek protection from disruptions, and intermediaries offer a more resilient sourcing technology in the face of risk.

My second contribution is to develop a model of global sourcing with supply chain risk and trade intermediation. Heterogeneous final-good producers face fixed matching costs per input supplier, but also idiosyncratic risk that a supply link might turn out inoperable.[2] Input costs and disruption probabilities both vary across source locations. At each location, producers can either source directly from one or multiple suppliers, or use intermediaries for a brokerage fee on input prices, gaining access to a diversified network with lower disruption probability. I consider scenarios with either identical or imperfectly substitutable suppliers.

Producers make global sourcing decisions in the expectation of disruptions by choosing

[2] I focus on the role of intermediaries in mitigating idiosyncratic disruptions, which are reported to be most frequent (McKinsey 2020). This aligns with the low correlation across link breakages observed in the data, even for the same buyer, product, and origin country ($\rho \approx 0.09$). Section 3.8 discusses how the model can accommodate correlated shocks.

source locations, the sourcing mode at each location, and the number of suppliers where they source directly. Sourcing indirectly raises *ex-post* input costs at any given location. However, *ex-ante* expected input costs can be lower due to greater network operability, depending on the resilience advantage of intermediaries over a producer's direct alternative. Producers weigh input costs and disruption probabilities across locations, and optimally protect against disruptions in risky markets. More productive firms engage in *diversification*, incurring higher matching costs to establish direct links with multiple suppliers, while less productive firms opt for *intermediation*. Thus, despite double marginalization, intermediaries can improve the efficiency-risk trade-off for smaller producers.

I provide empirical evidence supporting the model's prediction on how a rise in supply chain risk impacts producers' sourcing strategies. The model implies that smaller, less productive direct buyers would switch to indirect sourcing, while the smallest, least productive indirect buyers would altogether stop sourcing from the now riskier location.[3] The net effect on the total use of intermediation is thus ambiguous. Producers that continue sourcing directly would have greater incentives to diversify suppliers, particularly when substitution is easier within than across locations. Empirically, I confirm heterogeneity in the use of direct diversification and intermediation services in response to risk: fewer firms source directly as risk increases, but the largest firms expand their supplier base.

My third contribution is to quantify the role of trade intermediation in mitigating supply chain disruptions. The producer's problem can be stated as a two-step maximization: the *ex-ante* sourcing strategy is a combinatorial discrete-choice problem, given *ex-post* production decisions conditional on an operational network. I solve this problem numerically, using recent computational methods to tackle the dimensionality of the choice set (Antràs et al. 2017; Arkolakis et al. 2023; Huang et al. 2024), and Monte Carlo simulations to approximate complex expectations at each choice. I then operationalize this setting for Chile and five source regions: Latin America, China, the US, Europe, and Rest of the World.

The estimation strategy leverages the rich microdata for Chilean firms and their foreign suppliers. Based on model-driven equations, I exploit input price variation across locations within firms and differences in direct links across firms within locations to back out elasticities of substitution. I use the panel structure of the data to isolate location-specific costs from input prices, parameterize supplier separations based on risk measures to estimate disruption probabilities, and infer brokerage fees from additional export price data for producers and intermediaries. Finally, I apply the simulated method of moments to estimate aggregate demand

[3]Risk shocks in one location affect decisions elsewhere, as they jointly determine producers' marginal costs. Under sourcing complementarities, these interdependencies amplify the responses observed in a single-location setting, driving more buyers to switch modes or stop sourcing altogether. The extent of these responses also depends on the substitutability across input locations and among suppliers within locations.

and matching costs. I find elasticities consistent with the trade literature (Atkeson and Burstein 2008; Edmond et al. 2015; Huang et al. 2024), indicating greater substitution within locations than across them. Regions with lower input costs experience more disruptions, reflecting an efficiency-risk tradeoff, and matching costs are convex in the number of direct suppliers, suggesting high diversification costs. Brokerage fees are lower than estimates for domestic trade in developed countries (Ganapati 2024; Alexander et al. 2024).

My results show that trade intermediaries substantially reduce the impact of disruptions for mid-size producers that lack the scale to diversify directly. Profit losses are around 20% for this group, but would rise to nearly 40% in a counterfactual scenario without intermediation.[4] Large firms face smaller losses from disruptions (16%) and are almost unaffected by the absence of intermediaries, while small firms source mainly domestically. I also evaluate the role of brokerage fees, which entail a 20% markup on input prices in the baseline model. I consider alternatives of 10% and 30% markups, which are documented respectively for Chilean exporters and domestic transactions in developed countries. These bounds translate into 3 to 5 percentage point changes in the profit losses from disruptions for mid-size producers. Overall, these findings shed light on firms' responses to supply chain risk through trade intermediaries, and point to the scope for resilience gains through a more competitive intermediation sector.

Related Literature. This paper bridges and advances three strands of literature. First, I contribute to emerging work on supply chain resilience, exploring the effects of disruptions on aggregate production (Carvalho et al. 2021; Elliott et al. 2022; Kopytov et al. 2022; Alessandria et al. 2023; Acemoglu and Tahbaz-Salehi 2024; Korovkin et al. 2024), optimal policy responses (Grossman et al. 2023, 2024), and market responses through various mechanisms (Castro-Vincenzi 2022; Khanna et al. 2022; Balboni et al. 2023; Blaum et al. 2023; Castro-Vincenzi et al. 2024). Also relevant are works on export and FDI decisions under risk (Ramondo et al. 2013; Fillat and Garetto 2015; Esposito 2022). My paper is most closely related to Blaum et al. (2023) and Castro-Vincenzi et al. (2024), which respectively study how firms diversify suppliers in response to shipping and climate risks. Relative to these studies, I characterize heterogeneous sourcing responses where not all firms can afford diversification, considering matching costs alongside differences in firm productivity. Diversification is therefore restricted to the largest producers, leaving smaller firms unprotected in the absence of additional mechanisms.

A second line of research explores the role of intermediaries for trade and development. Intermediaries are responsible for a significant share of trade across and within countries (Bernard et al. 2010; Abel-Koch 2013; Crozet et al. 2013; Utar 2017). They are believed to

[4]The term *mid-size producers* refers to firms large enough to import but relatively small among importers. I define these firms as being below the 90th percentile of importers. Alternative thresholds would affect the magnitude of results but not the overall patterns and conclusions.

reduce transaction costs (Antràs and Costinot 2011; Bernard et al. 2015), but their operations generate price wedges that can harm local producers (Bergquist and Dinerstein 2020; Dhingra and Tenreyro 2020; Alexander et al. 2024). While canonical models focused on intermediaries' role in facilitating exporting (Blum et al. 2009; Antràs and Costinot 2011; Ahn et al. 2011; Akerman 2018), recent work highlights how they exploit economies of scale for input sourcing (Grant and Startz 2022; Ganapati 2024). My paper provides the first evidence on the resilience advantage of intermediaries, unpacking the characteristics of their supply networks and offering a microfoundation for economies of scale to arise. Intermediaries can thus relax efficiency-risk trade-offs in input sourcing despite imposing additional markups.

Bringing these literatures together, I unpack a novel adaptation mechanism to supply chain risk: sourcing from intermediaries with a bigger and more resilient portfolio of suppliers. Evidence on firm-to-firm networks shows that only the largest firms transact with multiple suppliers (Bernard and Moxnes 2018; Bernard et al. 2018a, 2022), suggesting high diversification costs. I show that intermediaries play a critical role for firms unable to diversify directly, underscoring the importance of firm heterogeneity in risk management strategies.

My paper also contributes to the literatures on global value chains and endogenous production networks. These works have shown that access to foreign inputs enhances firm productivity through various mechanisms (Amiti and Konings 2007; Goldberg et al. 2010; Gopinath and Neiman 2014; Bøler et al. 2015; Halpern et al. 2015; Blaum et al. 2018; Boehm and Oberfield 2020). Global sourcing amplifies the cost advantage of more productive firms, as they access more input locations (Antràs et al. 2017), and lower upstream markups disproportionately benefit larger buyers (Huang et al. 2024). In this setting, supply chain risk and intermediaries jointly shape sourcing patterns, respectively reducing and increasing access to foreign inputs. Moreover, changes in intermediation markups have a greater impact on mid-size producers, broadening the gains from global sourcing across the firm size distribution.

Recent studies have focused on the formation of firm networks under search and matching frictions (Chaney 2014; Carballo et al. 2018; Bernard et al. 2018b, 2019; Eaton et al. 2022). Intermediation influences the structure of these networks by enabling more matches, thereby increasing overall connectivity (Blum et al. 2024; Manova et al. 2024). By incorporating supply chain risk, I demonstrate how intermediaries generate additional gains from network stability, influencing resilience outcomes through producers' endogenous supply network decisions.

The rest of the paper is organized as follows. Section 2 describes the data and presents stylized facts on input sourcing under risk. Section 3 develops a global sourcing model with supply chain risk and trade intermediation. Section 4 provides empirical evidence supporting model predictions on sourcing responses. Section 5 estimates the model and quantifies the role of intermediaries in supply chain resilience. The final section concludes.

2. Stylized Facts

2.1. Data

Firm-to-Firm Trade and Intermediaries. I exploit data for Chile that includes the universe of firm-to-firm international transactions and detailed information on the business activity of domestic firms. First, the Chilean Customs Service provides the value, quantity, and unit value for all trade flows from 2005 to 2019, reporting origin country, HS 6-digit product, and buyer-seller identities for each transaction. Second, the Chilean Tax Authority provides data on the primary industry, sub-industry, and activity of Chilean firms over the same period, along with additional firm-level characteristics such as sales and number of employees. I match these datasets using a unique firm tax identifier (RUT).

I classify Chilean firms into three types based on their main industry: producers, wholesalers, and retailers. At this level, the Chilean Tax Authority closely follows the International Standard Industrial Classification (ISIC, rev. 4). Wholesalers specialize in the *"resale without transformation of new and used goods to retailers, to industrial, commercial, institutional or professional users, or to other wholesalers"*, and their operations may include trade-related services such as sorting, packaging, or storage. Retailers, on the other hand, specialize in the resale of goods to the general public for personal or household consumption. Thus, wholesalers focus on firm-to-firm transactions, while retailers carry out firm-to-consumer trade.

Table 1 presents summary statistics for trade activity by firm type. Producers are the largest group in number (80%) and contribute nearly half of all imports (45%) and the majority of exports (85%). Wholesalers represent only 7% of firms and 14% of exports, but they are prominent in global sourcing, accounting for a disproportional share of imports (44%).[5] Notably, 89% of imported products pass through wholesalers, indicating a significant overlap with producers in the types of goods sourced. Moreover, they engage with 45% of all foreign suppliers selling to Chile and conduct 41% of import transactions at the buyer-product-supplier level. Retailers, on the other hand, make up 13% of firms but are less relevant for international trade, accounting for 11% of imports and under 1% of exports.

Figure 1 shows firms' import shares over time in Panel A and the share of wholesale imports across broadly-defined sectors in Panel B. The role of wholesalers in global sourcing has increased over the past decades, particularly since the Great Recession, with their share rising from 33% in 2005 to 44% in 2019. Conversely, the import share of producers has steadily

[5] The relative importance of wholesalers in input sourcing aligns with recent evidence from developed countries. Utar (2017) documents that wholesalers' import shares exceed 50% in Denmark. Ganapati (2024) reports that wholesalers' domestic share in manufacturing trade increased from 43% to 54% in the US, driven by their global sourcing activities and technological advancements.

Table 1. Trade Activity by Firm Type

	Producers	Wholesalers	Retailers
# firms	528,617	43,084	86,627
% firms	0.803	0.065	0.132
% importers	0.439	0.302	0.259
% imported value	0.454	0.439	0.107
% imported products (HS6)	0.909	0.889	0.747
% foreign suppliers	0.448	0.446	0.242
% import transactions	0.331	0.405	0.264
% exporters	0.527	0.372	0.101
% exported value	0.852	0.141	0.008
% exported products (HS6)	0.874	0.722	0.382
% foreign customers	0.682	0.352	0.058
% export transactions	0.566	0.382	0.052

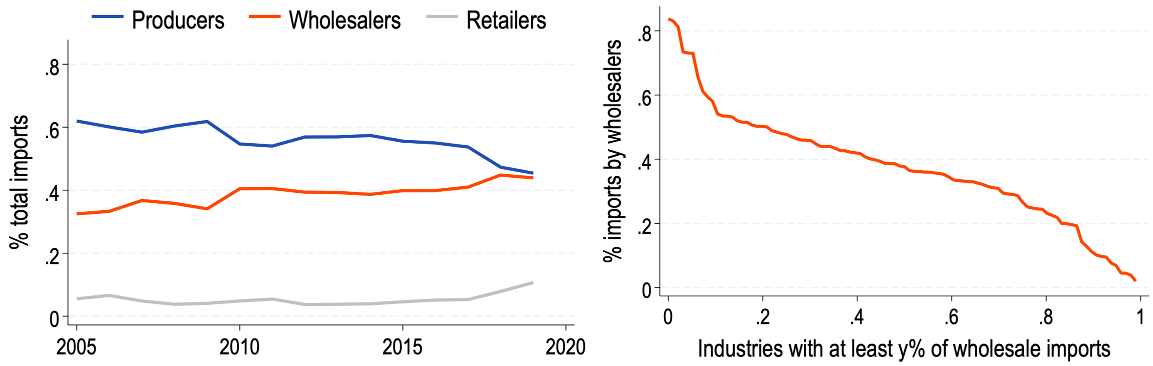
Notes: Summary statistics are reported for the universe of Chilean firms with positive sales in 2019. Firms are classified by their main business activity according to the Tax Authority of Chile (SII), closely following ISIC, rev. 4. International transactions are defined at the buyer-product (HS6)-supplier level.

declined over the same period. Wholesalers account for at least 20% of imports in 85% of all HS 2-digit sectors active in Chile, and for at least 40% in nearly half of these sectors, indicating that their sourcing activities are widely spread across the economy. Since I study the use of intermediaries to mitigate disruptions, I restrict the analysis to producers and wholesalers, excluding retailers. Therefore, I use the terms 'wholesaler' and 'intermediary' interchangeably hereinafter.

Supply Chain Risk. My analysis relies on three risk measures that proxy for the probability of disruptions in origin markets. First, the *Geopolitical Risk* (GPR) index developed by Caldara and Iacoviello (2022) provides a news-based measure of adverse events and threats associated with political tensions. This indicator has been linked to lower investment across firms and industries, although its relevance for sourcing decisions remains unexplored. The second variable is the *Economic Policy Uncertainty* (EPU) index developed by Baker et al. (2016), which follows a similar methodology to assess overall economic uncertainty and specific issues related to legislation and regulations. Both indexes capture variation across origin countries and over time. In terms of coverage, the GPR spans 44 economies, representing 92% of Chilean imports in 2019, while the EPU includes 29 countries, accounting for 78% of imports.

I also build a measure of *Trade Volatility* using a residualization procedure to isolate variation within origin-products over time, which covers the universe of Chilean imports. Specifically, I use trade flows from the *CEPII* database (Gaulier and Zignago 2010), considering exports

Figure 1. Import Shares Over Time and Across Sectors



A. Import shares over time

B. Wholesale imports across HS2-sectors

Notes: Panel A displays import shares for producers, wholesalers and retailers from 2005 to 2019. Panel B considers data across HS 2-digit sectors for 2019, showing the share of sectors where wholesalers comprise at least y% of imports on the x-axis and the corresponding share of imports on the y-axis.

X_{opdt} of HS 6-digit product p from origin country o to destination d in year t, excluding Chile. I residualize using product-destination-year and origin-destination-year fixed effects to account for shocks affecting buyer demand within a destination-product and bilateral trade costs, thus capturing supply-side volatility. I then compute the (log) standard deviation of residualized flows within origin-products over 5-year windows, as indicated below.

$$X_{opdt} = \delta_{pdt} + \delta_{odt} + \varepsilon_{opdt}\,, \qquad Risk_{opt} = \log\left(SD_{[t-4,t]}\left(\hat{\varepsilon}\right)\right) \tag{1}$$

The three measures are positively correlated but far from being collinear. As reported in Table A1, the correlation between economic policy uncertainty and the other indexes is around 0.4 in 2019, while the correlation between geopolitical risk and trade volatility is 0.35. Figures A3, A4, and A5 display heat maps for each risk measure across origin countries for 2019.[6]

2.2. Facts on Input Sourcing under Risk

I establish novel facts on input sourcing under supply chain risk. First, the share of intermediated imports for a given product and origin country rises with measures of risk. Second, intermediaries are more diversified than producers, maintaining a larger number of suppliers and less concentrated input purchases within origin-products. Third, intermediaries have more stable supply links than producers, experiencing lower separation rates. Fourth, the average number of

[6]For comparison, the trade volatility index built for origin-product pairs is aggregated at the origin-country level in this analysis.

suppliers and supplier separation rates are higher for producers sourcing directly from riskier locations. These facts suggest that producers actively seek protection from disruptions, and that intermediaries offer producers a more resilient sourcing technology in the face of risk.

Stylized Fact 1: *The aggregate share of intermediated imports increases with supply chain risk within an origin country and product.*

I use specification (2) to explore how the use of intermediaries varies with supply chain risk. Y_{opt} indicates the share of intermediated imports for a given origin country o and HS 6-digit product p in year t, while $Risk_{opt}$ is a time-varying measure of supply chain risk. I estimate this equation in long differences, considering the 5-year period from 2014 to 2019. Identification then comes from risk changes within origin country-product pairs, which are presumably orthogonal to economic conditions in a small economy like Chile. This approach also rules out the effect of time-constant origin country and product characteristics that may confound the relationship between risk and intermediation, since riskier locations can differ systematically from safer ones. Moreover, Z_{opt} controls for time-varying covariates that may affect firms' sourcing strategies.

$$\Delta_{t,t+5}\, Y_{op} = \alpha\left(\Delta_{t,t+5}\, Risk_{op}\right) + \Delta_{t,t+5}\, Z'_{op}\gamma + \epsilon_{op} \tag{2}$$

Table 2 shows that the share of intermediated imports increases with all risk measures described in Section 2.1: the *Geopolitical Risk* (GPR) and *Economic Policy Uncertainty* (EPU) indexes defined across input origins, and the *Trade Volatility* index at the origin-product level. The coefficients are normalized to reflect the effect of one standard deviation in each measure. Column (1) reports that an increase in *Geopolitical Risk* expands the intermediation share by one percentage point. Column (2) confirms this result when controlling for changes in origin-country productivity and trade costs, as well as changes in total imports by product to account for industry conditions.[7] Columns (3) to (6) display similar results for changes in *Economic Policy Uncertainty* and *Trade Volatility*, with effects ranging from 0.5 to 1.3 percentage points.

Overall, these results suggest that risk factors abroad shape firms' sourcing strategies, with intermediaries playing a greater role for input sourcing when risk increases. The next fact unpacks differences in the supply networks of producers and intermediaries that inform this pattern.

[7] I control for changes in total factor productivity (*Penn World Table 9.1*) and the number of trade procedures (*World Development Indicators*) as a proxy for trade costs. Note that there are virtually no changes in Chilean import tariffs during the period of analysis. On the other hand, time-constant trade barriers, such as distance or cultural differences, are subsumed under the long-differences approach.

Table 2. Trade Intermediation and Supply Chain Risk

	Δ % Intermediated imports					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Geopolitical risk	0.010***	0.011***				
	(0.003)	(0.003)				
Δ Economic policy uncertainty			0.010	0.013**		
			(0.006)	(0.005)		
Δ Trade volatility					0.007***	0.005**
					(0.002)	(0.002)
Δ Origin-country productivity	No	Yes	No	Yes	No	Yes
Δ Origin-country trade costs	No	Yes	No	Yes	No	Yes
Δ Product total imports	No	Yes	No	Yes	No	Yes
Observations	33,074	32,768	23,791	23,791	35,155	34,393

Notes: This table considers changes in the share of intermediated imports at the origin country-product (HS6) level over a 5-year period. Supply chain risk is measured by Geopolitical Risk and Economic Policy Uncertainty at the origin-country level, and by Trade Volatility at the origin country-product level. The coefficients are normalized to reflect the effect of one standard deviation. Controls include changes in origin country's total factor productivity and trade procedures, and changes in total imports by product. The sample includes all Chilean import transactions for 2014 and 2019. Standard errors are clustered at the level of the risk measure.

Stylized Fact 2: *Intermediaries transact with more suppliers and have less concentrated input purchases across suppliers within origin-products compared to producers.*

I compare the structure of supply networks between producers and intermediaries. Table 3 considers the (log) number of suppliers that firms have per origin-product (HS 6-digit), and a Herfindahl-Hirschman index (HHI) for the concentration of input purchases across suppliers. I regress these variables on a dummy indicating whether the firm is an intermediary. Columns (1) to (3) show that intermediaries systematically source from more suppliers than producers, while columns (4) to (6) indicate less concentrated input purchases. On average, intermediaries have 5% more suppliers and a 2 percentage points lower HHI within origin-products.[8] Since wholesalers may operate at a larger scale, I control for buyer size by including 10 bins based on total sales. Similarly, I control for imports per buyer-origin-product, ensuring that supplier differences are not driven by wholesalers purchasing larger amounts. Product and country fixed effects account for the possibility of intermediaries specializing in different input markets.

In principle, intermediaries might be sourcing different input varieties from different

[8]Figure A6 displays the average number of suppliers per origin-product for producers and intermediaries of different sizes, along with their Herfindahl-Hirschman index, with observations weighted by import value. While the median firm sources from a single supplier, larger firms tend to multi-source, and the differences between producers and intermediaries persist across the distribution. These patterns are further explored in Section 4 and then used for model estimation.

TABLE 3. Number of Suppliers and Concentration of Input Purchases

	(log) # suppliers			HHI suppliers		
	(1)	(2)	(3)	(4)	(5)	(6)
Intermediary dummy	0.061***	0.046***	0.049***	-0.024***	-0.018***	-0.019***
	(0.006)	(0.005)	(0.006)	(0.002)	(0.002)	(0.002)
Firm size (sales)	Yes	Yes	Yes	Yes	Yes	Yes
Imported value	Yes	Yes	Yes	Yes	Yes	Yes
Product FE (HS6)	No	Yes	No	No	Yes	No
Country FE	No	Yes	No	No	Yes	No
Product - country FE	No	No	Yes	No	No	Yes
Observations	371,200	370,834	346,949	371,200	370,834	346,949

Notes: This table compares the supply networks of producers and intermediaries. All regressions are at the firm-HS6 product-origin country level. The dependent variable in columns (1) - (3) is the (log) number of suppliers, and in columns (4) - (6) is a Herfindahl-Hirschman index (HHI) across suppliers. The independent variable is a dummy indicating whether the firm is a wholesaler. Controls include firm sales (10 bins) and imports per buyer-origin-product. The sample includes all import transactions by Chilean producers and wholesalers in 2019. Standard errors are clustered at the firm level.

suppliers: while HS 6-digit codes are narrowly defined for some goods, they allow for substantial heterogeneity within others. However, further exploration suggests that intermediaries maintain multiple suppliers even for the same variety. Table A2 restricts the sample to homogeneous goods according to the Rauch classification (i.e., goods traded in organized exchanges or with reference prices), reducing the scope for differentiation within product codes. This analysis confirms that intermediaries source from more suppliers than producers.[9]

Fact 2 indicates that producers can access a more diversified supply network by contracting with intermediaries. The next fact shows that, conditional on the number of suppliers, there are also systematic differences in the stability of supply links between producers and intermediaries.

Stylized Fact 3: *Intermediaries have more stable supply links within origin-products compared to producers.*

Table 4 compares the stability of links established by producers and intermediaries with foreign suppliers. The dependent variable is a dummy indicating whether supply links in period t will break in $t+1$, while the independent variable indicates whether the firm is an intermediary.[10]

[9] See Grant (2021) for a discussion on how heterogeneous goods are grouped in standard classifications, and how this process may ultimately reflect policy motives. The Rauch classification was originally proposed in Rauch (1999) and then updated in 2007, which is the version used in this study.

[10] Link separations are defined on a yearly basis for this analysis. Similar patterns emerge when considering breaks over longer intervals (t to $t+k$ with $k > 1$), although the number of observations decreases significantly. A potential concern is that some products, such as capital goods, are not sourced every year and may appear as

Columns (1) to (3) perform the analysis at the firm-origin-product (HS6) level, controlling for the initial number of suppliers, such that the coefficients reflect differences in the probability of a separation. Columns (4) to (6) repeat the analysis at the firm-origin-product-supplier level, where the dependent variable is defined for individual relationships. As before, I control for firm size and imported value, and include fixed effects to compare supply links within origin-products.

Table 4. Probability of Supply Link Separations: $\mathbb{D}$(separation = 1)

	Firm-product-country			Firm-product-country-supplier		
	(1)	(2)	(3)	(4)	(5)	(6)
Intermediary dummy	-0.115***	-0.114***	-0.113***	-0.094***	-0.095***	-0.092***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Firm size (sales)	Yes	Yes	Yes	Yes	Yes	Yes
Imported value	Yes	Yes	Yes	Yes	Yes	Yes
Number of suppliers	Yes	Yes	Yes	No	No	No
Product FE (HS6)	No	Yes	No	No	Yes	No
Country FE	No	Yes	No	No	Yes	No
Product - country FE	No	No	Yes	No	No	Yes
Observations	312,724	312,346	289,355	427,739	427,390	406,481

Notes: This table compares the probability of a separation with foreign suppliers for producers and intermediaries. The dependent variable is a dummy indicating whether supply links break from period t to $t+1$, and the independent variable is a dummy indicating whether the firm is an intermediary. Columns (1) - (3) perform the analysis at the firm-HS6 product-origin country level, controlling for the log-number of suppliers. Columns (4) - (6) are at the firm-HS6 product-origin country-supplier level. The sample considers all import transactions in 2018 for firms active in 2018 and 2019. Standard errors are clustered at the firm level.

My results indicate significant differences between producers and intermediaries, with intermediated links being around 10 percentage points less likely to break. These patterns are consistent with intermediaries having more robust supply networks. However, separations can also be demand-driven due to changes in downstream conditions that induce firms to stop sourcing from their suppliers. This would affect my results if such shocks differ systematically between producers and intermediaries, as it would be the case, for example, if intermediaries hold more diversified customer portfolios. To address this possibility, I control for changes in firm-level outcomes that respond to downstream conditions, such as firms' total imports and number of suppliers. Table A3 shows that the differences between producers and intermediaries are smaller but remain significant in this case.[11]

separations in the data. However, this should not affect my results as long as the comparison between producers and intermediaries is made within the same product.

[11]These demand controls are also included when estimating disruption probabilities across input locations for model quantification (Section 5). Moreover, the analysis shows that the probability of disruptions increases with

The fact that intermediaries face lower disruption probabilities can be microfounded in several ways that, while not explicitly modeled, are supported by the data. One possibility is that intermediaries match with safer suppliers due to better *screening* capabilities, which is explored by introducing supplier fixed effects. Another option is that intermediaries are more important customers, and can *monitor* suppliers more closely or be placed *first-in-line* during disruptions. This is assessed by controlling for the share of buyers in suppliers' total sales. Furthermore, intermediaries may source multiple products from the same supplier, maintaining relationships during *product-specific shocks*, which is tested by defining links at the supplier-product level. Table A4 shows that each channel individually reduces the gap in separation rates by nearly 3 percentage points. When all three are considered simultaneously, separation rates are only 2 percentage points lower for intermediaries, explaining a significant part of the differences.

Stylized Fact 4: *The average number of direct suppliers and separation rate with suppliers are higher in riskier origin-products.*

I now document how the outcomes of direct sourcing vary with supply chain risk. Table 5 examines the number of suppliers per producer buyer and the separation rate between buyers and suppliers by origin country and product. Columns (1) to (3) show that, on average, producers transact with more suppliers in riskier origin-products, according to any of the risk indexes described in Section 2.1. This pattern aligns with recent evidence on supplier diversification in countries such as India and the US, particularly in response to climate and shipping risks (Blaum et al. 2023; Castro-Vincenzi et al. 2024).[12] Columns (4) to (6), on the other hand, show that supply link separations occur more frequently in riskier origin-products. All columns include product fixed effects to account for industry-level covariates and also control for origin-country productivity and trade costs.

In sum, Fact 4 indicates that producers sourcing directly tend to diversify suppliers in riskier locations, where their supply links are more likely to break. Facts 2 and 3 in turn establish that intermediaries provide a means of indirect supplier diversification and of reducing the frequency of link separations. Finally, Fact 1 documents that the use of intermediation services increases systematically in locations that become riskier.

all three risk measures: *Geopolitical Risk*, *Economic Policy Uncertainty*, and *Trade Volatility*.

[12] I confirm this positive correlation at the firm level for both producers (Table A5) and intermediaries (Table A6) in the Chilean data. Furthermore, the difference in the number of suppliers between producers and intermediaries documented in Fact 2 is even larger in riskier locations (Table A7).

Table 5. Average Number of suppliers and Separation Rate under Direct Sourcing

	(log) # Suppliers			Separation rate		
	(1)	(2)	(3)	(4)	(5)	(6)
Geopolitical Risk	0.105***			0.055*		
	(0.018)			(0.029)		
Economic Policy Uncertainty		0.049**			0.067***	
		(0.023)			(0.019)	
Trade Volatility			0.039***			0.010***
			(0.001)			(0.002)
Product FE (HS6)	Yes	Yes	Yes	Yes	Yes	Yes
Origin-country productivity	Yes	Yes	Yes	Yes	Yes	Yes
Origin-country trade costs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	63,025	44,880	66,434	52,799	38,801	54,186

Notes: This table considers how the outcomes of direct sourcing vary with supply chain risk at the origin country-product (HS6) level. Columns (1) - (3) consider the average number of suppliers per producer buyer. Columns (4) - (6) consider the average separation rate with suppliers across producer buyers. Supply chain risk is measured by Geopolitical Risk and Economic Policy Uncertainty at the origin-country level, and by Trade Volatility at the origin country-product level. All columns include product fixed effects and control for origin country's total factor productivity and trade procedures. The sample includes all Chilean import transactions for 2019. Standard errors are clustered at the level of the risk measure.

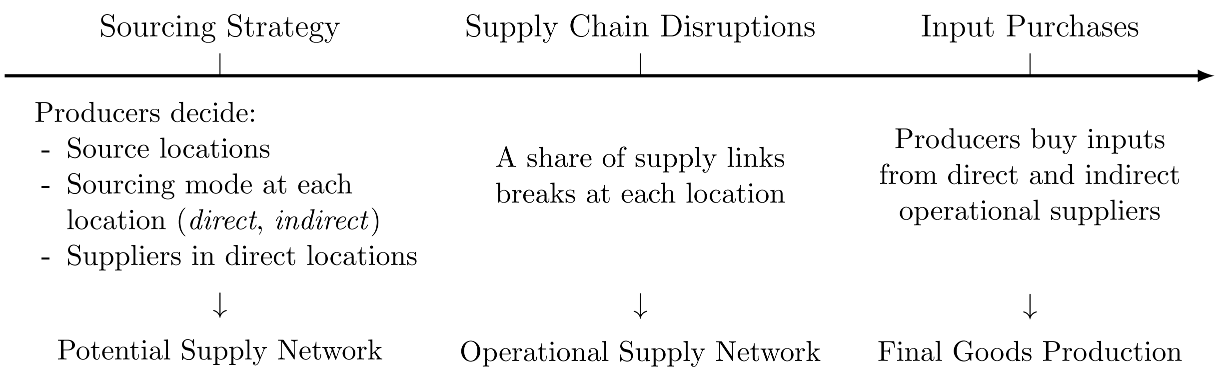
3. Theoretical Framework

Motivated by stylized facts 1-4 above, I next develop a general-equilibrium model of global sourcing that incorporates supply chain risk and trade intermediation. Specifically, I model the problem of heterogeneous final-good producers that source inputs from discrete sets of locations and suppliers, and face idiosyncratic risk of supplier link failure. Producers trade off input costs against disruption probabilities when selecting source locations, and have two mechanisms to mitigate disruptions within locations: matching directly with multiple suppliers (*diversification*) or sourcing inputs indirectly (*intermediation*), where intermediaries provide access to a more diversified network with lower disruption probability. The model characterizes producers' optimal sourcing strategies and their use of intermediation services under risk.

3.1. Setup

Timing. The model is static but producers make decisions in sequential stages. In the first stage, producers define their sourcing strategies to maximize expected profits. This includes the set of source locations, the sourcing mode at each location (i.e., directly or indirectly through an intermediary), and the set of suppliers when sourcing directly.[13] These choices involve sunk investments and define a *potential network* of direct and indirect suppliers. Supply chain disruptions are then realized, such that a share of supply links break at each location. Finally, producers make optimal input purchases and production decisions conditional on their *operational network*. Figure 2 summarizes the timeline of events.

Figure 2. Timeline of Events



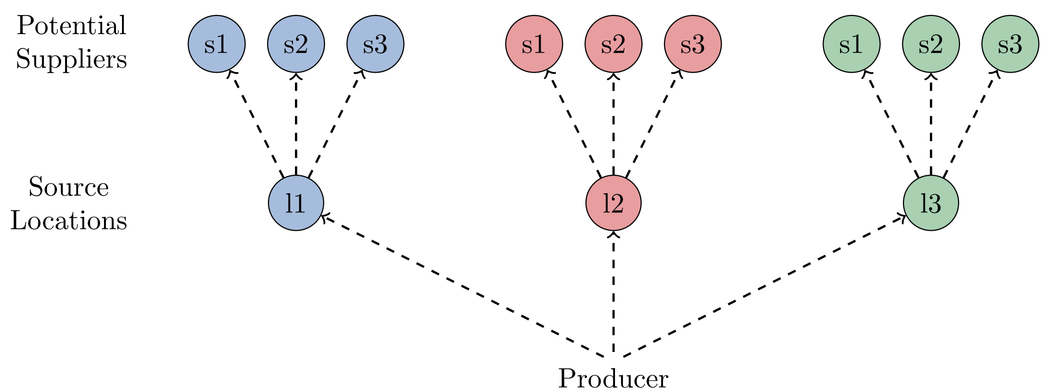
Input Markets. Consider producers in country i with access to a discrete set of source locations $\mathcal{L}$, each populated by a discrete set of suppliers $\mathcal{S}_l$. Locations differ in unit production costs (α_l), iceberg-type trade costs (τ_{il}), the probability of disruptions (ζ_l), and fixed sourcing costs (f_l). I assume that each location offers a differentiated input x_l that can be produced by all local suppliers. I first consider suppliers with homogeneous productivity, normalized to one, such that input prices are simply $p^x_{il} = \tau_{il}\alpha_l$.[14] In this case, suppliers are perfect substitutes within locations and precautionary motives are the only reason to establish multiple links. I later relax this assumption in Section 3.6 to consider variety-specific efficiencies that generate imperfect substitution across suppliers. As long as input prices are not perfectly correlated with supply chain risk across locations, producers face a risk-efficiency trade-off in sourcing decisions. Figure 3 illustrates the structure of input markets.

Supply Chain Risk. I model supply chain disruptions as shocks that break the links established with suppliers in the first stage. This captures any failures in production and distribution that prevent suppliers from serving their customers. Thus, if a link is disrupted in location l, the

[13] The concept of *location* can accommodate different geographic and industry partitions. In this context, they can be thought of as markets defined by the origin country and HS-sector of the intermediate goods.

[14] I abstract from a detailed microfoundation of input markets. However, α_l can be rationalized as the unit cost of production in a setting with perfect or monopolistic competition (e.g., $\alpha_l = \frac{w_l}{\phi_l}$ for wages w_l and labor productivity ϕ_l when inputs use only labor under constant returns to scale).

Figure 3. Input Markets with Discrete Locations and Suppliers



firm cannot purchase l-inputs unless it has another operational link in l.[15] Formally, I consider a discrete shock Z_l^M that disrupts supply links with an exogenous probability ζ_l^M and leaves them operational otherwise, allowing for differences across locations l and sourcing modes M. The assumption of independent disruptions is consistent with the low correlation of link separations observed in the data, so I focus on the role of intermediaries in mitigating idiosyncratic failures.[16] Although this structure adds tractability, the model can also accommodate correlated shocks under more general conditions, which are discussed as an extension.

Sourcing Modes. Producers have two modes to access any given location l. Under direct sourcing, producers select a set of suppliers S_l^D, face disruption probability ζ_l^D, and incur matching costs $f_l^D(S_l^D)$ that increase with the number of supply links. Under indirect sourcing, intermediaries charge a brokerage fee κ on input prices and offer a sourcing technology $\{S_l^I \geq S_l^D, \zeta_l^I \leq \zeta_l^D\}$, consistent with the empirical evidence in Section 2. The fixed cost of contracting with intermediaries is assumed to be lower than that of matching with suppliers directly, $f_l^I \leq f_l^D(\cdot)$.[17] Thus, producers have two risk mitigation strategies at each location: they can engage in *diversification* by establishing direct links with multiple suppliers, which involves higher matching costs, or they can opt for *intermediation*, accessing a resilient network

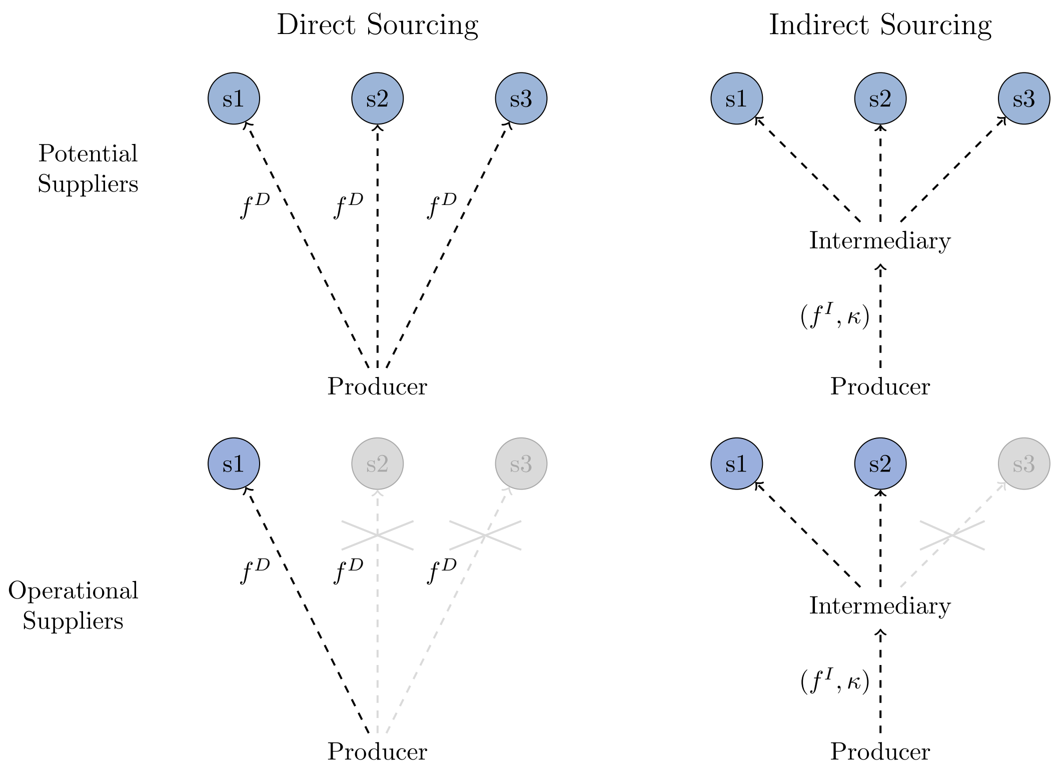
[15] This *on-and-off* approach is analogous to *percolation analysis* in graph theory (i.e., disabling edges at random). While my model considers supply networks that are bi-partite in nature, Elliott et al. (2022) implement this approach in the context of complex networks with multiple layers.

[16] The correlation across supply link breakages within the same buyer, product, and origin country is around 0.09 (Table A8). This aligns with business reports indicating that idiosyncratic disruptions are the most frequent (McKinsey 2020) and suggests that a substantial part can be treated as independent.

[17] The idea of intermediaries reducing fixed trade costs in exchange for a markup is well-established in the trade literature (Ahn et al. 2011; Bernard et al. 2015) and underlies recent works on intermediated production networks (Blum et al. 2024; Manova et al. 2024). My setting follows this insight but emphasizes the role that the attributes of the intermediation technology play under supply chain risk.

at higher input prices. Figure 4 illustrates both sourcing modes before and after the realization of disruptions.

FIGURE 4. Sourcing Modes and Disruptions within Locations



3.2. Final Demand

Consumers in country i have Cobb-Douglas preferences over homogeneous and differentiated final goods. The homogeneous good q_{i0} is freely traded and produced using labor under constant returns to scale, such that one unit of labor generates w_i units of output. Using the homogeneous good as *numeraire* sets wages to w_i. Consumers exhibit CES preferences for varieties $\omega \in \Omega_i$ of the non-tradable differentiated final good:

$$U_i = q_{i0}^{1-\beta}\left(\int_{\Omega_i} q_i(\omega)^{\frac{\sigma-1}{\sigma}} d\omega\right)^{\beta\sigma/(\sigma-1)},$$

where β is the expenditure share on differentiated goods, and $\sigma > 1$ is the elasticity of substitution across varieties. Given aggregate expenditure E_i and the price index P_i for differentiated goods, demand for variety ω with price $p_i(\omega)$ is:

$$q_i(\omega) = p_i(\omega)^{-\sigma} P_i^{\sigma-1} E_i \,. \tag{3}$$

3.3. Producers

Country i contains a continuum of heterogeneous final goods producers. They own a blueprint for a single variety ω under monopolistic competition, and draw productivity $\varphi \in [\underline{\varphi}_l, \overline{\varphi}_l]$ from some distribution $G(\varphi)$. The production technology transforms intermediate inputs into final goods under constant returns to scale:

$$q_i(\omega) = \varphi(\omega) X_i(\omega) \qquad X_i(\omega) = \left(\sum_{l \in \mathcal{L}(\omega)} x_{il}(\omega)^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \,, \tag{4}$$

where $X(\omega)$ is a composite intermediate combining inputs with an elasticity of substitution $\eta > 1$, and $x_{il}(\omega)$ is the quantity purchased from each location to which the producer has access, as indicated by $\mathcal{L}(\omega)$.[18] The marginal cost of producers thus depends on their own productivity and their input cost $C(\omega)$, which aggregates the prices $p_{il}^{x,M}(\omega)$ paid for inputs across locations given a sourcing mode M:

$$c_i(\omega) = \frac{C_i(\omega)}{\varphi(\omega)} \qquad C_i(\omega) = \left(\sum_{l \in L(\omega)} p_{il}^{x,M}(\omega)^{1-\eta} \right)^{\frac{1}{1-\eta}} \,. \tag{5}$$

Producers pay the price set by suppliers under direct sourcing, and a constant markup above it under indirect sourcing, which the intermediary charges as a brokerage fee:

$$p_{il}^{x,I} = \kappa \, p_{il}^{x,D} \,, \tag{6}$$

For now, input prices are not affected by the number of suppliers as they are perfect substitutes within locations: the only reason for having multiple links per location is to ensure input access. On the other hand, the CES structure generates variety gains from sourcing in multiple origins, since locations offer differentiated inputs that are imperfect substitutes in production.[19]

[18] I assume that inputs are the only factor of production for differentiated final goods. Although incorporating labor in a technology of the form $q(\omega) = \varphi(\omega) L(\omega)^{\beta} X(\omega)^{1-\beta}$ is straightforward, it adds complexity to the derivations without providing additional insights into sourcing responses.

[19] Under perfect substitutability, $\eta \to \infty$ and the production function is $q_i(\omega) = \varphi(\omega) \left(\sum_{l \in \mathcal{L}(\omega)} x_{il}(\omega) \right)$, such that the only incentive for having multiple locations is to ensure that at least one remains active. However, the literature on global value chains suggests that firms benefit from sourcing in multiple origins for reasons beyond variety gains, such as inducing tougher competition among suppliers (Antràs et al. 2017; Huang et al. 2024).

Note that heterogeneous producers will optimally make different decisions regarding the set of source locations and the sourcing mode and suppliers within them. Moreover, even if their decisions were identical, the realization of disruptions may lead to different outcomes.

3.4. Optimal Sourcing with One Location

I first characterize the producer's problem when only one input location is available, and then extend the analysis to multiple locations in Section 3.5. Given the timing of events, producers make decisions in two steps. First, they select their optimal sourcing strategy internalizing the probability of disruptions. After disruptions materialize, they make optimal input purchases and production decisions. I work in reverse order, starting with the *ex-post* problem followed by the *ex-ante* problem given the *ex-post* solution.

Ex-Post Problem. Producers have already selected a sourcing mode $M_l(\omega) \in \{D, I\}$ and a set of suppliers $S_l^D(\omega) \in \mathcal{S}_l$ if sourcing directly, and supply chain disruptions Z_l have materialized. Conditional on these choices and realizations, producers make input purchases and production decisions to maximize their *ex-post* operating profits:

$$\max_{p_i(\omega), q_i(\omega), x_{il}(\omega)} \pi_i^{\text{ex-post}}\left(\omega \mid M_l, S_l^D, Z_l\right) = \left[p_i(\omega) - c_i\left(\omega \mid M_l, S_l^D, Z_l\right)\right] q_i(\omega)$$

Given final demand (3) and monopolistic competition, producers optimally set a constant markup over their marginal cost such that $p_i(\omega) = \frac{\sigma}{\sigma-1} c_i(\omega \mid M_l, S_l^D, Z_l)$, which determines downstream quantities and therefore input purchases according to the production technology (4). The marginal production cost depends on the *ex-ante* sourcing strategy and disruption realizations. Conditional on direct sourcing, producer ω has access to inputs at a price p_{il}^{xD} if at least one direct link remains operational. Similarly, under indirect sourcing, inputs can be bought at p_{il}^{xI} if the intermediary has at least one operational supplier. *Ex-post* profits can be expressed as follows, where $p_{il}^{x} \to \infty$ when the supply network is not operational.[20]

$$\pi_i^{\text{ex-post}}\left(\omega \mid M_l, S_l^D, Z_l\right) = \begin{cases} \varphi(\omega)^{\sigma-1}\left(p_{il}^{x,M}\right)^{1-\sigma} \frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} P_i^{\sigma-1} E_i & \text{if operational} \\ 0 & \text{otherwise} \end{cases} \tag{7}$$

Indirect sourcing reduces *ex-post* profits conditional on network operability. The brokerage

[20] While losing access to l-inputs leads to zero operational profits in this simplified setting, the impact of disruptions is smoother in the general case with multiple locations. This is particularly true when a *safer* location is available (e.g., inputs sourced domestically may be less prone to disruptions). In that case, disruptions increase marginal production costs without forcing firms out of the market.

fee increases input costs as stated in (6), which raises producers' marginal costs and is passed on to consumers in the form of higher final-good prices. This, in turn, reduces producers' competitiveness and market shares downstream. On the other hand, inspection of (7) reveals *negative* complementarity between firm productivity and input costs. The impact of intermediation markups is thus amplified for more productive firms.

Proposition 1. (ex-post profits) *Conditional on network operability, producers' ex-post profits are lower under indirect sourcing, especially for more productive firms.*

Proof. *See Appendix C.*

Ex-Ante Problem. Before disruptions are realized, producers determine their optimal sourcing strategy at location l to maximize expected profits, which includes the sourcing mode $M_l(\omega) \in \{D, I\}$ and the set of suppliers $S_l^D(\omega) \in \mathcal{S}_l$ when sourcing directly. Given ex-post profits (7), the producer's *ex-ante* problem is:

$$\max_{M_l(\omega) \in \{D,I\},\, S_l^D(\omega) \in \mathcal{S}_l} \pi_i^{\text{ex-ante}}\left(\omega, M_l, S_l^D, Z_l\right) = \mathbb{E}_{Z_l}\left[\pi_i^{\text{ex-post}}\left(\omega, M_l, S_l^D, Z_l\right)\right] - \mathbb{I}_{\{M_l(\omega)=D\}} f_l^D\left(S_l^D(\omega)\right) - \mathbb{I}_{\{M_l(\omega)=I\}} f_l^I$$

where $\mathbb{I}_{\{M_l\}}$ are indicator variables for the selected sourcing mode, f_l^D is the cost of matching directly with suppliers, and f_l^I is the cost of contracting with an intermediary. Since these payments are irreversible, the expectation operates over *ex-post* profits, specifically over the input cost that determines producers' marginal cost in (5).

The probability of network operability and input prices jointly determine producers' expected input cost. Under idiosyncratic disruptions, the number of operational links $S_l^O(\omega)$, conditional on a sourcing mode $M_l(\omega)$ and set of suppliers $S_l^M(\omega)$ for producer ω, follows a Binomial distribution:

$$\Pr\left(S_l^O(\omega) = S \,\middle|\, M_l(\omega), S_l^M(\omega)\right) = \binom{S_l^M(\omega)}{S}\left(1-\zeta_l^M\right)^S \left(\zeta_l^M\right)^{S_l^M(\omega)-S},$$

Sourcing from location l requires that at least one link remains operational, such that the probability of network operability is given by:[21]

$$\Pr\left(S_l^O(\omega) \geq 1 \,\middle|\, M_l(\omega), S_l^M(\omega)\right) = 1 - \left(\zeta_l^M\right)^{S_l^M(\omega)}. \tag{8}$$

Enhancing operability is costly for producers. Under direct sourcing, establishing links with multiple suppliers ($S_l^D > 1$) entails greater matching costs $f^D(S_l^D)$. Indirect sourcing, by contrast, influences network operability through two channels: the number of potential links $S_l^I \geq S_l^D$ and the probability of facing disruptions $\zeta_l^I \leq \zeta_l^D$, but increases *ex-post* input prices due to the brokerage fee. Expected input costs under direct and indirect sourcing are then:

$$\mathbb{E}_{Z_l}\left[p_{il}^x(\omega)^{1-\sigma} \,\middle|\, M_l(\omega) = D, S_l^M(\omega)\right] = \left(1 - \left(\zeta_l^D\right)^{S_l^D(\omega)}\right)\left(p_{il}^x\right)^{1-\sigma} \tag{9}$$

$$\mathbb{E}_{Z_l}\left[p_{il}^x(\omega)^{1-\sigma} \,\middle|\, M_l(\omega) = I\right] = \frac{\left(1 - \left(\zeta_l^I\right)^{S_l^I}\right)}{\kappa^{\sigma-1}}\left(p_{il}^x\right)^{1-\sigma} \tag{10}$$

Producers' sourcing decisions weigh expected input costs and the fixed costs of transacting with suppliers or intermediaries. While there is no closed-form solution to this discrete-choice problem, I characterize its properties below. To facilitate comparison among sourcing modes, I define a mapping that converts the intermediation technology into an *equivalent* number of direct suppliers in terms of expected input costs, $\widetilde{S}_l^I(S_l^I, \zeta_l^I, \kappa)$. Intuitively, this number increases with a greater resilience advantage of intermediaries or lower brokerage fees.

$$\begin{aligned}\widetilde{S}_l^I(S_l^I, \zeta_l^I, \kappa) &\equiv \left\{S_l^D :\ \mathbb{E}_{Z_l}\left[\left(p_{il}^x(\omega)\right)^{1-\sigma} \,\middle|\, M_l(\omega) = D, S_l^D\right] = \mathbb{E}_{Z_l}\left[\left(p_{il}^x(\omega)\right)^{1-\sigma} \,\middle|\, M_l(\omega) = I\right]\right\} \\ &= \frac{\left|\ln\left(1 - \frac{1 - (\zeta^I)^{S^I}}{\kappa^{\sigma-1}}\right)\right|}{\left|\ln(\zeta^D)\right|}\end{aligned} \tag{11}$$

Sourcing Strategies. I first characterize producers' optimal strategies under direct sourcing and then consider their optimal sourcing mode. Part (a) of Proposition 2 states that direct supplier diversification increases network operability and lowers expected input costs compared

[21] Recall that suppliers are assumed to be perfect substitutes within locations. When this assumption is relaxed in Section 3.6, the number of suppliers itself affects input costs, and the full distribution of operational suppliers must be considered. Also note that there is a slight abuse of notation, as $S_l^O(\omega)$ and $S_l^M(\omega)$ are sets of suppliers, while network operability considers the cardinality of these sets.

to sourcing from a single supplier, which follows directly from (9). Part (b) shows that more productive firms are more likely to diversify suppliers when sourcing directly. Higher productivity amplifies the gains from network operability due to complementarities in the *ex-ante* profit function, while matching costs constrain diversification for less productive firms. This rationalizes precautionary diversification among risk-neutral producers and suggests that these responses vary across the firm size distribution.

PROPOSITION 2. (DIRECT SOURCING) *Producers' direct sourcing strategy is such that:*

a. *Direct supplier diversification increases network operability and reduces expected input costs for producers.*

b. *The optimal number of direct suppliers (weakly) increases with firm productivity:* $S_l^D(\varphi^H) \geq S_l^D(\varphi^L)$ *for* $\varphi^H \geq \varphi^L$.

Proof. *See Appendix C.*

Proposition 3 incorporates indirect sourcing into the analysis. Part (a) states that intermediaries enhance network operability and reduce expected input costs, but only for producers that could match directly with fewer than a certain number of suppliers. Although indirect sourcing implies higher *ex-post* input prices, from an *ex-ante* perspective, expected input costs can be lower if intermediaries' resilience advantage offsets the brokerage fee in (10). This relative advantage depends on the characteristics of the intermediation technology, as well as on the alternative network that producers could optimally build directly.

PROPOSITION 3. (INDIRECT SOURCING) *Producers' use of intermediaries is such that:*

a. *Intermediation increases network operability and reduces expected input costs for producers that can match fewer than* $\widetilde{S}_l^I(S_l^I, \zeta_l^I, \kappa)$ *suppliers directly.*

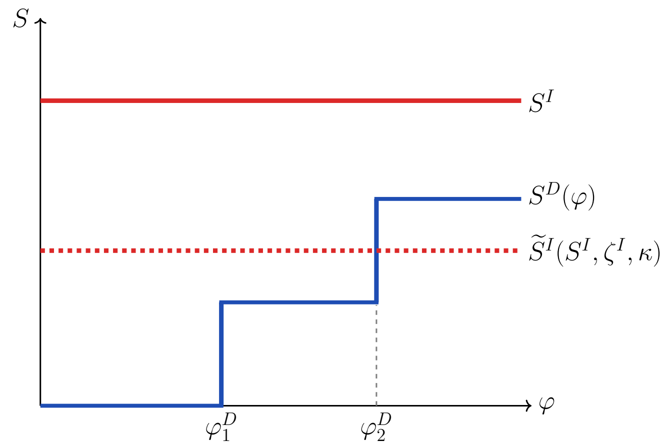
b. *There is a productivity threshold* φ^* *above which producers switch from indirect to direct sourcing:*

$$\varphi_l^* = \min_{S_l^D} \left[\frac{f_l^D(S_l^D) - f_l^I}{\left(1 - (\zeta_l^D)^{S_l^D} - \frac{1-(\zeta_l^I)^{S^I}}{\kappa^{\sigma-1}}\right)(P_{il}^x)^{1-\sigma} B} \right]^{\frac{1}{\sigma-1}} \quad \textit{for } S_l^D \in |\mathbb{S}_l|$$

Proof. *See Appendix C.*

Figure 5 illustrates this result. The blue line depicts the optimal choice of direct suppliers $S^D(\varphi)$, which follows a step function based on firm productivity, as described in Proposition 2. The solid red line S^I represents the number of indirect suppliers offered by intermediaries. The

Figure 5. Direct and Indirect Suppliers



Notes: The blue line shows the optimal number of suppliers under direct sourcing, $S^D(\varphi)$. The solid red line shows the intermediation technology, which provides access to S^I indirect suppliers. The dashed red line indicates the *equivalent* number of indirect suppliers $\widetilde{S}^I(S^I, \zeta^I, \kappa)$, after accounting for indirect disruption probabilities and the brokerage fee. Producers are sorted by productivity on the x-axis.

dashed red line indicates the *equivalent* number of direct suppliers $\widetilde{S}_l^I(S_l^I, \zeta_l^I, \kappa)$ defined in (11), which adjusts the number of indirect suppliers for disruption probabilities and brokerage fees. In this example, producers with productivity $\varphi_1^D < \varphi < \varphi_2^D$ source from one supplier directly, while those with $\varphi > \varphi_2^D$ source from two. Intermediaries reduce expected input costs for the former, while the latter can further lower costs by diversifying directly.

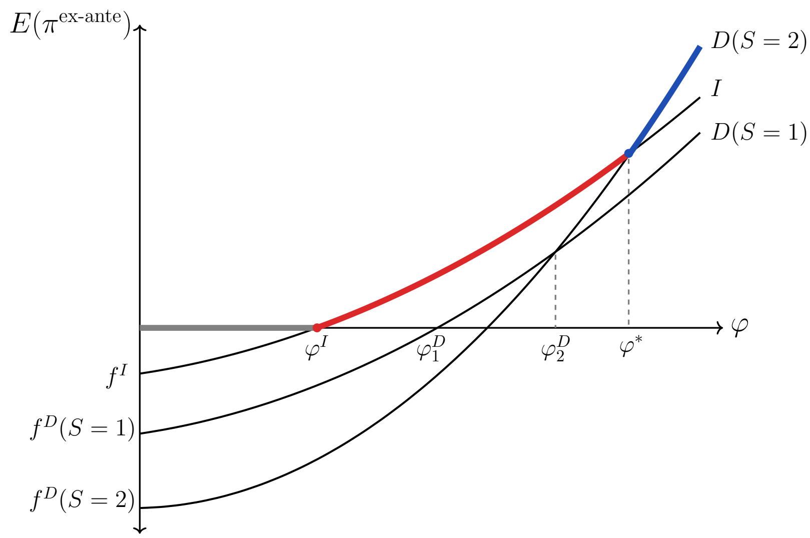
Part (b) of Proposition 3 characterizes producers' optimal sourcing mode and shows that more productive firms are less likely to source indirectly.[22] Producers compare *ex-ante* profits under indirect sourcing with those under direct sourcing, evaluated at the firm-specific optimal choice of direct suppliers. More productive firms can protect themselves by diversifying directly and are also more sensitive to brokerage fees. This implies a productivity cutoff φ_l^* at which firms switch from indirect to direct sourcing, determined by the minimum number of direct suppliers needed to equalize *ex-ante* profits under both sourcing modes. This threshold rises with a more resilient intermediation technology, lower brokerage fees, and higher matching costs with suppliers.[23]

Figure 6 plots several *ex-ante* profit lines to illustrate producers' indirect sourcing, direct sourcing from 1 supplier, and direct sourcing from 2 suppliers. Several patterns consistent with

[22]High-productivity firms may use intermediaries in locations where low-productivity firms refrain from sourcing. This is consistent with Proposition 3, which establishes monotonicity in sourcing modes, ruling out the case where low-productivity firms source directly and high-productivity firms indirectly in the same location.

[23]I assume a technological condition is satisfied for intermediation to take place, as shown in Appendix C. Intuitively, for some firms to use intermediaries, the greater resilience and lower contracting costs of using intermediaries must to some extent compensate for the brokerage fee.

FIGURE 6. Optimal Sourcing Strategy



Notes: This figure illustrates sourcing modes from a given location l. Each curve displays expected *ex-ante* profits under a given strategy: sourcing directly from one $(D(S=1))$ or two $(D(S=2))$ suppliers, or sourcing indirectly (I). Firms are sorted by productivity on the x-axis. Firms on the gray segment do not source from l, those on the red segment source indirectly, and those on the blue segment source directly.

Propositions 2 and 3 stand out. First, *ex-ante* profits increase with firm productivity along each line. Second, more direct matches entail higher fixed costs but lower *expected* input costs, such that the $D(S=2)$ line crosses the $D(S=1)$ line once from below. And third, more productive firms are more likely to engage in direct sourcing: firms in the productivity range $[\varphi^I, \varphi^*]$ use intermediaries, while those with productivity $\varphi > \varphi^*$ source directly.[24] In turn, contracting with intermediaries is cheaper than matching suppliers directly, $f^I < f_l^D(S_l^D)$, so indirect sourcing reduces both expected input costs and fixed costs for firms below φ_2^D. In contrast, intermediation imposes a trade-off for more productive firms, reflecting the effect of incurring higher matching costs or paying brokerage fees to enhance operability.[25]

Supply Chain Risk. I next analyze how producers adapt to changes in supply chain risk. Consider a proportional increase in direct and indirect disruption probabilities.[26] This reduces the profitability of inputs from l, increasing the minimum productivity required to source either directly or indirectly. As a result, some mid-productivity firms previously sourcing directly

[24]While this strict sorting pattern is unlikely to hold in the data, deviations can be rationalized with heterogeneous matching costs across producers that are not perfectly correlated with their productivity (Bernard et al. 2022; Manova et al. 2024). I allow for this possibility in the numerical solution.

[25]Note that firms between φ_2^D and φ^* could further reduce expected input costs through direct diversification, but source indirectly to save on matching costs. This is consistent with a broader role of intermediaries in facilitating transactions even without supply chain risk.

[26]One can think of intermediaries as being able to lower the probability of disruptions by some factor $\mu < 1$, such that $\zeta^I = \mu\zeta^D$. Therefore, changes in ζ^D generate proportional changes in ζ^I.

would now switch to indirect sourcing, while the least productive firms that previously source indirectly would stop sourcing from l altogether.[27] Intuitively, the attributes of the intermediation technology become more valuable when disruptions are more frequent, amortizing the cost of the brokerage fee. Finally, the most productive firms that continue to source directly have incentives to expand their supplier set. The relative value of backup suppliers increases for these firms, reducing the productivity cutoffs for multiple direct matches.

Proposition 4. (risk responses) *Given moderate disruption probabilities* $\zeta_l \equiv \{\zeta_l^D, \zeta_l^I\}$ *in source location l, a proportional increase in* ζ_l*:*

a. *Induces marginal firms sourcing indirectly to stop sourcing from l:* $\varphi^I(\zeta_l') \geq \varphi^I(\zeta_l)$
b. *Induces marginal firms sourcing directly to switch sourcing modes:* $\varphi^*(\zeta_l') \geq \varphi^*(\zeta_l)$
c. *Induces firms that keep sourcing directly to diversify suppliers:* $\varphi_S^D(\zeta_l') \leq \varphi_S^D(\zeta_l)$ *for* $S > 1$

Proof. *See Appendix C.*

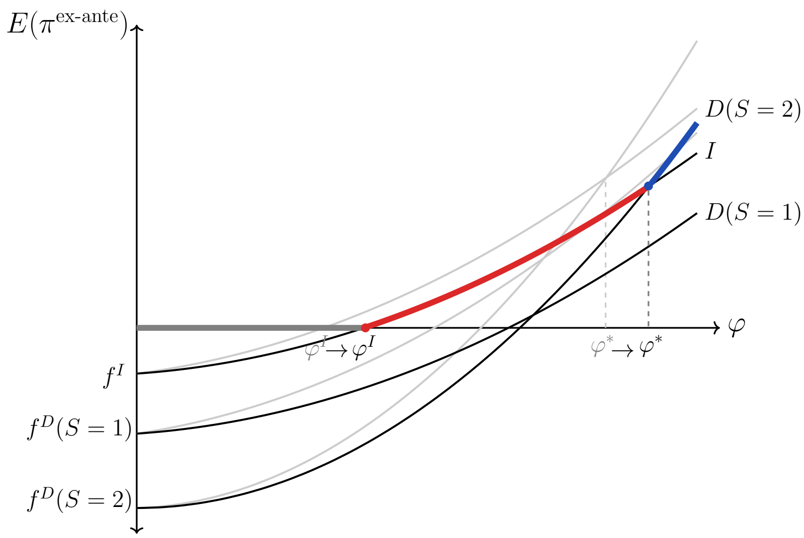
Figure 7 illustrates these patterns. The slope of *ex-ante* profits under direct sourcing, for any given choice of direct suppliers, is larger than for indirect sourcing.[28] Higher supply chain risk pushes down *ex-ante* profits under both sourcing modes, but the slope difference between indirect profits and any direct option shrinks. This, in turn, moves both the productivity cutoff to start sourcing indirectly, $\varphi^I(\zeta)$, and the threshold where producers switch from indirect to direct sourcing, $\varphi^*(\zeta)$, to the right. These responses affect the use of intermediaries in opposite directions, while the compositional shift among indirect buyers pushes up intermediation, as switching producers are larger than those exiting. The net effect on the total use of intermediaries is thus ambiguous. Note that these responses reflect complementarities between resilience investments and supply chain risk: accessing more suppliers and trimming disruption probabilities through intermediaries make a greater contribution when risk is higher.[29]

[27] Higher disruption probabilities make direct sourcing even less profitable for these firms. Therefore, in this single-location setting, producers in the productivity range $[\varphi_l^I(\zeta_l), \varphi_l^I(\zeta_l')]$ are driven out of the market. These firms may be able to substitute inputs in the general, multi-location case.

[28] Formally, the difference in slopes between *ex-ante* profits under any given choice of direct suppliers and indirect sourcing is $m^*(\zeta_l) \equiv \left(1 - (\zeta_l^D)^{S_l^D} - \frac{1-(\zeta_l^I)^{S^I}}{\kappa^{\sigma-1}}\right)\left(p_{il}^x\right)^{1-\sigma} \varphi^{\sigma-1} B_i$. Note that, if $m^*(\zeta_l) < 0$ for all direct options, then indirect profits would exhibit both a lower intercept and a higher slope than direct alternatives, and all producers would source indirectly.

[29] In principle, these results hold as long as the probability of disruptions is not particularly high: as shown in Appendix C.4, $\zeta_l \leq 0.5$ is a sufficient condition for Proposition 4. However, under any realistic calibration of the intermediation technology, the results are valid even for higher disruption probabilities.

FIGURE 7. Higher Probability of Disruptions



Notes: This figure illustrates how *ex-ante* expected profits evolve with an increase in the probability of disruptions. Each curve represents a sourcing strategy: sourcing directly from one $(D(S=1))$ or two $(D(S=2))$ suppliers, or sourcing indirectly (I). The lighter curves indicate profits before the increase in supply chain risk. Firms are sorted by productivity on the x-axis. Firms in the gray segment do not source from l, those in the red segment source indirectly, and those in the blue segment source directly.

3.5. Optimal Sourcing with Multiple Locations

I now consider firms' global sourcing strategy when they can access inputs from multiple locations. While the main results for the role of intermediation services and supply chain risk carry over, additional cross-country complementarities emerge. A sourcing strategy is a triplet $\left\{L(\omega), M_l(\omega), S_l^D(\omega)\right\}$ that includes the producer's set of source locations $L(\omega) \in \mathcal{L}$, the sourcing mode at each location, and the number of suppliers per location under direct sourcing. Producers thus have an additional margin of adjustment to supply chain risk, as they trade off input prices $p_{il}^{x,M}$ and disruption probabilities ζ_l^M when selecting source locations.

As before, producers make decisions in two steps, defining their sourcing strategies before disruptions materialize, and making input purchases and production decisions after disruptions. The *ex-post* solution is analogous to the single-location case (7), but the producer's input cost incorporates the prices obtained in each operational location, as described by (5). Therefore, producers' *ex-post* profits can be expressed as:

$$\pi_i^{\text{ex-post}}\left(\omega \,\middle|\, L, M_l, S_l^D, Z_l\right) = \begin{cases} \varphi(\omega)^{\sigma-1}\left(\sum_{L(\omega)}\left(p_{il}^{x,M}(\omega)\right)^{1-\eta}\right)^{\frac{1-\sigma}{1-\eta}} B & \text{if operational} \\ 0 & \text{otherwise} \end{cases} \quad (12)$$

where $B \equiv \frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} P_i^{\sigma-1} E_i$ and $\eta > 1$ is the elasticity of input substitution across locations. Given this *ex-post* solution, the producer's *ex-ante* problem is:

$$\begin{aligned} \max_{\substack{L(\omega)\in\mathcal{L} \\ \{M_l(\omega)\in\{D,I\}\} \\ \{S_l^D(\omega)\in\mathbb{S}_l\}}} \quad & \pi_i^{\text{ex-ante}}\big(\omega, L, M_l, S_l^D, Z_l\big) = \mathbb{E}_{Z_l}\Big[\pi_i^{\text{ex-post}}\big(\omega, L, M_l, S_l^D, Z_l\big)\Big] \\ & - \sum_{L(\omega)} \mathbb{1}_{\{M_l(\omega)=D\}} f_l^D\big(S_l^D(\omega)\big) - \sum_{L(\omega)} \mathbb{1}_{\{M_l(\omega)=I\}} f_l^I \end{aligned} \tag{13}$$

In the spirit of Antràs et al (2017), expected *ex-post* profits are an increasing function of the producer's *expected sourcing capability*:

$$\mathbb{E}_{Z_l}\Big[\pi_i^{\text{ex-post}}\big(\omega, L, M_l, S_l^D, Z_l\big)\Big] = \varphi(\omega)^{\sigma-1}\, \mathbb{E}_{Z_l}\left[\Theta\Big(\omega, L, M_l, S_l^D, Z_l\Big)^{\frac{\sigma-1}{\eta-1}}\right] B \tag{14}$$

where $\Theta \equiv \sum_L \left(p_{il}^{x,M}\right)^{1-\eta}$. Sourcing decisions influence this capability through various channels. At the outer level, a larger set of locations generates input variety gains and increases network operability, with more efficient and less risky locations making a greater contribution. At the inner level, the sourcing mode affects expected input prices as in the one-location case. However, the global sourcing problem entails interdependent decisions, as the choices made in locations l and l' jointly determine producers' expected marginal costs.

Producers' *ex-ante* global sourcing problem is a high-dimensional, combinatorial discrete-choice problem. In the one-location case, there are $2^{|\mathbb{S}_l|+2}$ possible choices, which reduce to $|\mathbb{S}_l|+2$ when suppliers are perfectly substitutable. With multiple locations, the number of choices expands to $\prod_{l\in\mathcal{L}}\Big(|\mathbb{S}_l|+2\Big)$. Proposition 5 characterizes producers' optimal sourcing strategies.

Proposition 5. (global sourcing) *Producers' global sourcing problem is such that:*

a. *The expected sourcing capability is non-decreasing in firm productivity:* $\mathbb{E}_{Z_l}\Big[\Theta(\varphi^H)^{\frac{\sigma-1}{\eta-1}}\Big] \geq \mathbb{E}_{Z_l}\Big[\Theta(\varphi^L)^{\frac{\sigma-1}{\eta-1}}\Big]$ *for* $\varphi^H \geq \varphi^L$.
b. *If* $\sigma > \eta$, *the optimal sets of source locations and direct suppliers per location are non-contracting in firm productivity:* $\mathcal{L}(\varphi^L) \subseteq \mathcal{L}(\varphi^H)$, $S_l^D(\varphi^L) \leq S_l^D(\varphi^H)$ *for* $\varphi^H \geq \varphi^L$.
c. *If* $\sigma > \eta$, *the choice of direct sourcing at each location (weakly) increases with firm productivity:* $\mathbb{1}_{\{M_l=D\}}(\varphi^H) \geq \mathbb{1}_{\{M_l=D\}}(\varphi^L)$ *for* $\varphi^H \geq \varphi^L$.

Proof. *See Appendix C.*

The choices made by high-productivity firms grant them a greater *expected sourcing capability*, which in turn amplifies their productivity advantage. In particular, more productive firms select a larger number of locations and direct suppliers per location, and are more likely to source directly. This occurs when $\sigma > \eta$, meaning that final goods are closer substitutes in consumption than intermediate inputs in production, generating complementarities in sourcing decisions. As in previous models of global sourcing, producers follow a *pecking order* of locations (Antràs et al. 2017; Huang et al. 2024), but this ranking now considers both input costs and disruption probabilities. The increasing number of direct suppliers based on firm productivity is consistent with the skewness of trade and production networks (Bernard et al. 2018b, 2022), while the choice of sourcing modes resembles canonical intermediation models where less productive firms sort into intermediaries (Ahn et al. 2011; Bernard et al. 2015).

Given an optimal sourcing strategy and a particular realization of disruptions, one can compute producers' input purchases from each operational location:

$$\widetilde{X}_{il}^{M}(\omega) = \left(\varphi(\omega)\right)^{\sigma-1}\left(p_{il}^{x,M}(\omega)\right)^{1-\eta}\left(\Theta(\omega)\right)^{\frac{\sigma-\eta}{\eta-1}}(\sigma-1)B \tag{15}$$

and therefore producers' global input purchases:

$$\widetilde{X}_{i}(\omega) = c(\omega)q(\omega) = \left(\varphi(\omega)\right)^{\sigma-1}\left(\Theta(\omega)\right)^{\frac{\sigma-1}{\eta-1}}(\sigma-1)B \tag{16}$$

More productive firms face greater final demand, which increases input purchases from all their operational locations (15). They also have greater incentives to transact with multiple suppliers per location and to avoid the brokerage fee, since *ex-ante* profits (13) are supermodular in productivity and the *expected sourcing capability*, and the latter increases monotonically with productivity. This monotonic relationship also ensures that mid-productivity firms switch from direct to indirect sourcing when faced with increased risk. The mechanisms driving sourcing mode decisions in the one-location case are thus amplified in the global sourcing setting.

3.6. Imperfect Supplier Substitution

Until now I have assumed that suppliers are identical and perfectly substitutable within locations, selling the local input x_l at the location-specific price $p_{il}^{x} = \tau_{il}\alpha_l$. Under this assumption, supply chain risk is the only reason for producers to match with multiple suppliers, and operational suppliers fully compensate for disrupted ones. It also implies that producers consider the number but not the identity of suppliers at each location, reducing the dimensionality of the combinatorial problem. To incorporate imperfect supplier substitution in a tractable manner, I now consider suppliers that are *ex-post heterogeneous* but remain *ex-ante homogeneous*.

I assume that each x_l is now a unit-measure bundle of intermediate varieties v, with constant elasticity of substitution $\lambda > 1$, such that the cost of x_l under sourcing mode M is:

$$p_{il}^{x,M} = \left(\int_0^1 p_{il}^{x,M}(v)^{1-\lambda} dv \right)^{\frac{1}{1-\lambda}}$$

Suppliers in l can produce all local varieties $v \in [0,1]$ at the location-specific costs $\tau_{il}\alpha_l$ plus a supplier-variety specific cost $\xi_s(v)$ that is revealed after supply links are formed. I treat the vector of variety-specific costs as independent realizations from a Fréchet distribution with dispersion parameter $\theta > 0$, which governs the degree of substitution across suppliers.[30] The price set by supplier s for variety v is then:

$$p_{sl}^{x}(v) = \tau_l\, \alpha_l\, \xi_s(v) \qquad \Pr(\xi_s(v) \geq t) = e^{-t^{\theta}} \tag{17}$$

Under direct sourcing in location l, producers purchase each variety from their lowest-cost operational supplier $S_l^{O,D}(\omega)$. Similarly, under indirect sourcing, the intermediary buys each variety from its lowest-cost operational option in $S_l^{O,I}$ on behalf of the producer.

$$p_{il}^{x,D}(v) = \min_{s \in S_l^{O,D}(\omega)} \left\{ \tau_{il}\, \alpha_l\, \xi_{sl}(v) \right\} \qquad p_{il}^{x,I}(v) = \kappa \min_{s \in S_l^{O,I}} \left\{ \tau_l\, \alpha_l\, \xi_{sl}(v) \right\}. \tag{18}$$

Since variety-specific costs are *iid* over a continuum of measure one, the share of inputs sourced from each operational supplier is given by the probability that a supplier is the lowest-cost option. Using the properties of the Fréchet distribution, the average prices faced by the producer in location l can be expressed as:

$$p_{il}^{x,D} = \gamma\, \tau_l\, \alpha_l \left(S_l^{O,D}(\omega) \right)^{-1/\theta} \qquad p_{il}^{x,I} = \gamma\, \tau_l\, \alpha_l \left(\frac{S_l^{O,I}}{\kappa_l^{\theta}} \right)^{-1/\theta} \tag{19}$$

where γ is a constant defined by the gamma function $\Gamma(\cdot)$.[31]

Allowing for imperfect supplier substitution gives rise to three additional results. First, producers benefit from a larger supply network not only by hedging disruptions but also by having additional cost draws, which reduces input prices through better matches. Second, since suppliers are not perfectly interchangeable, supply chain disruptions are costly for producers

[30] Note that *ex-ante* supplier heterogeneity can be incorporated by adding supplier-level production costs α_{ls}, or by including a supplier-specific technological parameter T_s in the Fréchet distribution.

[31] As in Eaton and Kortum (2002), $\gamma = \left[\Gamma\left(\frac{\theta+1-\lambda}{\theta}\right)\right]^{\frac{1}{\lambda-1}}$ so I need $\lambda < \theta + 1$ to have a well-defined price index. As long as this restriction is satisfied, λ appears only in a constant term without affecting any relevant outcomes.

even if their overall network remains operational. Third, producers' optimal risk responses are shaped by the degree of substitution across suppliers within locations (θ) and across inputs from different locations (η). Intuitively, when supply chain risk increases in a location, producers have stronger incentives to diversify there if suppliers are more homogeneous or if other locations specialize in different products.

3.7. General Equilibrium

In equilibrium, free-entry implies that *ex-ante* expected profits must equal the fixed cost of entry, f_i^e, such that only producers above a productivity threshold $\overline{\varphi}_i$ begin operations.

$$\int_{\overline{\varphi}_i}^{\infty} \mathbb{E}\big(\pi_i^{\text{ex-ante}}(\varphi)\big) dG_i(\varphi) = w_i f_i^e \tag{20}$$

It can be shown that equation (20) delivers a unique demand shifter B_i, and that producers' combinatorial discrete choice problem has a unique solution given B_i.The equilibrium mass of producers in country i is then given by:

$$N_i = \frac{\beta L_i}{\sigma\Big[\int_{\overline{\varphi}_i}^{\infty} \sum_{l \in \mathcal{L}(\varphi)} \Big(\mathbb{1}_{\{M_l(\varphi)=D\}} f_l^D\big(S_l^D(\varphi)\big) + \mathbb{1}_{\{M_l(\varphi)=I\}} f_l^I\Big) dG_i(\varphi) + f_i^e\Big]} \tag{21}$$

where $\mathbb{1}_{\{M_l(\varphi)\}}$ are indicator variables for the selected sourcing modes at each location l in the sourcing set $\mathcal{L}(\varphi)$ of a producer with productivity φ.

3.8. Model Extensions

While the baseline model abstracts away from the market structure of the intermediation sector, its main mechanisms and results would continue to hold in an extended framework with market clearing in that sector. For example, the equilibrium brokerage fee could be chosen by monopolistically competitive wholesalers that specialize in different origin countries and industries. Intermediaries would take into account how their brokerage fee influences their set of customers and downstream input demand, with no qualitative effect on producers' sourcing strategies. However, counterfactuals not directly targeting intermediaries may also impact equilibrium brokerage fees in this extension, affecting producers' sourcing outcomes.

I have also assumed that producers face independent disruptions on their supply links. Although the data suggest a low correlation across link separations, it is evident that some real-world shocks operate at a broader level. In practice, it is straightforward to incorporate location-level disruptions with some exogenous probability, introducing a correlation across disruptions within locations. More generally, it can be shown that model propositions remain valid under shock structures satisfying three conditions: a regularity condition ensuring that network operability increases with the number of suppliers, a supermodularity condition on expected profits for disruption and suppliers (such that extra suppliers are more valuable when risk increases), and a weak independence condition ruling out the possibility that adding a location changes the probability of disruptions in other places. The results on intermediated sourcing are thus more general than implied by a setting with idiosyncratic disruptions.

4. Reduced-Form Evidence

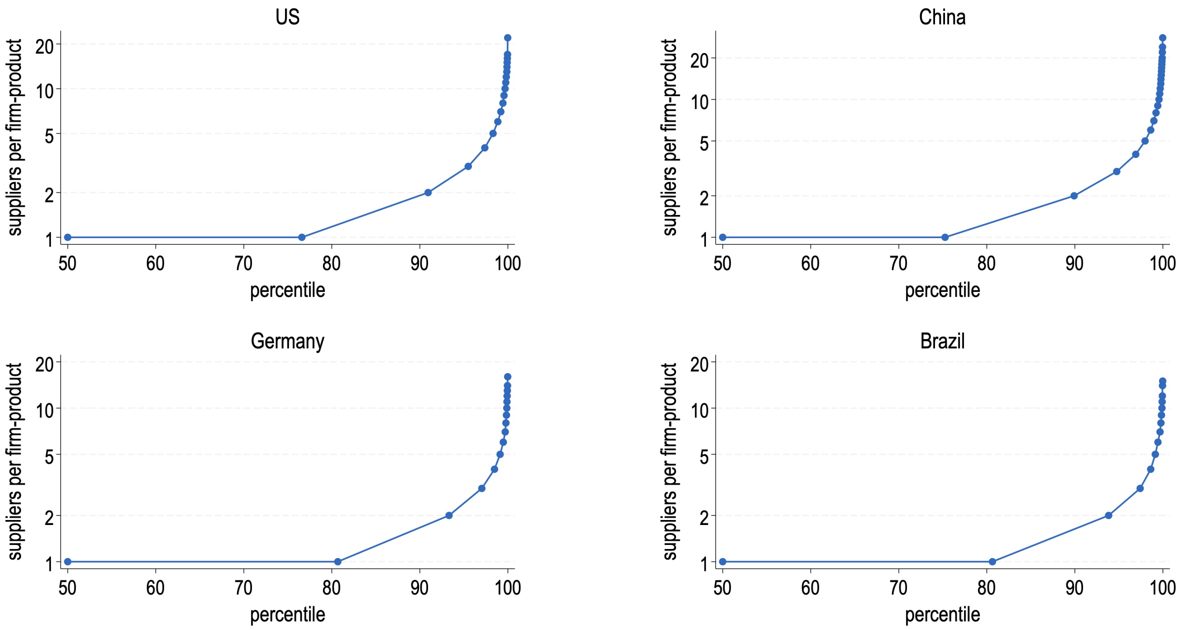
The model in Section 3 can rationalize the systematic rise in intermediated imports under higher origin country risk (Fact 1), with producers trading off risk and efficiency in choosing their input source locations and sourcing mode. In particular, the model shows that intermediaries' wider portfolio of suppliers (Fact 2) and lower supplier separation rates (Fact 3) make them an attractive sourcing technology, particularly for risky origins and for less productive firms. I now provide additional empirical evidence consistent with this key model mechanism. I first document the heterogeneity in direct sourcing activity across firms, and the relationship between the number of direct suppliers and input cost volatility. I then establish that fewer firms opt to source directly when supply chain risk rises, but those who do choose to expand their supplier base. These results support the role of both in-house diversification and access to intermediation services in minimizing the impact of supply chain disruptions on input costs.

4.1. Direct Supplier Diversification and Input Cost Volatility

Figure 8 plots the distribution of the number of suppliers at the firm-product level, considering the top origin countries for Chilean producers: the United States, China, Germany, and Brazil. The data reveals that about 20% of producers source products from multiple suppliers, while a few producers have many supply relationships. In turn, the subset of producers multisourcing in the same location accounts for two-thirds of total imports, indicating that they are larger on average. These numbers align with recent evidence for US firms, where 21% of importers source from multiple suppliers in the same origin country and account for three-quarters of imports (Blaum et al. 2023). They are also consistent with data on Colombian importers, where the share of firms with more than one supplier is around 30% (Bernard et al. 2018a). My evidence confirms the skewness of the number of suppliers in the Chilean data when only producers are considered in the sample. Moreover, these patterns are consistent with the presence of sizable matching costs preventing direct supplier diversification.

In the model, the combination of a discrete set of suppliers and independent disruptions

FIGURE 8. Number of Direct Suppliers in Selected Countries



Notes: This figure plots the distribution of the number of suppliers at the firm-product level, considering the main source locations for Chilean importers. The sample includes all Chilean producers importing directly in 2019.

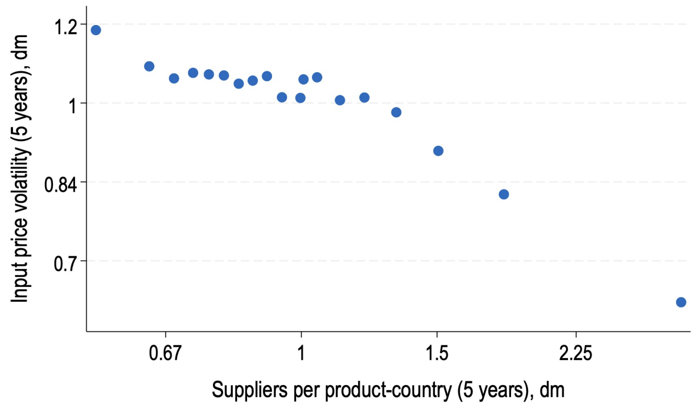
across supply links imply that input cost volatility decreases with a firm's number of suppliers. Figure 9 confirms this relationship in the Chilean data. The x-axis displays the average number of suppliers firms have for a given product and origin country over a 5-year period (2014–2019), while the y-axis shows input price volatility, measured by the standard deviation of unit values over the same period. Firms are grouped into 20 equal-sized bins, with dots indicating values for a representative firm. Both variables are demeaned using product-origin country fixed effects. The figure reveals a clear negative relationship between the number of suppliers and input cost volatility, with a linear slope of -0.33. This supports the idea of producers mitigating disruptions by maintaining multiple supply relationships.

4.2. Direct Supplier Diversification and Input Location Risk

I examine the risk responses of heterogeneous producers sourcing directly. Specifically, I assess how producers adjust the number of direct suppliers for a given location (origin country-HS6 product) as risk increases over time, incorporating interactions with terciles of firm size, defined by total imports in the initial period. The empirical strategy is analogous to that in Section 2, but implemented at the firm-country-product level using stacked data for periods t and $t + 5$.[32]

[32] Since the analysis is conducted at a more granular level, employing long-differences would require that the same firm sources the same input from the same origin country over five years, significantly reducing observations.

Figure 9. Number of Direct Suppliers and Input Cost Volatility



Notes: Firms are sorted into 20 equal-sized bins. The x-axis shows the average number of suppliers that a producer has for a given product and origin country over a 5-year period. The y-axis displays the corresponding standard deviation of input prices over the same period. Both variables are demeaned using product-origin country fixed effects. The linear slope is -0.33.

Table 6 shows a negative main effect for changes in *Trade Volatility*, while other risk measures have insignificant coefficients. However, interactions by firm size reveal that large producers increase the number of suppliers in response to both *Geopolitical Risk* and *Trade Volatility*, while the effect of *Economic Uncertainty* is insignificant. Note that country-product fixed effects ensure that comparisons are made within the same location over time, while firm fixed effects subsume the level effects of size dummies and cross-sectional heterogeneity among producers. Overall, these results support that large producers are the only ones that can afford precautionary diversification.

4.3. Sourcing Mode and Input Location Risk

The model predicts that fewer firms source directly from riskier origin countries and rely instead on intermediaries. To assess this implication, Table 7 examines how the number of producers sourcing directly from a given location (origin country-HS6 product) varies with risk shocks over a 5-year period, replicating the approach used in Section 2. As predicted, I find that the count of direct importers systematically decreases with all measures of supply chain risk. These results are robust to controlling for changes in origin-country productivity and trade costs, as well as changes in total imports by product to account for downstream conditions.[33] Overall, these findings are consistent with changes in the use of intermediation services due to the

Instead, I use stacked periods and include fixed effects to control for product, origin country, and firm characteristics.

[33]There were no significant changes in import tariffs in Chile during the analysis period. Meanwhile, time-constant trade barriers such as distance and cultural differences are absorbed by using long differences at the origin country-product level.

TABLE 6. Number of Direct Suppliers by Producer Size

	(log) # direct suppliers					
	Geopolitical Risk		Economic Uncertainty		Trade Volatility	
	(1)	(2)	(3)	(4)	(5)	(6)
Supply chain risk	-0.058	-0.068	-0.022	-0.019	-0.024***	-0.026***
	(0.049)	(0.047)	(0.025)	(0.024)	(0.005)	(0.005)
× 2nd size tercile	0.041**	0.042**	0.018	0.018	0.025***	0.025***
	(0.018)	(0.018)	(0.025)	(0.025)	(0.004)	(0.004)
× 3rd size tercile	0.069***	0.070***	-0.010	-0.009	0.062***	0.062***
	(0.017)	(0.018)	(0.031)	(0.031)	(0.008)	(0.008)
Origin country - product FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Origin-country productivity	No	Yes	No	Yes	No	Yes
Origin-country trade costs	No	Yes	No	Yes	No	Yes
Product total imports	No	Yes	No	Yes	No	Yes
Observations	269,913	269,251	235,431	235,431	269,958	268,416

Notes: All regressions consider the (log) number of direct suppliers at the firm-product-origin country-year level, stacking periods t and $t + 5$. Size terciles are defined using total imports at the firm level in period t. Supply chain risk is measured by the Geopolitical Risk (GPR) and Economic Policy Uncertainty (EPU) indexes at the origin-country level, and by Trade Volatility at the origin country-product level. Controls include changes in total factor productivity, trade procedures, and total imports by product. The sample includes all import transactions by Chilean producers for years 2014 and 2019. Standard errors are clustered at the level of the risk measure.

selection of producers into different sourcing modes.[34]

5. Quantitative Analysis

The theory developed in Section 3 allows me to quantify the role of trade intermediation in mitigating supply chain disruptions. Leveraging the detailed microdata at hand, I operationalize this setting for Chile, five source regions (Latin America, China, the United States, Europe, and Rest of the World), and one sector per region. My main result is that intermediaries substantially reduce the impact of disruptions for producers in the middle of the size distribution, which access foreign inputs but lack the scale to diversify directly. I also show that changes in brokerage fees influence the use of intermediaries and therefore their contribution to supply chain resilience. This suggests that industrial policy in the wholesale sector can have broader effects on the economy.

[34]An additional empirical test would be to examine whether the probability of producers switching to intermediaries increases with supply chain risk. This requires information on VAT domestic transactions between producers and intermediaries, contained in Form 29 of the Tax Authority of Chile. While access to this data has been requested, it is not yet operational and represents a natural next step for this project.

Table 7. Number of Producers Importing Directly

	Δ (log) # Direct Importers					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Geopolitical Risk	-0.037***	-0.035***				
	(0.009)	(0.012)				
Δ Economic Policy Uncertainty			-0.041***	-0.044***		
			(0.010)	(0.015)		
Δ Trade Volatility					-0.007**	-0.005*
					(0.003)	(0.003)
Δ Origin-country productivity	No	Yes	No	Yes	No	Yes
Δ Origin-country trade costs	No	Yes	No	Yes	No	Yes
Δ Product total imports	No	Yes	No	Yes	No	Yes
Observations	33,074	32,768	23,791	23,791	35,155	34,393

Notes: All regressions consider changes in the (log) number of direct producers within origin country-products over a 5-year period. Supply chain risk is measured by the Geopolitical Risk (GPR) and Economic Policy Uncertainty (EPU) indexes at the origin-country level, and by Trade Volatility at the origin-product level. Controls include changes in total factor productivity, the number of trade procedures, and total imports by product. The coefficients are normalized to reflect the effect of one standard deviation. The sample includes all import transactions in Chile for years 2014 and 2019. Standard errors are clustered at the level of the risk measure.

5.1. Numerical Solution

To solve the model numerically, the first challenge is the dimensionality of the choice set. In principle, the firm's maximization problem (13) involves decisions over $|\mathcal{L}|$ locations and $2^{|\mathcal{S}_l|+2}$ options at each of them. However, the assumption of *ex-ante* homogeneous suppliers reduces the latter to $|\mathcal{S}_l| + 2$ options. Even in a tractable setting with 5 locations and 4 suppliers per location, this contracts the choice set from nearly a billion combinations to less than ten thousand. I further reduce dimensionality using the model. The *equivalent* number of suppliers $\widetilde{S}_l^I$ defined in (11) allows me to compare direct choices with the intermediation technology, ruling out strictly dominated options at each location.[35] Finally, I apply a squeezing procedure to avoid evaluating all remaining options, following recent methods for combinatorial discrete choice problems (Arkolakis et al. 2023; Huang et al. 2024).[36]

The second challenge is that forward-looking producers anticipate the occurrence of

[35]In the model, I assumed $f_l^D(\cdot) \leq f_l^I$ ensuring that matching with $S_l^D \leq \widetilde{S}_l^I$ direct suppliers cannot be optimal. In the numerical solution, however, I allow for heterogeneous matching costs that exceed f_l^I on average (Section 5.2). In this case, the discard rule becomes more nuanced, depending on how f_l^I compares to $f_l^D(\cdot)$ for direct choices near $\widetilde{S}_l^I$. Firms with high matching costs still reduce their choices as before, intermediation is ruled out for firms with very low matching costs, while it is not always possible to reduce choices for firms in between.

[36]A key condition for this procedure is that producers' *ex-ante* expected profits satisfy single-crossing differences. In the next section, I show that the parametric condition $\sigma > \eta$ holds for standard values of σ and the estimated value of η, ensuring single-crossing differences from below.

disruptions, which involves a high-dimensional expectation over each choice. There are up to $|\mathcal{S}_l| + 1$ possible realizations at each location l in $L(\omega)$, which jointly determine producer ω's expected sourcing capability in (14). I address this issue by approximating these complex expectations using Monte Carlo simulations. As shown in (9) and (10), the pattern of disruptions implies that, given a set of potential suppliers at l, the number of operational suppliers follows a Binomial distribution. I use these distributions to generate random draws under each possible sourcing strategy and compute expected profits.[37]

5.2. Estimation Strategy

Elasticities. I calibrate the parameters governing substitution across final goods in consumption (σ), across inputs from different locations in production (η), and across suppliers within locations (θ). I take $\hat{\sigma} = 5$ as a median estimate from the trade literature (Broda and Weinstein 2006; Feenstra and Romalis 2014; Antràs et al. 2017) and infer η and θ using model-consistent equations.

First, I consider a log-linear version of (15) indicating firm f's input purchases from source location l, conditional on direct sourcing:

$$\log \widetilde{X}^D_{fl} = (\sigma - 1)\log \varphi_f + (1-\eta)\log p^{x,D}_{fl} + \left(\frac{\sigma-\eta}{\eta-1}\right)\log \Theta_f + \log\left(\sigma - 1\right)B$$

To back out η, I take the following empirical counterpart to the data:

$$\log \widetilde{X}^D_{flt} = \delta_{ft} + (1-\eta)\log p^{x,D}_{flt} + u_{flt} \tag{22}$$

where δ_{ft} absorbs differences in producers' marginal costs due to their core productivity and sourcing capability. Identification then comes from price variation across locations for the same firm and year. To address reverse causality concerns, I also estimate (22) for the last sample year (2019) using geographic distance from Chile as an instrument for input prices.[38] Table A9 reports estimates around $\hat{\eta} = 1.3$, which is similar to values typically used in the trade literature (Atkeson and Burstein 2008; Edmond et al. 2015).

For θ, I consider a log-linear version of (19) that relates input prices to firms' number of

[37] I use 100,000 simulations when estimating the model and implementing counterfactuals.

[38] In the model, input prices are unaffected by the amount purchased by atomistic producers. In reality, producers may obtain quantity discounts, or their purchases may affect market prices when they are large players. While tariffs are a standard time-varying instrument in the trade literature, their flat structure in Chile prevents their use. I then exploit geographic distance from Chile, which is positively related to import prices and unlikely to be correlated with other origin country conditions.

suppliers under imperfect substitution, expressed empirically as:

$$\log p^D_{flt} = \delta_{lt} - \frac{1}{\theta} \log S^D_{flt} + u_{flt} \tag{23}$$

where δ_{lt} captures location-specific trade and production costs. Identification thus arises from variation in the number of suppliers across firms sourcing from the same location (origin country - HS6 product) and year, and I also include firm-year fixed effects to account for changes in firm-level conditions.[39] Table A10 presents results considering the full panel (2005–2019) and the last sample year, with values for $\hat{\theta}$ ranging from 3.4 to 3.9, where the upper bound is equivalent to the estimates in Huang et al. (2024).

Panel A of Table 8 summarizes the estimated elasticities. There is greater substitution across inputs in production relative to final goods in consumption ($\sigma > \eta$), which is consistent with sourcing complementarities. Furthermore, substitution is easier among suppliers within locations than across different input locations ($\theta > \eta$).

Location Input Costs. Consider the cost structure defined in (17), which separates the cost of input varieties into location ($\tau_l \, \alpha_l$) and supplier-variety ($\xi_s(v)$) multiplicative factors. I assume that the average price charged by a foreign supplier to Chilean buyers follows this structure, and exploit the time dimension of the data to infer the location-specific component. The empirical specification is:

$$\log \bar{p}_{slt} = \delta_{lt} + \delta_{st} + e_{slt} \tag{24}$$

where δ_{lt} is interpreted as the average trade and production cost in each location (origin country - HS6 product) and year, which are then aggregated to source regions. The normalized version of these estimates (relative to Chile) is reported in Panel B of Table 8 for the last sample year (2019).[40] As expected, the estimated costs are significantly higher in Europe and the US compared to Latin America and China. Table A11 reports the raw cost estimates in USD and examines a longer time period, revealing similar patterns.

Disruption Probabilities. I parameterize the probability that producer-supplier links break in a given location using a nonlinear (logit) functional form. Specifically, I consider a vector

[39] The main econometric concern is that input prices influence firms' supplier choices through their impact on firms' sourcing capabilities. In a time-varying specification, this concern is reduced to the extent that moderate price changes are less likely to induce discrete changes in suppliers, especially in the presence of sizable matching costs. Moreover, the results in Table 8 also include δ_{ft} to absorb changes in firm-level conditions.

[40] Since domestic input sourcing is not observed, I assume similar production costs in Chile and Latin America, attributing all differences to iceberg trade costs. These costs are estimated to be around a factor of 2.7, following Anderson and Van Wincoop (2004). To facilitate comparisons, I normalize input costs in Chile to 1, such that, by construction, Latin America has an input cost of 2.7 in Table 8.

Table 8. Estimation Parameters

Panel A. Elasticities of substitution

σ *(final goods)*	5	η *(input locations)*	1.3	θ *(suppliers)*	3.6

Panel B. Input costs, disruption probabilities, and suppliers per region

	LAT	CHN	USA	EUR	ROW
$\tau_l \alpha_l$: *trade and production costs*	2.7	3.1	16.1	16.4	10.2
ζ_l^D: *direct disruption probability*	0.23	0.26	0.19	0.18	0.22
ζ_l^I: *indirect disruption probability*	0.17	0.21	0.13	0.13	0.16
$\mathcal{S}_l$: *(potential) direct suppliers*	4	4	4	4	4
S_l^I: *(intermediary) indirect suppliers*	3	4	3	3	3

Panel C. Sourcing costs and demand shifter

κ *(brokerage fee)*	1.2	β^0	1.39	$\beta^{Institutions}$	-2.79
ψ *(indirect contracting)*	0.05	$\beta^{Distance}$	3.07	$\beta^{Suppliers}$	9.49
$\beta^{Dispersion}$	1.02	$\beta^{Language}$	0.96	B *(final demand)*	1.11

Notes: This table summarizes the calibrated parameters used in the quantification. Panel A presents the elasticities of substitution. Panel B reports input costs, disruption probabilities, and supplier sets across regions. Panel C provides the demand shifter and sourcing costs, including the brokerage fee, (relative) indirect contracting costs, and the matching cost parameters from (27). Additionally, I assume a Pareto shape parameter of 1.5 for the distribution of producers, with the scale parameter normalized to 1.

of observable location characteristics, Z_l, which includes the supply chain risk indexes from Section 2 (*Geopolitical Risk*, *Economic Uncertainty*, and *Trade Volatility*), and a set of dummies classifying countries into low-, middle-, and high-income levels. This allows countries at different stages of development to differ in baseline probabilities, which then vary based on the risk measures within groups. Additionally, I include a vector D_b to control for changes in buyer-level downstream conditions, which are then excluded from the projected probabilities.[41] The empirical specification is:

$$\mathbb{D}(separation)_{bslt} = \frac{e^{Z'_{lt}\gamma + D'_{bt}\delta}}{1 + e^{Z'_{lt}\gamma + D'_{bt}\delta}} \tag{25}$$

where $\mathbb{D}(separation)_{bslt}$ is a dummy that equals 1 when a bs-link in location l and period t will break in $t + 1$.

[41] Following the analysis in Section 2, I include the changes in producers' total imports and number of suppliers from period $t-1$ to t. Without controlling for these factors, I find similar relative patterns for disruption probabilities across locations, but the average probability is about 9 pp higher.

Table 8 presents the results aggregated at the level of source regions. Direct disruption probabilities range from 0.18 to 0.26, with Europe being the safest region and China the riskiest for Chilean producers. More generally, disruption probabilities are higher in regions with lower input costs, posing an efficiency-risk tradeoff in the choice of source locations.[42] Table A12 reports the estimates for vectors Z_l and D_b. All coefficients are statistically significant and operate in the expected direction: the frequency of disruptions increases with the risk measures, and decreases in more developed countries or when buyers experience favorable downstream conditions.

For indirect disruption probabilities, I compare the supplier separation rates of producers and intermediaries in each source region. As in Section 2, the analysis considers supply links within the same product and origin country (when there is more than one country in the region), while incorporating the demand controls mentioned above. Table A13 reports these results, which are then used to adjust the direct probabilities. As shown in Table 8, indirect disruptions are about 6 pp less likely on average, representing a 25% reduction in the probability of disruptions relative to direct sourcing.[43]

Suppliers per Location. I use import transactions to compute the number of indirect suppliers offered by intermediaries. Specifically, I compute the average number of suppliers that wholesalers have per product (HS6)-region, weighting by wholesalers' import shares. Table 8 reports that the intermediation technology exhibits multisourcing in all regions: when producers source indirectly, they access 4 suppliers per product in China and 3 in the remaining regions. On the other hand, I assume that producers can match with up to 4 suppliers per region when sourcing directly. This corresponds to the 95th percentile in the distribution of direct suppliers per producer, and allows producers to build a diversified network if they can afford the associated matching costs.

Brokerage Fee. In principle, one would like to observe the prices charged by import intermediaries to local producers and compare them to those charged by foreign suppliers in the same industry. I take a similar approach by using customs data on Chilean exports, which allows me to compare the prices charged by producers and export intermediaries for the same

[42]In the baseline scenario, I consider disruptions in global sourcing but *safe* domestic links. This can be rationalized as producers facing lower matching costs in the home country, allowing them to find replacements within a reasonable time frame. However, it is straightforward to incorporate risk in the home country. The probability of disruptions in Chile could be inferred by extrapolating the coefficients estimated in (25). Alternatively, this probability can be estimated using VAT data on domestic transactions.

[43]These differences are smaller than those reported in Section 2 due to the demand-side controls. However, I consider my approach to be conservative in terms of the resilience advantage of intermediaries, as these buyer-level controls may partially absorb supply-side conditions.

destination and sector.[44] I run the following empirical specification:

$$\log p_{flt}^{Exp} = \delta_{lt} + (\kappa - 1)\, D^{Exp}(Intermediary = 1)_{ft} + \epsilon_{flt} \quad (26)$$

where p_{flt}^{Exp} denotes the price charged by firm f in location l (destination-sector), and $D(\text{Intermediary} = 1)_{ft}$ is a dummy indicating whether the exporter is an intermediary. I find intermediation markups to be around 11%. This is similar to the *accounting* markups documented in the US wholesaler sector (13.5%), although theory-consistent estimates suggest markups up to 30% in that market (Ganapati 2024). Likewise, recent evidence from microdata in Canada finds wholesale markups above 30% (Alexander et al. 2024). Thus, I take a middle point in the baseline estimation ($\kappa = 1.2$) and then evaluate scenarios with lower and higher markups.

Matching Costs and Demand Shifter. The last objects to estimate are the aggregate demand shifter B, the matching costs of sourcing directly in each region $f_l^D(S_l^D)$, and the costs of contracting with intermediaries f_l^I. To reduce the parameter space, I assume the intermediation costs are a constant share ψ of the cost of matching directly with suppliers. I then parameterize matching costs as a function of the number of direct suppliers and proxies for shipping, communication, and contracting costs: bilateral distance, common language, and control of corruption. These costs are drawn from a log-normal distribution with dispersion parameter β^{Disp} and the following scale parameter:[45]

$$\log f_l^D\left(S_l^D\right) = \log \beta^0 + \beta^{Dist} \log \text{Dist}_l + \text{Lang}_l \cdot \log \beta^{Lang} + \beta^{Inst}\, \text{Inst}_l + \beta^{Supp} \log S_l^D \quad (27)$$

I estimate the vector of 8 parameters $\Omega \equiv \{B, \psi, \beta_0, \beta^{Dist}, \beta^{Lang}, \beta^{Inst}, \beta^{Supp}, \beta^{Disp}\}$ using the Simulated Method of Moments (SMM). For any initial guess, the algorithm solves buyers' optimal sourcing strategy, computes the implied model moments, and iterates until the solution produces moments close to the data. I target a vector M of 8 moments: (1) the overall share of Chilean producers importing directly, (2) - (6) the shares of Chilean producers importing directly from each region, (7) the share of Chilean producers diversifying suppliers, and (8) the share of Chilean producers sourcing indirectly. Intuitively, (1) helps identify the aggregate

[44] The transactions between import intermediaries and local producers are observable in the VAT data from the Tax Authority, which has been requested but is not yet operational. Once available, the estimates for the brokerage fee in Chile can be further refined.

[45] This specification allows matching costs to vary across producers, rationalizing deviations from the strict sorting patterns predicted by the model for direct and indirect sourcing. On the other hand, Pareto draws for producers' productivity are taken using stratified random sampling, ensuring that more points are sampled on the right tail of the distribution.

demand shifter and the baseline matching cost, (2) - (6) account for variation in matching costs across regions, (7) captures how matching costs vary with the number of suppliers, and (8) identifies the relative cost of contracting with intermediaries.[46]

TABLE 9. Empirical and Simulated Moments

Moments	Data	Model
% producers importing directly	0.039	0.057
% producers importing directly per region:		
– Latin America	0.012	0.012
– China	0.020	0.045
– United States	0.014	0.021
– Europe	0.017	0.014
– Rest of the world	0.006	0.004
% producers with multiple suppliers	0.206	0.312
% producers importing indirectly	0.061	0.053

Notes: This table reports the model fit for the eight empirical targets used in the Simulated Method of Moments (SMM). This procedure estimates the vector Ω containing the demand shifter, indirect contracting costs, and the six parameters characterizing direct matching costs.

Panel C in Table 8 presents the estimates for Ω. As expected, matching costs increase with distance and decrease with common language and institutional quality. Moreover, these costs grow exponentially with the number of suppliers, indicating that diversification is much costlier than simply importing, while contracting with intermediaries is substantially cheaper than direct supplier matching. Table 9 reports the model fit for targeted moments. The model captures the relative importance of different source regions and the shares of producers sourcing directly and indirectly. However, the model overpredicts the share of firms sourcing from multiple suppliers, suggesting additional barriers to diversification. This implies that the role of disruptions and intermediaries is likely greater than indicated by the subsequent counterfactual analysis.

5.3. Counterfactuals

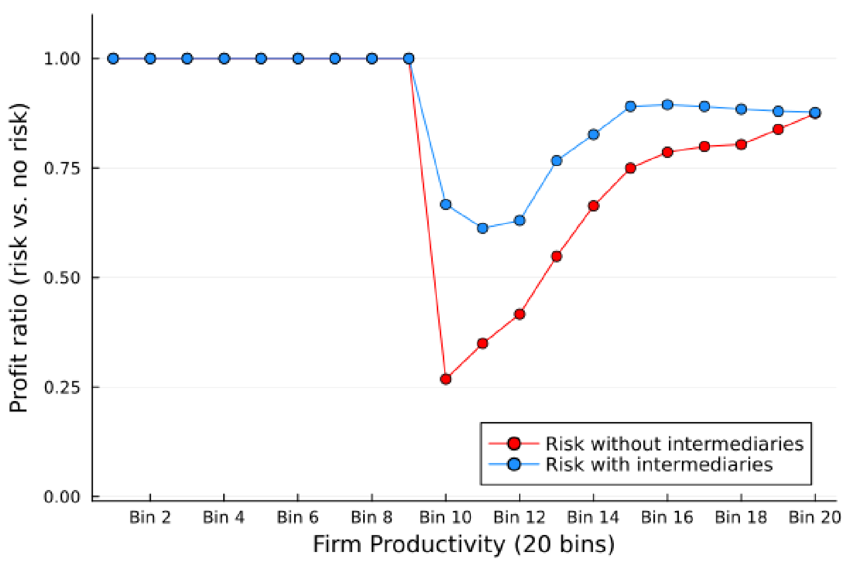
Having estimated the model, I perform counterfactuals to quantify the role of trade intermediation in mitigating disruptions. I first evaluate how supply chain risk affects the performance of heterogeneous producers relative to a scenario without disruptions. I then examine how the intermediation technology reduces the impact of disruptions across the firm size distribution.

[46] I describe the algorithm to solve the model numerically and implement the Simulated Method of Moments in Appendix D.1. Note that I use the identity matrix for weights in the minimization problem, following evidence on a better fit for import shares (Antràs et al. 2017; Huang et al. 2024).

Finally, I consider changes in intermediation markups, assessing to what extent industrial policy encouraging competition in this sector can enhance resilience in input sourcing.

The Impact of Disruptions. I compute firm profits in the baseline model with the estimated probability of disruptions, and in a counterfactual scenario where these probabilities are set to zero under both sourcing modes. The analysis is conducted for a sample of 1,200 producers, which are then divided into 20 equal-sized bins sorted by productivity. The blue line in Figure 10 plots the ratio of firm profits with and without risk, showing the average value for firms in each bin. The results indicate that supply chain disruptions have a greater impact on mid-size firms. Larger firms source from more locations and suppliers per location, ensuring network operability, while smaller firms source primarily domestically and are unaffected by foreign disruptions. Table 10 presents the average effect by size group: supply chain disruptions reduce the profits of mid-size producers by nearly 20%, compared to 16% for large firms.[47]

FIGURE 10. Supply Chain Disruptions and Trade Intermediaries



The Role of Intermediaries. I repeat the analysis for scenarios with and without risk, considering a counterfactual where the intermediation technology is not available. This case is represented by the red line in Figure 10. The impact of disruptions increases across the

[47] I consider the last two bins (19–20) to be large firms, the remaining importers (10–18) to be mid-size firms, and firms sourcing only domestically (1–9) to be small. Alternative thresholds would alter group effects without changing the overall pattern. Figure 10 helps visualize the effects across the distribution, but the mapping into aggregate measures is not direct. First, producers' Pareto draws are taken using stratified random sampling, ensuring more points in the right tail of the distribution. Additionally, aggregation must consider the relative weight of each bin, with higher bins accounting for a larger share of profits.

Table 10. Effect of Supply Chain Disruptions

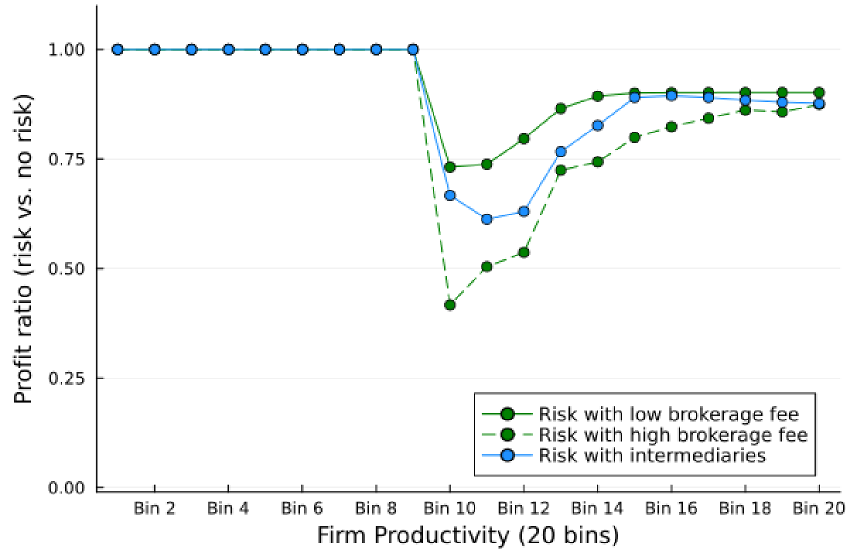
	Baseline (Intermediation)	No Intermediation	Lower Brokerage Fee	Higher Brokerage Fee
Panel A. Profit ratio relative to no-risk scenario				
Mid-size firms	0.799	0.601	0.853	0.768
Large firms	0.836	0.835	0.838	0.835
Panel B. Difference to baseline (pp)				
Mid-size firms	–	-0.199	0.054	-0.032
Large firms	–	-0.001	0.002	-0.001

Notes: Panel A reports the ratio of firm profits with and without supply chain risk, considering four scenarios: the baseline model, a model without intermediaries, lower brokerage fees ($\kappa = 1.1$), and higher brokerage fees ($\kappa = 1.3$). Panel B displays percentage point differences relative to the baseline model. Firms are classified as in Figure 10. Among 20 size bins in the baseline distribution, the last two correspond to large firms (19 - 20), the remaining importers are classified as mid-size firms (10 - 18), while small firms source only domestically and are omitted from the table (1 - 9).

firm distribution, but the effect is more pronounced among mid-size firms. While these producers are large enough to import, they lack the scale to diversify suppliers and protect from disruptions on their own. Shutting down intermediation is especially severe for firms on the lower end of the mid-size spectrum, which typically enter a single import market and supplier, meaning that disruptions could prevent their access to foreign inputs altogether. Table 10 shows that, on average, intermediaries reduce the impact of disruptions for mid-size firms by 20 percentage points, while their contribution is negligible for large firms. These effects are sizable, implying that the profit losses from disruptions would double for this group without access to intermediaries.

Changes in Intermediation Markups. Figure 11 displays the baseline model ($\kappa = 1.2$) alongside counterfactual scenarios with lower ($\kappa = 1.1$) and higher ($\kappa = 1.3$) brokerage fees. The results show that reducing markups improves the disruption buffer for mid-size producers, decreasing the impact of disruptions by 5.4 percentage points, as intermediation becomes more accessible across locations. Conversely, increasing intermediation markups to the levels observed in developed countries (Ganapati 2024; Alexander et al. 2024) hurts mid-size firms, raising the impact of disruptions by 3.2 percentage points. Overall, these results indicate that brokerage fees play a significant role in determining the contribution of intermediaries. This suggests that industrial policies in sectors instrumental to trade, such as wholesaling, could

FIGURE 11. Changes in Intermediation Markups



have meaningful effects on resilience, given evidence of high intermediation markups.

6. Conclusion

Firms often face disruptions in international supply chains that affect their operations. While producers could protect themselves through supplier diversification, evidence on trade and production networks suggests high matching costs, making this strategy prohibitive for many of them. This paper combines rich Chilean data on firms' supply networks with a quantitative model of global sourcing to examine a novel risk management strategy: the use of specialized intermediaries for input sourcing.

Three key takeaways emerge from this study. First, an effective approach to resilience must account for firm heterogeneity, as feasible adaptive responses differ across the firm size distribution. Second, intermediaries possess a resilience advantage that can relax efficiency-risk trade-offs despite imposing higher input markups. Third, intermediation services are quantitatively important for resilience, especially for mid-size producers that engage in offshoring but are unable to diversify. This points to a broader role of intermediaries in trade and development, especially in contexts where firms are constrained to make resilience investments.

My findings shed light on market responses to supply chain risk and suggest that policies targeting wholesale markups can enhance resilience. The design of such policies would benefit from further research into the business models of intermediaries and the factors driving their market power. More broadly, the distribution sector plays a pivotal role for resilience, and future research could explore how intermediaries interact with inventory management and transportation logistics. Ultimately, optimal adaptive strategies depend on the nature of disruptions, where our theoretical and empirical understanding remains preliminary.

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Appendix

A. Anecdotal Evidence on Intermediaries

A.1. Selected Quotes

"Our global supply chain connects thousands of suppliers and vendors with leading brands and retailers, all with the goal of meeting consumer demand. We focus on managing complexity and risk to maximize your profitability."

– Li & Fung, leader intermediary in apparel [link]

"Safety and compliance are the foundation of our supply chain network. We pride ourselves on taking proactive measures to help reduce supplier risk and ensure continual supply of products to our customers."

– Univar Solutions, leader intermediary in chemicals [link]

"Life goes on in these (high-risk) countries despite repeated riots, crises, etc... but we don't establish ourselves there and we remember to put in a buffer on the delivery time."

– Interviews with clothing supply chain actors using intermediaries,
Vedel & Ellegaard (2013) [link]

"Distributors play a critical role in the economy, and this role was elevated during recent unpredictable demand fueled by COVID and the subsequent supply-chain disruptions."

– Article on industrial intermediaries, Boston Consulting Group (2023) [link]

A.2. Intermediaries' Annual Reports

FIGURE A1. Li & Fung – Annual Report (2015)

Our supply chain

We believe in building sustainable supply chains that create value for our customers, factories, workers and communities. We partner with customers and suppliers who share this commitment and collaborate with industry stakeholders to further positive change.

15,000+
SUPPLIERS WORLDWIDE

THREE LARGEST SOURCING MARKETS

1. China
2. Vietnam
3. Bangladesh

At Li & Fung we manage complex and unique supply chains in over 40 economies around the world for our customers. Our global supplier network has been evolving for over 100 years. While over 80% of our sourcing business is with a core group of strategic suppliers, our network also allows us the flexibility to move production across markets, balance capacity constraints and respond to demand, while meeting specific customer needs, such as proximity to the end-consumer or technical expertise and distribution. By sourcing from multiple factories across multiple markets, we can also activate business contingency plans when unexpected issues occur and continue production for our customers.

Our Vendor Support Services (VSS) unit focuses on the needs of our global supplier base as it addresses the challenges facing the industry. In 2015 we developed services to support suppliers to enhance productivity, operational and resource efficiencies and product testing, and to capture performance data along the supply chain. We want to help suppliers mitigate the increasing costs of labor and other inputs by better managing material and resource usage, production swings, operations and logistics.

Addressing challenges and opportunities in our supply chain is integral to our Sustainability Strategy. Our initiatives focus on three areas:

- Managing risk and furthering compliance in our supply chains
- Sourcing responsibly
- Collaborating with customers and partners to build sustainable supply chains

Supply Chain Compliance

Improving workplace conditions and overall factory management practices brings benefits to workers, suppliers, factories and communities. Each of the locations in our supply chain has a unique set of challenges that we manage through our network of on-the-ground teams and in collaboration with industry and non-profit organizations and local authorities.

Managing our supply chain risk starts with strategic sourcing decisions by our customers and/or sourcing teams and our continuing efforts to direct business to suppliers that share our commitment to compliance and enhancing sustainability performance. Our Vendor Compliance & Sustainability (VCS) team assesses supplier risk and compliance and supports factories to continually improve performance.

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ANNUAL REPORT 2015

Figure A2. Univar Solutions – End of Year Note to Customers (2021)

Managing supply through a resilient and reliable network

Looking ahead to a new year

It's hard to believe another year is coming to an end. While 2021 had more than its share of challenges, the growth in our customer and supplier relationships will serve us all well in the new year. We are hopeful we will put many of the supply challenges behind us in 2022.

While many factors have created widespread product availability issues in 2021, the situation allowed our team to work with existing suppliers in creative new ways to ensure supply continuity by securing supply routes and finding new sources to keep customers running. Pairing our domestic and global network of manufacturers with our local sales and technical teams proved invaluable to keeping our customers supplied. We plan to keep those communications channels open in the new year and provide our customers with the products and services needed to help keep our communities healthy, fed, clean, operating and safe.

As your partner, we will continue leveraging our extensive geographic footprint and premier producer partners to give our customers an advantage in situations such as supplying materials that require steel drums. We will also remain vigilant in managing supply through reliable freight deliveries, reliable/sustainable packaging, warehousing/inventory, and secure supply routes from our supplier network.

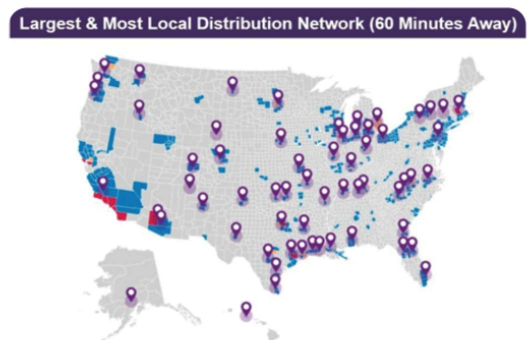
While no one can fully predict what 2022 will bring, Univar Solutions takes pride and is in a position to help our customers operate, overcome and plan for the challenges that remain in place going into 2022, as well as new challenges that arise to minimize disruptions. We are here for our customers, providing continuity to your business with teams of logistics experts, an extensive distribution network comprised of a significant private truck fleet, account managers, product managers, scientists, chemists and technical advisors to find your next solution.

2021 has taught us a lot about the global production base and supply chains. We have been nimble and challenged like most; but we have learned a lot in the process. We are using those learnings and focusing on improving your customer experience.

The new year will start fast as it always does. Your Univar Solutions team will be ready. Please work with your representative early to help you get what you need when you need it.

Thank you for the trust you place in our team every day. We do not take it for granted.

Have a wonderful and safe holiday season!



Our objectives are focused on customer success and include:

- **Safe handling and on-time delivery**
- **Leverage strong position with local manufacturing and supply chains**
- **Offer technical and application development expertise**
- **Expansion of key supplier relationships**
- **Enabling customers and suppliers ESG objectives**
- **Help customers unlock value using our Solution Centers**
- **Enabling sustainable solutions by offering more sustainably sourced, clean label products**

B. Empirical Appendix

B.1. Data Management

Firm-to-Firm Trade and Intermediaries

- Customs Service of Chile (*Servicio Nacional de Aduanas*)
  - Importer tax ID, foreign supplier name, origin country, product (HS6), value, quantity, and unit value for the universe of import transactions (2005–2019).
- Tax Authority of Chile (*Servicio de Impuestos Internos*)
  - Firm tax ID, industry, sub-industry, primary activity, size (sales bins), number of employees, age, and location for the universe of Chilean firms (2005–2019).
- I merge these datasets using the unique tax identifier (RUT) for Chilean firms.

Cleaning Procedure for Supplier Names

To address misreporting and spelling mistakes in the digitalized names of foreign suppliers, I implement the following cleaning routine.

- Drop observations without a name (15%).
- Suppress non-numerical characters and spaces within names.
- Remove spaces at the beginning and end of each name
- Trim names to their 30 first characters.
- Harmonize common abbreviations for Limited, Corporation, Company, Incorporated, etc.
- Collapse suppliers with the same name within origin country-product-buyer combinations.

Risk Measures

- Geopolitical Risk Index (Caldara and Iacoviello 2022) and Economic Policy Uncertainty Index (Baker et al. 2016) by origin country and year (2010–2019).[48]
- Trade Volatility Index by origin country, product (HS6) and year, using data on global trade flows by origin country, product (HS6), destination, and year (2010–2019) from the *CEPII* database (Gaulier and Zignago 2010).

Additional Data

- Other country characteristics
  - Trade procedures and GDP per capita (World Development Indicators), and Total Factor Productivity (Penn World Table 9.1) by origin country and year (2010–2019).

[48]The original monthly data is aggregated by year and each index is normalized between 0 and 1.

- Data on export prices
  - I collect additional data from the Customs Service of Chile: exporter tax ID, destination country, product (HS6), and unit value for all export transactions (2005–2019).

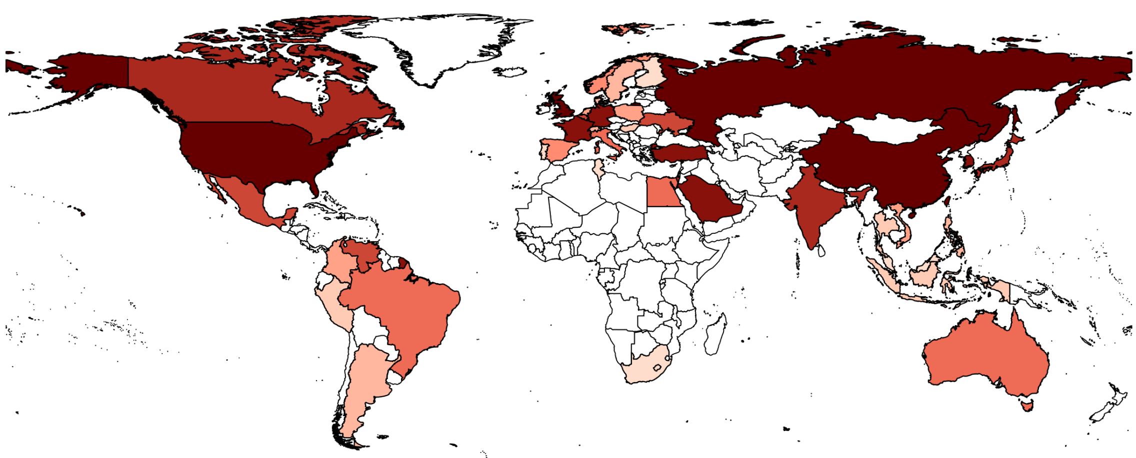
B.2. A Comparison of Risk Measures

TABLE A1. Pairwise Correlations across Risk Measures (origin-country level)

	Geopolitical Risk	Economic Uncertainty	Trade Volatility
Geopolitical Risk	1.000	–	–
Economic Uncertainty	0.422	1.000	–
Trade Volatility	0.343	0.401	1.000

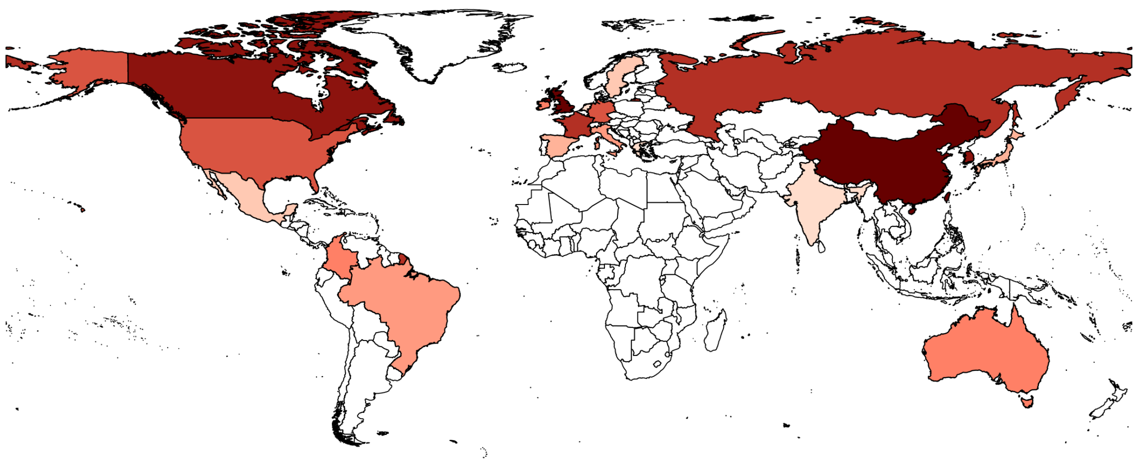
Notes: This table presents pairwise correlations for the three risk measures defined in Section 2.1 in year 2019. The Geopolitical Risk (GPR) and Economic Policy Uncertainty (EPU) indexes are defined at the origin-country level. Trade Volatility is built across origin-products and then aggregated at the country level to compute correlations.

FIGURE A3. Geopolitical Risk Index (GPR)



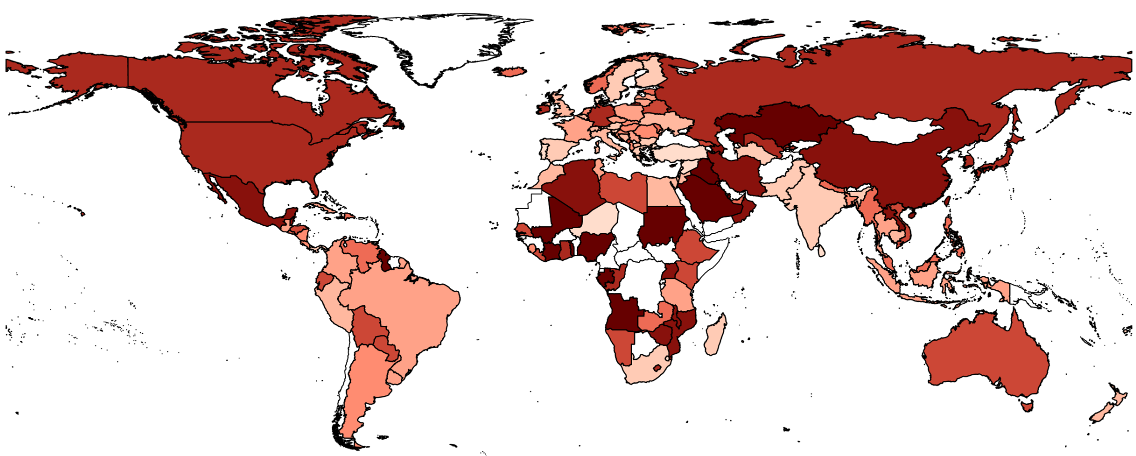
Notes: This figure displays a heat map for the Geopolitical Risk (GPR) index developed by Caldara and Iacoviello (2022), using data for 2019. The index is normalized between 0 and 1, and the map considers 10 levels of intensity.

FIGURE A4. Economic Policy Uncertainty Index (EPU)



Notes: This figure displays a heat map for the Economic Policy Uncertainty (EPU) index developed by Baker et al. (2016), using data for 2019. The index is normalized between 0 and 1, and the map considers 10 levels of intensity.

FIGURE A5. Trade Volatility Index



Notes: This figure displays a heat map for the Trade Volatility index developed in Section 2.1, considering data for 2019. The index is built across origin-products and then aggregated at the origin-country level. The map considers 10 levels of intensity.

B.3. Additional Evidence on Stylized Facts

TABLE A2. Number and Concentration of Suppliers (homogeneous goods)

	(log) # suppliers		HHI suppliers	
	(1)	(2)	(3)	(4)
Intermediary Dummy	0.044***	0.036***	-0.016***	-0.012***
	(0.007)	(0.008)	(0.002)	(0.003)
Firm size (sales)	Yes	Yes	Yes	Yes
Imported value	Yes	Yes	Yes	Yes
Product - country FE	Yes	Yes	Yes	Yes
Observations	120,930	42,543	120,930	42,543

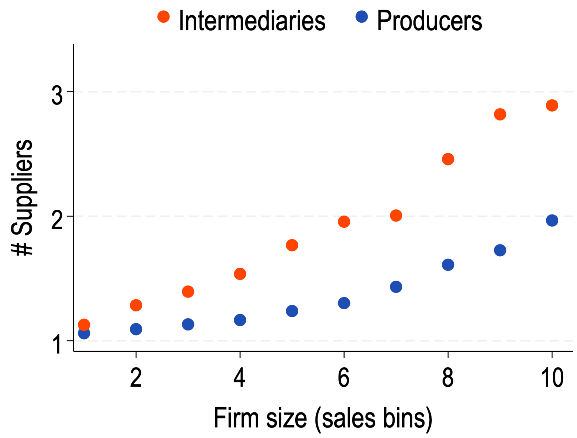
Notes: This table replicates Table 3 for the subsets of homogeneous goods according to the Rauch classification. Columns (1) and (3) exclude products classified as *differentiated* from the sample. Columns (2) and (4) consider only goods classified as *homogeneous* (i.e., goods traded on an organized exchange or where a reference price is available). All regressions are at the firm-product (HS6)-origin country level. The independent variable is a dummy indicating whether the buyer is a wholesaler. The sample includes all import transactions in Chile in 2019. Standard errors are clustered at the firm level.

TABLE A3. Probability of Supply Link Separations (demand controls)

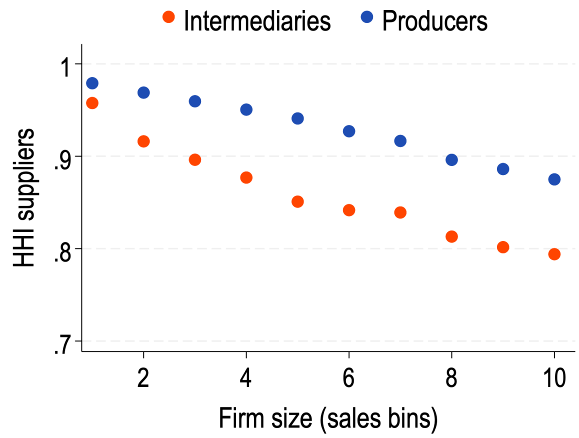
	Firm-product-country			Firm-product-country-supplier		
	(1)	(2)	(3)	(4)	(5)	(6)
Intermediary dummy	-0.078***	-0.063***	-0.061***	-0.060***	-0.048***	-0.046***
	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)
Δ Firm-level imports	Yes	No	Yes	Yes	No	Yes
Δ Firm-level suppliers	No	Yes	Yes	No	Yes	Yes
Firm size (sales)	Yes	Yes	Yes	Yes	Yes	Yes
Imported value	Yes	Yes	Yes	Yes	Yes	Yes
Number of suppliers	Yes	Yes	Yes	No	No	No
Product - country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	284,115	284,115	284,115	400,938	400,938	400,938

Notes: This table replicates Table 4 including controls for changes in demand conditions across buyers: changes in firm-level imports and suppliers. The dependent variable is a dummy indicating whether supply links break from period t to $t + 1$. The independent variable indicates whether the buyer is a wholesaler. The sample considers all import transactions in 2018 for firms active in both 2018 and 2019. Standard errors are clustered at the firm level.

Figure A6. Number and Concentration of Suppliers (weighted average)



A. # suppliers per firm-product-origin



B. Input Concentration across suppliers

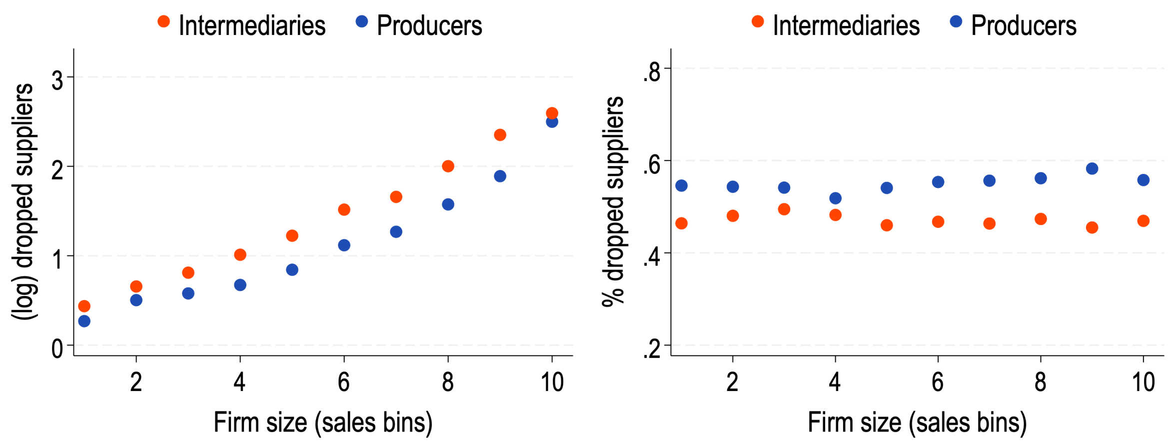
Notes: Panel A displays the number of suppliers that a firm has per product (HS6) and origin country. Panel B computes a Herfindahl-Hirschman index (HHI) across suppliers. Each panel groups firms into 10 bins according to total sales (Tax Authority of Chile, SII). Within each bin, a dot represents the mean value of the variable on the y-axis. Since firms source multiple products from multiple countries, I consider the weighted-average across products and origin countries within a firm. Weights are determined by imported values, reducing the influence of peripheral inputs and markets. The figure considers cross-sectional data for year 2019.

Table A4. Potential Mechanisms for Differences in Link Separations

	Firm-product-country-supplier				
	(1)	(2)	(3)	(4)	(5)
Intermediary dummy	-0.092***	-0.060***	-0.068***	-0.069***	-0.024***
	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)
Supplier FE	No	Yes	No	No	Yes
Share in supplier's sales	No	No	Yes	No	Yes
Supplier-product links	No	No	No	Yes	Yes
Firm size (sales)	Yes	Yes	Yes	Yes	Yes
Imported value	Yes	Yes	Yes	Yes	Yes
Product - country FE	Yes	Yes	Yes	Yes	Yes
Observations	406,481	352,770	406,481	406,481	352,770

Notes: This table explores mechanisms behind the lower supplier separation rates of intermediaries. Column (1) is identical to column (6) in Table 4. Column (2) includes supplier fixed effects to account for the possibility that intermediaries are better at screening suppliers. Column (3) controls for the share of buyers in suppliers' total sales to address whether intermediaries are more important customers. Column (4) defines supply links at the buyer-supplier-product level to assess if differences are driven by intermediaries sourcing multiple products per supplier. Column (5) combines all potential mechanisms.

Figure A7. Number and Share of Dropped Suppliers (weighted average)



A. # dropped suppliers per firm-product-origin B. % dropped suppliers per firm-product-origin

Notes: Panel A displays the number of dropped suppliers per product (HS6) and origin country across firms. Panel B is analogous for the share of dropped suppliers. Drops are defined as links active in year t but not in $t + 1$. Each panel groups firms into 10 bins according to total sales (Tax Authority of Chile, SII). Within each bin, a dot represents the mean value of the variable on the y-axis. Since firms source multiple products from multiple countries, I consider the weighted-average across products and origin countries within a firm. Weights are determined by imported values, reducing the influence of peripheral inputs and markets. The figure displays cross-sectional data for year 2019.

Table A5. Number of Suppliers and Supply Chain Risk (Producers)

	(log) # suppliers					
	Geopolitical Risk		Economic Uncertainty		Trade Volatility	
	(1)	(2)	(3)	(4)	(5)	(6)
Supply Chain Risk	0.037***	0.043***	0.024***	0.021**	0.046***	0.056***
	(0.005)	(0.009)	(0.007)	(0.009)	(0.002)	(0.002)
Firm size	Yes	Yes	Yes	Yes	Yes	Yes
Imported value	Yes	Yes	Yes	Yes	Yes	Yes
Product FE (HS6)	No	Yes	No	Yes	No	Yes
Origin-country productivity	No	Yes	No	Yes	No	Yes
Origin-country trade costs	No	Yes	No	Yes	No	Yes
Observations	126,671	125,718	108,687	108,088	127,327	125,809

Notes: This table shows how the number of suppliers of producers varies with supply chain risk. All regressions are at the firm-product (HS6)-origin country level. Geopolitical Risk and Economic Policy Uncertainty are measured across origin countries, while Trade Volatility is at the origin-product level. Controls include firm sales (10 bins), imports per buyer-product-origin, and the origin country's total factor productivity and trade procedures. The sample includes all import transactions by wholesalers in 2019. Standard errors are clustered at the level of the risk measure.

Table A6. Number of Suppliers and Supply Chain Risk (Intermediaries)

	(log) # suppliers					
	Geopolitical risk		Economic uncertainty		Trade volatility	
	(1)	(2)	(3)	(4)	(5)	(6)
Supply chain risk	0.040**	0.054***	0.042***	0.032***	0.057***	0.066***
	(0.015)	(0.011)	(0.008)	(0.011)	(0.002)	(0.002)
Firm size	Yes	Yes	Yes	Yes	Yes	Yes
Imported value	Yes	Yes	Yes	Yes	Yes	Yes
Product FE (HS6)	No	Yes	No	Yes	No	Yes
Origin-country productivity	No	Yes	No	Yes	No	Yes
Origin-country trade costs	No	Yes	No	Yes	No	Yes
Observations	190,945	189,323	166,198	165,679	189,742	186,800

Notes: This table shows how the number of suppliers of intermediaries varies with supply chain risk. All regressions are at the firm-product (HS6)-origin country level. Geopolitical Risk and Economic Policy Uncertainty are measured across origin countries, while Trade Volatility is at the origin-product level. Controls include firm sales (10 bins), imports per buyer-product-origin, and the origin country's total factor productivity and trade procedures. The sample includes all import transactions by wholesalers in 2019. Standard errors are clustered at the level of the risk measure.

Table A7. Number of Suppliers and Supply Chain Risk (Interactions)

	(log) # suppliers					
	Geopolitical Risk		Economic Uncertainty		Trade Volatility	
	(1)	(2)	(3)	(4)	(5)	(6)
Intermediary Dummy	0.049**	0.049***	0.055***	0.054***	0.047***	0.048***
	(0.019)	(0.011)	(0.006)	(0.005)	(0.002)	(0.002)
Intermediary × Supply Chain Risk	0.040***	0.003	0.039***	0.015***	0.057***	0.011***
	(0.014)	(0.004)	(0.006)	(0.004)	(0.002)	(0.002)
Firm size (sales)	Yes	Yes	Yes	Yes	Yes	Yes
Imported value	Yes	Yes	Yes	Yes	Yes	Yes
Product FE (HS6)	Yes	No	Yes	No	Yes	No
Product - Country FE	No	Yes	No	Yes	No	Yes
Observations	317,239	299,476	274,470	264,208	316,783	295,383

Notes: This table shows how the number of suppliers of producers and intermediaries varies with supply chain risk, including interactions for intermediaries. All regressions are at the firm-product (HS6)-origin country level. Geopolitical Risk and Economic Policy Uncertainty are measured at the origin-country level, while Trade Volatility is at the origin country-product level. Controls include firm sales (10 bins), imports per buyer-product-origin, and the origin country's total factor productivity and trade procedures. The sample includes all import transactions by wholesalers in 2019. Standard errors are clustered at the level of the risk measure.

Table A8. Correlation across Supply Link Separations (firm-origin-product)

	Average correlation (ρ)				
	1 supplier	2 suppliers	3 suppliers	4 suppliers	5 suppliers
All firms	–	0.067	0.090	0.092	0.085
Producers	–	0.093	0.094	0.103	0.109
Wholesalers	–	0.051	0.088	0.085	0.071

Notes: This table reports the average correlation across link separations at the buyer-origin country-product (HS6) level. The analysis is conducted separately for observations with $N = \{2, 3, 4, 5\}$ suppliers. The probabilistic event is represented by a binary variable indicating whether a link active in period t will break in $t + 1$. Pairwise correlations are computed for each combination of links (i, j) given N, such that ρ reports the average across pairs. The sample includes all producers in 2018 that remain active in 2019.

C. Theory Appendix

C.1. Proof of Proposition 1

Let's first derive the expression for *ex-post* profits conditional on network operability. Recall the *ex-post* maximization problem of producer ω in the single-location case:

$$\max_{p_i(\omega),\, q_i(\omega),\, x_{il}(\omega)} \pi_i^{\text{ex-post}}\left(\omega \,\middle|\, M_l, S_l^D, Z_l\right) = \left[p_i(\omega) - c_i\left(\omega \,\middle|\, M_l, S_l^D, Z_l\right)\right] q_i(\omega)$$

Considering the linear production technology $q_i(\omega) = \varphi(\omega) x_{il}(\omega)$, input purchases are determined by downstream quantities. We then have the standard firm problem with monopolistic competition and CES demand $q_i(\omega) = p_i(\omega)^{-\sigma} P_i^{\sigma-1} E_i$, which can be expressed in terms of downstream prices alone. Omitting indexes, the first-order condition is $q(p) + pq'(p) - cq'(p) = 0$, and producers set a constant markup $p = \frac{\sigma}{\sigma-1}c$ such that:

$$\pi_i^{\text{ex-post}} = c(\omega)^{1-\sigma} \frac{1}{\sigma} \left(\frac{\sigma}{\sigma - 1}\right)^{1-\sigma} P_i^{\sigma-1} E_i$$

where the marginal cost is given by input prices in the single location available, $c(\omega) = \frac{p^{x,M}}{\varphi(\omega)}$. Thus, *ex-post* profits under indirect sourcing can be expressed as a fraction of those under direct sourcing:

$$\pi_i^{\text{ex-post}}\left(M_l = I\right) = \varphi(\omega)^{\sigma-1} \left(\kappa p^x\right)^{1-\sigma} \frac{1}{\sigma} \left(\frac{\sigma}{\sigma - 1}\right)^{1-\sigma} P_i^{\sigma-1} E_i = \kappa^{1-\sigma} \pi_i^{\text{ex-post}}\left(M_l = D\right)$$

where $\kappa \geq 1$ and $\sigma > 1$.

For the second part, note that $\sigma > 1$ implies that *ex-post* profits are supermodular in firm productivity $\varphi(\omega)$ and a function $\phi(\kappa) \equiv \frac{1}{\kappa p^x}$, which is analogous to the *sourcing capability* defined in the multi-location case. This implies *complementarities* between $\varphi(\omega)$ and κ. Formally, the brokerage fee reduces *ex-post* profits $\left(\frac{\partial \pi_i^{\text{ex-post}}}{\partial \kappa} < 0\right)$, and this effect becomes more negative with higher productivity levels $\left(\frac{\partial^2 \pi_i^{\text{ex-post}}}{\partial \varphi \, \partial \kappa} < 0\right)$.

C.2. Proof of Proposition 2

Part (a). Consider the probability that a supply network in location l is operational, $\Pr\left(S_l^O(\omega) \geq 1\right)$, conditional on a sourcing strategy $\left(M_l(\omega),\, S_l^D(\omega)\right)$. Under direct sourcing, we need this probability to increase with the number of direct links:

$$\Pr\left(S_l^O(\omega) \geq 1 \middle| D, S+1\right) > \Pr\left(S_l^O(\omega) \geq 1 \middle| D, S\right) \quad \forall S \in \mathcal{N}$$

Since links are disrupted with exogenous probability ζ_l^D, the number of *operational* suppliers $S_l^O(\omega)$ follows a Binomial distribution, such that:

$$\Pr\left(S_l^O(\omega) \geq 1 \middle| D, S\right) = 1 - \Pr\left(S_l^O(\omega) = 0 \middle| D, S\right) = 1 - \binom{S}{0}\left(1-\zeta_l^D\right)^0\left(\zeta_l^D\right)^S = 1 - \left(\zeta_l^D\right)^S$$

and we only need $\left(\zeta_l^D\right)^{S+1} < \left(\zeta_l^D\right)^S$ for all $S \in \mathcal{N}$, which holds trivially for $\zeta_l^D \in (0,1)$. Since additional direct matches do not affect input prices, this implies lower expected input costs.

Part (b). Using the probabilities for network operability derived above, the expected *ex-ante* profits of producer ω under the direct sourcing strategy $\left(D, S^D\right)$ are:

$$\begin{aligned}\mathbb{E}\left[\pi^{\text{ex-ante}}(\omega) \middle| D, S^D\right] &= \left[1 - \left(\zeta^D\right)^{S^D}\right]\pi^{\text{ex-post}}(\omega, D) - f^D\left(S^D\right) \\ &= \chi(S^D)\, \varphi(\omega)^{\sigma-1}\left(p^x\right)^{1-\sigma}B - f^D\left(S^D\right)\end{aligned}$$

where $\chi(S^D) \equiv \left[1-\left(\zeta^D\right)^{S^D}\right]$ and $B \equiv \frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} P^{\sigma-1}E$. Consider two firms with productivity levels $\varphi^H > \varphi^L$ that, conditional on direct sourcing, choose to match with $S^{D,H}$ and $S^{D,L}$ suppliers. These choices are optimal if:

$$\chi(S^{D,H})\left(\varphi^H\right)^{\sigma-1}\left(p^x\right)^{1-\sigma}B - f^D\left(S^{D,H}\right) \geq \chi(S^{D,L})\left(\varphi^H\right)^{\sigma-1}\left(p^x\right)^{1-\sigma}B - f^D\left(S^{D,L}\right) \quad \text{(A1)}$$

$$\chi(S^{D,H})\left(\varphi^L\right)^{\sigma-1}\left(p^x\right)^{1-\sigma}B - f^D\left(S^{D,H}\right) \leq \chi(S^{D,L})\left(\varphi^L\right)^{\sigma-1}\left(p^x\right)^{1-\sigma}B - f^D\left(S^{D,L}\right) \quad \text{(A2)}$$

Combining inequalities (A1) and (A2) we get:

$$\left[\chi(S^{D,H}) - \chi(S^{D,L})\right]\left[\left(\varphi^H\right)^{\sigma-1} - \left(\varphi^L\right)^{\sigma-1}\right]\left(p^x\right)^{1-\sigma}B \geq 0 \quad \text{(A3)}$$

This implies that if $\varphi^H \geq \varphi^L$, then $\chi(S^{D,H}) \geq \chi(S^{D,L})$ and therefore $S^{D,H} \geq S^{D,L}$. Note that the number of suppliers affects expected profits through $\chi(S^D)$ but not p^x, which relies on perfect supplier substitution within locations. However, this result holds when relaxing this assumption, in which case additional suppliers can reduce input prices (e.g., due to better matches under search frictions or lower markups with imperfect competition) or increase them (e.g., due to less productive suppliers).[49]

C.3. Proof of Proposition 3

Part (a). For intermediation to increase operability, we need this probability to increase relative to sourcing directly from one supplier:

$$\Pr\left(S_l^O(\omega) \geq 1 \,\middle|\, I\right) > \Pr\left(S_l^O(\omega) \geq 1 \,\middle|\, D, 1\right), \text{ where } \Pr\left(S_l^O(\omega) \geq 1 \,\middle|\, I\right) = 1 - \left(\zeta_l^I\right)^{S_l^I}$$

Since the intermediation technology exhibits $\left\{S_l^I \geq S_l^D, \zeta_l^I \leq \zeta_l^D\right\}$, it follows $\left(\zeta_l^I\right)^{S_l^I} \leq \left(\zeta_l^D\right)$.[50]

Consider now the triplet $\mathcal{I} = \left\{S_l^I \geq 1, \zeta_l^I \leq \zeta_l^D, \kappa \geq 1\right\}$ containing the intermediation technology and brokerage fee to access inputs in location l, and expected input costs $\mathbb{E}\left[\left(p_{il}^x\right)^{1-\sigma} \middle| M_l, S_l^D\right]$ given a sourcing strategy $\{M_l, S_l^D\}$. I define a mapping $\widetilde{S}_l^I$ that transforms $\mathcal{I}$ into an *equivalent* number of direct suppliers:

$$\widetilde{S}_l^I(\mathcal{I}) \equiv \left\{S : \mathbb{E}\left[\left(p_{il}^x\right)^{1-\sigma} \middle| D, S\right] = \mathbb{E}\left[\left(p_{il}^x\right)^{1-\sigma} \middle| I\right]\right\}$$

Under independent disruptions across links the number of operational suppliers follows a Binomial distribution, such that:

$$\begin{aligned} \left[1 - \left(\zeta_l^D\right)^{\widetilde{S}_l^I}\right]\left(p_{il}^x\right)^{1-\sigma} &= \frac{\left[1 - (\zeta_l^I)^{S_l^I}\right]}{\kappa^{\sigma-1}}\left(p_{il}^x\right)^{1-\sigma} \\ \iff \widetilde{S}_l^I &= \frac{\ln\left(1 - \dfrac{1 - (\zeta_l^I)^{S_l^I}}{\kappa^{\sigma-1}}\right)}{\ln(\zeta_l^D)} > 0 \end{aligned} \tag{A4}$$

For the numerator in (A4) to be well-defined, we need $\left(1 - \dfrac{1 - (\zeta_l^I)^{S_l^I}}{\kappa^{\sigma-1}}\right) > 0$, which is always satisfied considering that $\kappa^{\sigma-1} \geq 1$ for $\sigma > 1$ and $\left(1 - (\zeta_l^I)^{S_l^I}\right) \in (0, 1)$. On the other hand, the denominator is well-defined for $\zeta_l^D \in (0, 1)$. Since both the numerator and denominator take

[49] The first case is considered in Section 3.6, where producers have two reasons to diversify: lower prices and risk mitigation. In the second case, the price effect reduces the incentives to diversify, but it remains true that more productive firms are more likely to afford it.

[50] Although this analysis considers independent disruptions on supply links, it is possible to incorporate correlated shocks. As discussed in the extensions, producers may face location-level disruptions affecting all l-suppliers with some probability ξ_l.

negative values, we have $\widetilde{S}_l^I > 0$. Intermediation then reduces (increases) expected input costs for firms that can match fewer (more) than $\widetilde{S}_l^I$ suppliers directly.

Part (b). Consider two firms with productivity levels $\varphi^H > \varphi^L$ and sourcing modes M^H and M^L. The proposition requires that $M^H = I$ and $M^L = D$ cannot be optimal, which can be shown by contradiction. If $M^H = I$ and $M^L = D$ are optimal, they must satisfy the following conditions:

$$\chi(D, S^{D,H})\left(\varphi^H\right)^{\sigma-1}\left(p^x\right)^{1-\sigma}B - f^D\left(S^{D,H}\right) \leq \chi(I)\left(\varphi^H\right)^{\sigma-1}\left(p^x\right)^{1-\sigma}B - f^I \tag{A5}$$

$$\chi(D, S^{D,L})\left(\varphi^L\right)^{\sigma-1}\left(p^x\right)^{1-\sigma}B - f^D\left(S^{D,L}\right) \geq \chi(I)\left(\varphi^L\right)^{\sigma-1}\left(p^x\right)^{1-\sigma}B - f^I \tag{A6}$$

where $\chi(M, S^D) \equiv \left[1 - \left(\zeta^D\right)^{S^D}\right]$ under direct sourcing, $\chi(I) \equiv \frac{1}{\kappa^{\sigma-1}}\left[1 - \left(\zeta^I\right)^{S^I}\right]$ under indirect sourcing, and $S^{D,H}$ and $S^{D,L}$ are the best direct options for each firm. In the case of φ^H, this implies that $M^H = I$ is also preferred to $S^{D,L}$. Replacing this in (A5) we get:

$$\chi(D, S^{D,L})\left(\varphi^H\right)^{\sigma-1}\left(p^x\right)^{1-\sigma}B - f^D\left(S^{D,L}\right) \leq \chi(I)\left(\varphi^H\right)^{\sigma-1}\left(p^x\right)^{1-\sigma}B - f^I \tag{A7}$$

and combining (A7) with the condition for φ^L to source directly (A6), we obtain:

$$\left[\chi(I) - \chi(D, S^{D,L})\right]\left[\left(\varphi^H\right)^{\sigma-1} - \left(\varphi^L\right)^{\sigma-1}\right]\left(p^x\right)^{1-\sigma}B \geq 0 \tag{A8}$$

The inequality (A8) requires $\chi(I) > \chi(D, S^{D,L})$. However, in that case it would not be optimal for φ^L to source directly in the first place: since $f^I < f^D(S)$, the condition (A6) would not be satisfied, leading to a contradiction.

I now derive the productivity threshold φ_l^* where producers switch from indirect to direct sourcing. Given the higher intercept of $\mathbb{E}\left[\pi_i^{\text{ex-ante}} \,\middle|\, I\right]$ and the monotonicity of expected *ex-ante* profits in φ, producers move to direct sourcing after the first direct curve $\mathbb{E}\left[\pi_i^{\text{ex-ante}} \,\middle|\, D, S_l^D\right]$ crosses the indirect curve from below. The intersections for each $S_l^D \in \mathcal{S}_l$ are:

$$\begin{aligned} &\mathbb{E}\left[\pi_i^{\text{ex-ante}} \,\middle|\, D, S_l^D\right] = \mathbb{E}\left[\pi_i^{\text{ex-ante}} \,\middle|\, I\right] \\ \iff\ & \varphi_l^*(S_l^D) = \left(\frac{f_l^D\left(S_l^D\right) - f_l^I}{\left(1 - (\zeta_l^D)^{S_l^D} - \frac{1-(\zeta_l^I)^{S^I}}{\kappa^{\sigma-1}}\right)\left(P_{il}^x\right)^{1-\sigma}B}\right)^{\frac{1}{\sigma-1}} \quad \text{for } S_l^D \in \mathcal{S}_l \end{aligned} \tag{A9}$$

We can then define the switching threshold as the minimum of the thresholds in (A9):

$$\varphi_l^* = \min_{S_l^D} \varphi_l^*(S_l^D) \text{ for } S_l^D \in |\mathcal{S}_l| \tag{A10}$$

Note that $\varphi_l^* > 0$ if $\frac{1-(\zeta_l^I)^{S^I}}{1-(\zeta_l^D)^{S_l^D}} < \kappa^{\sigma-1}$ for some S_l^D, while all producers would source indirectly otherwise (i.e., indirect *ex-ante* profits do not intersect with any of the direct *ex-ante* profits for positive values of φ).

It can be shown that the following condition is required for both indirect and direct sourcing to take place:

$$\frac{\kappa^{\sigma-1} f_l^I}{f_l^D(S_l^D)} < \frac{1-(\zeta_l^I)^{S^I}}{1-(\zeta_l^D)^{S_l^D}} < \kappa^{\sigma-1} \quad \forall\, S_l^D \in \mathcal{S}_l$$

Consider a set of productivity cutoffs $\left\{\varphi_l^D(S_l^D)\right\}$ such that, under direct sourcing and a particular choice $S_l^D \in \mathcal{S}_l$, expected *ex-ante* profits are zero. Each cutoff is unique as *ex-ante* expected profits are monotonically increasing in φ.

$$\mathbb{E}\left[\pi_i^{\text{ex-ante}} \,\middle|\, D, S_l^D\right] = 0 \iff \varphi_l^D(S_l^D) = \left(\frac{f_l^D(S_l^D)}{\left(1-(\zeta_l^D)^{S_l^D}\right)\left(P_{il}^x\right)^{1-\sigma} B}\right)^{\frac{1}{\sigma-1}} \text{ for } S_l^D \in \mathcal{S}_l \tag{A11}$$

Analogously, φ_l^I sets expected *ex-ante* profits to zero under indirect sourcing:

$$\mathbb{E}\left[\pi_i^{\text{ex-ante}} \,\middle|\, I\right] = 0 \iff \varphi_l^I = \left(\frac{\kappa^{\sigma-1} f_l^I}{\left(1-(\zeta_l^I)^{S^I}\right)\left(P_{il}^x\right)^{1-\sigma} B}\right)^{\frac{1}{\sigma-1}} \tag{A12}$$

For a positive mass of producers to source indirectly, we need both $\mathbb{E}\left[\pi_i^{\text{ex-ante}} \,\middle|\, I\right] > 0$ and $\mathbb{E}\left[\pi_i^{\text{ex-ante}} \,\middle|\, I\right] > \mathbb{E}\left[\pi_i^{\text{ex-ante}} \,\middle|\, D, S_l^D\right]$ for all $S_l^D \in \mathcal{S}_l$ in some productivity range. The monotonicity of expected profits ensures that $\mathbb{E}\left[\pi_i^{\text{ex-ante}} \,\middle|\, I\right]$ and each curve $\mathbb{E}\left[\pi_i^{\text{ex-ante}} \,\middle|\, D, S_l^D\right]$ intersect at most once. Since $f_l^I \geq f_l^D(S_l^D)$ for all $S_l^D \in \mathcal{S}_l$, this can only occur if expected indirect profits reach the zero-profit threshold before all direct curves.[51] From (A11) and (A12) we have:

$$\varphi_l^I < \varphi_l^D(S_l^D) \;\; \forall\, S_l^D \in \mathcal{S}_l \iff \frac{1-(\zeta_l^I)^{S_l^I}}{1-(\zeta_l^D)^{S_l^D}} > \frac{\kappa^{\sigma-1} f_l^I}{f_l^D(S_l^D)} \;\; \forall\, S_l^D \in \mathcal{S}_l \tag{A13}$$

[51] If some direct curve reaches zero-profits before, then all producers opt for direct sourcing. The technological condition above guarantees that this is not the case.

This provides a technological condition for intermediation to take place: the resilience of intermediated networks must be high enough to compensate for the brokerage fee, once adjusted for reductions in matching costs.

C.4. Proof of Proposition 4

Part (a). From Proposition 3, the productivity cutoff φ_l^I above which indirect sourcing generates positive expected *ex-ante* profits is given by (A12), which is a function of the indirect disruption probability ζ_l^I:

$$\varphi_l^I(\zeta_l^I) = \left(\frac{\kappa^{\sigma-1} f_l^I}{\left(1 - (\zeta_l^I)^{S^I}\right)\left(p_{il}^x\right)^{1-\sigma} B} \right)^{\frac{1}{\sigma-1}}$$

Assuming that the technological condition for intermediation (A13) is satisfied, there is a positive mass of firms sourcing indirectly starting from this cutoff. Given final demand B, the change in φ_l^I with respect to small changes in ζ_l^I is:

$$\begin{aligned}
\frac{\partial \varphi_l^I(\zeta_l^I)}{\partial \zeta_l^I} &= \frac{1}{\sigma - 1} \left(\frac{\kappa^{\sigma-1} f_l^I}{\left(1 - (\zeta_l^I)^{S^I}\right)\left(p_{il}^x\right)^{1-\sigma} B} \right)^{\frac{1}{\sigma-1}-1} \frac{\partial \left(1 - (\zeta_l^I)^{S^I}\right)^{-1}}{\partial \zeta_l^I} \frac{\kappa^{\sigma-1} f_l^I}{\left(p_{il}^x\right)^{1-\sigma} B} \\
&= \frac{1}{\sigma - 1} \varphi_l^I(\zeta_l^I) \frac{S^I (\zeta_l^I)^{S^I - 1}}{1 - (\zeta_l^I)^{S^I}} \quad > 0
\end{aligned}$$

This expression is positive given that $\sigma > 1$, $\zeta_l^I \in (0,1)$, $S^I \in \mathbb{N}^+$, and $\varphi_l^I(\zeta_l^I) > 0$. Thus, the threshold $\varphi_l^I(\zeta_l^I)$ increases and some indirect buyers stop sourcing indirectly.

Part (b). Consider now the productivity threshold where firms switch from indirect to direct sourcing, φ_l^*, as defined in (A9). This is a function of direct ζ_l^D and indirect ζ_l^I disruption probabilities:

$$\varphi_l^*(\zeta_l^D, \zeta_l^I) = \min_{S_l^D} \left[\frac{f_l^D(S_l^D) - f_l^I}{\left(1 - (\zeta_l^D)^{S_l^D} - \frac{1-(\zeta_l^I)^{S^I}}{\kappa^{\sigma-1}}\right)\left(P_{il}^x\right)^{1-\sigma} B} \right]^{\frac{1}{\sigma-1}} \quad \text{for } S_l^D \in |\mathbb{S}_l|$$

As before, I assume that the technological condition for intermediation (A13) is satisfied, ensuring that a positive mass of firms sources indirectly. Similarly, I assume $\kappa^{\sigma-1} > \frac{1-(\zeta_l^I)^{S^I}}{1-(\zeta_l^D)^{S_l^D}}$, which ensures $\varphi^*(\zeta_l^D, \zeta_l^I) > 0$ and therefore a positive mass of direct buyers. Since ζ_l^D and ζ_l^I vary in the same proportion, we can write $\zeta \equiv \zeta_l^D$ and $\zeta_l^I = \mu\zeta$ for some factor $\mu \in (0, 1)$. Considering $\tilde{S}_l^D$ as the number of direct suppliers that defines the cutoff $\varphi_l^*(\zeta_l)$ and differentiating with respect to ζ we get:

$$\frac{\partial \varphi_l^*(\zeta_l)}{\partial \zeta_l} = \frac{1}{\sigma - 1} \left[\frac{f_l^D(\tilde{S}_l^D) - f_l^I}{A(\zeta_l)\left(P_{il}^x\right)^{1-\sigma} B} \right]^{\frac{1}{\sigma-1}-1} \frac{\partial A^{-1}(\zeta_l)}{\partial \zeta_l} \frac{\left(f_l^D(\tilde{S}_l^D) - f_l^I\right)}{\left(P_{il}^x\right)^{1-\sigma} B}$$

where the auxiliary mapping is $A(\zeta_l) \equiv \left(1 - (\zeta_l)^{\tilde{S}_l^D} - \frac{1-(\mu\,\zeta_l)^{S_l^I}}{\kappa^{\sigma-1}}\right)$, such that:

$$\frac{\partial A(\zeta_l)}{\partial \zeta_l} = -\left(A(\zeta_l)\right)^{-2} \left(\frac{S_l^I\,(\zeta_l)^{S_l^I-1}\,\mu^{S_l^I}}{\kappa^{\sigma-1}} - \tilde{S}_l^D\,(\zeta_l)^{\tilde{S}_l^D-1} \right)$$

Since $\sigma > 1$, $f_l^D(S) > f_l^I$, and $A(\zeta_l) > 0$ under the condition for direct sourcing, we have that $\frac{\partial \varphi_l^*(\zeta)}{\partial \zeta_l} > 0$ when $\frac{\partial A(\zeta_l)}{\partial \zeta} > 0$. This requires the following condition to hold:

$$\left(\zeta_l\right)^{S_l^I - \tilde{S}_l^D} \left(\frac{S_l^I}{\tilde{S}_l^D}\right) < \left(\frac{\kappa^{\sigma-1}}{\mu^{S_l^I}}\right)$$

This is satisfied as long as the probability of disruptions ζ_L is not particularly high. In fact, noting that the RHS is always greater than one and defining $d \equiv S_l^I - \tilde{S}_l^D \geq 1$, a sufficient condition is $\zeta < \left(\frac{\tilde{S}_l^D}{\tilde{S}_l^D + d}\right)^{1/d}$. Since the upper bound increases with $\tilde{S}_l^D$ and d, we can set $\tilde{S}_l^D = d = 1$ to show that $\zeta_l < 0.5$ is sufficient (though not necessary) for $\frac{\partial A(\zeta)}{\partial \zeta} > 0$, in which case firms switch from direct to indirect sourcing in response to risk.

Part (c). Consider an arbitrary number of direct suppliers $S \in \mathbb{S}_l$ and define the productivity cutoff φ_{S+1}^D, which equalizes expected *ex-ante* profits for S and $S+1$ suppliers:

$$\varphi_{S+1}^D(\zeta_l^D) = \left(\frac{f_l^D(S+1) - f_l^D(S)}{\left(1 - (\zeta_l^D)^{S+1} - \left(1 - (\zeta_l^D)^S\right)\right)\left(p_{il}^x\right)^{1-\sigma} B} \right)^{\frac{1}{\sigma-1}} \qquad \text{(A14)}$$

Following Proposition 2(b), producers with productivity above this cutoff prefer to source from $S+1$ rather than S direct suppliers, while the opposite is true for those below. Differentiating with respect to ζ_l^D we obtain:

$$\frac{\partial \varphi_{S+1}^D(\zeta_l^D)}{\partial \zeta_l^D} = \frac{1}{\sigma - 1}\left[\frac{f_l^D(S+1) - f_l^D(S)}{A(\zeta_l^D)\left(P_{il}^x\right)^{1-\sigma} B}\right]^{\frac{1}{\sigma-1}-1} \frac{\partial A^{-1}(\zeta_l^D)}{\partial \zeta_l^D} \frac{\left(f_l^D(S+1) - f_l^D(S)\right)}{\left(P_{il}^x\right)^{1-\sigma} B}$$

where the auxiliary mapping is now $A(\zeta_l^D) \equiv (\zeta_l^D)^S\left(1 - \zeta_l^D\right) > 0$ and:

$$\frac{\partial A(\zeta_l^D)}{\partial \zeta_l^D} = -\left(A(\zeta)\right)^{-2}\left(S(\zeta_l^D)^S - (S+1)(\zeta_l^D)^{S+1}\right) < 0 \quad \text{for } \zeta_l^D < \frac{S}{S+1}$$

Given that $\sigma > 1$ and $f_l^D(S+1) > f_l^D(S)$, we have that $\frac{\partial \varphi_{S+1}^D(\zeta_l^D)}{\partial \zeta_l^D} < 0$ if the probability of disruptions ζ_l^D is not particularly high. This implies that some producers sourcing directly expand their supply sets. In turn, this condition always holds if $\zeta_l^D < 0.5$, and it becomes more flexible as the number of suppliers increases.

C.5. Proof of Proposition 5

Part (a). The expected *ex-ante* profits of producer ω given a sourcing strategy $\vartheta(\omega) \equiv \left\{L(\omega), M_l(\omega), S_l^D(\omega)\right\}$ are:

$$\mathbb{E}\left[\pi^{\text{ex-ante}}(\omega)\,\middle|\,\vartheta(\omega)\right] = \varphi(\omega)^{\sigma-1}\mathbb{E}\left[\Theta^{\frac{\sigma-1}{\eta-1}}\,\middle|\,\vartheta(\omega)\right] B - \sum_{L(\omega)} \mathbb{1}_{\{M_l(\omega)=D\}} f_l^D\left(S_l^D(\omega)\right) - \sum_{L(\omega)} \mathbb{1}_{\{M_l(\omega)=I\}} f_l^I$$

Consider two firms with productivity levels $\varphi^H > \varphi^L$. For readability, denote their sourcing strategies as ϑ^H and ϑ^L, and the associated fixed sourcing costs as $F(\vartheta^H)$ and $F(\vartheta^L)$. For these choices to be optimal, we require:

$$\left(\varphi^H\right)^{(\sigma-1)}\mathbb{E}\left[\Theta^{\frac{\sigma-1}{\eta-1}}\,\middle|\,\vartheta^H\right] B - F(\vartheta^H) \geq \left(\varphi^H\right)^{(\sigma-1)}\mathbb{E}\left[\Theta^{\frac{\sigma-1}{\eta-1}}\,\middle|\,\vartheta^L\right] B - F(\vartheta^L) \quad \text{(A15)}$$

$$\left(\varphi^L\right)^{(\sigma-1)}\mathbb{E}\left[\Theta^{\frac{\sigma-1}{\eta-1}}\,\middle|\,\vartheta^H\right] B - F(\vartheta^H) \leq \left(\varphi^L\right)^{(\sigma-1)}\mathbb{E}\left[\Theta^{\frac{\sigma-1}{\eta-1}}\,\middle|\,\vartheta^L\right] B - F(\vartheta^L) \quad \text{(A16)}$$

Combining both inequalities, we obtain:

$$\left[\mathbb{E}\left[\Theta^{\frac{\sigma-1}{\eta-1}} \,\middle|\, \vartheta^H\right] - \mathbb{E}\left[\Theta^{\frac{\sigma-1}{\eta-1}} \,\middle|\, \vartheta^L\right]\right]\left[\left(\varphi^H\right)^{\sigma-1} - \left(\varphi^L\right)^{\sigma-1}\right] B \geq 0 \qquad \text{(A17)}$$

Since $\sigma > 1$, this implies that $\mathbb{E}\left[\Theta^{\frac{\sigma-1}{\eta-1}} \,\middle|\, \vartheta^H\right] \geq \mathbb{E}\left[\Theta^{\frac{\sigma-1}{\eta-1}} \,\middle|\, \vartheta^L\right]$ for $\varphi^H \geq \varphi^L$. Note that this result does not depend on the specific pattern of disruptions assumed.

Part (b). I first show that expected *ex-ante* profits satisfy increasing differences in the choice of source locations $(\mathbb{1}_l, \mathbb{1}_{l'})$, where $\mathbb{1}_l$ and $\mathbb{1}_{l'}$ are indicator variables for whether l and l' are included in the sourcing strategy. In the case without risk and parameter space $\sigma > \eta$, this holds trivially in the profit function $\pi(\mathbb{1}_l, \mathbb{1}_{l'}) = \varphi^{\sigma-1}\left(\Theta(\mathbb{1}_l, \mathbb{1}_{l'})\right)^{\frac{\sigma-1}{\eta-1}} B - F(\mathbb{1}_l, \mathbb{1}_{l'})$, which implies:

$$\pi(1,1) - \pi(0,1) \geq \pi(1,0) - \pi(0,0) \iff$$

$$\Theta(1,1)^{\frac{\sigma-1}{\eta-1}} - \Theta(0,1)^{\frac{\sigma-1}{\eta-1}} \geq \Theta(1,0)^{\frac{\sigma-1}{\eta-1}} - \Theta(0,0)^{\frac{\sigma-1}{\eta-1}}$$

To extend this result to the case with independent disruptions, consider χ_l and χ_l' as the probabilities that each location is operational. Expected profits satisfy increasing differences if:

$$\mathbb{E}\left[\pi^{\text{ex-ante}}(1,1)\right] - \mathbb{E}\left[\pi^{\text{ex-ante}}(0,1)\right] \;\geq\; \mathbb{E}\left[\pi^{\text{ex-ante}}(1,0)\right] - \mathbb{E}\left[\pi^{\text{ex-ante}}(0,0)\right] \iff$$

$$\chi_{l'}\chi_l\Theta(1,1)^{\frac{\sigma-1}{\eta-1}} + \chi_{l'}\left(1-\chi_l\right)\Theta(1,0)^{\frac{\sigma-1}{\eta-1}} + \left(1-\chi_{l'}\right)\chi_l\Theta(0,1)^{\frac{\sigma-1}{\eta-1}} + \left(1-\chi_{l'}\right)\left(1-\chi_l\right)\Theta(0,0)^{\frac{\sigma-1}{\eta-1}}$$

$$-\left\{\chi_l\Theta(0,1)^{\frac{\sigma-1}{\eta-1}} + \left(1-\chi_l\right)\Theta(0,0)^{\frac{\sigma-1}{\eta-1}}\right\} \;\geq\; \chi_{l'}\Theta(1,0)^{\frac{\sigma-1}{\eta-1}} + \left(1-\chi_{l'}\right)\Theta(0,0)^{\frac{\sigma-1}{\eta-1}} \iff$$

$$\chi_{l'}\chi_l\left[\Theta(1,1)^{\frac{\sigma-1}{\eta-1}} - \Theta(0,1)^{\frac{\sigma-1}{\eta-1}} - \Theta(1,0)^{\frac{\sigma-1}{\eta-1}} + \Theta(0,0)^{\frac{\sigma-1}{\eta-1}}\right] \;\geq\; 0$$

where $\chi_{l'}\chi_l > 0$ and the term in brackets is positive under increasing differences without risk, which is satisfied for $\sigma > \eta$. Note that, for simplicity but without loss of generality, I have abstracted from risk in locations other than l and l'.[52]

I next show that expected *ex-ante* profits satisfy increasing differences in the choice of direct

[52]The assumption of independent disruptions adds tractability but is not necessary for this result. Intuitively, increasing differences in location choices without risk extend to the risk case as long as the contribution of additional locations does not reduce the contribution of current locations. This may not hold if sourcing from l' increases the probability of disruptions in l, but can accommodate global shocks to all locations. However, if shocks are more correlated, the benefits of diversification diminish.

suppliers $(S^D_l, S^D_{l'})$. To ease notation, consider the following mapping:

$$\mathsf{K}(S', S) \equiv \chi_{l'}(S')\chi_l(S)\big(\Theta(1,1)\big)^{\frac{\sigma-1}{\eta-1}} + \chi_{l'}(S')\big(1-\chi_l(S)\big)\big(\Theta(1,0)\big)^{\frac{\sigma-1}{\eta-1}} + \\ \big(1-\chi_{l'}(S')\big)\chi_l(S)\big(\Theta(0,1)\big)^{\frac{\sigma-1}{\eta-1}} + \big(1-\chi_{l'}(S')\big)\big(1-\chi_l(S)\big)\big(\Theta(0,0)\big)^{\frac{\sigma-1}{\eta-1}} \tag{A18}$$

where $\chi_{l'}(S')$ and $\chi_l(S)$ are the probabilities that locations l' and l are operational given choices S' and S.[53] For increasing differences to hold, we need:

$$\mathbb{E}\Big[\pi^{\text{ex-ante}}(S'+1, S+1)\Big] - \mathbb{E}\Big[\pi^{\text{ex-ante}}(S', S+1)\Big] \geq \mathbb{E}\Big[\pi^{\text{ex-ante}}(S'+1, S)\Big] - \mathbb{E}\Big[\pi^{\text{ex-ante}}(S', S)\Big]$$

$$\iff \mathsf{K}(S'+1, S+1) - \mathsf{K}(S', S+1) \geq \mathsf{K}(S'+1, S) - \mathsf{K}(S', S)$$

$$\iff \Big(\chi_{l'}(S'+1) - \chi_{l'}(S')\Big)\Big(\chi_l(S+1) - \chi_l(S)\Big) * \\ \Big[\big(\Theta(1,1)\big)^{\frac{\sigma-1}{\eta-1}} - \big(\Theta(0,1)\big)^{\frac{\sigma-1}{\eta-1}} - \big(\Theta(1,0)\big)^{\frac{\sigma-1}{\eta-1}} + \big(\Theta(0,0)\big)^{\frac{\sigma-1}{\eta-1}}\Big] \geq 0$$

The first two terms are positive as the probability that a location is operational increases with the number of suppliers, while the square brackets contain the condition for increasing differences without risk, which holds for $\sigma > \eta$.

I have shown that expected *ex-ante* profits satisfy increasing differences in $(\mathbb{I}_l, \mathbb{I}_{l'})$ and $(S^D_{l'}, S^D_l)$, while increasing differences in $(\mathbb{I}_l, S^D_l)$ follow trivially. Given that for any choice $(\mathbb{I}_l, S^D_{l'}, \cdot)$ we have $\mathbb{E}\Big[\pi^{\text{ex-ante}}(\mathbb{I}_l, S^D_l, \cdot)\Big] = \varphi^{\sigma-1}\mathsf{K}(\mathbb{I}_l, S^D_l, \cdot)\, B - F(\mathbb{I}_l, S^D_l, \cdot)$, this function also satisfies increasing differences in $(\mathbb{I}_l, \varphi)$ and (S^D_l, φ) for $\sigma > \eta > 1$. Applying Topkis's monotonicity theorem, we have that $\mathbb{I}_l(\varphi^H) \geq \mathbb{I}_l(\varphi^L)$ and $S^D_l(\varphi^H) \geq S^D_l(\varphi^L)$ for $\varphi^H \geq \varphi^L$.

Part (c). From Proposition 3, we know that at any location l', there exists an equivalent number of direct suppliers $\widetilde{S}_{l'}$ for the intermediation technology (A4). Only firms that can match with $S^D_{l'} > \widetilde{S}_{l'}$ suppliers consider sourcing directly in l', and $S^D_{l'}$ is an increasing function of firm productivity φ. In the single-location case, this guarantees that a high-productivity firm φ^H would not resort to indirect sourcing if a low-productivity firm φ^L sources directly. With multiple locations, sourcing decisions in l' are affected by decisions in all locations through the expected sourcing capability, $\mathbb{E}\Big[\Theta(\varphi)^{\frac{\sigma-1}{\eta-1}}\Big]$. Parts (a) and (b) demonstrated that this object is an increasing function of φ and, if $\sigma > \eta$, this increases the optimal number of direct suppliers at

[53] The number of suppliers enters only the probabilities and not the sourcing capability under perfect supplier substitution. However, it is straightforward to extend this result under imperfect supplier substitution as modelled in Section 3.6.

any location. This monotonic relationship extends the result to the multi-location context.

I prove this by contradiction for the case with two locations, l' and l. To ease notation, I use the mapping $\mathsf{K}(S', S)$ defined in (A18) for choices S' and S in locations l' and l. If φ^H sources indirectly from l', and S_l^H is the corresponding choice in l, the following condition would be satisfied:

$$\left(\varphi^H\right)^{\sigma-1}\mathsf{K}\left(\widetilde{S}_{l'}, S_l^H\right)B - f_{l'}^I - f_l^D(S_l^H) \geq \left(\varphi^H\right)^{\sigma-1}\mathsf{K}\left(S_{l'}, S_l\right)B - f_{l'}^D(S_{l'}) - f_l^D(S_l) \quad \forall S_{l'} \in \mathcal{S}_{l'}, S_l \in \mathcal{S}_l$$

where indirect sourcing in l' is *equivalent* to access $S' = \widetilde{S}_{l'}$ direct suppliers. This implies:

$$\left(\varphi^H\right)^{\sigma-1}\mathsf{K}\left(\widetilde{S}_{l'}, S_l^H\right)B - f_{l'}^I \geq \left(\varphi^H\right)^{\sigma-1}\mathsf{K}\left(S_{l'}^H, S_l^H\right)B - f_{l'}^D(S_{l'}^H) \tag{A19}$$

where $S_{l'}^H$ is the best direct alternative in l' given a choice S_l^H in l, and the fixed costs $f_l^D(S_l^H)$ offset each other. Analogously, if φ^L sources directly from $S_{l'}^L$ suppliers in l', and the corresponding choice in l is S_l^L, we have:

$$\left(\varphi^L\right)^{\sigma-1}\mathsf{K}\left(S_{l'}^L, S_l^L\right)B - f_{l'}^D(S_{l'}^L) - f_l^D(S_l^L) \geq \left(\varphi^L\right)^{\sigma-1}\mathsf{K}\left(\widetilde{S}_{l'}, S_l\right)B - f_{l'}^I - f_l^D(S_l) \quad \forall S_{l'} \in S_l \in \mathcal{S}_l$$

which implies that:

$$\left(\varphi^L\right)^{\sigma-1}\mathsf{K}\left(S_{l'}^L, S_l^L\right)B - f_{l'}^D(S_{l'}^L) \geq \left(\varphi^L\right)^{\sigma-1}\mathsf{K}\left(\widetilde{S}_{l'}, S_l^L\right)B - f_{l'}^I \tag{A20}$$

Combining inequalities (A19) and (A20) we get:

$$\begin{aligned} f_{l'}^D(S_{l'}^H) - f_{l'}^D(S_{l'}^L) \;\geq\; & \left(\varphi^H\right)^{\sigma-1}\Big(\mathsf{K}\left(S_{l'}^H, S_l^H\right) - \mathsf{K}\left(\widetilde{S}_{l'}, S_l^H\right)\Big)B \\ & - \left(\varphi^L\right)^{\sigma-1}\Big(\mathsf{K}\left(S_{l'}^L, S_l^L\right) - \mathsf{K}\left(\widetilde{S}_{l'}, S_l^L\right)\Big)B \end{aligned} \tag{A21}$$

However, if $S_{l'}^H$ is the best direct alternative in l' given a choice S_l^H in l, then we also have:

$$\left(\varphi^H\right)^{\sigma-1}\Big(\mathsf{K}\left(S_{l'}^H, S_l^H\right) - \mathsf{K}\left(S_{l'}^L, S_l^H\right)\Big)B \;\geq\; f_{l'}^D(S_{l'}^H) - f_{l'}^D(S_{l'}^L) \tag{A22}$$

which combined with inequality (A21) implies:

$$\left(\varphi^L\right)^{\sigma-1}\Big(\mathsf{K}\left(S_{l'}^L, S_l^L\right) - \mathsf{K}\left(\widetilde{S}_{l'}, S_l^L\right)\Big)B \;\geq\; \left(\varphi^H\right)^{\sigma-1}\Big(\mathsf{K}\left(S_{l'}^L, S_l^H\right) - \mathsf{K}\left(\widetilde{S}_{l'}, S_l^H\right)\Big)B \tag{A23}$$

We know that $\mathsf{K}\left(S_{l'}^L, S_l^L\right) - \mathsf{K}\left(\widetilde{S}_{l'}, S_l^L\right) \geq 0$ since $f_{l'}^D(S_{l'}^L) \geq f_{l'}^I$ in (A20). However, $\mathsf{K}\left(S_{l'}^L, S_l^H\right)$ –

$K\left(\widetilde{S}_{l'}, S_l^H\right)$ is also positive and larger in magnitude since $S_l^H \geq S_l^L$ for $\varphi^H > \varphi^L$, which is driven by the increasing differences established in part (b). This leads to a contradiction.

D. Estimation Appendix

D.1. Solution Algorithm

I describe the algorithm to solve the model numerically and estimate direct matching costs ($f_l^D(S_l^D)$), contracting costs with intermediaries (f_l^I), and the demand shifter (B) using the Simulated Method of Moments. This algorithm is implemented after all other parameters have been separately estimated following Section 5.2: elasticities of substitution (σ, η, θ), location-specific input costs ($\tau_l \alpha_l$), disruption probabilities by location and sourcing mode (ζ_l^M), number of indirect suppliers per location (S_l^I), number of potential direct suppliers per location (S_l^D), and brokerage fee (κ).

- **Step 1:** Draw N producers from a Pareto productivity distribution; each producer then draws its matching costs from a log-normal distribution.
- **Step 2:** Compute expected input costs for each possible choice of locations, sourcing mode at each location, and number of suppliers in direct locations: $\left\{L(\omega), M_l(\omega), S_l^D(\omega)\right\}$.
  - The number of combinations equals $\prod_{l \in \mathcal{L}} \left(|\mathbb{S}_l| + 2\right)$.
  - Expectations are approximated by sampling 100,000 draws from the Binomial distribution describing the number of operational suppliers for each choice.
- **Step 3:** Guess an initial value for parameters to be estimated (Ω_0).
- **Step 4:** Solve the optimal sourcing problem for each producer.
  - Discard strictly dominated direct choices relative to indirect sourcing.
  - Discard indirect sourcing when strictly dominated by all direct options.
  - Apply squeezing method for discrete choice (Arkolakis et al. 2023; Huang et al. 2024).
- **Step 5:** Compute simulated moments $M^{Model}(\Omega)$ given producers' optimal sourcing.
- **Step 6:** Compute Euclidean distance between simulated and data moments.

$$\min_{\Omega} Y_t = (M^{\text{Model}}(\Omega) - M^{\text{Data}})W(M^{\text{Model}}(\Omega) - M^{\text{Data}})', \quad W = I$$

- **Step 7:** Stop if $Y_t < \epsilon$; otherwise go back to Step 3 and evaluate a new guess Ω_{t+1}.

D.2. Estimation Results

Table A9. Elasticity of Substitution across Input Locations

	(log) Input purchases					1rst Stage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(log) Input prices	-0.248***	-0.224***	-0.251***	-0.404***	-0.378***		
	(0.002)	(0.002)	(0.008)	(0.082)	(0.074)		
(log) Distance						0.302***	0.338***
						(0.025)	(0.025)
Firm-Year FE	Yes	Yes	No	No	No	No	No
Firm FE	No	No	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	Yes	No	No	No	No	No
Country productivity	No	No	No	No	Yes	No	Yes
IV	No	No	No	Yes	Yes	Yes	Yes
Sample	2005-19	2005-19	2019	2019	2019	2019	2019
Observations	365,505	365,104	22,176	21,955	21,805	21,955	21,805

Notes: This table uses an empirical counterpart of equation (15) to estimate the elasticity of substitution across input locations (η). The dependent variable is (log) input purchases for a given buyer-origin country-year, the key regressor is (log) input prices, and the estimated coefficients correspond to $1 - \eta$. I include firm (firm-year) fixed effects, capturing variation for the same buyer across origins. Columns (1) and (2) use the full panel (2005–2019), column (3) considers the last year in the sample (2019), columns (4) and (5) instrument input prices with geographic distance from Chile, and columns (6) and (7) present first stages. The table reports robust standard errors.

TABLE A10. Elasticity of Substitution across Suppliers

	(log) Input prices			
	(1)	(2)	(3)	(4)
(log) # Suppliers	-0.256***	-0.279***	-0.266***	-0.295***
	(0.003)	(0.003)	(0.011)	(0.012)
Country-Product FE	No	No	Yes	Yes
Country-Product-Year FE	Yes	Yes	No	No
Firm FE	No	No	No	Yes
Firm-Year FE	No	Yes	No	No
Sample	2005-19	2005-19	2019	2019
Observations	1,954,843	1,917,790	115,483	112,903

Notes: This table uses an empirical counterpart of equation (19) to estimate the elasticity of substitution across suppliers within locations (θ). The dependent variable is (log) input prices for a given location (country - HS6 product) and year, the key regressor is the (log) number of suppliers, and the estimated coefficients correspond to $-1/\theta$. All regressions include location (location-year) fixed effects, capturing variation across buyers sourcing from the same market. Columns (1) and (2) consider the full sample of years, while columns (3) and (4) use the last year available (2019). The table reports robust standard errors.

TABLE A11. Location-Specific Trade and Production Unit Costs

	Raw estimates (USD)		Normalized (Chile=1)	
Region	All years (2005-19)	Only 2019	All years (2005-19)	Only 2019
CHN	12.67	17.31	1.93	3.12
EU	74.92	91.03	11.42	16.42
LAT	17.72	14.97	2.70	2.70
ROW	109.46	56.34	16.68	10.16
US	84.74	88.99	12.92	16.05

Notes: This table presents estimates for trade and production costs ($\tau_l \alpha_l$) across source regions. The raw estimates are in USD, and the normalized version is defined relative to input costs in Chile. Since domestic sourcing is not directly observed, I assume similar production costs in Chile and Latin America, attributing all differences to iceberg trade costs, which are estimated to be around a factor of 2.7 (Anderson and Van Wincoop 2004). Thus, by construction, Latin America has an input cost of 2.7 in the last two columns.

Table A12. Estimated Parameters for Link Separation Probabilities

Dep. Variable: $\mathbb{D}(separation)_{bsl}$					
Location factors (Z_l)				Demand factors (D_b)	
Geopolitical risk	0.328***	Low-income dummy	-1.817***	Δ firm imports	-0.254***
	(0.033)		(0.066)		(0.066)
Economic uncertainty	0.180***	Mid-income dummy	-1.993***	Δ firm suppliers	-1.057***
	(0.027)		(0.063)		(0.018)
Trade volatility	0.052***	High-income dummy	-2.385***		
	(0.007)		(0.011)		

Notes: This table presents the estimates for vectors Z_l and D_b in the logit model (25) estimating the probability of link separations. The regressions are at the buyer-supplier-location level, where locations are defined at the origin country-HS6 product level. The dependent variable is a dummy that equals 1 when a buyer-supplier link in period t will be inactive in $t+1$. The demand factors are excluded from the projected disruption probabilities. The sample considers all import transactions in 2018 for firms active in 2018 and 2019. The table reports robust standard errors clustered at the location level.

Table A13. Differences in Separation Rates by Region (Indirect vs. Direct)

	LAT	CHN	USA	EUR	ROW
	(1)	(2)	(3)	(4)	(5)
Intermediary dummy	-0.060***	-0.055***	-0.070***	-0.050***	-0.064***
	(0.015)	(0.012)	(0.013)	(0.012)	(0.018)
Firm size (sales)	Yes	Yes	Yes	Yes	Yes
Imported value	Yes	Yes	Yes	Yes	Yes
Number of suppliers	Yes	Yes	Yes	Yes	Yes
Product - country FE	Yes	Yes	Yes	Yes	Yes
Δ Firm-level imports	Yes	Yes	Yes	Yes	Yes
Δ Firm-level suppliers	Yes	Yes	Yes	Yes	Yes
Observations	29,694	72,881	49,715	87,922	43,868

Notes: This table compares supplier separation rates for producers and intermediaries in each source region: Latin America, China, the United States, Europe, and Rest of the World. For each group, the regressions are at the buyer-origin country-HS6 product level. The dependent variable is a dummy that equals 1 when the buyer has a separation from period t to $t+1$. The independent variable is a dummy indicating whether the buyer is an intermediary. Controls for changes in demand conditions across buyers are included (firm-level imports and suppliers). The sample includes all import transactions in 2018 for firms active in both 2018 and 2019. Standard errors are clustered at the firm level.