Trade and Firm-Level Adjustments to Geopolitical Shifts: Evidence from Armenia

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Abstract

This paper examines how sanctions on a major trading partner affect the firms, workers, and trade of a non-sanctioning economy, considering the case of Armenia and the Western sanctions on Russia. Using transaction-level customs data for 2018–2024 matched with employer–employee records for 2018–2023 I document a sharp increase in Armenia's intermediary role: exports to Russia rise markedly along pre-existing firm–product–partner relationships, sanctioned goods are disproportionately channeled through potential same-firm intermediation, and the expansion operates through new product lines, more sources, and higher recorded unit values. Relative to non-trading firms, trading firms expand turnover and turnover per worker with no increase in employment; furthermore, these rents are shared with their workers who obtain wage gains with no increase in hours worked. To interpret these patterns I develop a capability-based heterogeneous-firm model in which productivity governs export participation while a separate relationship capability governs direct versus indirect access. Calibrated to the administrative moments, the model attributes a welfare gain of 0.9 percent to the post-2022 adjustment, of which intermediation accounts for 0.17 percentage points, approximately 19 percent. The paper also introduces Armenia's newly accessible administrative datasets as a resource for future research.

Keywords: Trade, Sanctions, Geoeconomics, Firms, Employees, Armenia
JEL Codes: F14, F51, J31, J63, L25

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1 Introduction

Geopolitical tensions over the past decade have increasingly culminated in trade sanctions among major economic powers, reducing trade between sanctioning and target economies (Felbermayr et al., 2020, 2021; Morgan, Syropoulos and Yotov, 2023). By restricting target countries' access to traditional suppliers and markets, these measures create a relative advantage for non-sanctioning economies[1], opening new demand and sourcing opportunities even as they heighten payment, compliance, and enforcement risks (Corsetti, Demir and Javorcik, 2024; Chupilkin et al., 2024). Firms in these economies can fill the resulting trade vacuum through expanded domestic production, reallocation within existing relationships and product baskets, or indirect trade rerouting (Corsetti, Demir and Javorcik, 2024). This paper asks which of these margins drive the adjustment, which firms and workers benefit, and how much indirect market access contributes to domestic consumer welfare.

I study Armenia after the escalation of Western sanctions on Russia in February 2022. Armenia is a small open economy, Russia is its largest trading partner, and both countries belong to the Eurasian Economic Union (EAEU). These features make Armenia a useful setting in which to observe how a small non-sanctioning economy responds when trade between a target country and sanctioning economies becomes more costly. I use novel transaction-level customs data from January 2018 through December 2024 and matched annual firm and employer–employee records from 2018 through 2023.

I begin by documenting the margins of Armenia's post-2022 adjustment using descriptive evidence. Annual exports rise by approximately 95 percent between 2021 and 2023, while imports rise by 76 percent. Trade participation broadens mainly on the import side: the number of active importers increases by 58 percent, compared with 24 percent for exporters. The expansion is also highly heterogeneous across products and firms. The

[1]Throughout the paper, the terms "neutral partners" and "non-sanctioning partners" refer to economies that had not imposed trade sanctions on Russia by December 2024.

number of firms exporting sanctioned products rises by 59.6 percent, compared with only 3.1 percent for non-sanctioned products, while the quarterly firm-level 99th percentile of export value increases almost fivefold, from USD 3.56 million in 2021Q4 to USD 17.73 million in 2023Q4 (Table 1).

I then move to examine these two dimensions of heterogeneity in a series of empirical settings: differences between sanctioned and non-sanctioned products, and differences across Russia, sanctioning partners, and non-sanctioning partners. Combining these dimensions allows me to distinguish a general post-2022 expansion of Armenian trade from reallocation specifically associated with restricted products and the Russia-facing trade corridor. The empirical analysis then relies on the assumption that Armenia and Armenian firms in particular had no influence over the timing or the scope of geopolitical events and sanctions against Russia.

At the extensive margin, the results do not show relative firm entry into Russian export markets. Relative to non-sanctioning destinations, quarterly exporter entry into Russia falls by 9.4 percentage points, while exporter exit falls by 8.4 percentage points. Russia-linked export relationships therefore become more persistent. Among continuing firm–destination relationships, however, the probability of adding a product rises by 7.4 percentage points and the probability of dropping one rises by 6.8 percentage points, indicating substantial product-basket reshuffling (Table 3). The zero-inclusive product-level event studies uncover a different extensive margin. Extended two-way fixed-effects PPML estimates show increases in sanctioned-product export value and destination counts after listing, together with increases in the number of Armenian importers and foreign sourcing origins (Figure 4; Nagengast and Yotov, 2025). Thus, within-span interruption and reactivation matter at the product–quarter level, while the sourcing network broadens through additional participating firms and origins.

At the intensive margin, the evidence does not support a broad increase in Russia-bound physical quantities. Within active firm–product–partner relationships, Russia-bound

volume, value, and recorded unit values rise relative to non-sanctioning destinations. Much of the volume and value pattern, however, reflects contemporaneous changes common to the firm or product; after accounting for these forces, only the higher recorded unit values remain as a clear Russia-specific differential (Table 7). The sanctioned-product results similarly distinguish changes within active relationships from adjustment through previously inactive flows, pointing to a combination of within-relationship and extensive-margin reallocation rather than a single uniform response (Table 9). Direct measures of potential intermediation provide the clearest evidence on the mechanism: after 2022, sanctioned products are handled more intensively through intermediation, without a corresponding increase in the formation of new intermediation relationships (Table 12). Overall, the adjustment operates through the reorganization and deeper use of existing trade links (including changes in product baskets, sourcing, intermediation, and recorded unit values) rather than through a general surge in exports to Russia.

The firm-level incidence of the adjustment is concentrated in revenue rather than employment. Relative to non-traders, firms that were importers or dual traders in 2021 record post-2022 turnover increases of 0.23 and 0.25 log points, respectively, with much smaller employment responses. Higher pre-shock potential-intermediation exposure is likewise associated with greater turnover and turnover per employee but not employment (Table 13). The worker estimates also indicate higher salaries and hourly wages among workers initially attached to importers and dual traders, without a corresponding increase in hours worked (Table 14).

To interpret these patterns, I develop a capability-based heterogeneous-firm model of trade intermediation. Intermediation here differs from the conventional indirect-exporting arrangement in which a producer sells abroad through a separate specialized intermediary or wholesale firm (Ahn, Khandelwal and Wei, 2011; Bernard, Grazzi and Tomasi, 2015). Instead, I classify a firm–product relationship as potentially intermediated when the same Armenian firm exports an HS6 product after having imported that product during the

preceding twelve months. The measure, therefore, does not rely on wholesale-sector classifications or on observing a domestic producer selling through a middleman. Notably, these potential intermediaries are not predominantly marginal or small firms. In 2023, firms in the largest predetermined employment quartile account for 55.3 percent of measured intermediated volume, while firms in the largest turnover quartile account for 74.9 percent (Table 2).

Motivated by these facts, the model does not impose the standard productivity ranking under which less productive firms export indirectly and more productive firms export directly. Productivity determines whether a firm serves a foreign opportunity and how much it sells, while a separate relationship capability determines whether that opportunity is served directly or indirectly. In the baseline, route capability is independent of productivity. The remaining structure follows a small-open-economy Melitz environment with CES demand, Pareto productivity, fixed export costs, and free entry (Melitz, 2003; Demidova and Rodríguez-Clare, 2009). Foreign demand, foreign prices, the wage, and nominal expenditure are held fixed, while Armenian entry, domestic selection, active varieties, and the domestic price index adjust. Crucially, goods exported indirectly do not enter Armenian utility: intermediation affects Armenian consumer welfare only through its effect on expected export profits, free entry, selection, and the set of Armenian varieties available domestically. I discipline the no-intermediation counterfactual using the share of indirectly served export relationships that could preserve foreign-market access by switching to direct exporting if the indirect route disappeared. The model implies a consumption-equivalent gain of 0.9 percent between the calibrated pre- and post-shock states, of which intermediation accounts for approximately 19 percent.

The paper contributes to several strands of the literature. It adds to the body of research examining the economic effectiveness of sanctions and their consequences on trade patterns, studying that of sanctioning or target economies (Haidar, 2017; Crozet and Hinz, 2020; Babina et al., 2023; Drott, Goldbach and Nitsch, 2024), or of the non-sanctioning

economies (Hinz and Monastyrenko, 2022; Chupilkin, Javorcik and Plekhanov, 2023, 2024; Corsetti, Demir and Javorcik, 2024; Tyazhelnikov and Romalis, 2024). The contribution lies in bringing novel, micro-level evidence from a small open economy situated between a sanctioned major trading partner and the economies imposing the restrictions.

A related set of studies documents how firms adjust the operational terms of trade under geopolitical stress. Aksoy et al. (2022) show that firms responded to COVID-19 by increasing stockpiling and diversifying suppliers. Crozet, Demir and Javorcik (2022) find that trade secured through letters of credit expanded during crises, while Corsetti, Demir and Javorcik (2024) document a shift toward cash-in-advance transactions in Turkish exports to Russia, both reflecting firms' efforts to mitigate counterparty risk. Chupilkin et al. (2023) show that the share of Russian imports invoiced in yuan rose by 17 percentage points after the 2022 sanctions, with larger shifts among non-sanctioning partners trading in industrial or dual-use goods. These papers establish that firms actively reconfigure payment and sourcing arrangements in response to sanctions; the question that remains is how these adjustments reshape the direction and composition of trade at the firm–product level, which is the margin I study.

Firms respond differently to trade shocks. Sanctions reduce firm participation in the sanctioning country, though those with prior experience in sanctioned markets are more likely to persist, often rerouting trade through neighboring countries (Crozet et al., 2021). Firms that exported to both Russia and its neighbors before 2014 cut direct sales to Russia more than others after the 2014 sanctions. Ahn and Ludema (2020) show that directly targeted firms face greater losses than their non-targeted competitors. Geopolitical tensions drive economies toward "friendshoring" (prioritizing trade with allies) at the cost of GDP losses (Javorcik et al., 2024). Hinz and Monastyrenko (2022) find that consumers adjust their demand in response to sanctions, reducing their consumption of sanctioned products, as shown through a difference-in-differences analysis using wholesale and production data. I add to this strand of literature, providing evidence on how firms in non-

sanctioning economies such as Armenia adjust both the extensive and intensive margins in response to sanctions-induced disruptions and compliance risks.

The paper also adds to the literature on the distributional impacts of trade liberalization on the labor market (Autor, Dorn and Hanson, 2013; Autor et al., 2014; Ebenstein et al., 2014; Helpman et al., 2017; Autor, Dorn and Hanson, 2021; Dix-Carneiro et al., 2023; Kovak and Morrow, 2024). To the best of my knowledge, this paper is among the first to combine firm and worker evidence on the adjustment of a small non-sanctioning economy to sanctions on a major trading partner.

The paper proceeds as follows. Section 2 describes the sanctions timeline and Armenia's institutional setting. Section 3 introduces the customs, firm, and employee data and presents the descriptive evidence. Section 4 develops the empirical designs and reports the trade, firm, and worker results. Section 5 develops the model and its comparative statics. Section 6 maps the empirical moments into the model parameters and quantifies the contribution of indirect access. Section 7 concludes. Additional descriptives, regressions, event studies, and model derivations appear in Appendices A–D.

2 Timing of Sanctions

The Western sanctions imposed on Russia in 2022 expanded the measures introduced in 2014. The initial sanctions targeted Russian individuals, government officials, and entities through asset freezes and travel restrictions. In the later stage of the conflict in 2014, sanctions also involved trade of goods of great importance for the Russian economy, including arms, dual-use goods, and equipment required by the oil and gas industry (Ashford, 2016; Ahn and Ludema, 2020). All these efforts coincided with expansions in the list of Russian individuals and entities banned from accessing the Western capital markets and financial tools and led to retaliation from Russia, which restricted trade in selected agricultural products from the West (Crozet and Hinz, 2020; Hinz and Monastyrenko, 2022).

In response to Russia's recognition of independence of non-government-controlled areas in Ukraine's Donetsk and Luhansk regions, as well as the deployment of Russian troops into these territories, the European Union swiftly expanded its sanctions on February 23, 2022. These sanctions were broader and more restrictive along both the extensive and intensive margins. First, the new measures now covered more sectors, including not just arms or dual-use goods but also other advanced technologies such as quantum computing, sensitive machinery, transportation equipment, and maritime navigation. They also restricted exports of luxury goods. Imports of Russian commodities such as coal, iron, steel, wood, oil, gas were also banned. Further, the sanctions led to the withdrawal of many Western firms from Russia, leaving the production lines and other facilities and business operations that were subsequently taken over by Russian firms. Additionally, concerns over sanctions evasion led to scrutiny of similar product groups that could be misclassified in customs declarations to bypass restrictions. Over time, the EU broadened its scope, imposing additional controls on the transit of sanctioned goods through Russia to third countries. Chupilkin, Javorcik and Plekhanov (2024) offer a taxonomy of the products sanctioned by the EU at the 6-digit HS level based on announcements by the EU. Sonnenfeld et al. (2022) document more than 1000 firms that fled Russia. The list of sanctioned individuals and entities, subject to asset freezes or travel bans, had expanded to 1,800 individuals and 500 entities by the end of 2024. Furthermore, the sanctions also included restrictions on financial services and payment infrastructure: Russia was effectively cut off from the SWIFT system, the leading global platform for secure financial messaging and cross-border transactions, severely limiting its ability to conduct international payments.

3 Data and Background

In this section, I first describe the Armenian administrative datasets used in the analysis. I then present descriptive statistics on the Armenian economy, followed by a set of styl-

ized facts documenting changes in trade patterns, firm performance, and employee-level outcomes after sanctions on Russia were imposed.

3.1 Armenian Administrative Data

I combine three administrative sources from the State Revenue Committee of Armenia. Customs transactions run from January 2018 through December 2024.[2] The customs data cover all daily export and import transactions recorded between January 2018 and December 2024 and provide information about the goods traded, the volume and value of trade, the customs tax collected, and the origin/destination country. This includes trade both inside and outside the EAEU. The origin country is not separately identified for some imports reported under the EAEU regime (around 30%). In the baseline partner classification, I therefore assign these observations to Russia, an approximation that is quantitatively plausible given Russia's dominant role in Armenia's EAEU trade.[3] Where the information is available, a differentiated measure retains the individual EAEU partner. The traded goods with countries outside of the Eurasian Economic Union are classified by the Armenian classification system (called the Commodity Nomenclature of Foreign Economic Activity (CNFEA-2017)), which corresponds to the HS classification at the 6-digit level. Products traded with the EAEU are classified according to the EAEU's own classification, which again corresponds to the HS classification at the 6-digit level. The product-level analysis is conducted at the six-digit HS level. All product codes are harmonized to a common HS6 vintage using UN concordance tables of HS 2017 and HS2022. I take the informa-

[2]Access to Armenian administrative data has become possible thanks to the collaborative efforts between the Armenian Centre for Research in Economics (ACRE) and SRC of the Republic of Armenia. Currently, access to the data is limited to on-site use via a secure research facility hosted by the SRC. Researchers interested in using the data are required to submit a research proposal to ACRE, which conducts a preliminary review of the project's relevance and academic merit. Upon approval, ACRE forwards the proposal to the SRC for final authorization.

[3]Calculations from annual UN Comtrade data show that, during the complete sample years 2018–2024, Belarus, Kazakhstan, and Kyrgyzstan together accounted for only 2.7–4.9 percent of Armenia's imports from EAEU members, leaving Russia with 95.1–97.3 percent. Across imports and exports combined, the three countries accounted for 3.3–4.4 percent of Armenia's EAEU merchandise trade and only 0.9–1.7 percent of Armenia's total merchandise trade.

tion on sanctioned goods from Chupilkin, Javorcik and Plekhanov (2025), which identifies all 6-digit HS products sanctioned by the EU for trading with Russia. I also rely on UN COMTRADE data for robustness and certain descriptive statistics reported in Appendix B.

The firm- and employee-level annual administrative datasets span the years 2018 to 2023 and cover the entire universe of formally registered Armenian firms and workers. In the context of tax collection, all registered firms must report annually on each worker employed by the firm. As both the amount and the tax type collected are dependent on the turnover of the firm, each firm reports its annual turnover, along with the number of employees, main type of economic activity, wages paid to the employees, etc., to SRC. For the collection of the income tax, SRC maintains information on all the formally registered employees, including their annual salary, hours worked, age, sex, and firm of employment. The extract used in this paper does not contain a usable occupation classification as firms report an employee job title which is not standardized because SRC does not have a universal occupation classification. SRC assigns a unique identifier to each worker, which remains unchanged throughout the worker's lifetime. Similarly, each firm, upon entering the market, is assigned a unique taxpayer identification number (TIN). These identifiers enable the merging of employer information with employee information held in separate databases. The same anonymized firm identifier is used across the customs, firm, and worker datasets, allowing the records to be merged.

Armenia uses its own classification system for economic activity, which categorizes firms based on the primary industries in which they operate. This system is analogous to the European NACE Revision 2 classification and aligns with it at the aggregate sectoral level. One can differentiate industries at the 4-digit level and sectors at the 1-digit level, resulting in 21 sectors and 584 industries of economic activity. The location information of firms is available at the most aggregate level—the province (referred to as "marz" in Armenian), of which there are 11. Ten of these provinces (regions[4]) include both rural

[4]Hereafter, I will call these marzes regions.

and urban areas, while the remaining province, Yerevan, is the capital city and constitutes a separate entity.

3.2 Armenian Economy

Armenia has a population of 2.9 mln and a nominal GDP of 12.5 billion USD (in 2018), with the formal economy being highly concentrated both sectorally and geographically. In 2018, wholesale and retail trade accounted for 18.14 percent of formal employment, education for 17.60 percent, and manufacturing for 12.74 percent. Dual-trading firms (firms that both export and import) alone employed 52.98 percent of manufacturing workers and 77.56 percent of mining workers. Including exporter-only and importer-only firms, internationally trading employers accounted for 73.37 percent of manufacturing employment and 86.33 percent of mining employment (Table A1). Geographically, the capital, Yerevan, accounted for 55.31 percent of formal employment, whereas no other region accounted for more than 8.1 percent; approximately 59 percent of employment in the capital was located in internationally trading firms (Table A2). The firm distributions further show that most Armenian firms are non-traders and that importer-only firms are considerably more common than exporter-only or both exporting and importing firms, indicating that international activity is concentrated among a relatively small subset of firms (Table A3; Table A4). Conditional on year, activity, and region fixed effects, workers at dual-trading firms earn 0.36 log points more per hour than workers at non-trading firms; the corresponding differentials for exporter-only and importer-only firms are 0.20 and 0.19 log points (Table A5).

3.3 Facts on Armenia's Response to Sanctions

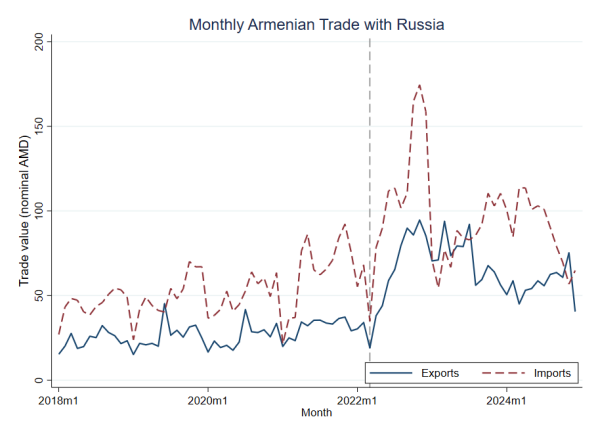
I document key facts and descriptive patterns characterizing Armenia's trade adjustments following the 2022 sanctions. These stylized facts provide motivation and context for the

empirical strategy that follows.

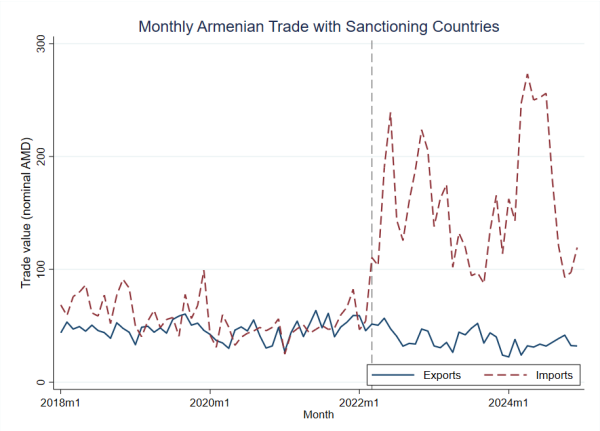
Figure 1: The Post-2022 Trade Boom and Its Geography



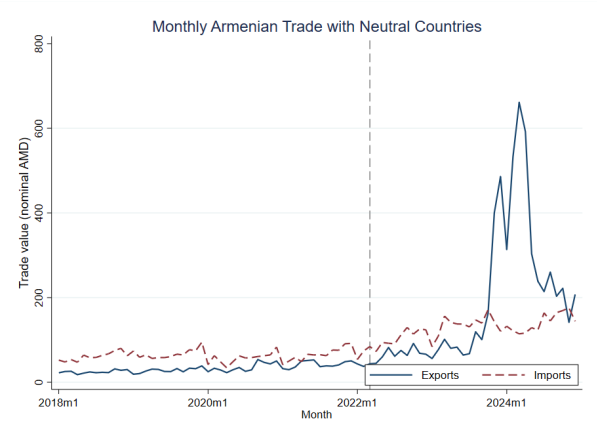
(a) All partners



(b) Russia



(c) Sanctioning partners



(d) Non-sanctioning partners

Notes: Each panel reports Armenia's raw monthly exports and imports from January 2018 through December 2024 for the indicated partner group. The blue solid line denotes exports and the red dotted line denotes imports. The dashed vertical line marks February 2022. Values are in current AMD. The panels are descriptive and do not net out common shocks or establish that the changes were caused by the sanctions. Source: Armenian customs microdata.

I divide Armenia's partners into *Russia, economies sanctioning Russia, and non-sanctioning economies*; Appendix Table B1 lists the classification.

Fact #1: the post-2022 trade boom is asymmetric across partner groups. Figure 1 documents a sharp increase in aggregate exports and imports, but with markedly different patterns across trade corridors. Trade with Russia rises on both sides (Panel

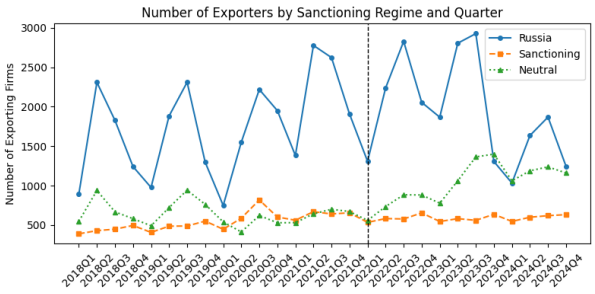
B), the adjustment with sanctioning economies is concentrated primarily in higher imports (Panel C), and exports to selected non-sanctioning destinations surge later in the sample (Panel D). These patterns are consistent with two potential directions of intermediation: goods sourced from sanctioning economies may be exported onward to Russia, while goods sourced from Russia may be redirected toward non-sanctioning destinations (rather than to sanctioning partners). The product composition reinforces this interpretation: the largest export increases occur in precious metals, electrical machinery, vehicles and automotive parts, and machinery and appliances, i.e. categories in which imports also rise substantially (Figure B3). Although these descriptive patterns do not trace individual goods from origin to final destination, they motivate the firm–product analysis of potential intermediation below. Longer-run trends and selected bilateral corridors are reported in Appendix Figure B1 and Figure B2, while changes in invoicing-currency shares are shown in Figure B7.

Fact #2: participation broadens mainly through importing, while product scope changes across all partner groups. Between 2021Q1 and 2023Q1, active importers rise from 7,964 to 12,568 (58 percent), whereas exporters rise from 2,137 to 2,649 (24 percent). These are stocks of active firms, not entry rates. Aggregate exported HS6 counts increase by 43 percent for non-sanctioning partners, 31 percent for Russia, and 27 percent for sanctioning partners. On the import side, HS6 counts increase by 17 percent for sanctioning partners, 16 percent for non-sanctioning partners, and 2 percent for Russia (Table 1, Panels A–B[5]). The stronger growth in importer participation is consistent with the relatively lower barriers to sourcing abroad in a small open economy, whereas exporting generally relies more heavily on destination-specific buyer relationships. Quarterly participation and product-count series are shown in Appendix Figure B4, Figure B5, and Figure B6.

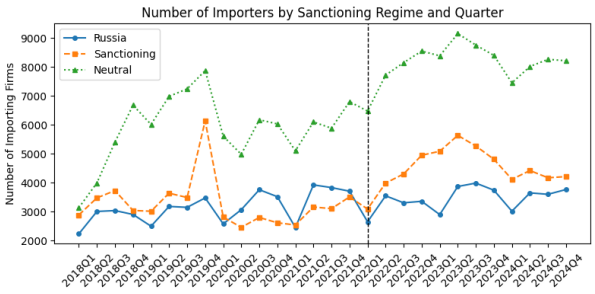
Fact #3: the export expansion is concentrated in sanctioned products and the

[5]A firm or product may appear in more than one partner group, so the group counts are not additive.

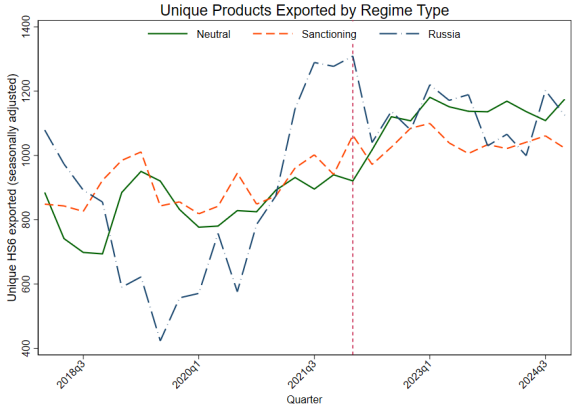
Figure 2: Firm Participation and Product Scope



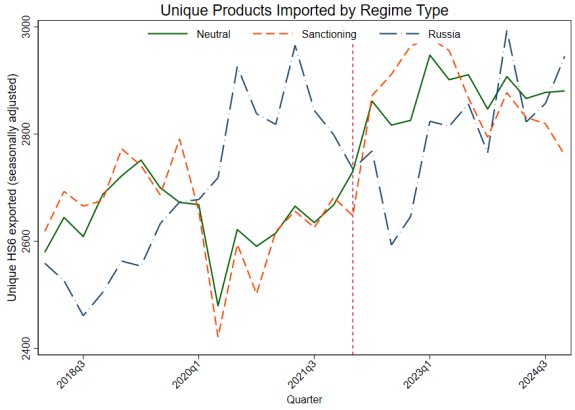
(a) Exporting firms



(b) Importing firms



(c) Exported HS6 products



(d) Imported HS6 products

Notes: Panels A–B report raw quarterly counts of Armenian firms exporting to or importing from Russia, sanctioning partners, and non-sanctioning partners. Panels C–D report raw counts of distinct HS6 products traded with each partner group. The dashed vertical line marks the first quarter of 2022. A firm or product may appear in more than one partner group in the same quarter, so group counts should not be summed to obtain the national total. Source: Armenian customs microdata.

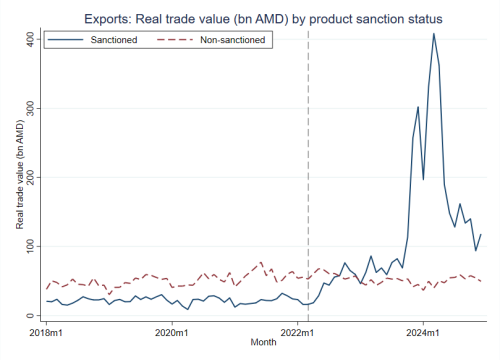
upper tail of the exporter distribution. Between 2021 and 2023, annual real exports of sanctioned products rise from AMD 257 billion to AMD 1,286 billion, while non-sanctioned exports fall from AMD 706 billion to AMD 587 billion. Consistently, between 2021Q1 and 2023Q1, the number of firms exporting sanctioned products increases by 59.6 percent, compared with only 3.1 percent for non-sanctioned products. The expansion is also highly skewed: between 2021Q4 and 2023Q4, the median firm-level export value doubles from USD 0.01 million to USD 0.02 million, while the 99th percentile rises nearly fivefold, from USD 3.56 million to USD 17.73 million (Table 1, Panels A, C, and D). These raw patterns show that the boom was neither broad-based across products nor evenly distributed across exporters, but they do not reveal whether upper-tail growth came from entrants, incumbent scaling, or intermediation.

Table 1: Descriptive Margins of the Trade Expansion

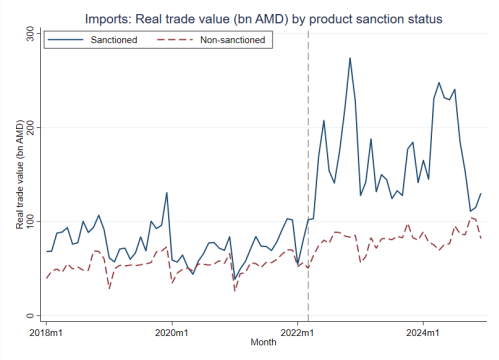
	Exports			Imports		
Metric	2021	2023	Change (%)	2021	2023	Change (%)
Panel A. Firm participation and within-firm-quarter distributions						
Active firms (Q1)	2,137	2,649	24	7,964	12,568	58
Median value per firm (Q4, mln USD)	0.01	0.02	100	0.01	0.01	0
P99 value per firm (Q4, mln USD)	3.56	17.73	398	2.38	2.67	12
Mean HS6 products per firm (Q1)	3.20	4.23	32	7.68	8.06	5
P99 HS6 products per firm (Q1)	25	38	52	80	86	8
Mean destinations/sources per firm (Q1)	1.29	1.26	-2	2.13	2.51	18
Panel B. Partner-group participation and aggregate product scope (Q1)						
Non-sanctioning: active firms	452	601	33	5,080	8,414	66
Sanctioning: active firms	510	483	-5	2,519	5,052	101
Russia: active firms	1,382	1,867	35	2,454	2,901	18
Non-sanctioning: unique HS6	686	980	43	2,612	3,023	16
Sanctioning: unique HS6	446	566	27	2,430	2,842	17
Russia: unique HS6	1,164	1,523	31	2,614	2,679	2
Panel C. Firm margins by sanctioned-product status (Q1)						
Non-sanctioned: active firms	1,481	1,527	3.1	4,888	7,677	57.1
Sanctioned: active firms	1,113	1,776	59.6	6,237	10,054	61.2
Non-sanctioned: mean HS6 per firm	2.67	3.49	30.7	5.25	5.23	-0.4
Sanctioned: mean HS6 per firm	2.59	3.30	27.6	5.71	6.09	6.5
Panel D. Annual real trade value (bn AMD)						
Non-sanctioned products	706	587	-17	656	946	44
Sanctioned products	257	1,286	400	891	1,771	99

Notes: The table contains raw descriptive comparisons and no regression estimates. Unless a row states otherwise, the comparison is 2021Q1 versus 2023Q1. Firm-value percentiles use Q4 in both years to match the same seasonal quarter. Panel D compares calendar years 2021 and 2023 and uses CPI-deflated AMD. Firms and products may appear in multiple partner or product groups. The complete underlying statistics remain in Appendix B in Tables B2, B4, B3, and B6. Source: Armenian customs microdata.

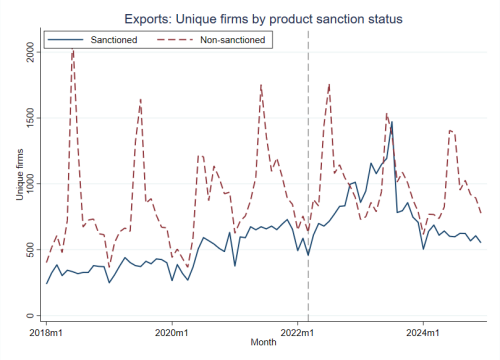
Figure 3: Sanctioned Goods and Potential Intermediation



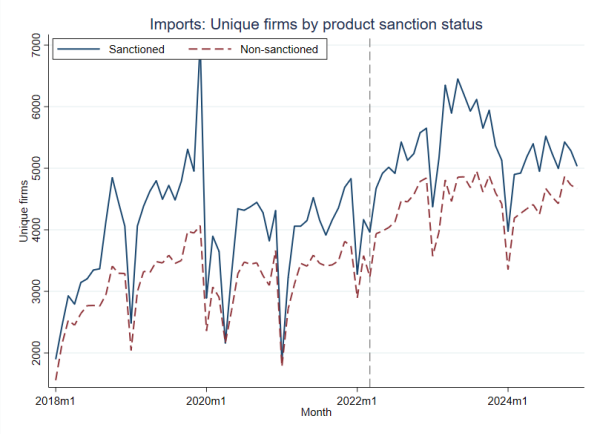
(a) Export value by product status



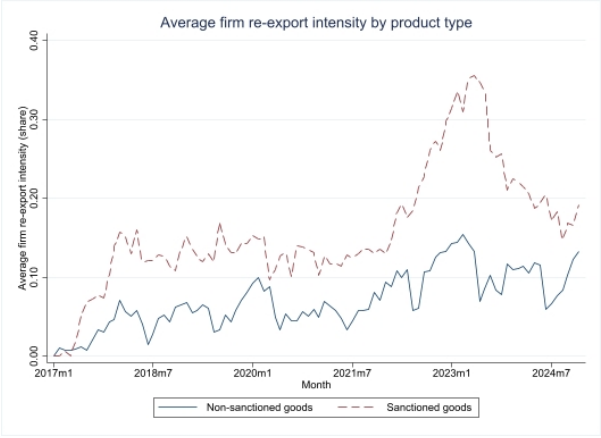
(b) Import value by product status



(c) Exporting firms by product status



(d) Importing firms by product status



(e) Potential intermediation (W12)

Notes: Panels A–D show raw trade values and active-firm counts separately for sanctioned and non-sanctioned HS6 products; values are reported in the units shown on the original axes. Panel E reports the monthly mean, across exporting firm–HS6 cells, of the share of export volume covered by the same firm's imports of that HS6 product during the preceding 12 months (the W12 measure defined in (1)). W12 is a measure of potential same-firm intermediation; it does not establish that the good has zero Armenian value added. The aggregate W12 series remains in Appendix B. Source: Armenian customs microdata.

Fact #4: potential same-firm intermediation becomes more sanctioned-product intensive, broader, and Russia oriented. For each firm f, HS6 product g, and month t with positive exports, I define potential same-firm intermediation as

$$W12_{fgt} = \min\left\{1, \frac{\sum_{\ell=1}^{12} Q^{\text{imp}}_{fg,t-\ell}}{Q^{\text{exp}}_{fgt}}\right\}, \qquad Q^{\text{exp}}_{fgt} > 0, \tag{1}$$

where Q^{exp}_{fgt} is the firm's export volume of product g in month t, and $Q^{\text{imp}}_{fg,t-\ell}$ is the same firm's import volume of the same product ℓ months earlier. Export and import volumes are measured using the same customs gross-weight variable. Months with no recorded imports contribute zero to the numerator. The ratio is capped at one, so $W12_{fgt}$ is the share of current export volume that could be covered by the firm's imports of the same product during the preceding twelve months. The corresponding potentially intermediated volume is $W12_{fgt}Q^{\text{exp}}_{fgt}$.

Because the numerator is a rolling measure rather than a depleted inventory stock, the same earlier import can enter more than one overlapping twelve-month window. W12 should therefore be interpreted as potential coverage rather than as a shipment-level re-export share. It does not identify the same physical shipment, domestic processing or value added, inventory depletion, or legal evasion. Panel (e) of Figure 3 shows a larger post-2022 increase in W12 for sanctioned products. The corresponding aggregate series is reported in Appendix Figure B9.

Table 2 shows that measured intermediated volume deconcentrates sharply: the top firm's share falls from 81.1 to 13.5 percent and the number of firms needed to cover half of W12 volume rises from one to 53. The Russia destination share rises from 14.4 to 80.4 percent. Intermediaries are larger, trade more products and origins, and have a higher sanctioned-product share than other exporters, but these are selected cross-sectional differences, not effects of becoming an intermediary. Complete tables are reported in Ap-

pendix Table B9, Table B10, Table B11, and Table B12.

Table 2: Descriptive Composition and Concentration of Potential Intermediation

Metric	2021	2023
Panel A. Concentration of intermediated export volume		
Top-1 firm share (%)	81.1	13.5
Top-5 firms share (%)	85.1	24.4
Top-10 firms share (%)	87.3	29.0
Firms required to cover 50%	1	53
Firms required to cover 90%	20	476
Top-5 HS6 products share (%)	85.2	41.4
HS6 products required to cover 50%	1	9
Panel B. Destination and size composition		
Russia share of intermediated volume (%)	14.4	80.4
Sanctioning-partner share (%)	0.9	1.3
Non-sanctioning-partner share (%)	84.8	18.2
Largest employment quartile share (%)	9.1	55.3
Largest turnover quartile share (%)	96.4	74.9
Sanctioned-product export HHI	0.057	0.051
Non-sanctioned-product export HHI	0.137	0.121

	2021		2023	
Exporter characteristic	Other exporters	Intermediaries	Other exporters	Intermediaries
Panel C. Characteristics of intermediaries and other exporters				
Mean employment	20.7	98.6	19.9	70.0
Mean turnover (mn AMD)	584	4,196	645	3,135
Median export value (mn AMD)	2.4	9.0	2.8	32.6
Mean HS6 products exported	2.5	9.9	3.1	7.1
Mean export destinations	1.1	2.2	1.2	1.8
Mean import sources	0.3	7.7	0.6	8.0
Sanctioned-product value share (%)	32.1	59.0	35.7	73.3

Notes: Potential intermediation is positive W12 intermediated export volume: exports of an HS6 product covered by the same firm's imports of that product during the preceding 12 months. Size quartiles are fixed using 2021 firm characteristics, with Q4 the largest. The HHI rows measure concentration of firm export shares within month and product-sanction status and are averaged over the year; they are not W12 concentration measures. The complete underlying tables remain in Appendix B as Tables B9, B10, B11, B12. Source: Armenian customs and firm administrative data.

These facts show that Armenia's post-2022 trade boom was highly uneven. Imports expanded particularly from sanctioning economies, while export growth was concentrated toward Russia and selected non-sanctioning destinations; participation broadened mainly through importing; and export growth was concentrated among the largest firms and in sanctioned products. Most strikingly, the number of firms exporting sanctioned goods rose by 59.6 percent, compared with only 3.1 percent for non-sanctioned goods, while imports and exports increased together in several leading product categories. These patterns motivate three parts of the empirical analysis. First, I examine how the adjustment differs

across Russia, sanctioning partners, and non-sanctioning partners. Second, I test whether it is disproportionately concentrated in sanctioned rather than non-sanctioned products. Third, I investigate the central intermediation hypothesis: that potential intermediation (importing a product before exporting the same HS6 product onward) was an important margin through which Armenian trade expanded, particularly for sanctioned goods.

4 Estimation and Results

4.1 Effects on Trade

The aggregate trade boom can arise through several distinct margins: firms may form or terminate partner relationships, continuing firms may reorganize their product baskets, active trade lines may change in size, previously inactive cells may begin trading, and imported goods may increasingly be routed into subsequent exports. I examine these margins in that order. I first study firm entry, exit, relationship persistence, and product scope. I then condition on positive firm–product–partner flows to examine changes in physical volume, trade value, and recorded unit values. Next, I broaden the analysis to sanctioned-product participation, zero-inclusive outcomes, and dynamic responses around the dates on which products were first listed in EU sanctions packages. Finally, I test potential intermediation directly. Throughout, Russia and sanctioning partners are compared with non-sanctioning partners, while sanctioned products are compared with non-sanctioned products.

4.1.1 Extensive-margin adjustment

Firm entry, exit, and relationship persistence. The descriptive increase in the number of active traders can reflect new entry, lower exit, or repeated participation by incumbent firms. To distinguish these margins, I study whether the formation and termination of firm–partner relationships, and product-basket changes within continuing relationships, evolved

differently across partner groups after 2022. I construct four partner–quarter outcomes: the firm-entry rate, firm-exit rate, product-addition rate, and product-drop rate. I estimate the following specification separately for each outcome and separately for exports and imports:

$$Y_{p,t} = \beta_S \left[\text{Sanctioning}_p \times Post_t\right] + \beta_R \left[\text{Russia}_p \times Post_t\right] + \alpha_p + \tau_t + \varepsilon_{p,t}. \tag{2}$$

The dependent variable $Y_{p,t}$ denotes one of the four transition rates for partner p in quarter t. For exports, p denotes the destination country; for imports, it denotes the origin country. Sanctioning_p and Russia_p identify sanctioning partners and Russia, respectively, while non-sanctioning partners form the omitted group. $Post_t$ equals one from 2022Q2 onward. Partner fixed effects α_p absorb permanent differences across destinations or origins, and quarter fixed effects τ_t absorb seasonality and shocks common to all partner groups. Thus, β_S and β_R measure the differential post-2022 change in the relevant transition rate for sanctioning partners and Russia relative to non-sanctioning partners.

The outcomes distinguish short-run transitions from product-basket changes within continuing relationships. The entry rate is the share of firms trading with partner p in quarter t that did not trade with that partner in $t-1$; a firm returning after a temporary interruption is therefore counted as an entrant (Dunne, Roberts and Samuelson, 1988). The exit rate is defined symmetrically as the share of firms active with partner p in t that are not observed with that partner in $t+1$. An intermittent relationship can consequently generate more than one entry or exit over the sample. Product-addition and product-drop rates are calculated among firms that continue trading with the same partner across adjacent quarters. They indicate whether at least one HS6 product enters or leaves the firm's partner-specific basket.

The estimates shown in Table 3 do not indicate a broad increase in new Russia-facing relationships. Relative to non-sanctioning destinations, exporter entry into Russia falls by 9.4 percentage points, while exporter exit falls by 8.4 percentage points. Lower entry is

Table 3: Entry, Exit, and Product Adjustment Rates

	Exporters		Importers		Export Product Mix		Import Product Mix	
	Entry Rate (1)	Exit Rate (2)	Entry Rate (3)	Exit Rate (4)	Add Rate (5)	Drop Rate (6)	Add Rate (7)	Drop Rate (8)
$Sanctioning \times Post_t$	-0.025	-0.015	0.014	0.002	0.020	0.014	-0.001	-0.008
	(0.029)	(0.034)	(0.014)	(0.014)	(0.013)	(0.014)	(0.009)	(0.010)
$Russia \times Post_t$	-0.094***	-0.084***	-0.027**	-0.033***	0.074***	0.068***	0.010	0.000
	(0.022)	(0.026)	(0.012)	(0.013)	(0.010)	(0.012)	(0.007)	(0.008)
Partner FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,306	2,305	4,002	3,985	2,306	2,306	4,002	4,002

Standard errors clustered by partner in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: All regressions are estimated at the partner-quarter level using linear fixed-effects regressions with partner and quarter fixed effects. Neutral partners are the reference group. Entry is defined as the share of firms trading with a partner in quarter t but not in $t-1$, so re-entry after a temporary gap is included. Exit is defined as the share of firms trading with a partner in quarter t but not in $t+1$. Product add and drop rates are computed only among continuing firm-partner relationships, meaning firms must trade with the same partner in both adjacent quarters. Add equals one when a continuing firm adds at least one HS6 product relative to the previous quarter; drop equals one when it drops at least one HS6 product. $Post_t$ equals one from 2022Q2 onward. Source: Armenian Customs Data.

therefore paired with greater persistence: fewer firms start or restart exporting to Russia, but active relationships are also less likely to terminate. The same pattern appears on the import side, where entry from Russia falls by 2.7 percentage points and exit falls by 3.3 percentage points. The corresponding quarterly coefficients for sanctioning partners are generally small and statistically insignificant.

Adjustment within continuing export relationships is more pronounced. The probability of adding at least one product to a Russia-bound basket rises by 7.4 percentage points, while the probability of dropping at least one product rises by 6.8 percentage points. Because both margins increase, the result indicates product-basket reshuffling rather than uniform diversification. By contrast, the Russia coefficients for import additions and drops are close to zero. The quarter-to-quarter results therefore point to more persistent Russia-linked relationships together with substantial product turnover among continuing exporters.

The adjacent-quarter measures above capture short-run entry, exit, and product turnover,

but because temporary interruptions and subsequent returns are counted as new transitions, they cannot distinguish such churn from the first formation or final termination of a relationship; Table 4 addresses this limitation using first and final observed appearances over the full customs history, following Haidar (2017). A firm–partner pair contributes at most one *first entry*, defined as the first quarter in which it is observed trading with that partner, and at most one *final exit*, defined as the last quarter in which it is observed doing so. Likewise, an HS6 product contributes at most one first addition and one final drop within a firm–partner basket. Thus, temporary inactivity followed by re-entry is counted by the baseline transition measure but does not create a second event in the Haidar-style measure. The baseline therefore captures quarter-to-quarter churn, whereas the Haidar-style definition places greater weight on longer-run formation and termination over the observed sample. Because the customs panel begins in 2018 and ends in December 2024, these are first and final *observed* appearances, not necessarily the true lifetime birth or death of a relationship.

Table 4: Entry, Exit, and Product Adjustment Rates: Haidar-Style Definition

	Exporters		Importers		Export Product Mix		Import Product Mix	
	First Entry	Final Exit	First Entry	Final Exit	First Add	Final Drop	First Add	Final Drop
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Sanctioning \times Post_t$	-0.036	-0.018	0.042***	-0.003	0.017	0.023	0.012	0.037***
	(0.030)	(0.030)	(0.014)	(0.015)	(0.015)	(0.016)	(0.010)	(0.010)
$Russia \times Post_t$	-0.092***	-0.059**	-0.020	-0.114***	0.060***	0.056***	-0.017**	0.033***
	(0.023)	(0.024)	(0.012)	(0.014)	(0.012)	(0.014)	(0.008)	(0.009)
Partner FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,306	2,305	4,002	3,985	2,306	2,305	4,002	3,985

Standard errors clustered by partner in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: All regressions are estimated at the partner-quarter level using linear fixed-effects regressions with partner and quarter fixed effects. Neutral partners are the reference group. This table uses a Haidar-style first/last appearance definition. First entry is the first quarter in which a firm is ever observed trading with a partner. Final exit is the last quarter in which a firm is ever observed trading with that partner. First add is the first-ever appearance of an HS6 product in a firm-partner product basket. Final drop is the last-ever appearance of an HS6 product in that basket. This definition captures longer-run extensive-margin restructuring rather than repeated quarter-to-quarter entry, exit, addition, or dropping. $Post_t$ equals one from 2022Q2 onward. Source: Armenian Customs Data.

The alternative definition in Table 4 broadly reinforces the Russia-facing persistence pattern found using adjacent-quarter transitions in Table 3. Relative to non-sanctioning destinations, the first-entry rate for exporters to Russia falls by 9.2 percentage points, while the final-exit rate falls by 5.9 percentage points. Thus, the post-2022 expansion in Russia-bound exports was not associated with a disproportionate increase in firms establishing their first observed export relationship with Russia. Instead, established relationships became less likely to reach their final observed termination. On the import side, first entry from Russia does not change significantly, whereas final exit falls by 11.4 percentage points, again pointing to greater persistence rather than increased formation of Russia-facing relationships.

The product results indicate substantial adjustment within these relationships. For exports to Russia, first product additions and final product drops rise by 6.0 and 5.6 percentage points, respectively. Because both margins rise, the evidence indicates product-basket turnover rather than uniform diversification. For imports from Russia, first product additions fall by 1.7 percentage points and final product drops rise by 3.3 percentage points, consistent with a narrowing or reorientation of Russian sourcing. The pattern differs for sanctioning origins: first importer entry rises by 4.2 percentage points, while final importer exit does not change significantly. Final product drops from sanctioning origins also rise by 3.7 percentage points, suggesting that new sourcing relationships were formed alongside turnover within import baskets (Table 4).

Accordingly, the conclusion that entry did not increase should be restricted to Russia-facing relationships and should not be generalized to every partner group. The Haidar-style results provide evidence of greater first entry into importing from sanctioning economies. More generally, the adjacent-quarter and Haidar-style measures are complementary rather than interchangeable: the former captures short-run entry, exit, and re-entry, whereas the latter isolates first and final appearances observed over the sample. Neither table measures changes in trade values; the corresponding aggregate country-level trade-value specifica-

tion is reported separately in Appendix Table C1.

Product scope and basket composition within continuing relationships. The preceding addition and drop rates measure whether a continuing firm–partner basket changes at all. They do not reveal how many products are added, whether the total breadth of the basket changes, or whether its composition shifts toward sanctioned goods. I therefore turn to monthly firm–partner outcomes and estimate, separately for exports and imports,

$$Y_{i,p,t}^{k} = \beta_{S}^{k}\left[\text{Sanctioning}_{p} \times Post_{t}\right] + \beta_{R}^{k}\left[\text{Russia}_{p} \times Post_{t}\right] + \alpha_{i,p} + \tau_{t} + \varepsilon_{i,p,t}^{k}. \tag{3}$$

Here, i denotes the firm, p the export destination or import origin, and t the month. The outcome $Y_{i,p,t}^{k}$ varies across specifications. In Table 5, the outcomes are total product scope, measured as $\log(1 + \#\text{ HS6 products})$, and gross product additions, measured as $\log(1 + \#\text{ HS6 products newly added})$ relative to the same firm–partner basket in the preceding month. In Table 6, the outcomes are the sanctioned-product share, the sanctioned-value share, $\log(1 + \#\text{ sanctioned products})$, and $\log(1 + \#\text{ non-sanctioned products})$. The sanctioned-product share is based on the number of HS6 products, whereas the sanctioned-value share is based on real trade value. The $\log(1+x)$ transformation retains zero counts, including months with no newly added products or no products of a given sanction status. Firm–partner fixed effects $\alpha_{i,p}$ absorb permanent differences in the breadth and composition of each relationship, while month fixed effects τ_t absorb shocks common to all relationships. Non-sanctioning partners form the reference group. Consequently, β_S^k and β_R^k measure whether the same firm's basket with a sanctioning partner or Russia changes differentially after February 2022 relative to its relationships with non-sanctioning partners.

Table 5 first examines basket breadth and gross product additions. Russia-bound export scope does not change significantly relative to non-sanctioning destinations, while the $\log(1 + \#)$ measure of newly added products rises by 0.03 log points. Combined with the earlier finding that both the probability of adding and the probability of dropping a

Table 5: Post-2022 Changes in Product Scope Within Firm–Partner Relationships (HS6, Monthly)

	Exports		**Imports**	
	Product Scope	Products Added	Product Scope	Products Added
	(1)	(2)	(3)	(4)
$Sanctioning \times Post_t$	-0.04***	0.01	-0.05**	-0.05
	(0.01)	(0.01)	(0.02)	(0.03)
$Russia \times Post_t$	-0.00	0.03***	-0.10***	-0.09***
	(0.01)	(0.01)	(0.02)	(0.03)
Firm×Partner FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
R^2	0.77	0.56	0.68	0.53
N	104,430	103,852	906,679	901,640

Standard errors clustered by partner in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The unit of observation is firm × partner × month. Product scope is measured as $\log(1 + \#\text{HS6 products})$. Products added is measured as $\log(1 + \#\text{HS6 products added})$ relative to the firm's product bundle with the same partner in the previous month. The omitted group is non-sanctioning partners. $Post_t$ equals one after February 2022. All regressions absorb firm–partner and month fixed effects.

product rise within continuing Russia-bound relationships, this points to greater product turnover without a net broadening of export baskets. Export scope toward sanctioning destinations falls by 0.04 log points relative to non-sanctioning destinations, without a significant change in additions. On the import side, product scope falls by 0.10 log points for Russia and by 0.05 log points for sanctioning origins, while additions from Russia fall by 0.09 log points. Thus, the post-2022 adjustment involves product turnover and basket narrowing rather than broad partner-specific diversification.

Changes in total product scope do not reveal whether this reorganization is concentrated among sanctioned or non-sanctioned products. Table 6 therefore decomposes each basket by sanctioned status using the same specification in Equation (3).

Exports to sanctioning destinations become less sanctioned-product intensive: the sanctioned-product and sanctioned-value shares fall by 2.0 and 2.6 percentage points, respectively, and the transformed count of sanctioned products also declines, while the transformed

Table 6: Basket Switching Across Destinations and Origins

	Exports				Imports			
	Share Sanctioned Products (1)	Share Sanctioned Value (2)	$\ln(1+\#$ Sanctioned Products) (3)	$\ln(1+\#$ Non-sanctioned Products) (4)	Share Sanctioned Products (5)	Share Sanctioned Value (6)	$\ln(1+\#$ Sanctioned Products) (7)	$\ln(1+\#$ Non-sanctioned Products) (8)
$Sanctioning \times Post_t$	-0.020***	-0.026***	-0.042***	-0.008	0.003	0.009	-0.041	-0.032*
	(0.007)	(0.008)	(0.008)	(0.015)	(0.008)	(0.008)	(0.030)	(0.018)
$Russia \times Post_t$	0.011**	0.007	0.034***	-0.030**	0.014**	0.022***	-0.092***	-0.068***
	(0.004)	(0.005)	(0.005)	(0.013)	(0.007)	(0.008)	(0.028)	(0.017)
Firm-partner FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	104,430	104,430	104,430	104,430	906,679	906,671	906,679	906,679
R^2	0.896	0.902	0.824	0.818	0.713	0.712	0.706	0.686

Standard errors clustered by partner in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The regressions are estimated at the firm-partner-month level with firm-partner and month fixed effects. Columns (1)–(4) use export baskets by destination; columns (5)–(8) use import baskets by origin. The sanctioned-product shares are computed either by number of HS6 products or by real trade value. The product-count outcomes are transformed as $\ln(1+x)$. Non-sanctioning partners are the reference group. $Post_t$ equals one from March 2022 onward. Source: Armenian Customs Data.

count of non-sanctioned products does not change significantly. Russia-bound export baskets move in the opposite direction in product-count terms. Their sanctioned-product share rises by 1.1 percentage points, the transformed count of sanctioned products rises by 0.034 log points, and the transformed count of non-sanctioned products falls by 0.030 log points. The sanctioned-value share does not rise significantly, indicating a reallocation in product-count composition rather than a disproportionate increase in sanctioned export value.

The import results likewise indicate concentration rather than broad expansion. Within firm–Russia import relationships, the sanctioned-product and sanctioned-value shares rise by 1.4 and 2.2 percentage points, respectively, even though the transformed counts of both sanctioned and non-sanctioned products fall. Russian import baskets therefore become relatively more concentrated in sanctioned goods while narrowing overall. By contrast, import baskets sourced from sanctioning partners show no significant change in either the sanctioned-product or the sanctioned-value share. The transition rates, Table 5, and Table 6 distinguish relationship entry and persistence, product turnover, basket breadth, and sanctioned-product composition. The next subsection turns to the intensive margin

by examining how volume, value, and recorded unit values change within positive firm–product–partner flows.

4.1.2 Adjustment within positive trade flows

The extensive-margin results establish whether firms and products enter, exit, or change their participation in particular markets. I now ask a distinct question: conditional on a firm–product–partner flow being positive, how do its physical volume, value, and recorded unit value change after 2022? This distinction helps separate larger flows within established relationships from changes in the firms, products, and partners represented in the observed trade basket.

Partner-specific responses. I begin with a specification that follows positive firm–product–partner flows over time:

$$\log y_{i,g,p,t} = \beta_S \left[\text{Sanctioning}_p \times Post_t\right] + \beta_R \left[\text{Russia}_p \times Post_t\right] + \lambda_{i,g,p} + \tau_t + \varepsilon_{i,g,p,t}. \quad (4)$$

The outcome $y_{i,g,p,t}$ is, in separate regressions, physical volume, trade value, or recorded unit value for firm i, HS6 product g, partner p, and month t. The specification is estimated separately for exports and imports. Firm–product–partner fixed effects $\lambda_{i,g,p}$ absorb time-invariant differences in the size and composition of each trade relationship, while month fixed effects τ_t absorb seasonality and shocks common to all partners. Thus, β_S and β_R measure differential post-2022 changes in positive flows involving sanctioning partners and Russia, respectively, relative to positive flows involving non-sanctioning partners.

Equation (4) corresponds to Panel A of Table 7. The remaining panels alter the fixed-effect structure to ask whether the pattern persists when the products and partners in a firm's active basket may change and when firm-wide and product-wide monthly shocks are absorbed. The panels therefore recover economically distinct comparisons. Panel A follows

the same positive firm–product–partner flow over time. Panel B uses firm and month fixed effects, allowing the products and partners represented in a firm's observed trade basket to change. Panel C returns to firm–product–partner fixed effects and additionally absorbs firm–month and product–month shocks. It isolates partner-specific reallocation after removing both firm-wide monthly scaling and product-wide monthly conditions.

Table 7: Partner-Specific Trade Responses Across Fixed-Effect Structures

	Exports			Imports		
	Volume	Value	Unit value	Volume	Value	Unit value
Panel A. Firm–product–partner and month fixed effects						
$Sanctioning \times Post_t$	-0.10***	-0.05**	0.04***	0.05***	0.07***	0.02***
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.00)
$Russia \times Post_t$	0.07***	0.14***	0.07***	0.03***	0.08***	0.05***
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.00)
Observations	295,987	295,987	295,987	3,319,692	3,319,570	3,319,514
Panel B. Firm and month fixed effects						
$Sanctioning \times Post_t$	-0.15***	-0.17***	-0.03	0.02**	0.13***	0.12***
	(0.03)	(0.03)	(0.02)	(0.01)	(0.01)	(0.00)
$Russia \times Post_t$	0.03	0.04	0.01	0.18***	0.16***	-0.02***
	(0.03)	(0.02)	(0.01)	(0.01)	(0.01)	(0.00)
Observations	378,927	378,926	378,926	4,060,609	4,060,441	4,060,367
Panel C. Firm–product–partner, firm–month, and product–month fixed effects						
$Sanctioning \times Post_t$	-0.08*	0.01	0.09***	-0.08***	-0.07***	0.01**
	(0.05)	(0.05)	(0.02)	(0.01)	(0.01)	(0.00)
$Russia \times Post_t$	-0.24***	-0.10**	0.14***	-0.16***	-0.16***	-0.01
	(0.04)	(0.05)	(0.02)	(0.01)	(0.01)	(0.01)
Observations	203,317	203,317	203,317	3,091,655	3,091,525	3,091,467

Notes: OLS estimates at the firm–HS6–partner–month level. Outcomes are log physical volume, log trade value, and log recorded unit value. Only positive flows enter these specifications. Non-sanctioning partners are the omitted group, and $Post_t$ begins after February 2022. Panel A identifies changes within an established firm–product–partner relationship. Panel B permits the product and partner composition of a firm's trade to change. Panel C absorbs firm-wide and product-wide monthly shocks and identifies partner-specific reallocation within firm and product time cells. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Panel A shows that the initial adjustment occurred partly within established trade relationships. For Russia-bound exports, the 0.14-log-point increase in value is divided almost evenly between a 0.07-log-point increase in physical volume and a 0.07-log-point increase

in recorded unit value. Incumbent Russia-facing relationships therefore expanded both the quantity shipped and the value recorded per unit, consistent with improved effective access to Russian demand. Exports to sanctioning destinations exhibit the opposite quantity response: volume falls by 0.10 log points, while higher unit values partly offset the resulting decline in export value. Taken at face value, these patterns are consistent with a redirection of established export activity toward Russia rather than a uniform expansion across destinations.

The more saturated specification shows, however, that much of this apparent Russia-specific expansion is shared with the firms and products involved. After absorbing firm-wide monthly scaling and product-wide monthly conditions, the Russia export coefficients become -0.24 for volume and -0.10 for value, while recorded unit value rises by 0.14 log points. Because export value is the product of volume and unit value, this combination means that Russia-bound physical shipments decline relative to non-sanctioning destinations, but their value declines considerably less because recorded value per unit increases. The Russia-facing adjustment is therefore better characterized as a lower-volume, higher-unit-value reallocation than as a broad quantity boom within comparable trade lines. Higher unit values could reflect stronger markups under reduced competition, the pass-through of higher transport and compliance costs, scarcity premia, changes in quality or contract terms, or shifts among varieties within HS6 categories; the customs data cannot distinguish among these channels.

Imports display a similarly compositional pattern. In Panel B, where the product and partner composition of each firm's active basket may change, the Russian import response is primarily quantity-driven: volume and value rise by 0.18 and 0.16 log points, respectively, while unit values fall slightly. Imports from sanctioning partners instead become more unit-value intensive, with value rising by 0.13 log points but volume by only 0.02 log points. Once firm-wide and product-wide monthly shocks are absorbed in Panel C, however, import volume and value from both Russia and sanctioning partners fall relative to

non-sanctioning origins. Thus, the import boom appears to operate mainly through the expansion of particular firms and products and through changes in the composition of sourcing, rather than through uniformly larger flows within every established relationship. The evidence points to a reorganization of firms' trade networks—combining firm-wide scaling, product and partner reallocation, and higher recorded unit values on Russia-bound exports—rather than a generalized increase in physical trade along all Russia-linked relationships.

Pooled sanctioned-product scaling within positive flows. The partner comparisons do not yet ask whether active sanctioned-product lines changed differently from active non-sanctioned lines. Pooling partner groups, I therefore estimate variants of

$$\log y^k_{i,g,p,t} = \gamma^k \left[S_g \times Post_t\right] + \lambda_{i,g} + \phi_{i,t} + \varepsilon^k_{i,g,p,t}, \tag{5}$$

where S_g identifies HS6 products covered by the EU sanctions list and $y^k_{i,g,p,t}$ is physical volume, value, or recorded unit value. Firm–product fixed effects $\lambda_{i,g}$ absorb persistent differences in a firm's trade across products, while firm–month fixed effects $\phi_{i,t}$ absorb the firm's overall monthly expansion or contraction. In this most demanding specification, γ^k is identified from differential changes between a firm's sanctioned and non-sanctioned positive trade lines in the same month. Table 8 also reports less restrictive specifications with firm and month fixed effects and with firm–product and month fixed effects. The exercise is informative about scaling within observed sanctioned-product activity, but because it pools partners it cannot determine whether the lines connect sanctioning origins to Russia.

In the most demanding specification of Table 8, there is no positive differential increase in the volume, value, or recorded unit value of sanctioned goods within positive trade observations. The export-value coefficient is weakly negative, while the remaining export and import coefficients are statistically indistinguishable from zero. Thus, once firm-wide

Table 8: Sanctioned goods after February 2022: within-cell (intensive) margins

	FE: F, M			FE: F×P, M			FE: F×P, F×M		
	vol	value	UV	vol	value	UV	vol	value	UV
Panel A: Exports									
Sanctioned × Post	−0.079	−0.178***	−0.099***	0.054	−0.023	−0.077*	−0.064	−0.071*	−0.006
	(0.075)	(0.062)	(0.036)	(0.060)	(0.055)	(0.040)	(0.043)	(0.041)	(0.024)
Obs	380,095	380,095	380,095	379,324	379,324	379,324	305,689	305,689	305,689
Panel B: Imports									
Sanctioned × Post	−0.023	−0.076**	−0.053***	−0.042***	−0.034***	0.008	−0.019	−0.004	0.015
	(0.031)	(0.030)	(0.018)	(0.012)	(0.012)	(0.011)	(0.013)	(0.012)	(0.010)
Obs	3,948,951	3,948,951	3,948,951	3,944,630	3,944,630	3,944,630	3,211,957	3,211,957	3,211,957

Notes: OLS on the firm×HS6×partner×month customs panel, positive flows only. Outcomes are log physical volume, log CPI-deflated value, and log unit value. *Sanctioned* = HS6 on the EU sanctions list; *Post* = March 2022 onward. Product×month fixed effects cannot be included because treatment varies only at the product×time level; the tightest identified specification interacts firm×product and firm×month effects, so identification comes from within-firm, within-month differences between sanctioned and non-sanctioned lines. Standard errors clustered by HS6. The absence of within-cell effects, against the ninefold aggregate rise, indicates adjustment on the extensive margin. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

monthly scaling is absorbed, sanctioned positive-flow lines do not expand faster than non-sanctioned lines within the same firm and month. The aggregate sanctioned-product boom is therefore not explained by uniform within-firm intensive scaling. Because the sample conditions on positive flows, these estimates do not capture the activation or disappearance of trade lines.

Partner-specific sanctioned-product heterogeneity. I next ask whether the partner-specific changes within active flows differ for products covered by EU sanctions against Russia. I estimate

$$\begin{aligned}\log y_{i,g,p,t} = {} & \beta_S(\text{Sanctioning}_p \times Post_t) + \beta_R(\text{Russia}_p \times Post_t) + \beta_G(S_g \times Post_t) \\ & + \theta_S(\text{Sanctioning}_p \times Post_t \times S_g) + \theta_R(\text{Russia}_p \times Post_t \times S_g) \\ & + \lambda_{i,g,p} + \tau_t + \varepsilon_{i,g,p,t},\end{aligned} \tag{6}$$

where S_g identifies sanctioned HS6 products using Chupilkin, Javorcik and Plekhanov (2025). The triple interactions θ_S and θ_R measure whether the post-2022 change for

sanctioned products differs in flows involving sanctioning partners or Russia, relative both to non-sanctioned products and to non-sanctioning partners. They are differential effects, not the total post-2022 effects for sanctioned trade; the latter also depend on the lower-order interactions. For example, the total post-2022 differential for a sanctioned product exported to Russia is $\beta_R+\beta_G+\theta_R$. The coefficient θ_R alone measures the additional Russia–sanctioned differential beyond the separate Russia and sanctioned-product components. Time-invariant partner-group and product-status terms are absorbed by the relationship fixed effects. Equation (6) corresponds to Panel A. Panel B instead absorbs firm–partner, firm–product, firm–month, and partner–month fixed effects, removing permanent firm-specific partner and product differences as well as firm-wide and partner-wide monthly shocks.

Table 9: Partner-Specific Sanctioned-Product Responses Within Positive Trade Flows

	Exports			Imports		
	Volume	Value	Unit value	Volume	Value	Unit value
Panel A. Firm–product–partner and month fixed effects						
$Sanctioning \times Post_t \times S$	0.17***	-0.04	-0.22***	-0.01	0.02**	0.03***
	(0.05)	(0.05)	(0.03)	(0.01)	(0.01)	(0.01)
$Russia \times Post_t \times S$	0.30***	0.06	-0.25***	-0.08***	-0.09***	-0.00
	(0.04)	(0.04)	(0.02)	(0.01)	(0.01)	(0.01)
Observations	295,987	295,987	295,987	3,319,692	3,319,570	3,319,514
Panel B. Firm–partner, firm–product, firm–month, and partner–month fixed effects						
$Sanctioning \times Post_t \times S$	-0.04	-0.11*	-0.07***	-0.01	0.00	0.01
	(0.06)	(0.06)	(0.03)	(0.01)	(0.01)	(0.01)
$Russia \times Post_t \times S$	-0.09*	-0.13***	-0.04**	0.00	-0.03**	-0.03***
	(0.05)	(0.05)	(0.02)	(0.01)	(0.01)	(0.01)
Observations	259,729	259,729	259,729	3,365,743	3,365,599	3,365,539

Notes: OLS estimates using positive firm–HS6–partner–month flows. The table reports triple interactions with the sanctioned-product indicator S; non-sanctioning partners and non-sanctioned products are the reference categories. Panel A absorbs firm–product–partner and month fixed effects. Panel B absorbs firm–destination, firm–product, firm–month, and destination–month fixed effects. Product–month fixed effects are not included, so the lower-order $S_g \times Post_t$ term remains identified; the reported triple interactions themselves would remain identified through partner-group variation. Standard errors, two-way clustered by HS6 product and partner, are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Panel A reveals a similar offset between quantities and recorded unit values across

the two export corridors. For sanctioned exports to sanctioning destinations and Russia, the triple-difference volume coefficients are 0.17 and 0.30 log points, respectively, while the corresponding unit-value coefficients are -0.22 and -0.25 log points. Consequently, neither corridor exhibits a statistically significant export-value differential: the apparent relative expansion in physical shipments is offset by lower recorded value per unit. These patterns reverse under the richer fixed-effect structure. In Panel B, all three Russia export interactions become negative, while the sanctioning-destination interactions are either negative or statistically insignificant. On the import side, neither partner group exhibits a positive sanctioned-product quantity differential, and the Russia interactions for value and unit value are negative. Because these are triple-difference coefficients, the negative estimates do not by themselves imply that the total level of sanctioned trade fell; they show that the sanctioned-product differential within the relevant partner group is not positive after the richer comparison is imposed. Overall, the positive-flow estimates provide no robust evidence of a broad quantity-driven expansion of sanctioned goods toward Russia once firm-wide and partner-wide shocks are absorbed. The reversal across specifications points to an important role for the composition of active firms, products, and partners, although the panels use different identifying variation and should not be interpreted as a mechanical decomposition. Recorded unit values also cannot establish domestic value-added upgrading, quality changes, or markup adjustment.

4.1.3 Sanctioned-product participation, zero-inclusive adjustment, and listing dynamics

The preceding regressions condition on positive trade and therefore answer how large observed flows become. They cannot determine whether aggregate trade expanded because firms began handling products they had not traded before. I address this limitation in three steps. I first aggregate the data to the HS6–quarter level to examine total product activity and the number of participating firms. I then construct zero-filled firm–status panels to

retain the activation and disappearance of sanctioned and non-sanctioned activity. Finally, I exploit variation in products' formal EU listing dates to trace dynamic responses around listing.

Product-level participation under a common post-2022 break. For each HS6 product g and quarter q, I estimate

$$\log Y_{g,q}^{k} = \delta^{k} \left[S_g \times Post_q \right] + \eta_g + \tau_q + u_{g,q}^{k}, \tag{7}$$

where S_g identifies products covered by the EU sanctions list, $Post_q$ equals one from 2022Q2 onward, and $Y_{g,q}^{k}$ is total trade value, total physical volume, or the number of firms trading product g. Product fixed effects η_g absorb permanent differences between sanctioned and non-sanctioned products, while quarter fixed effects τ_q absorb aggregate trade conditions. The coefficient δ^{k} therefore compares the post-2022 change in sanctioned products with the contemporaneous change in non-sanctioned products. The number-of-firms outcome measures the stock of firms participating in each product, not a firm-entry rate. This aggregation captures participation more directly than a positive firm-level flow regression, but the log specification still does not retain a product–quarter with a zero outcome.

Table 10: Product-level responses: HS6×quarter panel

	Exports			Imports		
	log value	log volume	log # firms	log value	log volume	log # firms
Sanctioned × Post	0.045	0.034	0.097***	0.108***	0.108***	0.103***
	(0.061)	(0.072)	(0.026)	(0.038)	(0.041)	(0.019)
Product FEs	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	47,341	47,341	47,341	63,502	63,502	63,502

Notes: HS6×quarter aggregates of the customs data. All specifications include product and quarter fixed effects. Treatment is EU-sanctioned HS6 × post-2022Q1. Standard errors are clustered by HS6. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 10 shows that the number of firms exporting a given sanctioned HS6 product rises by 0.097 log points relative to the corresponding change for non-sanctioned products, while the export-value and volume differentials are statistically insignificant. On the import side, sanctioned products exhibit relative increases of approximately 0.108 log points in both value and volume and 0.103 log points in the number of importing firms. These results indicate that sanctioned-product activity broadened along the firm-participation margin, particularly for imports. The firm-count outcome measures the stock of firms trading each product in a quarter, not firm entry. Because the specification pools destinations and origins, it does not establish whether the additional activity connects sanctioning suppliers to Russia. Moreover, the log specifications omit product–quarter cells with zero trade and therefore remain conditional on positive product-level activity, motivating the zero-inclusive PPML analysis below.

Zero-filled firm–status PPML. The missing-zero problem is economically important. Because $\log(0)$ is undefined, the positive-flow specifications omit the corresponding firm–status–month observation whenever a firm trades no product of status s in month t. Zero-to-positive and positive-to-zero transitions are therefore excluded from those estimands. If the post-2022 shock changes which firm–status cells are active, conditioning on positive trade also changes the composition of the estimation sample. A small response among continuing positive cells can consequently coexist with substantial aggregate growth generated by the activation of previously inactive cells.

To retain this margin, I aggregate each firm's monthly exports and imports into two product-status cells (sanctioned and non-sanctioned) and rectangularize each panel within the firm's observed active trading window for that direction of trade. I define this window separately for exports and imports as the interval between the firm's first and last month of positive trade in the relevant direction. If a firm is inside that window but records no trade of status s in month t, its firm–status–month outcome is set to zero. This zero denotes an

observed absence of that activity rather than missing data. I do not fill months outside the firm's active window because those observations need not represent a meaningful within-firm choice between product statuses. The resulting design captures temporary inactivity and changes between sanctioned and non-sanctioned activity within the firm's observed trading spell. It does not capture entry into exporting or importing before the beginning of that spell, or permanent exit after its end.

For the number of HS6 products and trade value, I estimate the following multiplicative specification by PPML:

$$Y_{i,s,t} = \exp\left[\beta_A(S_s \times Post_t) + \lambda_{i,s} + \tau_t + \varepsilon_{i,s,t}\right] \tag{8}$$

where S_s equals one for the sanctioned-product cell and zero for the non-sanctioned cell, $\lambda_{i,s}$ denotes firm–status fixed effects, τ_t denotes month fixed effects, and $\varepsilon_{i,s,t}$ is a multiplicative error term with conditional mean one. Equation (8) corresponds to Panel A of Table 11 and compares the post-2022 evolution of sanctioned and non-sanctioned activity within firms. For Panel B, I replace τ_t with firm–month fixed effects $\phi_{i,t}$ and estimate the corresponding coefficient β_B. Identification then comes from differences between a given firm's sanctioned and non-sanctioned activity in the same month. Panel B is therefore not merely a more controlled version of Panel A: it absorbs all firm-wide monthly scaling and isolates within-firm-month reallocation across product statuses. PPML estimates the conditional mean in levels, allowing zero outcomes to enter without an arbitrary transformation. Standard errors are clustered by firm.

Within the constructed active window, the product-count outcome captures both activation from zero and changes in product scope, while trade value combines extensive- and intensive-margin adjustment. Partner groups remain pooled, so neither specification identifies whether the additional activity connects sanctioning suppliers to Russia.

Panel A indicates that the post-2022 expansion is disproportionately concentrated in firm–month cells handling sanctioned exports. The PPML coefficient of 0.292 implies an

Table 11: Sanctioned-Product Responses in Zero-Filled Firm–Status Cells

	Exports		Imports	
	# HS6	Value	# HS6	Value
Panel A. Firm–status and month fixed effects				
$S \times Post_t$	0.292***	1.701***	0.050***	0.389
	(0.023)	(0.394)	(0.011)	(0.281)
Panel B. Firm–status and firm–month fixed effects				
$S \times Post_t$	-0.114***	0.046	-0.074***	-0.367***
	(0.021)	(0.153)	(0.007)	(0.101)
Observations	1,265,782	1,265,782	1,021,437	1,021,437

Notes: PPML estimates on rectangularized firm–month–product-status cells. Within each firm's observed active trading window, a status cell is recorded as zero in months in which the firm trades no product of that status. Product count is the number of distinct HS6 products, and value is CPI-deflated trade value. Partner groups are pooled. Panel A compares the post-2022 evolution of sanctioned and non-sanctioned cells within firms. Panel B absorbs each firm's total monthly conditions and identifies within-firm-month reallocation between the two statuses. Standard errors are clustered by firm and reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

approximately 34 percent relative increase in the number of sanctioned HS6 products, while the coefficient of 1.701 implies that sanctioned-export value rises by a factor of about 5.5 relative to non-sanctioned export value. The much larger value response suggests that the adjustment is not simply the proliferation of additional sanctioned product lines; it is concentrated in economically large flows or in firms whose sanctioned trade scales up sharply.

Panel B separates this firm-scaling margin from changes in the composition of a given firm's monthly trade. Once firm–month fixed effects absorb each firm's total monthly export expansion, the sanctioned-product count falls by approximately 11 percent relative to the firm's non-sanctioned count, while the sanctioned-export-value differential becomes small and statistically insignificant. Thus, firms that expand after 2022 do not systematically reallocate their monthly export value from non-sanctioned toward sanctioned goods. Rather, the large Panel A response is associated with the expansion of firm–month cells in which sanctioned activity is present and with the activation or scaling of economically

large sanctioned flows.

The import results reinforce this interpretation. Without firm–month fixed effects, the number of sanctioned products rises modestly relative to non-sanctioned products, while the value response is imprecisely estimated. Within the same firm and month, however, the sanctioned-product count and value fall by approximately 7 and 31 percent, respectively, relative to non-sanctioned imports. These negative coefficients do not necessarily imply that sanctioned imports decline in absolute terms; they indicate that non-sanctioned sourcing expands more strongly within the firm's monthly import basket. The results point to heterogeneity in which firms and trade lines expand, rather than a uniform within-firm reallocation toward sanctioned goods. Because destinations and origins are pooled, the estimates characterize product-status adjustment but do not establish a specific route from sanctioning suppliers through Armenia to Russia.

Dynamic product-level responses around EU listing. The common post-2022 specifications classify products according to whether they are ever covered by EU sanctions and impose a common break after February 2022. This design captures differential adjustment following the common geopolitical shock but suppresses variation in the timing of the restrictions themselves. EU sanctions coverage expanded through successive packages, so different HS6 products became formally restricted in different quarters. I therefore complement the common-date estimates with product-level event studies indexed by each product's quarter of first listing. These event studies trace adjustment before and after formal listing, distinguish products first listed in different cohorts, and allow responses to vary with time since listing.

A conventional two-way fixed-effect event study can be difficult to interpret under staggered adoption because products listed earlier may implicitly serve as controls for products listed later. If effects differ across listing cohorts or exposure horizons, these comparisons can combine economically different effects using non-transparent weights. For outcomes

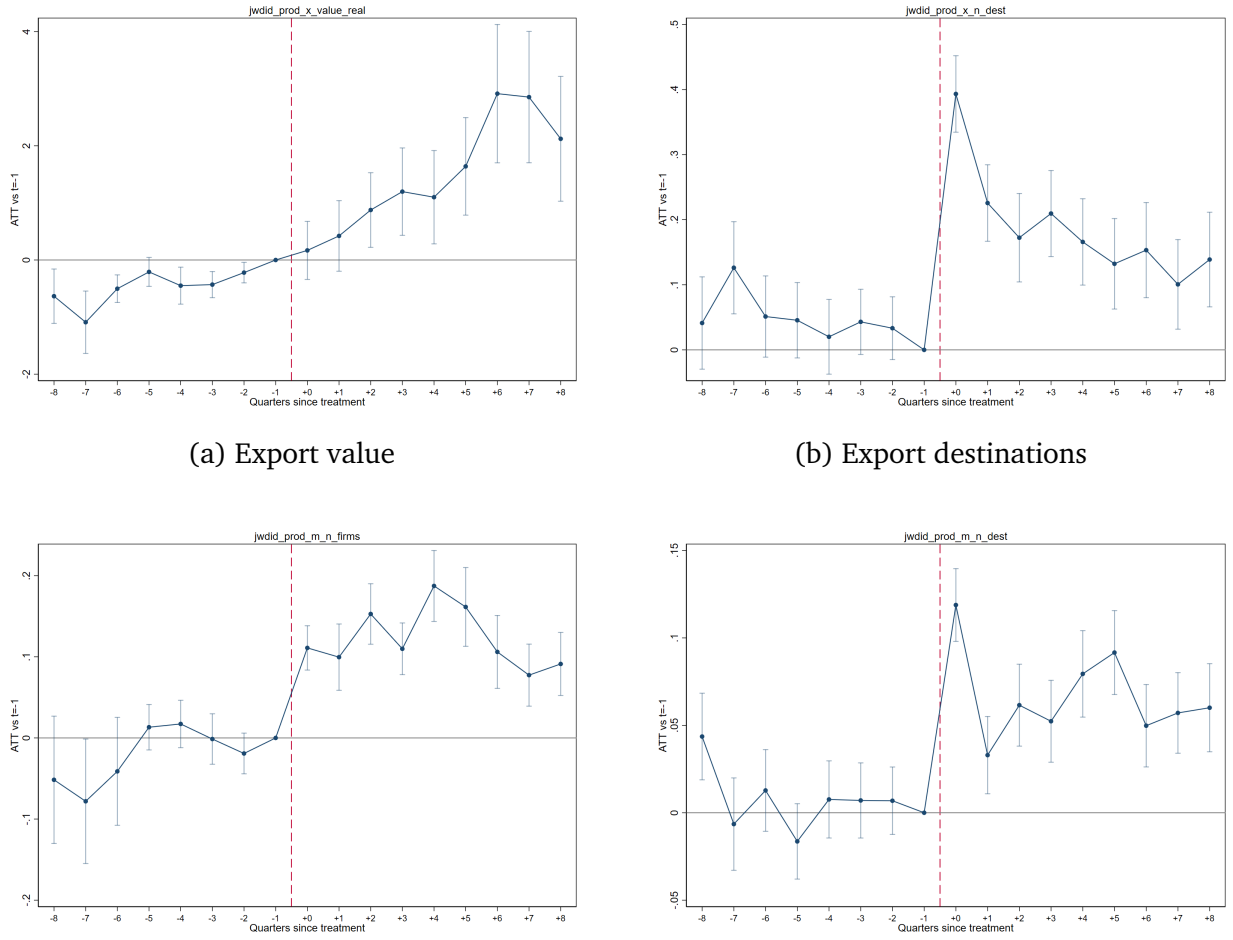
observed only when the relevant cell is active, including shares, ratios, and recorded unit values, I therefore use the group-time difference-in-differences estimator of Callaway and Sant'Anna (2021). Let $G_g = c$ denote product g's quarter of first listing. The estimator constructs cohort-time effects $\mathrm{ATT}(c,t)$ by comparing cohort c with products that remain untreated in quarter t, using never-listed and not-yet-listed products as the comparison set, and then aggregates these effects by event time. I use this estimator because it accommodates heterogeneous effects across listing cohorts and exposure horizons and avoids using already-listed products as controls. This choice is unrelated to whether the outcomes are bounded. Inference is based on a wild bootstrap clustered by HS6 product.

The Callaway and Sant'Anna (2021) estimates nevertheless condition on the relevant product cell being active. For non-negative outcomes for which zero is economically meaningful (trade value, physical volume, the number of firms, and the number of destinations or origins) I additionally rectangularize each HS6–quarter panel within the product's observed active span and record a missing within-span outcome as zero. This construction fills only gaps between a product's first and last observed positive quarter. It does not assign zeros before the product first appears in Armenian trade or after its final observed appearance. The estimates, therefore, capture interruptions and reactivation within an observed trading span, but not first-ever product entry or final disappearance. I then estimate event-time effects using PPML with the extended two-way fixed-effects estimator of Nagengast and Yotov (2025), which accommodates PPML estimation. PPML retains zero outcomes without applying an arbitrary transformation, while the extended fixed-effect structure permits effects to vary across listing cohorts and calendar periods in the multiplicative model. Event time -1 is omitted, and standard errors are clustered by HS6 product.

The two estimators therefore recover complementary rather than interchangeable objects. The Callaway–Sant'Anna estimates describe dynamics conditional on active trade. The extended-TWFE (ETWFE) PPML estimates incorporate changes in positive activity

together with within-span transitions between zero and positive trade. If listing affects whether a cell is active, the former should be interpreted as a response conditional on positive activity, while the latter captures the broader observed margin within the product's constructed active span. Figure 4 reports selected zero-inclusive outcomes from the ETWFE PPML estimates.

Figure 4: Zero-Inclusive Product-Level Dynamics Around EU Listing



(a) Export value

(b) Export destinations

(c) Importing firms

(d) Import origins

Notes: Event-time coefficients are estimated by PPML using the extended two-way fixed-effect estimator on rectangularized HS6–quarter panels. Missing outcomes between a product's first and last observed positive quarters are recorded as zero; quarters outside that active span are not added to the panel. Treatment occurs in the quarter in which an HS6 product is first listed in an EU sanctions package; never-listed and not-yet-listed products form the comparison set. Effects are normalized to event time -1, and standard errors are clustered by HS6 product. The figure displays selected headline outcomes. The remaining zero-inclusive outcomes are reported in Appendix Figure C3.

The ETWFE PPML estimates show that, in the quarters following formal listing, the export value of listed products and the number of destinations to which they are shipped both increase. On the import side, the clearest responses occur in the number of participating firms and sourcing origins, while value and physical volume respond less uniformly. Appendix Figure C3 reports the remaining zero-inclusive outcomes, and Appendix Figure C1 and Figure C2 report the corresponding conditional positive-cell estimates.

The adjustment, therefore, appears more clearly in the breadth of the trade network (more export destinations, importing firms, and sourcing origins) than in uniform growth in physical quantities. The combination of a broader trading network and a comparatively weak volume response points to an extensive-margin adjustment. Firms appear to establish, reactivate, or test additional product–partner relationships rather than simply shipping larger quantities through pre-existing links. On the import side, the entry of additional firms and origins without a comparable increase in aggregate volume may also indicate that sourcing is becoming more fragmented among suppliers and participants. Such fragmentation is consistent with search for alternative supply channels following the disruption of established trade relationships. This pattern is consistent with firms creating or reactivating product–market links and diversifying sourcing rather than simply scaling up every existing trade flow. The export response has a related interpretation. Rising export value together with an expansion in the number of destinations suggests that the additional activity is not confined to one established bilateral corridor. Instead, listed products become traded across a wider set of markets, potentially reflecting firms' attempts to exploit newly emerging demand and intermediation opportunities. The product-level design cannot distinguish genuine Armenian production from re-exporting, however, so this interpretation must be evaluated using the direct firm–product intermediation measures below.

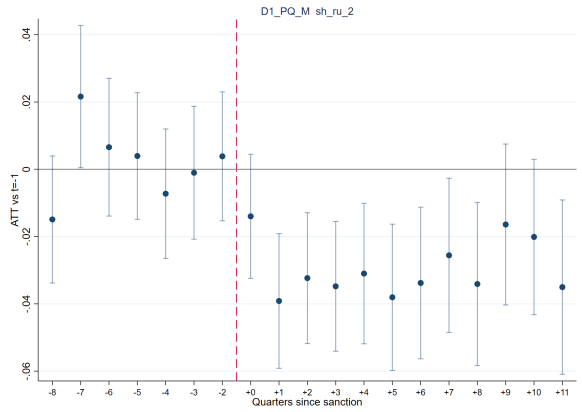
These dynamics should nevertheless be interpreted cautiously. The conditional Callaway–Sant'Anna estimates in Appendix Figure C1 and Figure C2 are informative about ad-

justment among active cells, but several value and count outcomes exhibit non-flat pre-treatment coefficients. Moreover, formal listing may lag the common February 2022 shock, and firms may anticipate products' subsequent inclusion in sanctions packages. The estimates therefore describe product-level adjustment around formal listing rather than clean causal effects of listing or of the war as a whole.

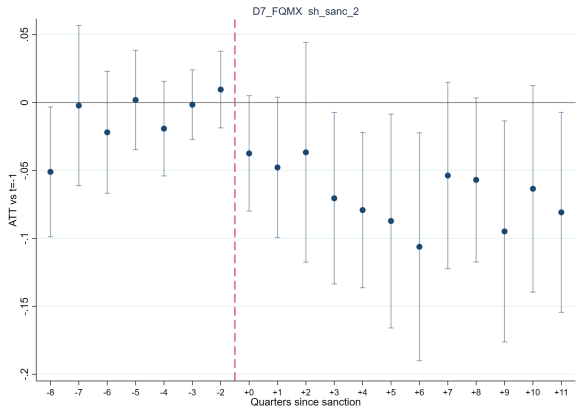
Sourcing and export-basket reorientation. The zero-inclusive product-level estimates show that sanctioned-product activity expands along several margins, but they do not reveal how sourcing and exports are redirected across partner groups. I therefore examine two directional outcomes in Figure 5: the Russia share of imports for listed products and the sanctioned-product share of exports for firms exposed through their 2021 import baskets. These outcomes are defined only when their denominators are positive, so assigning zero when the denominator is absent would not produce an economically meaningful share. I estimate their dynamic responses using the Callaway–Sant'Anna estimator because listing is staggered, effects may vary across cohorts and exposure horizons, and already-listed units should not serve as controls. The active-cell nature of the outcomes determines the estimation sample; it is not the econometric reason for selecting the estimator.

After formal listing, the Russia share of imports for listed products falls by approximately 3 percentage points, indicating a relative shift toward alternative sourcing origins. This decline is economically notable because Russia was traditionally an important supplier to Armenian firms. It suggests that formal restrictions are associated with supplier substitution rather than a proportional contraction across all origins. Combined with the increase in the number of import origins documented above, the result points to diversification away from a concentrated source and toward a broader international supplier base. Such diversification may improve resilience to country-specific disruptions, although establishing new sourcing relationships may also involve higher search, transport, and compliance costs. Among firms exposed through their 2021 import baskets, the sanctioned-product

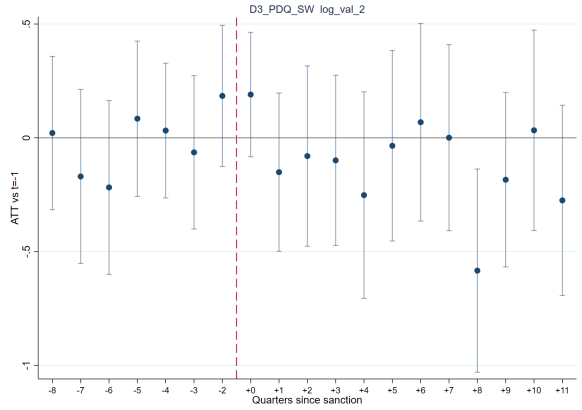
Figure 5: Sourcing and Export-Basket Reorientation



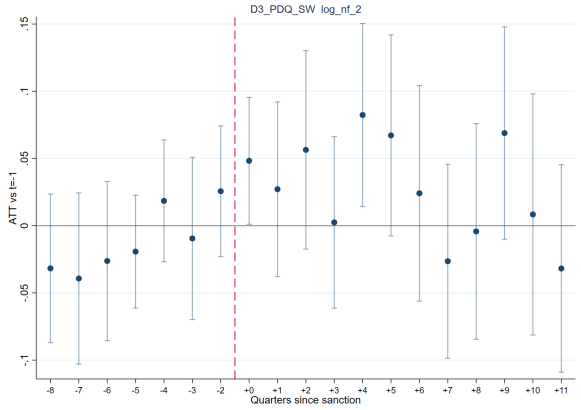
(a) Russia share of product imports



(b) Sanctioned share of firm exports



(c) Placebo: export value to sanctioning destinations



(d) Placebo: exporting firms to sanctioning destinations

Notes: Panels A–B report staggered event-study estimates using never-listed or never-exposed and not-yet-treated controls with wild-bootstrap inference. Panel A tracks the Russia share of imports for listed HS6 products. Panel B tracks the sanctioned-product share of exports for firms exposed through their 2021 import baskets. Panels C–D apply the corresponding design to sanctioned goods shipped to sanctioning destinations as a placebo corridor. Effects are normalized to event time -1. Additional sanctioning-destination placebo outcomes are reported in Appendix Figure C4.

share of exports is estimated to decline by approximately 6.8 percentage points, while their overall Russia export share does not change significantly. This is a compositional result rather than a statement about the absolute level of sanctioned exports. A declining sanctioned-product share can coexist with growing sanctioned-export value if firms' non-sanctioned exports expand even faster. Economically, it indicates that import expo-

sure does not lead firms to specialize uniformly in sanctioned products; their post-listing expansion may instead encompass a wider export basket. The decline in the sanctioned-product share does not necessarily imply that these firms reduce sanctioned exports in absolute terms; it may instead reflect faster growth in their non-sanctioned exports. The placebo outcomes for listed goods exported to sanctioning destinations remain comparatively flat. The absence of a comparable response in the placebo corridor makes a purely product-wide export boom less consistent with the evidence. The reorientation appears to depend on the interaction between product status, firms' prior import exposure, and destination opportunities rather than on listed products expanding equally toward every market.

The results reveal two distinct adjustments: listed products are sourced from a wider and less Russia-dependent set of origins, while exposed firms alter the composition of their export baskets. These linked changes are consistent with firms reorganizing supply chains after 2022, but they remain insufficient to establish re-exporting because the import-share and export-share outcomes do not match individual imported products to subsequent exports.

4.1.4 Potential intermediation

The descriptive evidence in Figure 3 shows that measured potential-intermediation intensity rose sharply after 2022, particularly for sanctioned products. The preceding regressions show greater sanctioned-product participation, product-basket reorganization, and directional sourcing and export adjustments, but none matches a firm's imports of a product to its later exports of the same product. I therefore test the potential-intermediation measure introduced in Section 3. I use the W12 measure formally defined in (1).[6]

Using the resulting firm–product–month panel, I estimate

[6]Because the estimation sample contains firm–HS6–months with positive exports, W12 captures variation in potential import coverage among observed exporting cells; it is not an indicator of entry into exporting.

$$y_{f,g,t} = \beta \left[Post_t \times S_g \right] + \lambda_f + \mu_g + \tau_t + \varepsilon_{f,g,t}, \tag{9}$$

where $y_{f,g,t}$ is alternatively: (i) the share of current export volume covered by imports of the same product during the previous twelve months (*Intensity*); (ii) an indicator for positive potential intermediation (*Participation*); or (iii) an indicator for a month-to-month switch into positive potential intermediation (*Entry*). S_g identifies sanctioned goods, and $Post_t$ equals one after February 2022. All specifications include firm fixed effects λ_f, product fixed effects μ_g, and month fixed effects τ_t, with standard errors clustered by firm. Because the sample requires positive exports, the entry outcome records switches in route status among observed exporting cells; it is not entry into exporting itself.

Table 12 provides the most direct evidence on the proposed mechanism. Relative to non-sanctioned products, potential-intermediation intensity for sanctioned goods rises by 3.8 percentage points after February 2022, and the probability of positive potential intermediation rises by 3.0 percentage points. There is no corresponding differential increase in monthly entry into intermediation. The increase therefore comes from more intensive and more frequent use of potential intermediation within observed firm–product relationships rather than from a wave of new monthly switches into that route. This null is not inconsistent with the descriptive deconcentration in Table 2: the entry outcome measures month-to-month switches into intermediation among cells already exporting, relative to non-sanctioned products, whereas the concentration statistics describe how the level of W12 volume is distributed across firms.

Columns (4) and (5) examine whether this response varies with pre-sanctions import dependence and firm size. Among firms below the median of pre-sanctions import dependence, the sanctioned-product response remains positive and statistically significant, but the interaction with high import dependence is small and insignificant. This supports the presence of a response among initially less import-dependent firms, not the stronger claim that those firms uniquely drive it. Large firms reduce potential-intermediation intensity

Table 12: Sanctions and Intermediation at the Firm–Product–Month Level

	Intensity	Participation	Entry	Intensity × Pre-Import	Intensity × Size
	(1)	(2)	(3)	(4)	(5)
$Post_t \times S$	0.038***	0.030***	-0.001	0.025***	0.031
	(0.011)	(0.010)	(0.001)	(0.009)	(0.021)
$Post_t \times S \times HighPreImport$				0.015	
				(0.036)	
$Post_t \times LargeFirm$					-0.038***
					(0.014)
$Post_t \times S \times LargeFirm$					0.015
					(0.026)
Firm FE	Yes	Yes	Yes	Yes	Yes
HS6 FE	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes
R^2	0.642	0.640	0.082	0.709	0.646
N	338,576	338,576	338,576	228,625	255,268
Clusters	18,325	18,325	18,325	11,372	11,672

Standard errors clustered by firm in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The unit of observation is firm × HS6 product × month. The sample is restricted to observations with positive export volume. S equals one for sanctioned HS6 products. Intensity is the share of export volume accounted for by imports of the same product by the same firm within the previous 12 months. Participation is an indicator for any re-exported content. Entry is an indicator equal to one when a firm–product switches into intermediation relative to the previous observed month. Columns (4) and (5) interact the baseline specification with median splits of pre-sanctions import dependence and pre-sanctions firm export scale. Lower-order interaction terms are included but not reported.

overall after the sanctions, but the triple interaction between the post period, sanctioned status, and large-firm status is insignificant. There is therefore no strong evidence that the sanctioned-product response differs systematically by firm size.

The estimates distinguish several margins behind Armenia's aggregate trade boom. Russia-linked relationships become more persistent, and continuing exporters reorganize their product baskets. Positive-flow estimates show that much of the apparent expansion reflects firm-wide scaling and changes in product and partner composition rather than uniform quantity growth within every Russia-linked line. Product-level and zero-inclusive designs reveal broader firm, product, destination, and origin activity around sanctioned

goods. Most directly, sanctioned products exhibit greater potential-intermediation intensity and participation without a surge in monthly route entry. The evidence is therefore consistent with deeper use of existing intermediation capacity as one mechanism of adjustment. It does not identify domestic value added, follow individual shipments to their final destination, or by itself establish sanctions evasion.

4.2 Effects on Firm and Employee Outcomes

Both the firm and employee data are at the annual level, ranging from 2018 to 2023. To examine how trading status relates to firm performance, I divide the firms according to their trading status in the year prior to the sanctions of 2022 and estimate the following specification:

$$\begin{aligned} y_{u,t} = \alpha &+ \delta_E D^E_{u,2021} Post_t + \delta_I D^I_{u,2021} Post_t + \delta_D D^D_{u,2021} Post_t \\ &+ \beta_E D^E_{u,2021} + \beta_I D^I_{u,2021} + \beta_D D^D_{u,2021} \\ &+ \tau_t + \mathrm{FE}_u + X'_{u,t}\gamma + \varepsilon_{u,t}. \end{aligned} \tag{10}$$

where $y_{u,t}$ denotes firm outcomes such as log employment, log turnover, or log turnover per employee. $D^E_{u,2021}$, $D^I_{u,2021}$, and $D^D_{u,2021}$ are indicators for Exporter, Importer, and Dual trader status, with non-traders as the reference group (Appendix Table B8 shows the characteristics of each group of firms by year.). The interactions with $Post_t$ capture how each type of trading firm adjusted after 2022. Year fixed effects τ_t absorb aggregate shocks, firm fixed effects FE_u are included in even-numbered columns, and $X_{u,t}$ includes legal form and status controls.

Table 13 examines where the firm-level incidence of the post-2022 adjustment was concentrated. Trading status is fixed in 2021, before the sanctions, so the interaction terms compare subsequent changes among pre-existing exporters, importers, and dual traders with those among non-trading firms. Fixing the classification before the shock avoids redefining firms according to trading decisions that may themselves have responded to the

new environment. Firm fixed effects absorb persistent differences in firm size and other time-invariant characteristics.

Panel A reveals a marked asymmetry across pre-shock trading modes. Importers and dual traders experience strong relative growth in turnover after 2022, whereas exporter-only firms contract relative to non-traders. Employment changes are much smaller: importer employment rises only modestly, dual traders record a limited increase, and the exporter-only response is statistically indistinguishable from zero. The common feature of the expanding groups is therefore access to international sourcing, not export participation alone. This pattern is consistent with importers benefiting from changes in domestic demand or sourcing opportunities, while dual traders were particularly well placed to combine foreign supplier relationships with access to export markets. Exporter-only firms lacked this import-side capacity and may also have been more exposed to adverse demand or sectoral shocks. The regressions do not separately identify these mechanisms, but they show that the trade boom did not benefit all internationally active firms uniformly.

More broadly, sales adjust much more strongly than employment. For importers and dual traders, the expansion appears to have been accommodated mainly through greater sales per existing worker rather than substantial job creation. This may reflect changes in quantities, prices, product composition, capacity utilization, or the organization of trading activity. Conversely, exporter-only firms reduce turnover without a comparable contraction in employment, consistent with labor adjusting more slowly than revenue. Turnover per employee should therefore be interpreted as a measure of revenue intensity, not as direct evidence of higher physical productivity or markups.

Panel B sharpens the connection between these firm-level outcomes and firms' pre-existing capacity for potential intermediation. Firms whose 2021 exports were more strongly covered by prior imports of the same HS6 products subsequently experience greater growth in turnover (0.276 log points per unit of the 2021 share) and turnover per employee (0.230 log points), but no corresponding employment response. Econom-

Table 13: Firm Incidence

	Log employment	Log turnover	Log turnover/employee
Panel A. Coefficient on $Post_t$ interacted with 2021 trading status			
Exporter in 2021	-0.02	-0.18***	-0.24***
	(0.02)	(0.06)	(0.07)
Importer in 2021	0.01***	0.23***	0.16***
	(0.00)	(0.01)	(0.01)
Dual trader in 2021	0.03***	0.25***	0.09***
	(0.01)	(0.03)	(0.03)
Observations	381,792	591,769	315,669
Panel B. Coefficient on $Post_t\times$ 2021 intermediation share			
2021 intermediation share	0.010	0.276***	0.230***
	(0.023)	(0.081)	(0.081)
Observations	11,787	12,349	10,969
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Status and legal-form FE	Yes	Yes	Yes

Notes: Panel A restricts the sample to firms present in 2021 and fixes trading status in that year; non-trading firms are the reference group. Panel B restricts the sample to firms present in 2021 with non-missing 2021 potential-intermediation exposure. That exposure is the share of the firm's 2021 export volume covered by imports of the same HS6 product during the preceding 12 months. The table reports the preferred firm-fixed-effect columns; the full paired specifications remain in Appendix C in Tables C4 and C5. Standard errors clustered by firm are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

ically, firms that had already established the supplier relationships, product knowledge, logistics, and customs capacity needed to import and export the same goods were better positioned to respond when trade routes and relative market opportunities changed. The result is therefore consistent with the post-2022 expansion making intensive use of capabilities accumulated before the shock rather than requiring a proportionate expansion of firms' workforces.

This interpretation is also consistent with the earlier descriptive evidence. Firms with positive potential intermediation (a subset of firms operating on both sides of trade) are considerably larger in employment and turnover, export more products, reach more destinations, and source from substantially more origins than other exporters (Table 2). These characteristics may have made them particularly capable of absorbing fixed costs and responding quickly to new trading opportunities. At the same time, they underscore the

selected nature of intermediation exposure: the Panel B estimates do not show that potential intermediation itself caused firm growth. The exposure measure may also capture pre-existing scale, networks, product composition, or organizational capability. Nor does it establish that the same imported shipment was subsequently re-exported. It identifies where post-2022 revenue growth was concentrated, not direct shipment-level intermediation or markup gains.

Appendix Tables C4 and C5 report the complete specifications underlying the preferred fixed-2021 results. Appendix Table C6 instead classifies firms according to their contemporaneous trading status. Because firms could enter importing, exporting, or dual trading in response to the shock, these estimates combine changes in firm performance with endogenous sorting across trading modes. Their coefficients consequently differ from the fixed-status estimates and are treated as descriptive rather than as preferred incidence estimates.

Appendix Table C7 similarly replaces predetermined exposure with the current-year W12 measure. The contemporaneous association remains positive and significant for turnover (about 0.112 log points) but smaller and statistically insignificant for turnover per employee (0.083). Because current intermediation activity can rise mechanically alongside current sales, these estimates cannot distinguish whether intermediation predicts firm expansion or simply accompanies it. The fixed-2021 specification is therefore the more informative design for asking whether capabilities in place before the sanctions predict which firms subsequently expanded.

To link firm trading status to worker outcomes, I estimate regressions at the employee level of the form:

$$y_{ift} = \alpha + \sum_{r\in\{E,I,D\}} \beta_r D^r_{i,2021} + \sum_{r\in\{E,I,D\}} \delta_r \left(D^r_{i,2021} \times Post_t\right) + \tau_t + \mu_{if} + X'_{ift}\gamma + \varepsilon_{ift}, \tag{11}$$

where $y_{i,f,t}$ denotes the log annual salary, log hours worked, or log hourly wage of

worker i employed by firm f in year t. The indicators $D^{E}_{i,2021}$, $D^{I}_{i,2021}$, and $D^{D}_{i,2021}$ classify the worker according to whether the worker's 2021 employer was an exporter, importer, or dual trader; workers attached to non-trading firms form the reference group. This baseline classification remains fixed throughout the panel. In the preferred specification, the time-invariant baseline-status indicators are absorbed by the worker–firm match fixed effects μ_{if}, so the coefficients of interest are their interactions with $Post_t$. Year fixed effects τ_t absorb economy-wide wage growth and other common shocks, while $X_{i,t}$ contains the worker controls that are not absorbed by the fixed effects. Standard errors are clustered by firm.

The preferred specification is identified primarily by worker–firm matches observed both before and after 2022. It therefore describes differential changes within continuing employment relationships rather than wage differences generated by changes in worker composition, new hiring, or movement across employers. Appendix specifications using employee or firm fixed effects provide less restrictive comparisons. As with the firm-level analysis, fixing employer status in 2021 prevents workers from being reclassified according to trading decisions that may themselves have responded to the shock. The estimates nevertheless capture differential changes associated with pre-existing employer type, not the causal effect of employment at a trading firm.

Table 14 reports the results. Panel A shows that workers initially attached to importing and dual-trading firms experience higher salary and hourly-wage growth after 2022 than workers attached to non-trading firms. Their hours worked do not change significantly. The increase in annual earnings, therefore, operates almost entirely through higher hourly compensation rather than longer working hours. Exporter-only estimates are imprecise and do not support a clear conclusion for that group.

This pattern closely mirrors the firm-level incidence documented in Table 13. The firm types experiencing the strongest turnover growth are also those whose continuing workers receive relative wage gains, while neither employment nor hours responds comparably.

Table 14: Worker Incidence

	Log salary	Log hours worked	Log wage per hour
Panel A. Coefficient on $Post_t$ interacted with the 2021 type of the worker's employer			
Exporter in 2021	-0.04	-0.29	0.32
	(0.04)	(0.26)	(0.25)
Importer in 2021	0.12***	0.01	0.11***
	(0.02)	(0.01)	(0.01)
Dual trader in 2021	0.12***	0.02	0.10***
	(0.03)	(0.02)	(0.02)
Panel B. Coefficient on $Post_t\times$ 2021 intermediation share of the worker's employer			
2021 intermediation share	0.021	0.064	-0.010
	(0.094)	(0.053)	(0.050)
Firm×worker FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Worker controls	Yes	Yes	Yes

Notes: The sample is restricted to workers observed in 2021. Panel A fixes the employer's trading status in 2021; workers in non-trading firms are the reference group. Panel B uses the employer's 2021 W12 potential-intermediation share. The table reports only the preferred firm-by-worker fixed-effect estimates; full employee-FE, firm-FE, and firm-by-worker-FE specifications remain in Appendix C in Tables C8 and C9. Worker controls include sex and age bins where they are not absorbed. Standard errors clustered by firm are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The adjustment operated mainly through monetary margins with the firms sharing their newly acquired rents with their workers, rather than through a broad expansion of labor inputs. Firms appear to have increased the value of activity undertaken with their existing workforce, with at least part of the associated gains reaching workers through hourly pay.

Panel B does not reveal an additional wage gradient with respect to the baseline employer's potential-intermediation intensity. Workers at firms with higher 2021 W12 exposure do not experience statistically distinguishable changes in salary, hours, or hourly wages after 2022. Thus, the worker results are stronger for the broad distinction between importing or dual-trading firms and other employers than for differences in intermediation intensity within the smaller group for which that exposure can be measured.

Appendix Tables C8 and C9 report the complete fixed-baseline specifications. Appendix Table C10 instead classifies workers using the contemporaneous trading status of their employer. Because employer status may itself change in response to post-2022 opportunities,

that exercise mixes worker outcomes with endogenous changes in employer type and is treated as descriptive.

5 A Model of Indirect Export Access

The empirical analysis documents a sharp post-2022 expansion of trade through Armenia, concentrated among incumbent firms and existing relationships. Russia-bound baskets shifted toward sanctioned products, while potential intermediation increased mainly because existing firms used it more intensively, rather than because new intermediaries entered (Table 7, Table 6, and Table 12). These findings raise a quantitative question: how much did this rerouting contribute to welfare in Armenia? Gross rerouted trade does not provide the answer. Much of its customs value reflects the acquisition value of goods produced abroad; only the intermediary's margin and other locally retained value added accrue to Armenian factors, while goods subsequently shipped abroad do not enter consumption in Armenia. This distinction is central to entrepot trade (Feenstra and Hanson, 2004). Because import and export declarations cannot be linked shipment by shipment, the empirical measure identifies a potentially indirect route rather than establishing that the same physical units were re-exported. I develop a Melitzian heterogeneous-firm model to quantify the welfare contribution of access to this route. The exercise reports the full pre–post welfare change and compares it with a counterfactual that removes indirect access while retaining direct export opportunities. Under the model's closure, isolating this contribution amounts to asking how indirect export access affects the price index of Armenian-produced varieties consumed in Armenia through export profitability, firm entry, and domestic selection.

The W12-based classification identifies routes rather than firms. Direct and potentially indirect exporting are not mutually exclusive within a firm, and an "intermediary" need not be a wholesaler rather than a manufacturer. Standard models of indirect exporting

predict productivity sorting because exporting through an intermediary combines lower fixed costs with higher variable costs (Ahn, Khandelwal and Wei, 2011). Network models instead allow contacts, information, and matching capabilities to determine route access separately from productivity (Rauch and Watson, 2004; Antràs and Costinot, 2011). I adopt this second logic in reduced form: productivity determines whether an export opportunity is served and its scale, while a separate relationship capability determines whether it is served directly or indirectly.

The separate capability is not motivated simply by variation in indirect-export shares across markets, which productivity sorting could also generate. Rather, the indirect-to-direct ratio of mean gross sales varies across partner–product cells, and some firms use mixed and hybrid routes. Because intermediary sales include the acquisition value of imported goods, these differences cannot be interpreted as clean productivity rankings. I therefore do not use mode-specific sales to identify separate productivity cutoffs, but retain them as untargeted tests of the route-independence approximation in Appendix Figure D2. The model traces how indirect export access affects entry, domestic selection, export participation, the mass of Armenian varieties, and the domestic price index, and then translates the resulting price-index change into a consumption-equivalent measure.

5.1 Preferences

The economy is populated by a representative household that consumes a homogeneous outside good X and a CES composite of differentiated varieties:

$$U = X^{1-\alpha} Y^{\alpha}, \qquad Y = \left[\int_{i \in \mathcal{V}_H} y(i)^{\frac{\sigma-1}{\sigma}} \, di + \int_{i \in \mathcal{V}_F} y(i)^{\frac{\sigma-1}{\sigma}} \, di \right]^{\frac{\sigma}{\sigma-1}}, \qquad \sigma > 1,$$

where $\mathcal{V}_H$ and $\mathcal{V}_F$ denote the sets of Armenian and foreign varieties absorbed in Armenia, respectively. The parameter $\alpha \in (0,1)$ is the expenditure share on differentiated goods, $\sigma > 1$ is the elasticity of substitution, and I write $a \equiv \sigma - 1$. Cobb–Douglas pref-

erences imply expenditure αE on the differentiated composite. Cost minimization then gives demand for variety i,

$$y(i) = \alpha E \, P_Y^{\sigma-1} \, p(i)^{-\sigma}, \qquad P_Y = \left[\int_{i \in \mathcal{V}_H \cup \mathcal{V}_F} p(i)^{1-\sigma} \, di \right]^{\frac{1}{1-\sigma}}.$$

It is convenient to track the domestic and foreign contributions to $P_Y^{1-\sigma}$ separately:

$$P_Y^{1-\sigma} \equiv \Omega = \Omega_{AA} + \Omega_{FA}, \qquad \lambda_{AA} \equiv \frac{\Omega_{AA}}{\Omega},$$

where Ω_{AA} and Ω_{FA} denote the price-index contributions of Armenian and foreign varieties absorbed in Armenia, respectively. Consequently, λ_{AA} is the Armenian contribution share in the differentiated price index. Armenia is a small open economy: foreign expenditures and price indices are exogenous to domestic outcomes (Demidova and Rodríguez-Clare, 2009, 2013).

5.2 Technology

The outside good is produced one-for-one from labor under constant returns and serves as numéraire, pinning the wage at one. In the differentiated sector, a firm with productivity φ produces $y = \varphi \ell$, pays a fixed operating cost f_H, and prices at the constant CES markup,

$$p(\varphi) = \frac{1}{\rho \, \varphi}, \qquad \rho \equiv \frac{\sigma - 1}{\sigma},$$

so domestic operating profits are

$$\pi_H(\varphi) = A_H \, \varphi^{\sigma-1} - f_H, \qquad A_H \equiv \frac{1}{\sigma} \, \rho^{\sigma-1} \alpha E \, P_Y^{\sigma-1}.$$

An export opportunity is a cell c, defined by destination group and product-sanction status. Serving the cell requires a per-period fixed cost f_{Xc}, and operating profits are

$$\pi_c(\varphi) = A_c\, \varphi^{\sigma-1} - f_{Xc}, \tag{12}$$

where A_c is an operating-profit shifter that combines foreign expenditure, foreign prices, bilateral variable trade costs, and the CES markup term. The calibration does not separately identify these components.

5.3 Export routes and switching capability

Conditional on serving cell c, a relationship operates indirectly with probability s_{Ic} and directly otherwise. In the baseline, route type is independent of firm productivity. This assumption captures, in reduced form, the idea that sourcing networks, destination knowledge, and compliance capacity may affect the available route separately from firm scale. It is motivated by mixed route use within firms and by the absence of a stable direct-versus-indirect sales ranking across cells, although the appendix shows that route independence does not hold literally in every cell.

When the indirect route is removed, a fraction θ of indirect relationships can switch to direct access. The retained share of export opportunities in cell c is therefore

$$h_c(\theta) = 1 - (1-\theta)\, s_{Ic}, \qquad h_c(0) = 1 - s_{Ic}, \quad h_c(1) = 1. \tag{13}$$

A successfully switched relationship is assumed to retain the same revenue and fixed-cost schedule. Thus, θ captures both the ability to switch and the absence of additional switching costs. This is a strong assumption: if switching also reduced revenue or raised costs, removing indirect access would have larger effects than in the baseline.

5.4 Entry, selection, and free entry

A mass N_e of entrants pays a sunk cost f_e and draws productivity from a Pareto distribution $G(\varphi) = 1 - \varphi^{-k}$ with $k > \sigma - 1$. Setting $\pi_H(\varphi_H) = 0$ and $\pi_c(\varphi_{Xc}) = 0$ gives the survival and export cutoffs

$$\varphi_H = \left(\frac{f_H}{A_H}\right)^{\frac{1}{\sigma-1}}, \qquad \varphi_{Xc} = \left(\frac{f_{Xc}}{A_c}\right)^{\frac{1}{\sigma-1}}, \qquad t_{Xc} \equiv \frac{\varphi_{Xc}}{\varphi_H}, \qquad p_{Xc} = t_{Xc}^{-k}, \tag{14}$$

with p_{Xc} the export-participation share among survivors. Free entry requires the expected value of a draw to equal the entry cost,

$$\left[1 - G(\varphi_H)\right] \bar{\pi} = f_e, \qquad \bar{\pi} = \int_{\varphi_H}^{\infty} \pi_H(\varphi)\, d\widetilde{G}(\varphi) + \sum_c \omega_c h_c(\theta) \int_{\varphi_{Xc}}^{\infty} \pi_c(\varphi)\, d\widetilde{G}(\varphi). \tag{15}$$

where $\widetilde{G}(\varphi)$ is the productivity distribution conditional on survival and ω_c counts the destinations pooled into cell c; in the observed equilibrium all routes are available, so $h_c(\theta) \equiv 1$, and values below one arise only in the no-intermediation counterfactual. Under Pareto every expected-surplus integral has the closed form $\kappa_2 f\, t_0^{-k}$ with $\kappa_2 \equiv (\sigma - 1)/(k - \sigma + 1)$ (Appendix D.3), so (15) becomes

$$f_e = S_H \left[\kappa_2 f_H + \sum_c \omega_c\, h_c(\theta)\, \kappa_2 f_{Xc}\, p_{Xc}\right] \equiv S_H\, B(\theta), \qquad S_H = \varphi_H^{-k}, \tag{16}$$

and the bracket B summarizes the expected-profit component of the entry condition. Under Pareto productivity, the domestic cutoff has the closed-form solution: because $p_{Xc} = t_{Xc}^{-k}$ rises exactly as fast as S_H falls when φ_H moves, the export term of $S_H B$ is invariant to φ_H, and

$$\varphi_H = \left[\frac{\kappa_2 f_H}{f_e - X(\theta)}\right]^{1/k}, \qquad X(\theta) \equiv \sum_c \omega_c\, h_c(\theta)\, \kappa_2 f_{Xc}\, \varphi_{Xc}^{-k}. \tag{17}$$

An interior equilibrium requires $f_e > X(\theta)$. Expected export surplus therefore acts as

an entry subsidy: it lowers the net entry cost that expected domestic profits must cover, so richer foreign opportunities support both a larger entrant mass and a tougher survival threshold. Finally, the domestic survival condition pins down the price index:

$$\Omega = \frac{\alpha E\, \varphi_H^{\sigma-1}}{\sigma f_H\, \mu^{\sigma-1}}, \qquad \Omega_{AA} = M\, \mu^{-(\sigma-1)} \kappa_1 \varphi_H^{\sigma-1}, \qquad M = N_e S_H, \qquad \kappa_1 \equiv \frac{k}{k-\sigma+1},$$

with $\mu \equiv 1/\rho$ the markup, so every counterfactual object (including entry, selection, varieties, participation, and the price level) follows from φ_H and the closure on Ω_{FA}.

Holding the foreign price-index contribution fixed, the identity $\Omega = \Omega_{AA} + \Omega_{FA}$ determines the required domestic variety mass and, through $M = N_e S_H$, the mass of entrants. This is the channel through which foreign export opportunities affect domestic entry and consumer prices.

5.5 Comparative statics: entry, selection, and export margins

Under the maintained closure, changes in indirect access operate through three margins: domestic selection, firm entry, and export participation. Their proportional responses do not depend on α; the expenditure share matters only when these responses are translated into the consumption-equivalent price-index measure. The magnitudes quoted below are drawn from the calibrated model of Section 6 and preview that section's results.

Selection and survival. The closed form (17) carries every selection static. Better access (i.e., higher A_c, lower f_{Xc}, or a larger retained share h_c) raises X and therefore φ_H: intermediation *toughens* domestic selection. Removing it softens selection; more low-productivity firms survive.

Entry and varieties. Removing indirect access lowers expected export profits and therefore reduces entry. In the post-shock calibration, the response of the entrant mass is substantially larger than the changes in the domestic cutoff or the mass of active varieties. At the transition-based benchmark, entry falls by approximately 0.017 log points

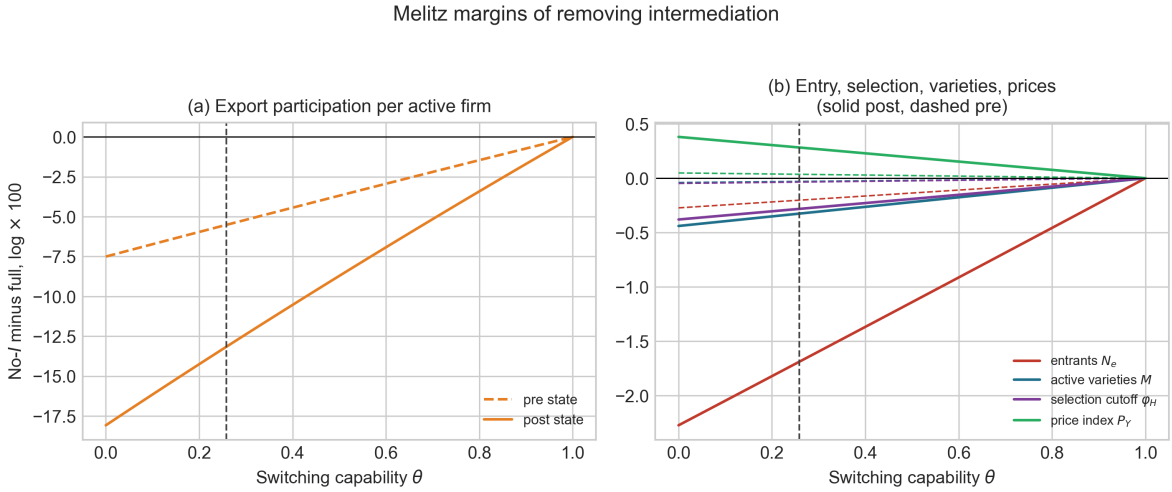
(about 1.7%), while the domestic cutoff, active-variety mass, and price index each move by less than 0.4 log percent. The main domestic effect of indirect access therefore operates through expected entry returns rather than through a large change in the productivity threshold.

Export participation. Removing the indirect route affects export participation in two ways. Some relationships disappear because they cannot switch, while weaker domestic selection increases the number of surviving firms that are not productive enough to export. Together these effects produce a much larger decline in export participation than in the domestic margins. At the transition-based benchmark, expected export participation per active firm falls by approximately 13.2 log percent in the post state. Indirect access consequently matters primarily as a means of preserving foreign-market relationships, with smaller indirect effects on domestic selection and varieties.

Market-access statics. Changes in a cell's access composite or fixed cost affect export participation directly and domestic entry and selection through expected export profits. Better access lowers the cell-specific export cutoff and raises participation; it also increases entry and raises the domestic survival cutoff. When domestic entry is re-solved, the tighter selection margin further lowers the export cutoff expressed relative to surviving firms. Removing indirect access produces the opposite movements. Appendix Figure D1 illustrates these responses for the post-shock Russia–sanctioned cell. t

The statics establish an ordering: indirect access matters first for preserving export relationships, second for entry incentives, and only marginally for domestic selection, varieties, and consumer prices — the ordering the welfare accounting in Section 6 confirms.

Figure 6: Equilibrium responses to removing indirect export access



Notes: Log differences ($\times 100$) between the re-solved no-intermediation equilibrium and the full equilibrium, by switching capability θ, holding technology, fixed costs, recovered market access, nominal expenditure, and the foreign price-index contribution fixed. Panel (a): aggregate expected export participation per active firm. Panel (b): entrants N_e, active varieties M, selection cutoff φ_H, and price index P_Y (solid post state, dashed pre state). All margins are exactly zero at $\theta = 1$ and are invariant to the expenditure share α.

6 Quantifying the Contribution of Indirect Access

The quantification is disciplined by four sets of moments: cell-level export participation, mean exporter sales, indirect-route shares, and the domestic contribution λ_{AA} to the Armenian price index. It does not target the reduced-form estimates of Section 4; those results motivate the margins the model includes — in particular, the concentration of potential intermediation within existing relationships motivates a route capability distinct from contemporaneous entry. The A_c and f_x are wedge-like summaries: they rationalize the targeted moments under the CES–Pareto structure and do not separately identify foreign demand, trade costs, or compliance costs. Finally, the firm-turnover and worker-wage results lie outside the model, which contains neither wage setting nor importer-only, exporter-only, and dual-trader types; they are complementary incidence evidence, not validation targets.

6.1 Mapping Cell Moments into Model Parameters

The empirical implementation divides export opportunities into six cells in each state: three destination groups—Russia, sanctioning economies, and non-sanctioning economies—crossed with sanctioned and non-sanctioned products. For each cell, the participation share p_{Xc} and mean gross sales among exporters $\bar{x}_{Xc}$ recover the relative export cutoff and the fixed-cost shifter under the CES–Pareto assumptions:

$$t_{Xc} = p_{Xc}^{-1/k}, \qquad f_{Xc} = \frac{\bar{x}_{Xc}}{\sigma\kappa_1}, \qquad A_c = \frac{f_{Xc}}{(t_{Xc}\varphi_H)^{\sigma-1}}. \tag{18}$$

The indirect share s_{Ic} is measured separately and enters only the retained-access term $h_c(\theta)$ used in the no-intermediation counterfactual.

These mappings reproduce participation and pooled exporter sales by construction and should therefore be viewed as parameter recovery rather than evidence of model fit. Gross exporter sales include the acquisition value of indirectly sourced goods, which may also affect the pooled-sales moment used to recover f_{Xc}. I consequently interpret f_{Xc} as a reduced-form transaction-value shifter rather than a literal structural fixed export cost.

The calibrated relationship states use January 2019–December 2021 as the pre-shock period and March 2022–December 2023 as the post-shock period. These structural windows align the customs relationships with the years for which the complete active-firm denominator is observed. The annual firm inputs used to construct domestic sales and the home share cover 2019–2021 before the shock and 2022–2023 afterward.

An empirical export opportunity is defined at the firm–destination–product-status–period level, where product status distinguishes sanctioned from non-sanctioned goods. For cell c, the denominator $n_{\text{active},c}$ contains all active-firm–destination opportunities, including firms that do not export to that cell. Export participation is therefore

$$p_{Xc} = \frac{n_{Ic} + n_{Dc} + n_{Uc}}{n_{\text{active},c}},$$

where I, D, and U denote indirect, direct, and route-unclassified exporting opportunities, respectively. Unclassified exporters enter the participation numerator rather than being treated as non-exporters; in the released baseline, $n_{Uc} = 0$ in every cell.

Route classification begins with the firm–HS6–month W12 measure defined in (1). These firm–product–month observations are aggregated, using export-value weights, to the firm–destination–product-status–period opportunity. An opportunity is classified as indirect when at least half of its export value is classifiable, and its value-weighted W12 share is at least 0.5; it is classified as direct when classification coverage is at least one-half, and the W12 share is below 0.5. Remaining exporting opportunities are classified as U.

The pooled mean exporter sales moment weights the two classified routes by their relationship counts:

$$\overline{x}_{Xc} = \frac{n_{Ic}\overline{x}_{Ic} + n_{Dc}\overline{x}_{Dc}}{n_{Ic} + n_{Dc}}.$$

The opportunity weight ω_c is the integer number of individual destinations represented by the pooled partner–product cell. Relationship sales are first annualized over the respective 36- and 22-month structural windows. Real dram values are then converted into model units according to

$$x^{\text{model}} = x^{\text{data}} \frac{\sigma f_H \kappa_1}{\overline{x}_H^{\text{data}}},$$

where $\overline{x}_H^{\text{data}}$ is mean positive domestic differentiated sales in the pre-shock state and $f_H = 1$.

6.2 Calibration

Table 15 summarizes the calibration inputs and their roles. I set $\sigma = 5$ in the baseline and report results for $\sigma \in \{4, 6\}$. The Pareto shape is $k = (\sigma - 1)\hat{\zeta}_{\text{emp}} = 4.83$, using the pre-period employment tail. I use employment because gross-sales tails are affected by the acquisition value contained in indirectly sourced goods and produce values inconsistent with $k > \sigma - 1$.

I normalize $f_H = 1$ and set $f_e/f_H = 1$ in the baseline. Mean positive domestic differentiated sales determine the conversion of monetary observations into model units. Because the ratio f_e/f_H affects entry and selection, it is a maintained calibration rather than an additional normalization.

The numerator of λ_{AA} is domestic differentiated sales net of exports. The denominator adds absorbed imports, measured as gross imports minus the estimated acquisition value associated with potential reexports. The resulting baseline shares are 0.828 before the shock and 0.777 afterward; gross and wholesale-excluded constructions are reported as alternative accounting scenarios.

The baseline expenditure share $\alpha = 0.68$ uses the broad merchandise share of household expenditure. The narrower values 0.45 and 0.30 progressively exclude categories less plausibly represented by differentiated traded varieties. Results are reported for all three values.

Table 15: Calibration inputs and parameter mapping

Object	Identifying moment	Status	Baseline
σ	assigned benchmark	assigned	5
α	ILCS expenditure shares	assigned	0.68
k	$(\sigma-1)\times$ empl. Hill tail	calibrated	4.83
Scale	mean domestic sales	calibrated	pre mean
t_{Xc}	export participation	inversion	12 cells
f_{Xc}	exporter mean sales	inversion	12 cells
A_c	zero-profit condition	inversion	12 cells
s_{Ic}	indirect share	measured	12 cells
f_H	unit normalization	normalized	1
f_e/f_H	maintained entry-cost ratio	assigned	1
λ_{AA}	net absorption share	constructed	$0.83/0.78$
θ	I-continuer switching	transition-based benchmark	0.258

Notes: Participation and pooled exporter sales recover the cell objects under the maintained CES–Pareto structure and therefore match by construction. Gross exporter sales may contain the acquisition value embodied in potential reexports. The transition-based value of θ is a scenario benchmark rather than a point-identified structural parameter; all results are therefore also reported over $\theta \in [0, 1]$. Additional accounting constructions and sensitivity exercises are reported in Appendix D.8.

6.3 Recovered Cell-Level Objects and Untargeted Diagnostics

The inversion maps the observed changes in participation and pooled exporter sales into changes in the model-implied access and fixed-cost shifters. The Russia cells combine higher recovered access with larger fitted fixed-cost shifters, while the sanctioned-product cell serving non-sanctioning economies also exhibits a large access increase (Figure 7). These objects summarize the changes required to rationalize the targeted moments under the CES–Pareto structure.

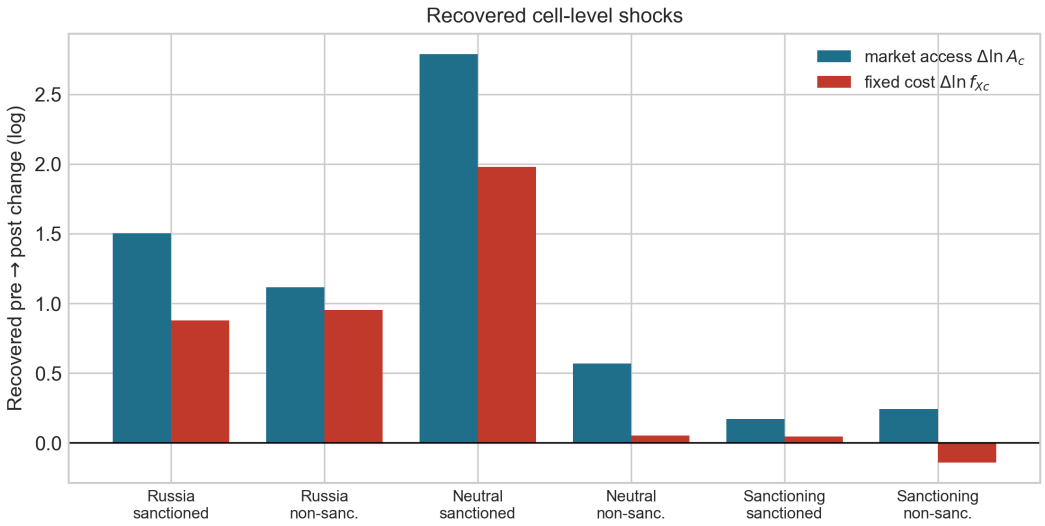
6.4 The welfare metric

With Cobb–Douglas preferences over the outside good and the differentiated composite, household indirect utility is, up to an irrelevant constant,

$$W = \frac{E}{P_Y^{\alpha}}, \qquad \Delta \ln W = -\alpha \, \Delta \ln P_Y = \frac{\alpha}{a} \Delta \ln \Omega \quad \text{at fixed } E, \tag{19}$$

where $\Omega \equiv P_Y^{1-\sigma}$ and P_Y^{α} is the ideal consumer price index given the numéraire outside good. W is a *real-expenditure (indirect-utility) index*: at fixed nominal expenditure, changes in W measure the cost-of-living effect of changes in the differentiated price index, the same object priced by the variety-adjusted price-index exercises of Broda and Weinstein (2006) and Cravino and Levchenko (2017), and reported below as the exact consumption-equivalent $100[\exp(\Delta \ln W) - 1]$. Under this closure, W is the model's welfare measure. Holding nominal expenditure and the wage fixed deliberately excludes income, distributional, and trade-balance channels.

Figure 7: Recovered pre–post changes in cell-level shifters



Notes: The figure reports pre–post log changes in the recovered foreign-access composite A_c and export fixed-cost shifter f_{Xc}. For the maintained technology parameters, entry-cost ratio, monetary normalization, and recovered equilibrium cutoff, these objects are obtained through the exact inversion of cell participation and pooled mean exporter sales. They are model-implied transformations of targeted moments, not independently estimated causal shocks. The access composite combines foreign expenditure, foreign prices, and trade costs; the fixed-cost shifter should therefore not be interpreted as a directly observed monetary cost.

For state $r \in \{\text{pre}, \text{post}\}$, define the within-state value of indirect access as

$$\begin{aligned} G_r(\theta) &\equiv \ln W_r^{\text{full}} - \ln W_r^{\text{noI}}(\theta) \\ &= \alpha \left[\ln \varphi_{H,r}^{\text{full}} - \ln \varphi_{H,r}^{\text{noI}}(\theta)\right] \\ &= \frac{\alpha}{k} \ln \left[\frac{B_r^{\text{full}}}{B_r^{\text{noI}}(\theta)}\right]. \end{aligned} \tag{20}$$

Here, B_r^{full} is the expected-profit bracket in (16) evaluated in the full equilibrium, while $B_r^{\text{noI}}(\theta)$ is evaluated after re-solving the no-intermediation equilibrium. The contribution of indirect access to the pre–post change is $G_{\text{post}}(\theta) - G_{\text{pre}}(\theta)$.

6.5 The no-intermediation counterfactual

The counterfactual removes the indirect route via (13), under the maintained assumption that successful direct switching preserves the relationship's cell-level revenue and cost

schedule. The switching proxy is $\hat{\theta} = 77/(77 + 221) = 0.258$, the share of released continuing pre-indirect relationships observed direct in the post state.[7]. Because suppression and exit prevent point identification, the headline is reported over the full grid $\theta \in [0, 1]$. At $\hat{\theta}$, the within-state consumption-equivalent value of indirect access is 0.024% before the shock and 0.192% afterward. The model-implied pre–post change is 0.902% in the full model and 0.733% when indirect access is removed. Their exact consumption-equivalent ratio implies a contribution of 0.168%, with a model-implied scenario range of $[0, 0.226]\%$ over $\theta \in [0, 1]$. These values describe the difference between calibrated pre- and post-shock states.

At $\hat{\theta}$, the contribution is 0.224%, 0.168%, and 0.134% for $\sigma = 4, 5, 6$, respectively, after recalibrating k and the cell block. It is 0.074%, 0.111%, and 0.168% for $\alpha = 0.30, 0.45, 0.68$. Replacing the count-weighted indirect share with its gross-sales-weighted counterpart lowers the contribution to 0.103%. The two weighting schemes are robustness specifications rather than formal bounds because gross sales need not be proportional to export surplus.

Table 16: Welfare value of intermediation across switching scenarios

	Switching capability θ					
Consumption-equivalent (%)	0	0.25	$\hat{\theta} = 0.258$	0.50	0.75	1
Within-state value, pre, $G_{\text{pre}}(\theta)$	0.033	0.025	0.024	0.016	0.008	0
Within-state value, post, $G_{\text{post}}(\theta)$	0.259	0.194	0.192	0.130	0.065	0
Contribution to pre→post change	0.226	0.170	0.168	0.114	0.057	0
Memo: model-implied full pre→post change 0.902%; no-I change at $\hat{\theta}$ 0.733%.						

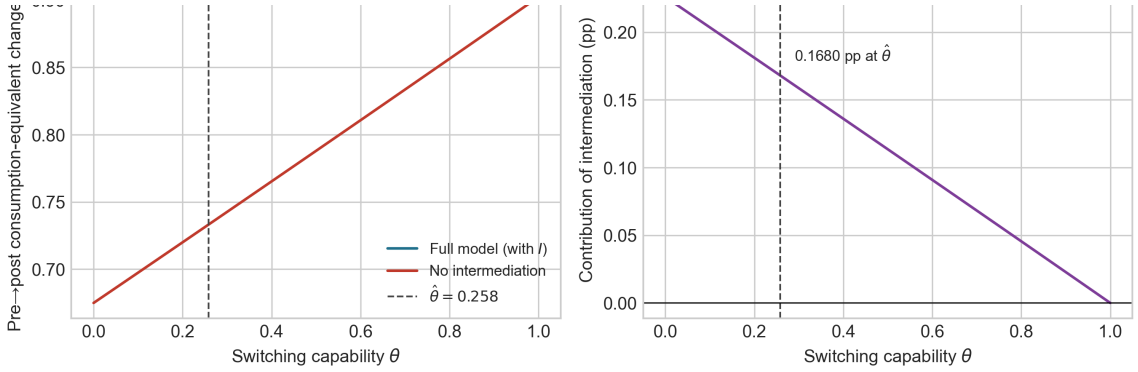
Notes: Model counterfactuals at $\sigma = 5$, $\alpha = 0.68$, $k = 4.83$. Each entry re-solves the no-intermediation equilibrium via (13) in both states, holding technology, fixed costs, the recovered access composites, nominal expenditure, and the foreign price-index contribution Ω_{FA} fixed. All values are exact consumption-equivalent changes in the real-expenditure index (19); the contribution row is $100\{\exp[G_{\text{post}} - G_{\text{pre}}] - 1\}$. The contribution equals zero at $\theta = 1$ directly from $h_c(1) = 1$.

Three conclusions survive every reported parameterization. First, the mechanism: within the model, intermediation operates as an entry subsidy as it preserves foreign-market relationships and feeds expected export profits into entry, with only second-order

[7]Wilson interval $[0.212, 0.311]$; 95 relevant transition rows are disclosure-suppressed; group-specific released shares range from zero to 0.392

effects on domestic selection, varieties, and consumer prices. And this subsidy is roughly an order of magnitude more valuable in the post state than before the shock (G_{post} versus G_{pre} in Table 16). Second, the magnitude: the cost-of-living value of the indirect route stays below one-third of one percent of consumption in every reported parameterization and is about 0.17 percent at the transition benchmark; it's positive, but far below what gross rerouted flows would suggest. Third, the boundaries: the exercise prices an export mode through the domestic price index; it excludes the transitional quasi-rents documented in the firm and worker regressions, and its binding measurement limitation is θ itself, which suppression prevents from being point identified—hence the grid. Within those boundaries the conclusion is stable: indirect access mattered for Armenia primarily by keeping export relationships alive, and its consumer-welfare content is real but small.

Figure 8: Welfare contribution of intermediation over switching capability



Notes: Panel (a): pre-to-post consumption-equivalent change in the real-expenditure index in the full model (data-implied, θ-invariant) and in the re-solved no-intermediation equilibrium, over a dense θ grid. Panel (b): their difference, the contribution of intermediation, with the transition proxy $\hat{\theta} = 0.258$ marked; the grid endpoints $\theta = 0$ (intermediation as essential infrastructure) and $\theta = 1$ (costless direct re-routing) bound the contribution at $[0, 0.226]$ percent. Baseline $\sigma = 5$, $\alpha = 0.68$, $k = 4.83$.

7 Conclusion

Trade sanctions have become the default instrument of great-power rivalry, and their effects do not stop at the borders of the sanctioning and target economies. Restricted flows

search for new routes, and small non-sanctioning economies located between the blocs become the margin along which world trade reorganizes. Which margins carry that adjustment, which firms and workers inside the bystander economy capture the gains, and how much the new intermediary role is worth to its own consumers are open questions with direct consequences for the design and enforcement of sanctions and for the growth prospects of the economies doing the rerouting. This paper answers them for Armenia which is a small open economy whose largest trading partner became the target of an unprecedented expansion of Western sanctions. The paper uses novel administrative data covering the universe of formal firms, workers, and customs transactions.

The expansion was real as real exports nearly doubled between 2021 and 2023, but its two sides worked differently. The import side genuinely broadened: active importers grew far more than exporters, first entry into sourcing from sanctioning economies increased, and formally listed products attracted additional importing firms and origins while their Russia sourcing share fell. This was a reorganization of supply chains that did run through new relationships. The export side, by contrast, ran through incumbents: Russia-facing entry did not rise, established relationships became more persistent, continuing exporters reshuffled their baskets toward sanctioned products in count terms, and the only Russia-specific differential that survives the most demanding within-flow comparison is higher recorded unit values, not larger volumes. Across products, the sanctioned-good boom is an extensive-margin phenomenon: it appears in designs that retain zeros, through the activation and scaling of sanctioned trade lines, while within a firm's positive lines in a given month there is no reallocation toward sanctioned goods. The potential same-firm intermediation of sanctioned goods intensified within existing firm–product relationships, with no rise in entry into that route. The pattern that emerges is incumbent exporters deepening intermediation capacity built before the shock, supplied by a sourcing network that widened beneath them.

The incidence of the boom was concentrated in trading firms rather than in the broader

economy, and within them in revenue rather than employment. Relative to non-traders, firms already trading internationally in 2021 expanded turnover and turnover per employee with little job creation; the exception is exporter-only firms, which lacked import-side capacity and contracted. Higher pre-shock intermediation exposure predicts additional turnover and turnover-per-employee growth but no employment response. Workers attached to the expanding trading firms gained roughly ten percent in hourly pay with no change in hours worked, so higher earnings ran through compensation rather than labor input. These patterns identify where the gains landed; they do not identify markups or the division of surplus between firms and workers.

Gross rerouted trade cannot be read as a welfare gain: much of its customs value is the acquisition cost of goods produced abroad, and goods shipped onward are consumed abroad. Translating the new indirect market access into domestic welfare therefore requires structure. I build a small-open-economy Melitz model with capability-based routing in which productivity determines whether a foreign opportunity is served and at what scale, while a separate relationship capability determines whether it is served directly or through intermediation. The model implies a consumption-equivalent gain of 0.9 percent between the pre- and post-shock states, of which indirect access accounts for 0.17 percentage points, about 19 percent. The mechanism highlights the entry subsidy whereby intermediation preserves foreign-market relationships and raises expected export profits, with only small effects on domestic selection, varieties, and consumer prices.

The broader lesson is that geopolitical fragmentation creates real but narrow windfalls for the economies through which trade reroutes. Armenia gained market access without a production boom: quantities within comparable trade lines did not surge, relative employment barely moved, and the consumer-welfare content of the rerouting is far smaller than the gross flows suggest. What the shock did produce is a redistribution toward trading firms and their workers which can be interpreted as returns on relationships and sourcing networks built before the shock, and contingent on the sanctions regime that created

them. For sanctioning coalitions, this implies that neutral-hub rerouting blunts the quantity effects of restrictions, while the higher recorded unit values on Russia-bound flows indicate that access through the hub came at a premium, whether from compliance costs, scarcity, or markups. For bystander economies, it implies that the intermediary role is a windfall built on incumbent capabilities rather than a development strategy. Whether Armenia's new relationships harden into durable productive capacity or dissipate with the geopolitical conditions that created them is the central open question.

7.1 Scope and Open Questions

This study measures short-run adjustment in Armenian trade, firms, and workers over 2018–2024; the boundaries of the evidence indicate where to go next. First, intermediation is measured indirectly, through customs-based import–export linkages at the firm–product level. Firm-to-firm VAT network data would separate domestic production, domestic sourcing, and foreign re-exporting more cleanly, and would reveal whether the trade surge reflects temporary geopolitical arbitrage or a deeper reconfiguration of Armenia's position in regional value chains. Second, the model inherits these measurement limits and adds one: the switching capability θ is only partially identified because transition cells are disclosure-suppressed, and the welfare exercise is a conditional price-index counterfactual that holds nominal expenditure, wages, and the foreign price-index block fixed. Third, the analysis covers formal firms and formal employment; informal adjustment, ownership changes, and household-level distributional effects remain outside its scope. Finally, the persistence of Armenia's intermediary role is uncertain: the gains documented here are contingent on the continuation of sanctions, on enforcement intensity, and on Armenian firms' ability to retain foreign buyers and suppliers once conditions change. Whether these adjustments outlast the sanctions regime that produced them is the natural next test, and one the lengthening administrative panel will soon permit.

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A Descriptive Features of Armenia

A.1 Regional and Sectoral Distribution of Employment and Firms

Appendix Tables A1 and A2 describe the sectoral and geographic distribution of formal employment, while A3 and A4 report the corresponding distribution of firms by trade type. They show that activity is concentrated in Yerevan and that trading firms are disproportionately represented in several high-turnover sectors. A5 documents conditional wage premia associated with employment in trading firms; these are descriptive panel correlations and are not the post-2022 worker estimands studied in Section 4.

Table A1: Sectoral Employment Shares, Relative Mean Log Wages per Hour, and Relative Mean Log Revenues, 2018

	Emp Share (%)	Rel. Mean Log Wage p.h	Rel. Mean Log Revenue	**Employment by Firm Types (%)**			
				Exporter Only (%)	Importer Only (%)	Dual (%)	Non-Trading (%)
Agriculture	1.55	-0.19	-0.14	19.06	21.78	10.61	48.56
Mining	1.46	0.55	2.13	2.76	6.01	77.56	13.67
Manufacturing	12.74	-0.48	0.50	2.00	18.39	52.98	26.63
Construction	4.74	-0.03	0.61	0.17	40.46	8.26	51.11
Electricity	2.99	0.05	2.78	0.02	68.63	14.43	16.92
Water Supply	1.01	-0.47	0.50	0.03	1.93	48.55	49.49
Trade	18.14	-0.52	0.03	0.42	33.58	23.96	42.03
Transport	3.46	-0.26	0.56	0.47	14.97	41.70	42.86
Accommodation	6.11	-0.75	-0.30	0.19	23.71	5.67	70.43
Information	4.08	0.63	0.25	0.06	20.89	28.92	50.13
Finance	3.70	0.53	2.57	0.09	51.64	5.95	42.31
Real Estate	1.71	-0.07	-1.27	0.56	11.20	2.59	85.64
Professional Services	3.65	0.26	-1.05	1.32	19.71	5.26	73.71
Admin Services	2.75	-0.43	-0.85	0.05	15.63	1.34	82.98
Public Admin	0.35	-0.10	-0.18	–	0.79	–	99.21
Education	17.60	-0.32	-1.35	0.01	8.96	3.14	87.89
Health	7.13	-0.16	-0.49	–	17.37	12.82	69.81
Arts	2.84	-0.34	0.51	1.21	24.28	11.44	63.07
Other Services	3.74	-0.33	-2.35	0.32	10.06	1.25	88.37
Households	0.00	-0.80	-1.55	–	–	–	100.00
Extraterritorial	0.26	0.97	-1.70	0.05	32.49	4.43	63.03

Notes: This table reports sectoral employment shares and relative economic indicators for 2018. *Emp Share (%)* denotes the sector's share of total national formal employment. *Rel. Mean Log Wage* and *Rel. Mean Log Revenue* represent the deviation of the sectoral mean log value from the aggregate national average. Employment within each sector is further decomposed by the trade status of the employer: *Exporter Only* and *Importer Only* denote firms that conducted only exporting or only importing activities, respectively; *Dual* refers to firms that engaged in both; and *Non-Trading* indicates firms engaged exclusively in domestic activities.

Table A2: Regional Employment Shares, Relative Mean Log Wages per Hour, and Relative Mean Log Revenues, 2018

	Emp Share (%)	Rel. Mean Log Wage (Per Hour)	Rel. Mean Log Revenue	**Employment by Firm Types (%)**			
				Exporter Only (%)	Importer Only (%)	Dual (%)	Non-Trading (%)
Aragatsotn	3.05	0.04	-0.06	0.04	20.63	17.51	61.83
Ararat	6.03	-0.25	0.50	0.65	10.96	34.25	54.13
Armavir	8.07	0.05	1.01	0.03	40.30	23.22	36.45
Gegharkunik	3.00	0.06	-0.56	0.22	7.13	1.45	91.20
Yerevan	55.31	0.07	0.93	0.40	31.92	26.21	41.47
Lori	5.06	-0.23	-0.76	0.02	11.99	22.40	65.59
Kotayk	6.72	-0.23	0.29	1.08	19.50	20.42	59.00
Shirak	4.47	-0.32	-0.88	1.23	16.65	7.91	74.20
Syunik	4.53	0.22	0.66	0.85	13.99	30.90	54.27
Vayots Dzor	1.30	-0.32	-0.52	0.36	9.32	15.25	75.07
Tavush	2.45	0.07	-0.05	1.30	11.14	23.24	64.32

Notes: This table reports regional employment shares and relative economic indicators for 2018. *Emp Share (%)* denotes the region's share of total national formal employment. *Rel. Mean Log Wage* and *Rel. Mean Log Revenue* represent the deviation of the regional mean log value from the national average. Employment within each region is further decomposed by the trade status of the employer: *Exporter Only* and *Importer Only* denote firms that conducted only exporting or only importing activities, respectively; *Dual* refers to firms that engaged in both; and *Non-Trading* indicates firms engaged exclusively in domestic activities.

Table A3: Shares of Firms by Sector and Firm Type, 2018

Sector	Firm Share (%)	**Firms by Type (%)**			
		Exporter (%)	Importer (%)	Dual (%)	Non-Trading (%)
Agriculture	2.35	0.02	0.15	0.05	2.13
Mining	3.56	0.05	0.18	0.04	3.29
Manufacturing	25.06	0.45	3.22	1.11	20.28
Construction	6.05	0.02	0.47	0.08	5.47
Electricity	1.05	0.01	0.16	0.03	0.85
Water Supply	1.02	0.00	0.05	0.02	0.95
Trade	36.02	0.18	8.52	1.42	25.90
Transport	5.10	0.02	0.37	0.09	4.62
Accommodation	10.03	0.03	0.62	0.17	9.21
Information	5.12	0.01	0.66	0.22	4.23
Finance	2.60	0.01	0.18	0.06	2.35
Real Estate	4.50	0.02	0.26	0.08	4.14
Professional Services	5.15	0.03	0.28	0.10	4.74
Admin Services	3.12	0.01	0.20	0.05	2.86
Public Admin	1.00	0.00	0.05	0.01	0.94
Education	7.02	0.02	0.39	0.12	6.49
Health	3.56	0.01	0.22	0.06	3.27
Arts	2.13	0.02	0.15	0.03	1.93
Other Services	8.56	0.03	0.29	0.07	8.17
Extraterritorial	1.02	0.00	0.08	0.02	0.92
Total	100	1	15	5	79

Notes: This table presents the distribution of firms across sectors in Armenia for 2018. Firms are further categorized by their trade status based on their activity throughout the year: *Exporter* and *Importer* denote firms that conducted only exporting or only importing activities, respectively; *Dual* refers to firms that conducted both; and *Non-Trading* indicates firms engaged exclusively in domestic activities.

Table A4: Shares of Firms by Region and Firm Type, 2018

Region	Firm Share (%)	**Firms by Type (%)**			
		Exporter (%)	Importer (%)	Dual (%)	Non-Trading (%)
Aragatsotn	3.37	0.15	8.55	1.07	90.23
Ararat	6.64	0.70	9.39	2.56	87.35
Armavir	5.92	0.35	10.53	1.57	87.55
Gegharkunik	4.64	0.22	6.00	0.56	93.22
Yerevan	45.76	0.43	25.81	3.99	69.76
Lori	7.18	0.14	8.68	1.08	90.10
Kotayk	9.10	1.13	17.68	2.49	78.70
Shirak	6.79	0.53	10.09	0.61	88.78
Syunik	5.40	0.29	7.35	1.05	91.31
Vayots Dzor	2.07	0.75	5.24	1.75	92.26
Tavush	3.63	0.43	5.82	0.85	92.90
Total	100	0.5	14.33	2.68	82.49

Notes: This table presents the distribution of firms across Armenian regions for 2018. Firms are categorized by their trade status based on their international activity: *Exporter* and *Importer* denote firms that conducted only exporting or only importing activities, respectively; *Dual* refers to firms that engaged in both; and *Non-Trading* indicates firms that conducted exclusively domestic activities.

A.2 Trade Status and Worker Wages

Employees of trading firms generally earn higher wages. Table A5 reports worker-level panel regressions estimating the wage premium associated with employment at a trading firm. The specifications absorb individual, year, region, and sector fixed effects and use three alternative measures of trade status. First, the indicators *Index Exporting* and *Index Importing* identify whether a worker's employer exports or imports. Second, the categorical variable *Firm Type* classifies firms as non-traders, exporters only, importers only, or two-way traders. Third, a set of *Regime* indicators identifies whether the employer exports to or imports from Russia, countries sanctioning Russia, or non-sanctioning partners.

Column (1) associates employment at exporting and importing firms with hourly-wage differentials of 0.17 and 0.19 log points, respectively. Column (2) reports differentials of 0.20, 0.19, and 0.36 log points for exporter-only, importer-only, and dual-trading firms. Column (3) reports export-side differentials of 0.07, 0.11, and 0.12 log points for Russia, sanctioning partners, and non-sanctioning partners, and import-side differentials of 0.10, 0.16, and 0.07 log points. These coefficients are descriptive conditional associations rather than estimates of the causal effect of trading.

Table A5: Wage Premiums Associated with Employment in Trading Firms

	Log Wage per Hour			Log Salary		
	(1)	(2)	(3)	(4)	(5)	(6)
Index Exporting	0.17***			0.40***		
	(0.03)			(0.04)		
Index Importing	0.19***			0.46***		
	(0.02)			(0.04)		
Firm Type						
Exporter		0.20***			0.43***	
		(0.04)			(0.09)	
Importer		0.19***			0.46***	
		(0.02)			(0.04)	
Dual		0.36***			0.86***	
		(0.03)			(0.05)	
Regime						
Export to Russia			0.07**			0.25***
			(0.03)			(0.05)
Export to Sanctioning			0.11***			0.17***
			(0.02)			(0.05)
Export to Neutral			0.12**			0.15**
			(0.04)			(0.07)
Import from Russia			0.10***			0.20***
			(0.02)			(0.03)
Import from Sanctioning			0.16***			0.39***
			(0.02)			(0.04)
Import from Neutral			0.07**			0.14**
			(0.03)			(0.07)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Activity FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	No	Yes	Yes	No	Yes	Yes
Observations	2,746,359	2,746,359	2,746,359	2,931,881	2,931,881	2,931,881
R^2	0.33	0.33	0.34	0.37	0.37	0.38

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: This table reports worker-level panel regressions estimating the wage premium associated with employment in trading firms. Columns (1)–(3) use log hourly wages as the dependent variable, while Columns (4)–(6) use log annual salary. Three sets of trade-related variables are used: (i) *Index Exporting* and *Index Importing*, indicating whether a worker's employer engages in exporting or importing; (ii) a categorical *Firm Type* variable distinguishing non-traders, exporters, importers, and dual traders; and (iii) *Regime* dummies identifying whether the firm trades with Russia, sanctioning countries, or neutral partners. All specifications include year and activity fixed effects; region fixed effects are included where indicated.

B Trade Statistics

B.1 Country-Group Classification

Table B1 lists the fixed partner classification used throughout. Figure B1 verifies the post-2022 break in a longer UN Comtrade series, and Figure B2 shows that the non-sanctioning aggregate masks highly uneven bilateral changes, including large movements involving the UAE. These figures are external-data validation and do not replace the customs-based main Figure 1.

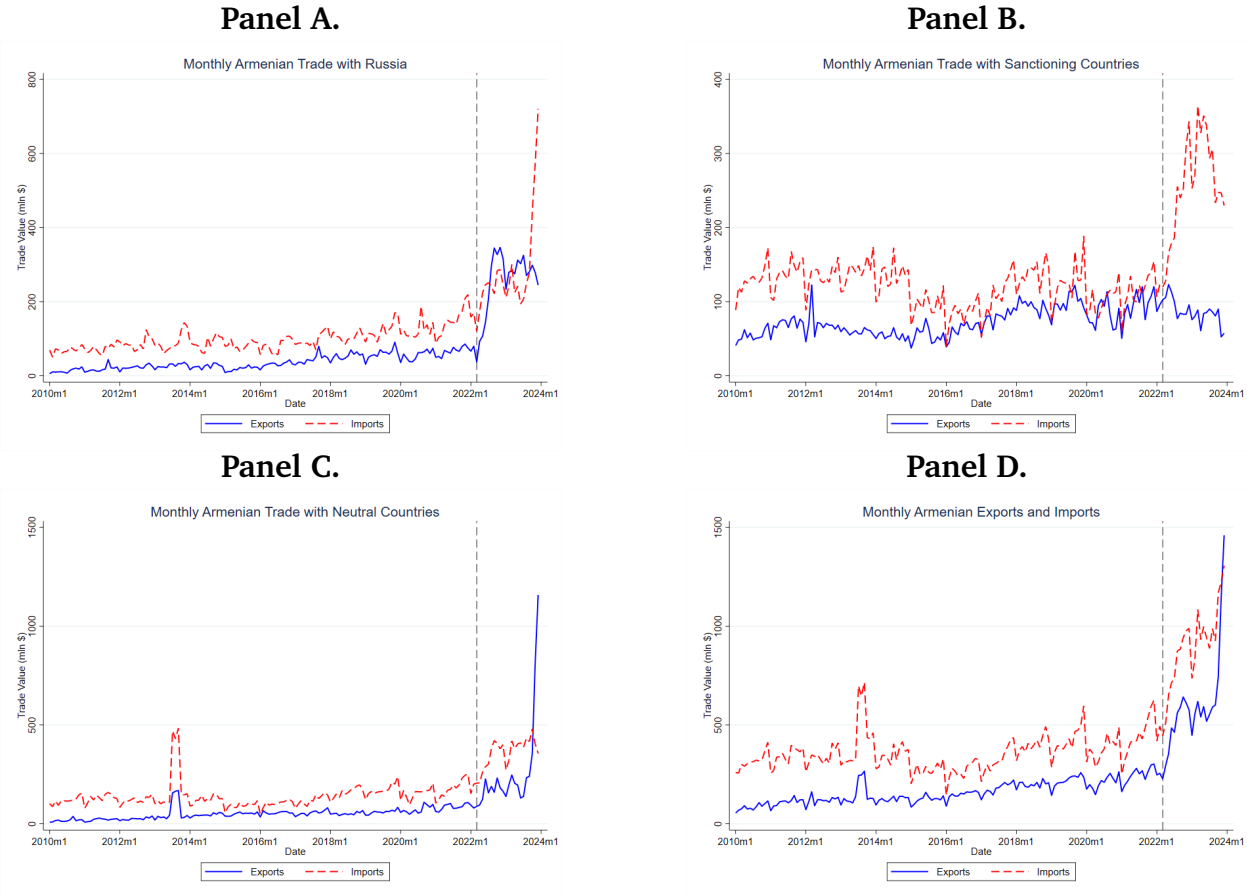
Table B1: Partner-Country Groups

Group	Countries
Non-sanctioning	Afghanistan, Algeria, Andorra, Angola, Antarctica, Antigua and Barbuda, Areas, nes, Argentina, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belize, Benin, Bhutan, Bolivia (Plurinational State of), Bonaire, Botswana, Bouvet Island, Brazil, Brunei Darussalam, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Central African Rep., Chad, Chile, China, China, Hong Kong SAR, China, Macao SAR, Christmas Isds, Colombia, Comoros, Congo, Cook Isds, Costa Rica, Cuba, Côte d'Ivoire, Dem. People's Rep. of Korea, Dem. Rep. of the Congo, Djibouti, Dominica, Dominican Rep., Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, FS Micronesia, Fiji, Fr. South Antarctic Terr., Gabon, Gambia, Georgia, Ghana, Grenada, Guam, Guatemala, Guinea, Guyana, Haiti, Holy See (Vatican City State), Honduras, India, Indonesia, Iran, Iraq, Israel, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Kuwait, Kyrgyzstan, Lao People's Dem. Rep., Lebanon, Lesotho, Liberia, Libya, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Isds, Mauritania, Mauritius, Mexico, Mongolia, Montserrat, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Nicaragua, Niger, Nigeria, Oman, Other Asia, nes, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Rep. of Moldova, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, San Marino, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Solomon Isds, Somalia, South Africa, Sri Lanka, State of Palestine, Sudan, Sudan (...2011), Suriname, Syria, Tajikistan, Thailand, Timor-Leste, Togo, Trinidad and Tobago, Tunisia, Turkmenistan, Tuvalu, Türkiye, Uganda, United Arab Emirates, United Rep. of Tanzania, Uruguay, Uzbekistan, Vanuatu, Venezuela, Viet Nam, Western Sahara, Yemen, Zambia, Zimbabwe.
Russia	Russian Federation.
Sanctioning	Albania, American Samoa, Anguilla, Aruba, Australia, Austria, Belgium, Bermuda, Bosnia Herzegovina, Br. Indian Ocean Terr., Br. Virgin Isds, Bulgaria, Canada, Cayman Isds, Croatia, Curaçao, Cyprus, Czechia, Denmark, Estonia, Faeroe Isds, Falkland Isds (Malvinas), Finland, France, French Polynesia, Germany, Gibraltar, Greece, Greenland, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Montenegro, N. Mariana Isds, Netherlands, New Caledonia, New Zealand, Niue, Norfolk Isds, North Macedonia, Norway, Other Europe, nes, Pitcairn, Poland, Portugal, Rep. of Korea, Romania, Saint Barthélemy, Saint Helena, Singapore, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tokelau, Turks and Caicos Isds, USA, Ukraine, United Kingdom, United States Minor Outlying Islands, Wallis and Futuna Isds.

Note: Countries are classified according to their participation in sanctions against Russia. Russia is treated as a separate partner group throughout the analysis.

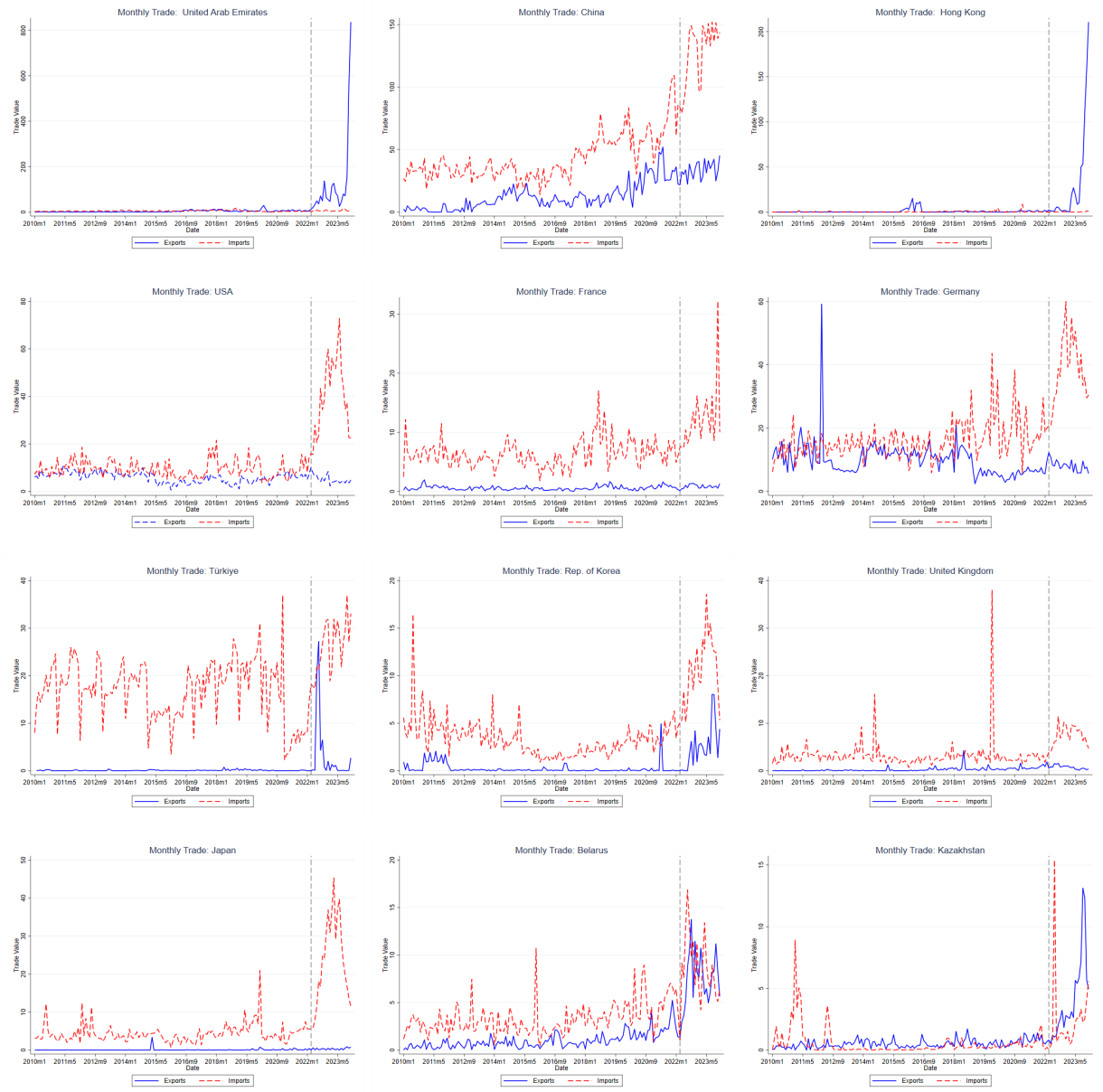
B.2 Aggregate and Bilateral Trade Flows

Figure B1: Armenian Monthly Exports and Imports by Partner Group



Note: Panels A–D show Armenia's total monthly exports (solid blue line) and imports (dotted red line) to or from (A) Russia, (B) countries sanctioning Russia, (C) non-sanctioning countries, and (D) the world, from January 2010 to January 2024. The dashed vertical line marks the onset of Western sanctions against Russia in February 2022. Values are expressed in current US dollars. The data source is UN Comtrade.

Figure B2: Armenian Monthly Trade with Selected Partners

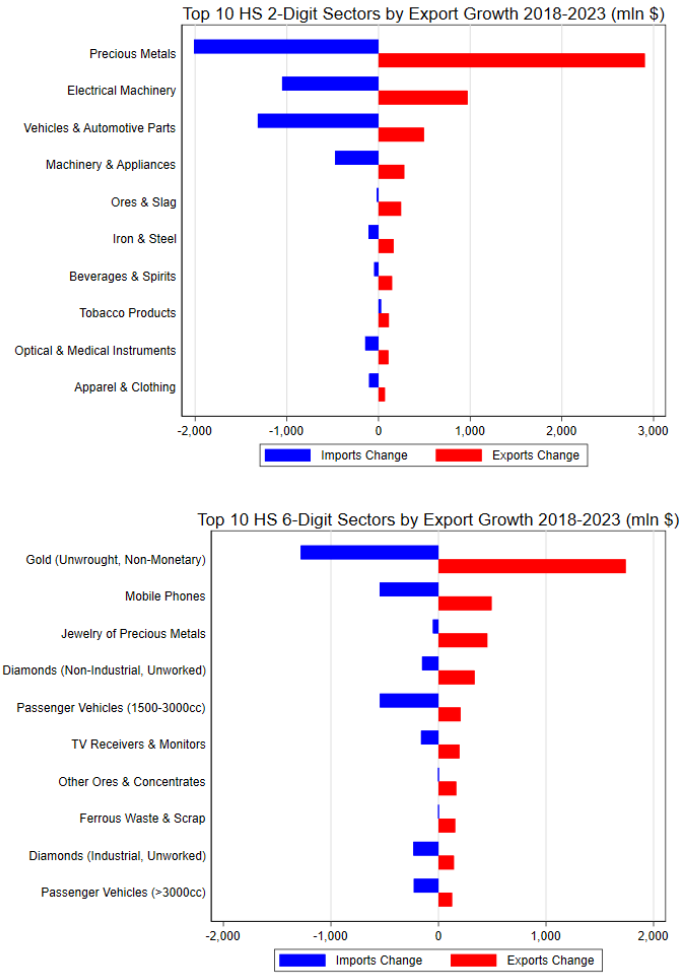


Note: Each panel shows Armenia's monthly exports (solid blue line) and imports (dotted red line) with the indicated partner. The dashed vertical line marks the onset of Western sanctions against Russia in February 2022. Values are expressed in current US dollars. The data source is UN Comtrade.

B.3 Product Composition of Export Growth

Figure B3 shows that a small set of HS2 and HS6 categories accounts for a large share of the gross export increase. Figure B7 documents concurrent changes in invoicing currency by trade direction and product status. The currency figure is contextual evidence on payment adjustment, not identification of the rerouting mechanism.

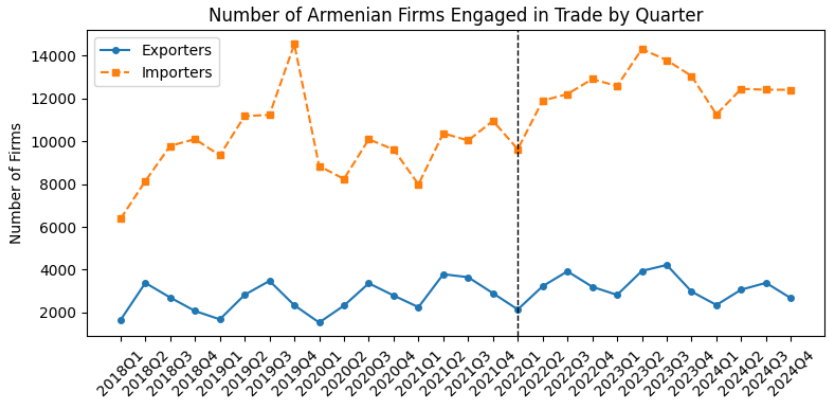
Figure B3: HS2 and HS6 Products with the Largest Increases in Export Value, 2018–2023



Note: The panels show the ten HS2 and HS6 product categories with the largest increases in Armenian export value between 2018 and 2023. Product classifications and names follow the Harmonized System 2007 nomenclature. Export values are expressed in millions of current US dollars. The data source is UN Comtrade.

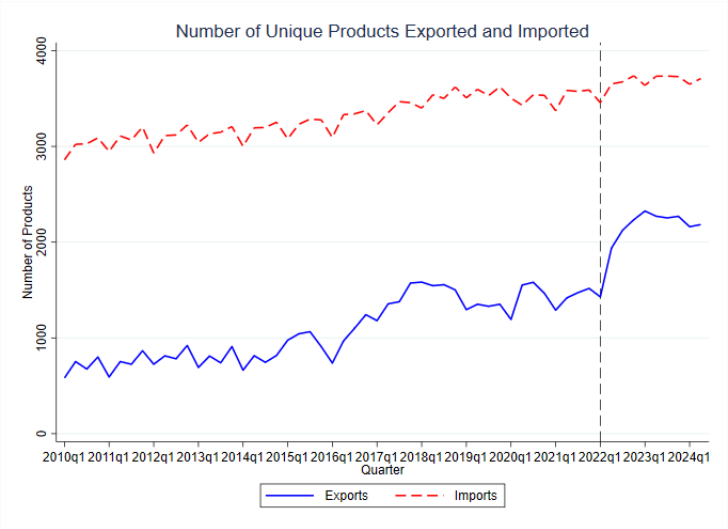
B.4 Firm Participation and Product Scope

Figure B4: Number of Armenian Exporters and Importers by Quarter



Note: The figure reports the quarterly number of Armenian firms engaged in exporting or importing. The dashed vertical line marks the onset of Western sanctions against Russia in February 2022. The data source is the SRC Customs Service.

Figure B5: Number of Unique Products Exported and Imported by Quarter



Note: The figure reports the quarterly number of distinct products exported or imported by Armenia. The dashed vertical line marks the onset of Western sanctions against Russia in February 2022. The data source is UN Comtrade.

Figure B6: Number of Products Exported and Imported by Partner Group and Quarter

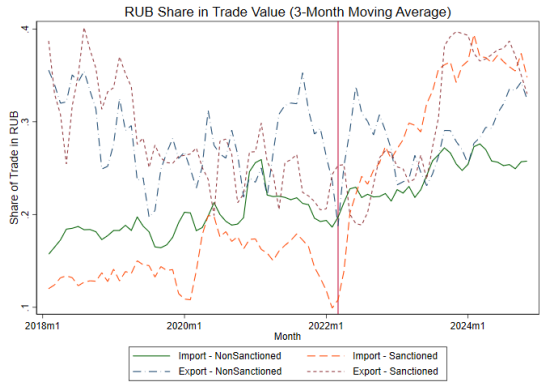


Note: The panels report the quarterly number of distinct HS6 products that Armenia exports to or imports from each partner group: countries sanctioning Russia, non-sanctioning countries, and Russia. The dashed vertical line marks the onset of Western sanctions against Russia in February 2022. The data source is UN Comtrade.

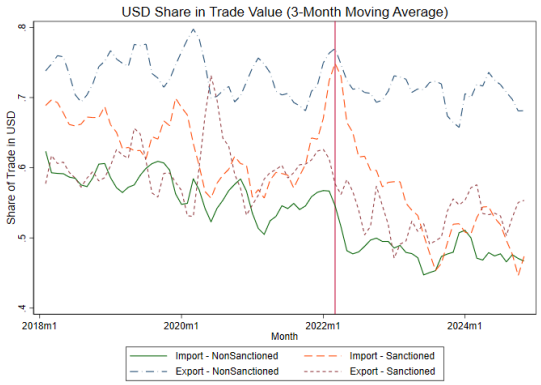
B.5 Currency Composition of Trade

Figure B7: Currency Composition of Trade by Product Sanction Status and Trade Direction, 2018–2024

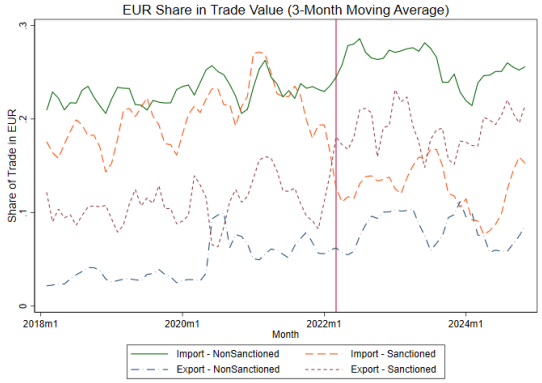
Panel A. Russian ruble



Panel B. US dollar



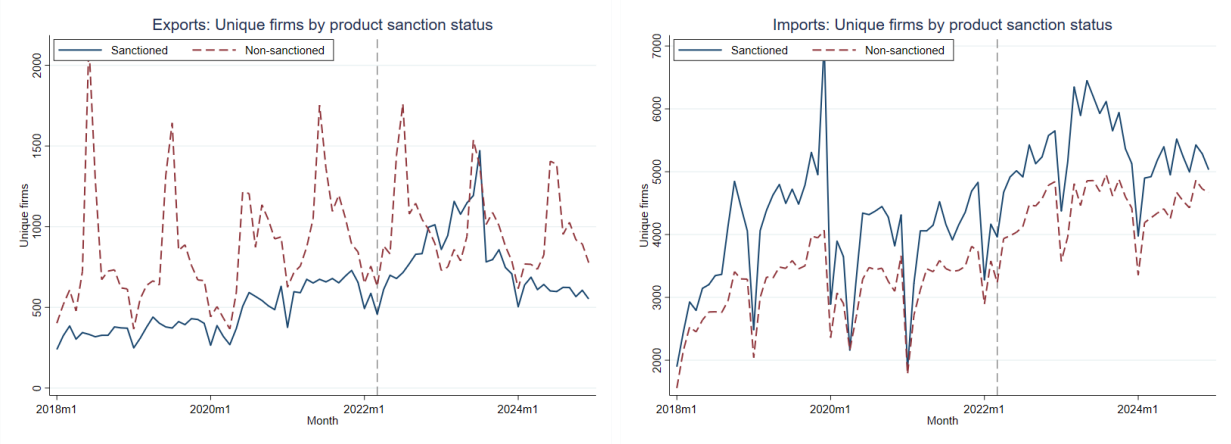
Panel C. Euro



Note: Each panel reports a three-month moving average of the share of trade value invoiced in the indicated currency. The share is the value invoiced in that currency divided by total trade value in the month, calculated separately for imports and exports and for sanctioned (`EU_sanction = 1`) and non-sanctioned (`EU_sanction = 0`) products. The vertical red line marks March 2022. The underlying data are transaction-level customs records.

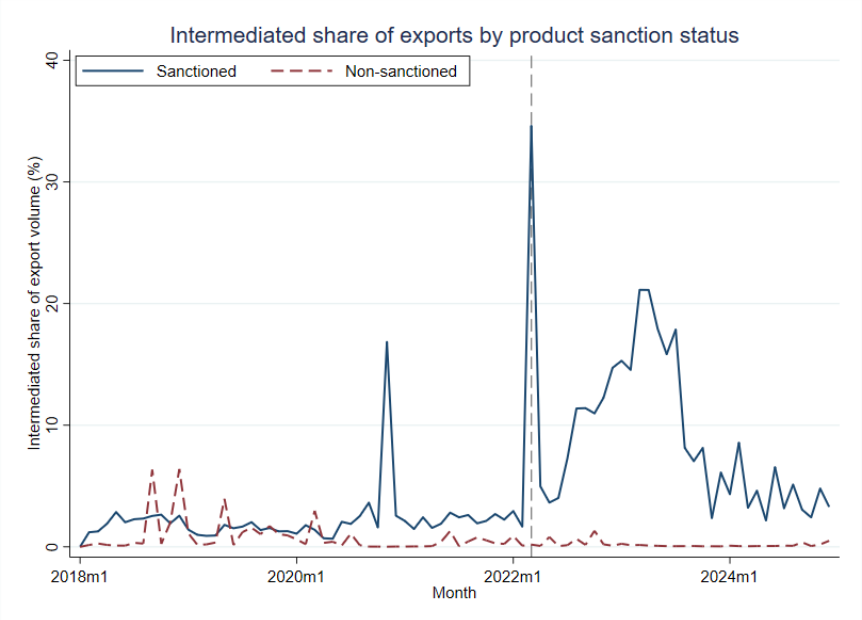
B.6 Sanctioned Goods and Potential Intermediation

Figure B8: Exporters and Importers of Sanctioned and Non-Sanctioned Products



Note: The panels show the number of Armenian exporters and importers trading sanctioned and non-sanctioned products. A firm may appear in both product groups if it trades products in both categories.

Figure B9: Aggregate Potential Intermediation of Sanctioned and Non-Sanctioned Products



Note: The figure reports the aggregate potential-intermediation rate separately for sanctioned and non-sanctioned products. Potential intermediation is measured using the paper's product-level import–export matching procedure.

B.7 Supplementary Descriptive Tables

B.7.1 Trading Firms, Partners, and Products

Table B2: Firm-Level Trade Summary Statistics by Quarter, 2021 vs. 2023 (values in million USD)

		2021				2023			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Panel A. Exports									
Exports: Value (mln USD)	Mean	0.26	0.21	0.20	0.28	0.53	0.37	0.38	1.21
	SD	3.48	3.98	3.17	3.25	5.22	4.13	4.69	13.48
	Median	0.01	0.01	0.01	0.01	0.03	0.02	0.02	0.02
	P99	3.45	2.20	2.20	3.56	6.45	4.03	4.79	17.73
	Obs	2,137	3,635	3,458	2,752	2,649	3,752	3,991	2,740
# Products exported	Mean	3.20	2.88	3.60	3.57	4.23	3.33	3.36	4.04
	SD	12.97	14.03	19.48	22.94	10.84	10.65	13.47	13.56
	Median	1	1	1	1	2	1	2	1
	P99	25	24	26	27	38	31	30	38
	Obs	2,137	3,635	3,458	2,752	2,649	3,752	3,991	2,740
# Destinations exported	Mean	1.29	1.20	1.21	1.29	1.26	1.24	1.26	1.33
	SD	1.32	1.11	1.08	1.28	1.11	1.11	1.01	1.29
	Median	1	1	1	1	1	1	1	1
	P99	7	6	6	7	6	5	5	6
	Obs	2,137	3,635	3,458	2,752	2,649	3,752	3,991	2,740
Panel B. Imports									
Imports: Value (mln USD)	Mean	0.09	0.11	0.11	0.13	0.22	0.19	0.18	0.24
	SD	0.61	0.76	0.70	1.05	4.48	2.36	2.43	4.59
	Median	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	P99	1.59	1.88	1.95	2.38	2.49	2.46	2.44	2.67
	Obs	7,964	10,290	9,978	10,921	12,568	14,274	13,745	13,039
# Products imported	Mean	7.68	8.21	8.08	8.30	8.06	8.18	8.37	8.36
	SD	20.07	20.87	18.46	18.70	19.77	21.49	21.42	21.40
	Median	2	3	2	3	3	3	3	3
	P99	80	82	84	83	86	83	86	93
	Obs	7,964	10,290	9,978	10,921	12,568	14,274	13,745	13,039
# Source countries	Mean	2.13	2.12	2.12	2.17	2.51	2.45	2.39	2.39
	SD	3.35	3.30	3.27	3.40	4.02	3.84	3.70	3.80
	Median	1	1	1	1	1	1	1	1
	P99	17	17	17	18	21	20	20	20
	Obs	7,964	10,290	9,978	10,921	12,568	14,274	13,745	13,039

Notes: Each cell reports firm-level statistics within quarter. Trade values are converted from AMD to million USD using year-specific average exchange rates (2021: 1 USD = 505.05 AMD; 2023: 1 USD = 392.54 AMD). "P99" denotes the 99th percentile. "# Products" counts distinct 6-digit HS codes; "# Destinations/Sources" counts distinct partner countries.

Table B3: Firm-Level Trade Margins by Sanctioned-Goods Status

	Non-sanctioned goods			Sanctioned goods		
	2021Q1	2023Q1	% change	2021Q1	2023Q1	% change
Panel A. Exports						
Number of firms	1,481	1,527	3.1	1,113	1,776	59.6
Mean HS6 products per firm	2.67	3.49	30.7	2.59	3.30	27.6
Mean value per firm, mln USD	0.281	0.395	40.4	0.116	0.456	291.7
Panel B. Imports						
Number of firms	4,888	7,677	57.1	6,237	10,054	61.2
Mean HS6 products per firm	5.25	5.23	-0.4	5.71	6.09	6.5
Mean value per firm, mln USD	0.067	0.110	63.7	0.066	0.190	187.8

Values are converted from AMD to million USD using annual average exchange rates.

Notes: The unit is firm × quarter × trade type × sanctioned-goods status. Sanctioned goods are HS6 products identified as restricted or sanctioned goods. The percentage change compares 2023Q1 to 2021Q1. Source: Armenian customs microdata.

Table B4: Trade Margins by Partner Group, 2021Q1 vs. 2023Q1

	Neutral partners			Sanctioning partners			Russia		
	2021Q1	2023Q1	% change	2021Q1	2023Q1	% change	2021Q1	2023Q1	% change
Number of exporting firms	452	601	33	510	483	-5	1,382	1,867	35
Number of importing firms	5,080	8,414	66	2,519	5,052	101	2,454	2,901	18
Unique HS6 exported	686	980	43	446	566	27	1,164	1,523	31
Unique HS6 imported	2,612	3,023	16	2,430	2,842	17	2,614	2,679	2
Total export value, mln USD	185	578	212	220	208	-5	141	632	348
Total import value, mln USD	307	1,128	267	230	1,093	375	202	530	162
Mean export value per firm, 1000 USD	410	960	134	432	430	-0	102	339	232
Mean import value per firm, 1000 USD	60	134	123	91	217	138	82	182	122

Notes: Partner groups are neutral countries, sanctioning countries, and Russia. Values are converted from AMD to USD using annual average exchange rates. Percentage changes compare 2023Q1 to 2021Q1. Source: Armenian customs microdata.

B.7.2 Potential Intermediation and Concentration

Table B9 shows how measured intermediated volume shifts across predetermined firm-size quartiles; Table B10 distinguishes general export concentration from W12 concentration; and Table B11 documents that intermediaries are selected, larger, and more internationally connected than other exporters. Table B12 shows substantial deconcentration and reorientation toward Russia.

Table B5: Firm Characteristics by Trade Mode, 2021

	H Non-trader	Importer only	I Intermediator	D Exporter only	D Dual
Number of firms	150,119	11,189	628	708	689
Employees	1.54	10.91	107.35	4.57	39.14
	(8.61)	(63.07)	(352.16)	(14.37)	(112.27)
Turnover, mln AMD	19.50	260.00	4,420.00	143.00	1,290.00
	(615.00)	(2,610.00)	(34,300.00)	(1,110.00)	(6,270.00)
Labor productivity, mln AMD/worker	8.31	26.40	98.50	26.20	48.40
	(257.00)	(99.30)	(485.00)	(95.50)	(286.00)
Intermediation share	–	–	0.54	0.01	0.00
	–	–	(0.43)	(0.09)	(0.00)

Notes: Values are means, with standard deviations in parentheses. The table classifies firms according to their 2021 trade status. Non-traders have no customs trade activity in 2021. Importer-only firms import but do not export, while exporter-only firms export but do not import. Dual traders are firms that both import and export in 2021. I split these dual traders into two groups according to measured intermediation: *Intermediators* are dual traders with a positive 2021 intermediation share, meaning that part of their exports can be matched to products imported by the same firm within the preceding 12 months. The remaining dual traders, reported as *Dual*, both import and export but have zero or missing measured intermediation intensity. Thus, intermediation is a stricter category within dual trading. Turnover and labor productivity are expressed in million AMD. Source: Armenian Customs and firm administrative data.

Table B6: Armenian trade by product sanction status, 2018–2024

	Value (bn AMD, real)		Trading firms		HS6 products	
Year	Sanct.	Non-s.	Sanct.	Non-s.	Sanct.	Non-s.
Panel A: Exports						
2018	256	549	1,746	5,368	1,149	1,206
2019	283	591	2,132	5,312	1,059	1,046
2020	255	604	2,589	5,190	1,054	1,066
2021	257	706	3,510	6,204	1,213	1,283
2022	508	700	3,692	5,861	1,245	1,492
2023	1,286	587	4,357	5,324	1,251	1,456
2024	2,413	607	2,988	4,993	1,206	1,460
Panel B: Imports						
2018	1,041	632	16,964	10,928	1,935	2,341
2019	959	666	21,101	13,688	1,967	2,396
2020	779	625	15,658	11,483	1,931	2,368
2021	891	656	17,150	12,237	1,942	2,363
2022	1,907	884	19,688	15,453	1,916	2,628
2023	1,771	946	22,855	17,122	1,942	2,612
2024	2,184	1,021	19,971	15,732	1,923	2,625

Notes: CPI-deflated customs values. Sanctioned = HS6 on the EU sanctions list. Firms and products are unique counts within year×direction×status.

Table B7: Median real unit values, pre vs. post February 2022

	Pre	Post	Δ%	N pre	N post
Exports, by destination					
Russia	430	980	+128	128,510	123,341
Sanctioning	1,033	1,354	+31	32,076	27,223
Neutral	1,176	1,558	+32	35,909	40,042
Exports, by product type					
Sanctioned	2,157	2,480	+15	75,433	86,549
Non-sanctioned	330	526	+59	121,062	104,057
Imports, by origin					
Russia	1,168	1,018	−13	501,396	451,000
Sanctioning	7,874	8,403	+7	565,379	655,505
Neutral	2,048	2,221	+8	888,880	954,143
Imports, by product type					
Sanctioned	4,572	4,084	−11	1,177,112	1,283,663
Non-sanctioned	1,305	1,452	+11	778,543	776,985

Notes: transaction-cell medians of CPI-deflated unit values, trimmed at the within-direction 1st/99th percentiles. Pre = 2018m1–2022m2. N counts customs cells (firm×HS6×partner×month), not firms.

Table B8: Firm types by year (regressions use the fixed 2021 classification)

Year	Type	N firms	Mean emp.	Med. emp.	Mean turn.	Med. turn.	Mean tax
2018	Exporter	515	4.4	1	0.06	0.013	0.004
	Importer	9,850	11.2	1	0.27	0.017	0.027
	Dual	960	79.8	12	2.38	0.223	0.280
	Non-trading	355,115	0.5	0	0.02	0.002	0.002
2021	Exporter	708	4.6	2	0.14	0.016	0.005
	Importer	11,189	10.9	2	0.26	0.022	0.029
	Dual	1,317	71.7	8	2.79	0.192	0.284
	Non-trading	150,119	1.5	0	0.02	0.002	0.002
2022	Exporter	769	6.6	2	0.19	0.017	0.009
	Importer	13,289	10.3	2	0.27	0.018	0.027
	Dual	2,213	42.7	4	1.60	0.151	0.207
	Non-trading	170,078	1.5	0	0.02	0.002	0.002
2023	Exporter	900	8.9	1	0.61	0.021	0.006
	Importer	15,162	9.7	2	0.27	0.017	0.029
	Dual	2,892	35.4	3	1.56	0.138	0.177
	Non-trading	185,657	1.4	0	0.02	0.002	0.002

Notes: annual trade status; turnover and tax CPI-deflated, bn AMD.

Table B9: Share of intermediated export volume by 2021-size quartile (%)

	By 2021 employment				By 2021 turnover			
Year	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
2018	1.5	0.2	2.5	95.7	1.4	0.3	0.3	98.0
2019	6.4	2.3	15.4	75.8	2.3	1.8	4.6	91.3
2020	3.6	0.8	2.8	92.8	0.4	1.6	1.1	96.9
2021	5.4	1.2	84.2	9.1	0.1	1.0	2.5	96.4
2022	8.5	5.4	47.0	39.0	5.7	1.5	5.4	87.3
2023	20.1	5.3	19.3	55.3	9.7	4.7	10.6	74.9
2024	5.8	2.5	14.1	77.6	2.9	1.8	9.5	85.9

Notes: quartiles fixed at 2021 firm characteristics; Q4 largest.

Table B10: Export concentration: annual mean HHI of firm export shares

	2018	2019	2020	2021	2022	2023	2024
Sanctioned	0.116	0.119	0.158	0.057	0.056	0.051	0.105
Non-sanctioned	0.124	0.126	0.118	0.137	0.115	0.121	0.069

Notes: HHI over firm shares of export value within month$\times$status, averaged to the year. Higher = more concentrated.

Table B11: Exporter characteristics: intermediaries vs. other exporters, 2021 and 2023

	2021		2023	
	Other	Interm.	Other	Interm.
N firms	7,540	806	6,057	2,019
Mean employment (2021)	20.7	98.6	19.9	70.0
Median employment (2021)	3	11	4	6
Mean turnover (mn AMD)	584	4,196	645	3,135
Mean turnover/emp. (mn)	38.0	92.1	24.5	66.3
Mean avg. log wage	13.0	13.5	13.1	13.3
Mean export value (mn AMD)	49.8	729.5	131.9	532.0
Median export value (mn AMD)	2.4	9.0	2.8	32.6
Mean # HS6 exported	2.5	9.9	3.1	7.1
Mean # destinations	1.1	2.2	1.2	1.8
Mean # import sources	0.3	7.7	0.6	8.0
Mean # sanctioned HS6	0.8	5.0	1.2	4.2
Mean # non-sanctioned HS6	1.7	4.8	1.9	2.9
Sanctioned value share (%)	32.1	59.0	35.7	73.3
Russia export share (%)	76.9	49.5	66.4	65.8
New-product value share (%)	74.8	55.8	80.8	83.6

Notes: intermediary = firm with positive intermediated export volume (W12 measure) in the year. Turnover and export value CPI-deflated. Employment and turnover fixed at 2021 values.

Table B12: Concentration and composition of export intermediation, 2021 vs. 2023

Metric	2021	2023
Firm concentration		
N intermediating firms	806	2,019
Top-1 firm share (%)	81.1	13.5
Top-5 firms share (%)	85.1	24.4
Top-10 firms share (%)	87.3	29.0
Top 1% of firms (%)	86.9	36.7
Top 10% of firms (%)	96.3	75.3
# firms covering 50%	1	53
# firms covering 90%	20	476
Product concentration		
N HS6 with interm.	1,774	1,935
Top-5 HS6 share (%)	85.2	41.4
# HS6 covering 50%	1	9
# HS6 covering 90%	18	158
Firm–product pairs		
N firm–HS6 pairs	4,727	8,882
Top-10 pairs share (%)	85.1	21.7
Destination of intermediated volume		
Russia share (%)	14.4	80.4
Sanctioning share (%)	0.9	1.3
Neutral share (%)	84.8	18.2

Notes: intermediated volume = W12 imported-component measure. Destination shares allocate each firm×HS6 cell's intermediated volume by its export destination value shares.

C Additional Regression Evidence

This appendix reports estimates and diagnostics that are not displayed in full in the main text. It is organized in the same substantive order as the empirical analysis: additional trade-flow specifications, complete dynamic responses around EU listing, destination-specific unit-value evidence, and full firm and worker specifications. Tables and figures already shown in full in the main text are not reproduced here.

C.1 Additional Trade-Flow Specifications

C.1.1 Aggregate Country-Level Trade

The firm-level specifications in the main text use Armenian customs records from 2018 onward. Table C1 provides a more aggregated counterpart using monthly country-level UN Comtrade data over 2010–2023. The OLS columns use log positive trade, whereas the PPML columns use trade levels and retain country–month zero flows. The two estimators therefore do not recover the same margin. In particular, the Russia export coefficient is sensitive to whether zero flows are included, while the positive Russia import response is more stable. The table is consequently useful as a longer-run aggregate check, but it should not be interpreted as reproducing the firm–product–partner estimands in the main text.

C.1.2 Pre-Period Placebo

Table C2 assigns an artificial treatment beginning in February 2021 and restricts the sample to the pre-war period. The basic firm and month fixed-effect specification displays differential pre-period movements for some export outcomes. Those coefficients become small and statistically insignificant when firm–product and firm–month fixed effects are included. The exercise therefore shows why the tighter comparison is useful for the pooled sanctioned-product specification. It does not, by itself, validate every post-2022 design or

Table C1: Effect of Sanctions on Country-level Trade

	Exports		Imports	
	OLS	*PPML*	*OLS*	*PPML*
	(1)	(2)	(3)	(4)
Regime * Post				
$Sanctioning * Post_t$	-0.6*	-2.0***	-0.1	-0.2**
	(0.3)	(0.2)	(0.1)	(0.1)
$Russia * Post_t$	0.5**	-0.2	0.4***	0.6***
	(0.2)	(0.2)	(0.1)	(0.2)
Regime Dummy				
$Sanctioning$	1.5***	1.2***	2.2***	0.7***
	(0.5)	(0.06)	(0.6)	(0.05)
$Russia$	8.1***	4.8***	9.9***	4.7***
	(0.3)	(0.07)	(0.3)	(0.05)
$Post_t$	1.5***	2.1***	0.9***	0.9***
	(0.2)	(0.2)	(0.1)	(0.09)
N	10749	39672	20910	39672

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: OLS models (columns 1 and 3) use the log of exports/imports, while PPML models (columns 2 and 4) use trade levels and account for zero trade flows by including all possible country-month pairs. The regime is a categorical variable equaling 1 for the partners sanctioning Russia, 2 for Russia itself, and 0 for partners not sanctioning Russia, which are the reference group. Post is a dummy equal to 1 for the period of sanctions after March 2022. The source of the trade data is UN COMTRADE, with trade values aggregated at the country-month level. Covers the period from January 2010 to December 2023.

eliminate the need to inspect the event-study leads reported below.

Table C2: Placebo test: artificial treatment in February 2021, pre-period data only

	Exports				Imports			
	basic FE		fp+ft FE		basic FE		fp+ft FE	
	vol	val	vol	val	vol	val	vol	
Sanct. × Placebo	0.162**	0.134**	0.017	0.031	0.004	−0.046*	−0.020	−(
	(0.068)	(0.057)	(0.035)	(0.038)	(0.027)	(0.027)	(0.020)	(0
Obs	189,635	189,635	132,887	132,887	1,968,403	1,968,296	1,593,220	1,5

Notes: sample restricted to 2018m1–2022m2; placebo treatment assigns *Post* = February 2021 onward. *basic* = firm and month fixed effects; *fp+ft* = firm×product and firm×month fixed effects (the paper's preferred specification, Table 8). Rejection in the basic specification and non-rejection in the preferred one indicates the latter absorbs the differential pre-dynamics. Standard errors clustered by HS6. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

C.2 Dynamic Responses Around EU Listing

The main text reports selected headline outcomes. This subsection presents the complete companion panels and separates two estimands. The Callaway–Sant'Anna estimates describe changes among active product cells. The ETWFE PPML estimates retain economically meaningful zero outcomes and therefore also capture interruptions and reactivation within the constructed panel. Neither design should be interpreted as a shipment-level test of intermediation.

C.2.1 Conditional Product-Level Responses

An HS6 product is treated in the quarter in which it first appears in an EU sanctions package, following the product taxonomy of Chupilkin, Javorcik and Plekhanov (2025). I use the group-time estimator of Callaway and Sant'Anna (2021), which compares each listing cohort with products that are never listed or not yet listed in the relevant quarter and aggregates cohort-time effects by event time. This avoids using already-listed products as controls and permits effects to differ across listing cohorts and exposure horizons. Inference uses a wild bootstrap clustered by HS6 product. Because the outcomes in Figure C1–Figure C2 are observed only for positive product–quarter cells, these figures

describe adjustment conditional on active trade.

C.2.2 Additional Zero-Inclusive Product-Level Responses

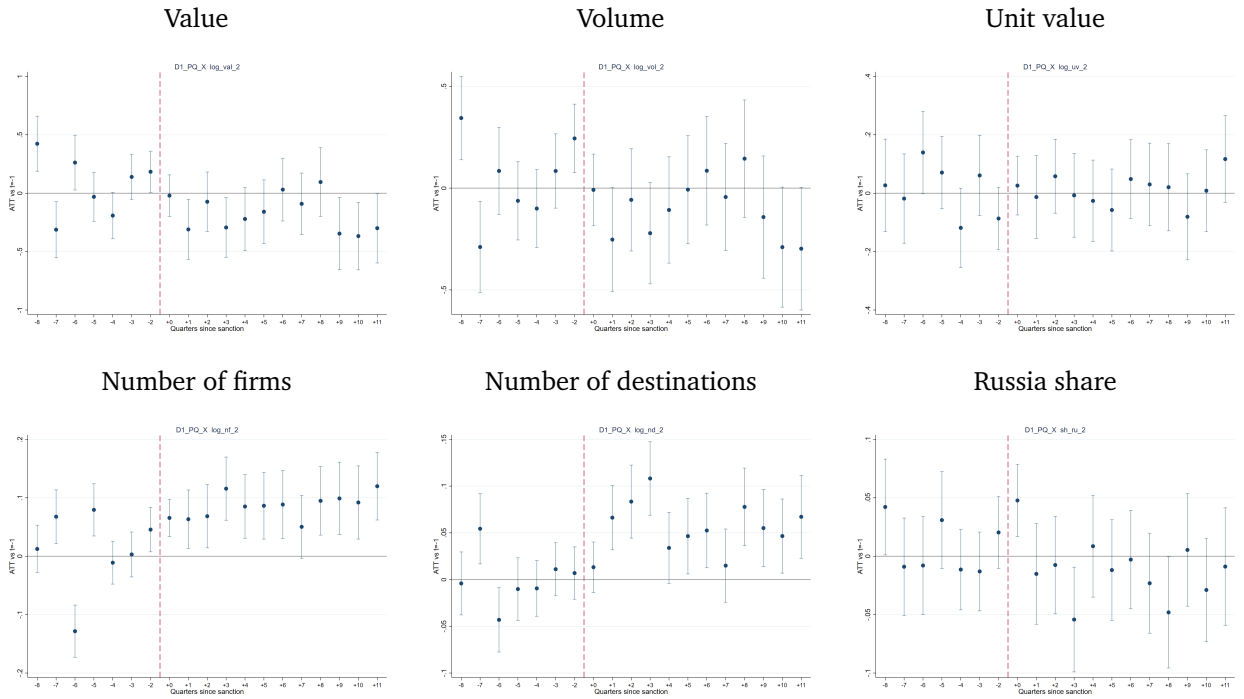
The conditional figures omit quarters in which the relevant product records no trade. For non-negative outcomes for which zero is meaningful—trade value, physical volume, the number of firms, and the number of destinations or origins—I additionally use the PPML implementation of the extended two-way fixed-effect estimator of Nagengast and Yotov (2025). Missing quarters between a product's first and last observed positive quarter are recorded as zero. This construction admits within-span transitions from positive trade to zero and from zero back to positive trade without applying an arbitrary log transformation.

The active-span restriction is important. It does not create leading zeros before a product's first observed positive quarter or trailing zeros after its last observed positive quarter. Accordingly, these estimates capture interruption and reactivation within an observed product span, but not a product's first-ever appearance in Armenian trade or its final disappearance from the sample. Estimating those margins would require a common risk window that includes economically meaningful pre-entry and post-exit zeros. Recorded unit value is also undefined when trade is zero, so it is intentionally omitted from the zero-inclusive figures and remains only in the conditional figures above.

Figure C3 reports the four zero-inclusive outcomes not displayed in the main text: export volume, the number of exporting firms, import value, and import volume.

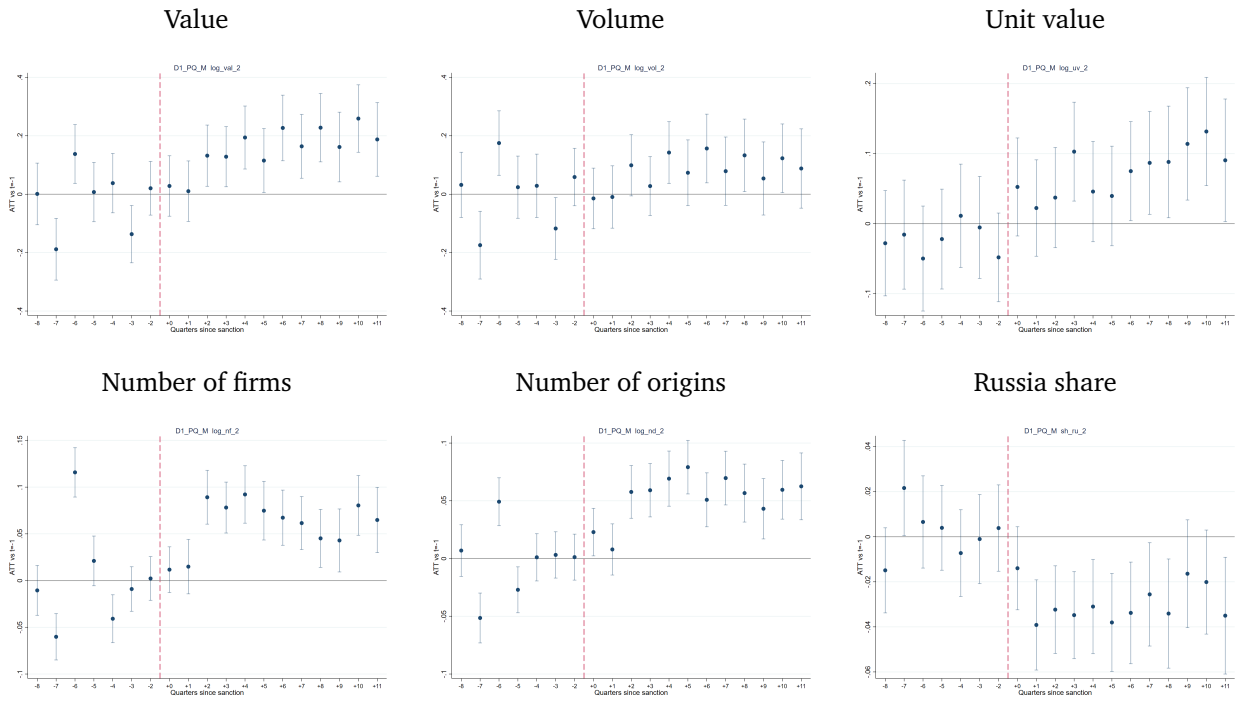
Figure C1–Figure C3 show why the conditional and zero-inclusive estimands should not be combined mechanically. The former describe the evolution of active cells, while the latter also retain within-span inactivity. The expansion in value, destinations, participating firms, and sourcing origins is consistent with product-network adjustment, but these product-level panels alone do not establish intermediation. The direct firm–product matching evidence is reported in the main text.

Figure C1: Conditional Product-Level Event Studies: Exports



Notes: Each panel reports event-time average treatment effects from the Callaway and Sant'Anna (2021) estimator on a quarterly HS6-product export panel, 2018Q1–2024Q4. Treatment is the product's quarter of first EU listing; never-listed and not-yet-listed products form the comparison set. Outcomes are log value, log volume, log recorded unit value, log numbers of exporting firms and destinations, and the Russia share of the product's exports. Event time -1 is omitted. Wild-bootstrap inference is clustered by HS6 product. The value, volume, and firm-count panels display non-flat leads near listing and should be interpreted as conditional dynamics, not as clean causal effects of listing.

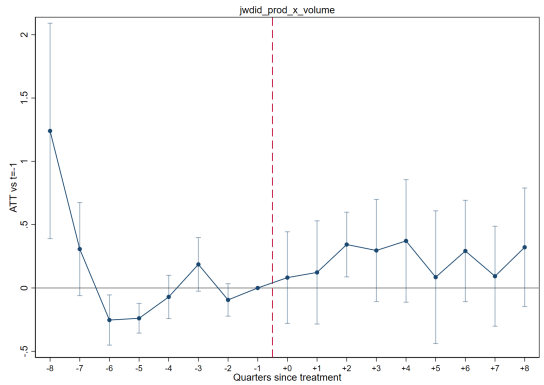
Figure C2: Conditional Product-Level Event Studies: Imports



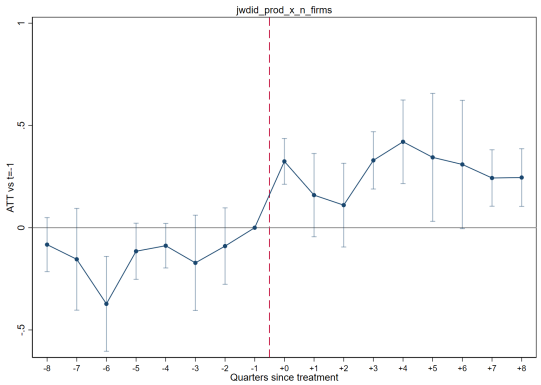
Notes: The design and inference follow Figure C1 on the import side. Outcomes are log value, log volume, log recorded unit value, log numbers of importing firms and origin countries, and the Russia share of the product's imports. The near-window leads are comparatively flat for recorded unit value and the Russia share but not for several value and count outcomes. The latter panels should therefore be treated as descriptive conditional dynamics.

Figure C3: Additional Zero-Inclusive Product-Level Outcomes

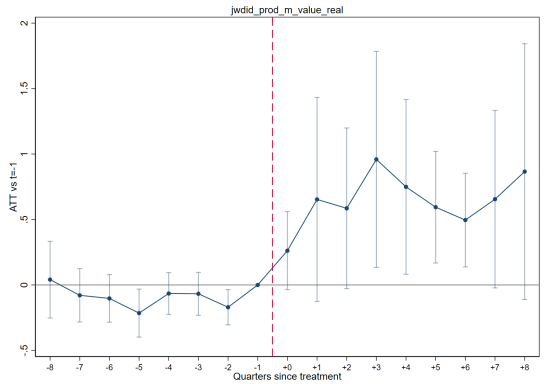
Panel A. Export volume



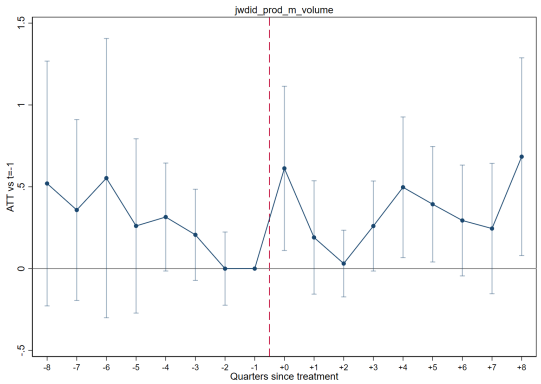
Panel B. Number of exporting firms



Panel C. Import value



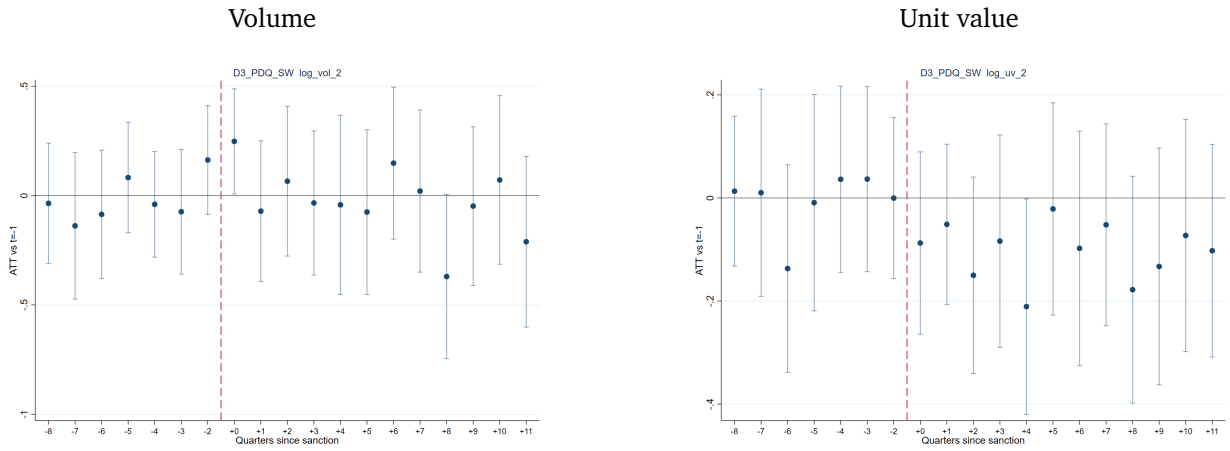
Panel D. Import volume



Notes: Event-time coefficients are estimated by PPML using the extended two-way fixed-effect estimator on rectangularized HS6-product–quarter panels. Panels A–B use the export panel ($N = 69{,}585$), while Panels C–D use the import panel ($N = 123{,}884$). Missing quarters inside a product's observed active span are recorded as zero; quarters preceding its first positive observation and following its last positive observation are not added. Treatment occurs in the quarter of the product's first EU listing, with never-listed and not-yet-listed products forming the comparison set. Event time -1 is omitted, standard errors are clustered by HS6 product, and coefficients are semi-elasticities. These panels complement the selected headline zero-inclusive outcomes reported in Figure 4. They document the remaining value, volume, and firm-count responses without implying that the goods are ultimately consumed in Armenia or subsequently re-exported.

C.2.3 Sanctioning-Destination Placebo

Figure C4: Additional Sanctioning-Destination Placebo Outcomes



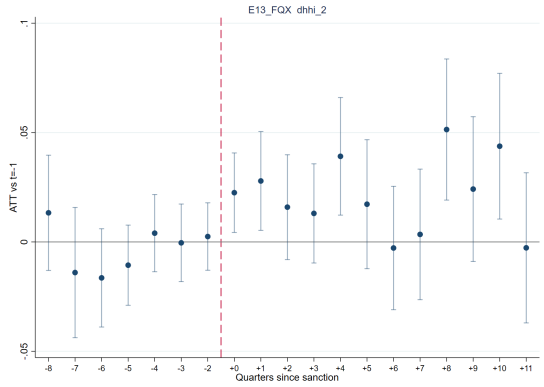
Notes: The product–destination–quarter design is restricted to listed goods exported to sanctioning destinations. Treatment is the product's quarter of first EU listing; inference follows the conditional Callaway–Sant'Anna specifications above. The displayed outcomes and their pre-treatment coefficients are comparatively flat; joint tests over event-time leads -8 through -2 have p-values between 0.69 and 0.94. These nulls weigh against an explanation based solely on a common shock to listed products. They are consistent with corridor-specific reallocation but do not identify a three-leg shipment route.

C.2.4 Secondary Firm-Level Margins

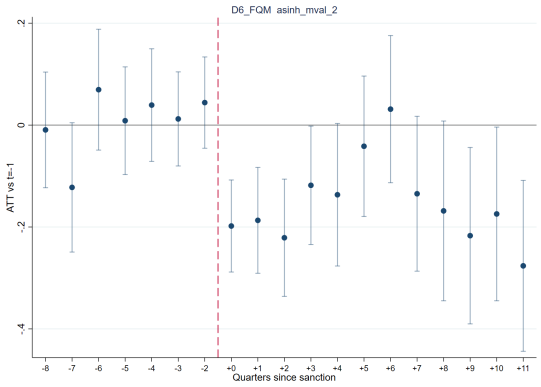
Figure C5 collects four secondary diagnostics with different outcomes, treatment definitions, and samples. The panels should not be treated as four outcomes from one common regression or combined into a single causal mechanism.

Figure C5: Secondary Firm-Level Adjustment Margins

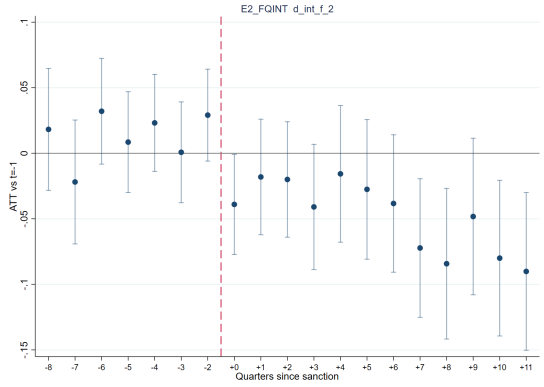
Destination concentration (HHI)



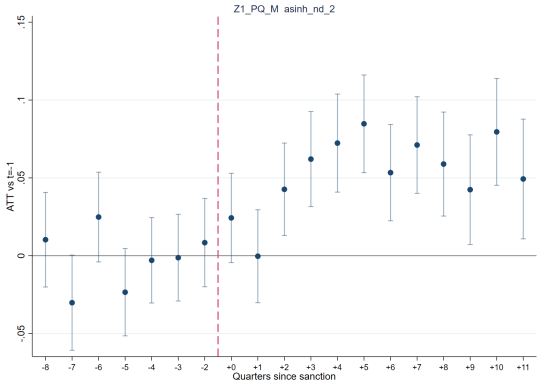
Sanctioned imports, early- versus late-listed firms



Firm intermediation indicator



Import origins, zero-inclusive IHS



*Notes:*Each panel uses a staggered group-time design with not-yet-treated comparisons and wild-bootstrap inference, but the units and treatments differ. The upper-left panel indicates greater destination concentration among exposed exporters. The upper-right panel compares firms exposed to early- and late-listed products; because both groups are eventually treated, it is a descriptive contrast in timing rather than a causal level effect. The lower-left panel shows a decline in a firm-level intermediation indicator among exposed incumbents. This is not the same estimand as the main firm–product–month regression, which compares sanctioned and non-sanctioned products conditional on positive exports. The lower-right panel re-estimates the import-origin response using an inverse-hyperbolic-sine outcome on a panel that retains zeros; the joint near-window pre-trend test has $p = 0.18$.

C.3 Destination-Specific Unit Values and Intermediary Margins

To examine whether Russia-bound exports exhibit a destination-specific unit-value differential, I estimate

$$\begin{aligned}\log UV_{i,g,p,t} = {} & \beta_S(\text{Sanctioning}_p \times Post_t) + \beta_R(\text{Russia}_p \times Post_t) \\ & + \theta_S(\text{Sanctioning}_p \times Post_t \times S_g) + \theta_R(\text{Russia}_p \times Post_t \times S_g) \\ & + \lambda_{i,g,p} + \phi_{i,g,t} + \varepsilon_{i,g,p,t},\end{aligned} \tag{21}$$

where $UV_{i,g,p,t}$ is the recorded export unit value for firm i, HS6 product g, destination p, and month t. The firm–product–destination fixed effects $\lambda_{i,g,p}$ absorb permanent relationship differences, while the firm–product–month fixed effects $\phi_{i,g,t}$ compare destinations served by the same firm–product in the same month. Columns without the triple-interaction terms set $\theta_S = \theta_R = 0$. The trade-pattern specification further replaces $\lambda_{i,g,p}$ with a firm–product–destination–pattern effect, where the pattern is the complete set of destinations served by that firm–product in the month. It therefore compares only months in which the full destination set is unchanged.

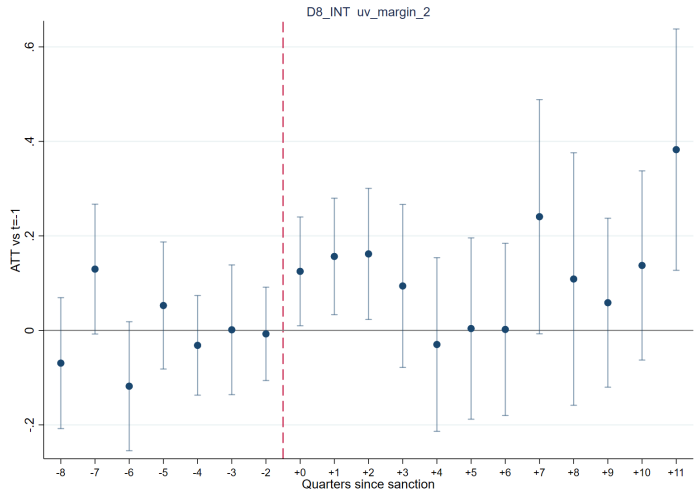
Table C3 reports a Russia differential of approximately 0.20 log points under the ordinary fixed effects and approximately 0.12 log points when the complete destination set is held fixed. The sanctioning-partner coefficients and the sanctioned-product triple interactions are not statistically significant. These are differences in recorded unit values, not direct measures of prices or markups. They may also reflect quality, packaging, contract terms, transport costs, or residual unit composition within HS6.

Table C3: Destination-Specific Export Pricing: Within Firm–Product–Month Unit Values

	Ordinary FE		TPSFE	
Dep. var.: log unit value	(1)	(2)	(3)	(4)
Post × Sanctioning	0.073	0.085	0.016	0.035
	(0.047)	(0.070)	(0.043)	(0.056)
Post × Russia	0.196***	0.228**	0.116**	0.117*
	(0.071)	(0.103)	(0.047)	(0.062)
Post × Sanctioning × Sanctioned HS6		−0.039		−0.065
		(0.076)		(0.074)
Post × Russia × Sanctioned HS6		−0.105		0.003
		(0.108)		(0.074)
Firm×product×destination FE	✓	✓		
Firm×product×destination×pattern FE			✓	✓
Firm×product×month FE	✓	✓	✓	✓
Observations	53,471	53,471	31,176	31,176
Firms (clusters)	515	515	479	479
Firm–products	1,534	1,534	1,449	1,449
Firm–product–destination cells	5,951	5,951	4,156	4,156
Trade patterns with pre & post			2,556	2,556

Note: Firm×HS6×destination×month panel of Armenian export unit values, 2018m1–2024m6, positive flows only, log unit value trimmed at the 1st/99th percentile within HS2. Base group: neutral (non-sanctioning) destinations; *Post* equals one from March 2022. Lower-order interactions are absorbed by the fixed effects: the sanctioned-product indicator is a product constant (absorbed with *Post* in the firm–product–month effects) and destination group is a destination constant (absorbed in the firm–product–destination effects). Columns (1)–(2) absorb firm–product–destination and firm–product–month fixed effects, so coefficients measure relative price movements across destinations of the same good, by the same firm, in the same month — a destination-specific pricing/markup-adjustment proxy, not a markup level. Columns (3)–(4) replace the firm–product–destination effect with a firm–product–destination–*trade-pattern* effect (Corsetti, Crowley and Han, 2022), where the pattern is the complete destination set served by the firm–product in that month; identification then comes only from months in which the firm–product serves the identical destination set. Standard errors clustered by firm in parentheses. $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

Figure C6: Event Study of the Export–Import Unit-Value Wedge



Notes: The Callaway and Sant'Anna (2021) estimator is applied to the firm–product intermediation panel. The outcome is the difference between the firm–product's log export and log import unit values. Event time -1 is omitted, and wild-bootstrap inference follows the event-study construction. The wedge rises by approximately 0.12 log points after exposure; the joint test over near-window leads has $p = 0.49$. The figure is a unit-value-margin proxy and does not separately identify markups, domestic value added, or the profit earned on the same physical shipment.

Together, Table C3 and Figure C6 indicate a wider recorded unit-value differential on Russia-facing and intermediated flows. They support a pricing- or margin-related interpretation only in a reduced-form sense; they do not establish a structural markup response.

C.4 Firm and Worker Outcomes

The main text reports selected coefficients from the preferred fixed-baseline specifications. This subsection provides the complete outcome and fixed-effect sets. Fixed 2021 classifications appear before contemporaneous classifications because they are determined before the post-2022 adjustment and do not change endogenously with a firm's subsequent trading or intermediation status.

C.4.1 Firm Outcomes Using Fixed 2021 Exposure

Table C4 classifies firms by their 2021 trading mode, with non-traders as the comparison group. Table C5 uses the firm's 2021 potential-intermediation exposure. These tables contain the full employment, turnover, and turnover-per-worker specifications underlying the selected columns reported in the main text.

Table C4: Firm Outcomes and Pre-Sanctions (2021) Trading Status

	Log Employment		Log Turnover		Log Turnover / Employee	
	(1)	(2)	(3)	(4)	(5)	(6)
	No Firm FE	Firm FE	No Firm	Firm FE	No Firm FE	Firm FE
Firm Type (2021)						
Exporter$_{pre}$	0.18***		0.78***		0.50***	
	(0.05)		(0.07)		(0.07)	
Importer$_{pre}$	0.47***		1.38***		0.94***	
	(0.01)		(0.02)		(0.02)	
Dual$_{pre}$	1.57***		2.77***		1.27***	
	(0.05)		(0.06)		(0.04)	
Firm Type$_{pre}$ $\times$ D						
Exporter$_{pre}$ $\times$ D	-0.10***	-0.02	-0.09	-0.18***	-0.03	-0.24***
	(0.03)	(0.02)	(0.07)	(0.06)	(0.07)	(0.07)
Importer$_{pre}$ $\times$ D	-0.09***	0.01***	0.17***	0.23***	0.22***	0.16***
	(0.01)	(0.00)	(0.01)	(0.01)	(0.02)	(0.01)
Dual$_{pre}$ $\times$ D	-0.19***	0.03***	0.14***	0.25***	0.25***	0.09***
	(0.02)	(0.01)	(0.04)	(0.03)	(0.04)	(0.03)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes	No	Yes
Status FE	Yes	Yes	Yes	Yes	Yes	Yes
Legal Form FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	399,314	381,792	604,019	591,769	332,990	315,669
R^2	0.24	0.91	0.28	0.80	0.09	0.68

Standard errors clustered by firm (HVHH) in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Sample restricted to firms present in 2021 (`present_2021=1`). D is a post-2022 dummy ($D = 1$ for $year \geq 2022$). *Firm Type$_{pre}$* is defined using the firm's trading status in 2021, with non-trading firms in 2021 as the reference group. In columns with firm fixed effects, the main effects of Firm Type$_{pre}$ are absorbed and therefore omitted; identification comes from the interaction terms Firm Type$_{pre} \times D$. All specifications absorb year, status, and legal-form fixed effects; even-numbered columns additionally absorb firm fixed effects.

Table C5: Firm Outcomes and Pre-Sanctions Intermediation Exposure

	Log Turnover		**Log Turnover / Employee**		**Log Employment**		**Log(Employment+1)**	
	No Firm FE (1)	Firm FE (2)	No Firm FE (3)	Firm FE (4)	No Firm FE (5)	Firm FE (6)	No Firm FE (7)	Firm FE (8)
2021 int. share	1.419***		1.036***		0.464***		0.372***	
	(0.131)		(0.094)		(0.109)		(0.095)	
$Post_t \times$ 2021 int. share	0.228**	0.276***	0.259***	0.230***	-0.034	0.010	-0.045	0.005
	(0.094)	(0.081)	(0.092)	(0.081)	(0.044)	(0.023)	(0.037)	(0.021)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Status FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legal Form FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	12,420	12,349	11,106	10,969	11,913	11,787	14,035	14,022
R^2	0.287	0.863	0.112	0.700	0.241	0.963	0.384	0.964

Standard errors clustered by firm (HVHH) in parentheses. $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

Notes: The sample is restricted to firms present in 2021 with non-missing 2021 intermediation exposure. The 2021 intermediation share is defined as the share of the firm's 2021 export volume covered by imports of the same HS6 product by the same firm within the previous twelve months. $Post_t$ equals one from 2022 onward. All specifications absorb Year, Status, and Legal Form fixed effects; even-numbered columns additionally absorb firm fixed effects (HVHH).

C.4.2 Firm Outcomes Using Contemporaneous Classifications

Table C6 and Table C7 reclassify firms using their current trading and potential-intermediation status. Because those statuses may themselves respond to post-2022 outcomes, these estimates are descriptive within-period associations rather than preferred exposure designs.

Table C6: Firm Outcomes and Trading Status

	Log Employment		Log Turnover		Log Turnover / Employee	
	(1)	(2)	(3)	(4)	(5)	(6)
	No Firm FE	Firm FE	No Firm FE	Firm FE	No Firm FE	Firm FE
Firm Type						
Exporter	0.18***	0.07***	0.99***	0.65***	0.71***	0.51***
	(0.03)	(0.01)	(0.05)	(0.04)	(0.05)	(0.04)
Importer	0.39***	0.04***	1.52***	0.55***	1.21***	0.48***
	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Dual	1.46***	0.11***	2.98***	0.97***	1.69***	0.82***
	(0.04)	(0.01)	(0.05)	(0.02)	(0.03)	(0.02)
Firm Type $\times$ D						
Exporter $\times D$	-0.16***	-0.04*	0.26***	0.05	0.48***	0.02
	(0.04)	(0.02)	(0.06)	(0.05)	(0.07)	(0.06)
Importer $\times D$	-0.07***	-0.01	-0.11***	0.07***	-0.06***	0.04***
	(0.01)	(0.00)	(0.01)	(0.01)	(0.02)	(0.01)
Dual $\times D$	-0.73***	-0.04***	-0.14***	0.34***	0.56***	0.25***
	(0.03)	(0.01)	(0.04)	(0.03)	(0.04)	(0.03)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes	No	Yes
Status FE	Yes	Yes	Yes	Yes	Yes	Yes
Legal Form FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	491,001	442,746	777,704	712,941	392,236	349,552
R^2	0.20	0.91	0.27	0.81	0.11	0.69

Standard errors clustered by firm (HVHH) in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: D is a post-2022 dummy ($D = 1$ for $year \geq 2022$). *Firm Type* is measured contemporaneously and is therefore endogenous to post-sanctions adjustment. The base group is non-trading firms. All specifications absorb Year, Status, and Legal Form fixed effects; even-numbered columns additionally absorb firm fixed effects (HVHH).

Table C7: Firm Outcomes and Current-Year Intermediation Intensity

	Log Turnover (1)	Log Turnover per Employee (2)	Log Employment (3)	Log Employment+1 (4)
Current-year int. share	0.112**	0.083	0.009	0.013
	(0.053)	(0.056)	(0.019)	(0.019)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	8,660	7,599	7,680	8,873
R^2	0.919	0.830	0.974	0.975
Within R^2	0.001	0.001	0.000	0.000

Standard errors clustered by firm (HVHH) in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The unit of observation is firm-year. The sample is restricted to firms present in 2021 with non-missing current-year intermediation intensity. Current-year intermediation share is the share of export volume covered by the firm's imports of the same HS6 product within the previous twelve months. The table is descriptive because current-year intermediation is itself an outcome of post-2022 adjustment.

C.4.3 Worker Outcomes Using Fixed 2021 Employer Exposure

Table C8 and Table C9 classify workers by the trading mode and potential-intermediation exposure of their 2021 employer. The interpretation requires that this baseline classification remain attached to the worker after any subsequent employer change. Under worker–firm fixed effects, the time-invariant exposure main effects are absorbed; the post-2022 interactions provide the relevant differential changes.

Table C8: Employee Outcomes and Trading Status (Pre-2022 Firm Type)

	Log Salary			**Log Hours Worked**			**Log Wage per Hour**		
	Emp FE	Firm FE	Firm×Emp FE	Emp FE	Firm FE	Firm×Emp FE	Emp FE	Firm FE	Firm×Emp FE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Firm Type (2021)									
Exporter$_{pre}$	0.35***	—	—	0.22**	—	—	0.13*	—	—
	(0.10)			(0.09)			(0.08)		
Importer$_{pre}$	0.36***	—	—	0.26***	—	—	0.14***	—	—
	(0.03)			(0.03)			(0.01)		
Dual$_{pre}$	0.66***	—	—	0.44***	—	—	0.30***	—	—
	(0.03)			(0.03)			(0.02)		
Firm Type (2021) × D									
Exporter$_{pre}$ × D	-0.01	-0.00	-0.04	-0.18	-0.15	-0.29	0.23	0.25	0.32
	(0.04)	(0.05)	(0.04)	(0.24)	(0.23)	(0.26)	(0.23)	(0.22)	(0.25)
Importer$_{pre}$ × D	0.14***	0.12***	0.12***	0.04***	0.04***	0.01	0.10***	0.09***	0.11***
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Dual$_{pre}$ × D	0.16***	0.12***	0.12***	0.04**	0.04***	0.02	0.09***	0.07***	0.10***
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Employee FE	Yes	No	No	Yes	No	No	Yes	No	No
Firm FE (HVHH)	No	Yes	No	No	Yes	No	No	Yes	No
Firm×Emp FE	No	No	Yes	No	No	Yes	No	No	Yes
Observations	5,685,595	5,693,471	5,263,235	4,017,284	4,036,959	3,644,759	3,939,207	3,959,445	3,583,649
R^2	0.53	0.42	0.76	0.42	0.31	0.66	0.70	0.55	0.86

Standard errors clustered by firm (HVHH) in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: D is the period indicator (`dummy`), equal to one from 2022 onward. *Firm Type (2021)* is measured pre-2022 at the firm level using `firm_type_pre`; the sample is restricted to workers observed in 2021. In columns with Firm FE or Firm×Employee FE, the main effects of Firm Type (2021) are absorbed and therefore omitted; the interaction terms remain identified. All specifications include year fixed effects and age-bin controls. Standard errors are clustered by firm (HVHH).

Table C9: Worker Outcomes and Pre-Sanctions Firm Intermediation Exposure

	Employee FE (1)	Firm FE (2)	Firm×Employee FE (3)
Coefficient on $Post_t \times$ 2021 firm intermediation share			
Log salary	0.017	-0.031	0.021
	(0.097)	(0.088)	(0.094)
Log wage per hour	-0.010	-0.038	-0.010
	(0.053)	(0.049)	(0.050)
Log total income	0.038	0.010	0.036
	(0.091)	(0.079)	(0.088)
Log income per hour	-0.010	-0.038	-0.010
	(0.053)	(0.049)	(0.050)
Log hours worked	0.060	0.020	0.064
	(0.057)	(0.048)	(0.053)
Log experience	-0.100*	-0.093*	-0.072
	(0.059)	(0.050)	(0.079)
Year FE	Yes	Yes	Yes
Worker Controls	Yes	Yes	Yes
Employee FE	Yes	No	No
Firm FE	No	Yes	No
Firm×Employee FE	No	No	Yes

Standard errors clustered by firm (HVHH) in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Each cell reports the coefficient on the interaction between the post-2022 dummy and the firm's 2021 intermediation share. The sample is restricted to workers observed in 2021 whose employer has non-missing 2021 intermediation exposure. Worker controls include sex and age-bin controls where not absorbed by fixed effects. Standard errors are clustered at the firm level.

C.4.4 Worker Outcomes Using Contemporaneous Employer Status

Table C10 classifies workers by the contemporaneous trading status of their employer. As with the contemporaneous firm tables, the classification is potentially endogenous to the post-2022 response and is therefore reported as a descriptive robustness exercise rather than the preferred exposure specification.

Table C10: Employee Outcomes and Trading Status

	Log Salary			Log Hours Worked			Log Wage per Hour		
	Emp FE	Firm FE	Firm×Emp FE	Emp FE	Firm FE	Firm×Emp FE	Emp FE	Firm FE	Firm×Emp FE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Firm Type									
Exporter	0.13***	0.02	-0.01	0.14**	0.06	0.09	0.07	-0.04	-0.06
	(0.03)	(0.04)	(0.03)	(0.06)	(0.06)	(0.07)	(0.05)	(0.05)	(0.06)
Importer	0.25***	0.04***	0.08***	0.20***	0.06***	0.10***	0.11***	-0.04***	-0.04***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Dual	0.45***	0.12***	0.16***	0.35***	0.10***	0.15***	0.23***	-0.01	-0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
Firm Type × D									
Exporter ×D	0.08	0.09	0.06	-0.18	-0.19	-0.25	0.25	0.29	0.33
	(0.06)	(0.06)	(0.06)	(0.25)	(0.25)	(0.28)	(0.24)	(0.24)	(0.28)
Importer ×D	0.12***	0.11***	0.10***	0.03**	0.05***	0.03**	0.08***	0.07***	0.09***
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Dual ×D	0.13***	0.06***	0.09***	0.02	0.02	0.01	0.10***	0.06***	0.10***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Employee FE	Yes	No	No	Yes	No	No	Yes	No	No
Firm FE (HVHH)	No	Yes	No	No	Yes	No	No	Yes	No
Firm×Emp FE	No	No	Yes	No	No	Yes	No	No	Yes
Observations	6,672,644	6,844,015	6,072,216	4,520,668	4,689,499	4,021,251	4,427,087	4,593,650	3,950,523
R^2	0.55	0.42	0.76	0.44	0.31	0.67	0.71	0.55	0.86

Standard errors clustered by firm (HVHH) in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: D is the period indicator (`dummy`), equal to one from 2022 onward. *Firm Type* is measured contemporaneously at the firm-year level, so the table is descriptive and should not be interpreted causally. The base group is employees in non-trading firms. Columns (1),(4),(7) absorb employee fixed effects; (2),(5),(8) absorb firm fixed effects; (3),(6),(9) absorb firm×employee fixed effects. All specifications include year fixed effects and age-bin controls. Standard errors are clustered by firm (HVHH).

D Model Derivations and Quantitative Appendix

This appendix derives the capability-based model used in the main text, documents the exact inversion of the cell moments, distinguishes the conditional equilibrium from a full national general equilibrium, and reports the diagnostics and sensitivity exercises behind the welfare calculation.

D.1 Notation

Table D1 collects the notation used below.

Table D1: Model notation

Symbol	Definition
$\sigma > 1$, $a = \sigma - 1$, $\mu = \sigma/a$	CES elasticity, shorthand, and constant markup
$\alpha \in (0, 1)$	Cobb–Douglas expenditure share on differentiated goods
φ, φ_H, $t = \varphi/\varphi_H$	Productivity, domestic survival cutoff, and relative productivity
$k > a$, $\kappa_1 = k/(k-a)$, $\kappa_2 = a/(k-a)$	Pareto shape and two recurring Pareto coefficients
f_e, f_H, f_{Xc}	Entry, domestic-operation, and cell-specific export fixed costs
c, ω_c	Partner–product export cell and its destination-opportunity weight
A_c, Q_c, t_{Xc}, p_{Xc}	Reduced-form profit shifter, relative-revenue shifter, relative export cutoff, and export participation
s_{Ic}, θ, $h_c(\theta)$	Indirect share, switching capability, and retained access
S_H, N_e, M	Survival probability, entrant mass, and active Armenian variety mass
Ω, Ω_{AA}, Ω_{FA}	Total differentiated price-index aggregate and its Armenian/foreign blocks
$\lambda_{AA} = \Omega_{AA}/\Omega$	Armenian contribution share in the differentiated price index
E, P_Y, $P_A = P_Y^{\alpha}$, $W = E/P_A$	Nominal expenditure, price indices, and the welfare object
$G_t(\theta)$	Within-state log welfare value of intermediation

D.2 Preferences, domestic demand, and the price index

The representative household has normalized Cobb–Douglas utility

$$U = \frac{X^{1-\alpha} Y^{\alpha}}{(1-\alpha)^{1-\alpha}\alpha^{\alpha}}, \qquad Y = \left[\int_{i \in \mathcal{V}_H \cup \mathcal{V}_F} y(i)^{(\sigma-1)/\sigma}\, di\right]^{\sigma/(\sigma-1)}. \tag{22}$$

where X is the homogeneous outside good, Y is the differentiated-goods composite, and $\mathcal{V}_H$ and $\mathcal{V}_F$ are the sets of Armenian and foreign varieties absorbed in Armenia.

The outside good has price one. Cobb–Douglas demand allocates αE to the differentiated composite. CES demand and expenditure on variety i are

$$y(i) = \alpha E P_Y^{\sigma-1} p(i)^{-\sigma}, \qquad x(i) \equiv p(i)y(i) = \alpha E P_Y^{\sigma-1} p(i)^{1-\sigma}. \tag{23}$$

The differentiated-goods price index satisfies

$$P_Y^{1-\sigma} \equiv \Omega = \int_{i \in \mathcal{V}_H \cup \mathcal{V}_F} p(i)^{1-\sigma}\, di = \Omega_{AA} + \Omega_{FA}, \qquad W = E\,\Omega^{\alpha/a}. \tag{24}$$

Re-exported goods are consumed abroad and enter neither Ω_{AA} nor Ω_{FA}. Their gross value therefore cannot raise Armenian welfare directly.

An Armenian producer with productivity φ has marginal cost $1/\varphi$ and charges $p_H(\varphi) = \mu/\varphi$. Domestic operating profit is $\pi_H = x_H/\sigma - f_H$. The survival cutoff satisfies $x_H(\varphi_H) = \sigma f_H$. Substituting CES demand into the cutoff condition gives

$$\Omega = \frac{\alpha E\, \varphi_H^{a}}{\sigma f_H \mu^{a}}. \tag{25}$$

Consequently, at fixed E, f_H, and α, the total price index is a monotone function of the domestic cutoff. This is the source of the exact sufficient statistic in (20).

Let M denote the mass of active Armenian varieties. Conditional on survival, $\mathbb{E}[\varphi^{a} \mid \varphi \geq \varphi_H] = \kappa_1 \varphi_H^{a}$, so the Armenian contribution is

$$\Omega_{AA} = M\mu^{-a}\kappa_1\varphi_H^a, \qquad M = N_e S_H, \qquad \lambda_{AA} = \frac{\Omega_{AA}}{\Omega}. \tag{26}$$

Equations (25) and (26) separate the level of the total price index from its domestic and foreign composition.

D.3 Pareto productivity, selection, and expected profit

Normalize the lower support of productivity to one and assume

$$G(\varphi) = 1 - \varphi^{-k}, \qquad \varphi \geq 1, \qquad k > a. \tag{27}$$

The survival probability is $S_H = \varphi_H^{-k}$. Conditional on survival, $t = \varphi/\varphi_H$ is again Pareto: $\Pr(t \geq z \mid t \geq 1) = z^{-k}$. The domestic cutoff condition implies

$$x_H(t) = \sigma f_H t^a, \qquad \pi_H(t) = f_H(t^a - 1), \qquad \overline{x}_H = \sigma f_H \kappa_1. \tag{28}$$

The last identity maps data sales into model units after normalizing $f_H = 1$. If $\overline{x}_H^{\text{data}}$ is mean positive domestic differentiated sales, then

$$x^{\text{model}} = x^{\text{data}} \frac{\sigma f_H \kappa_1}{\overline{x}_H^{\text{data}}}. \tag{29}$$

Two Pareto integrals recur. For $1 \leq l < u \leq \infty$,

$$\Pr(l \leq t < u) = l^{-k} - u^{-k}, \qquad \int_l^u t^a \, dG(t) = \kappa_1 \left(l^{a-k} - u^{a-k}\right). \tag{30}$$

Pareto-surplus identity. Suppose $\pi(t) = bt^a - f$ becomes nonnegative at $t_0 = (f/b)^{1/a} \geq 1$. Then

$$\int_{t_0}^{\infty} \pi(t) \, dG(t) = \kappa_2 f t_0^{-k}. \tag{31}$$

To see this, integrate revenue and the fixed cost separately: $b\kappa_1 t_0^{a-k} - f t_0^{-k}$. Using $b t_0^a = f$ leaves $(\kappa_1 - 1) f t_0^{-k} = \kappa_2 f t_0^{-k}$.

D.4 Export cells and exact inversion

Unit of observation. A cell c is a partner group crossed with sanctioned-product status within a given pre- or post-shock state. The underlying empirical observation is a firm–destination–product-status–state opportunity. In the pooled calibration, $n_{\text{active},c}$ is the number of active firm–destination opportunities represented in cell c, and ω_c is the number of individual destinations pooled into that cell. The route counts satisfy

$$n_{0c} + n_{Ic} + n_{Dc} + n_{Uc} = n_{\text{active},c}, \tag{32}$$

where n_{0c} denotes non-exporting opportunities and n_{Ic}, n_{Dc}, and n_{Uc} denote potentially indirect, direct, and route-unclassified exporting opportunities, respectively. Observed export participation is therefore

$$p_{Xc} = \frac{n_{Ic} + n_{Dc} + n_{Uc}}{n_{\text{active},c}} = 1 - \frac{n_{0c}}{n_{\text{active},c}}. \tag{33}$$

Route-unclassified exporters are included in the participation numerator rather than treated as non-exporters. The indirect share among classified exporters is

$$s_{Ic} = \frac{n_{Ic}}{n_{Ic} + n_{Dc}}. \tag{34}$$

In the baseline cell aggregates, $n_{Uc} = 0$ in every cell, although firms may still use mixed or hybrid flows. The baseline route assignment is conditional on the binary W12 classification threshold described in Section 6.1.

Participation and sales. For cell c, the reduced-form revenue and profit schedules are those in (12). If the export cutoff is interior,

$$p_{Xc} = \Pr(t \geq t_{Xc}) = t_{Xc}^{-k}. \tag{35}$$

The count-weighted mean among classified exporters is

$$\overline{x}_{Xc} = \frac{n_{Ic}\overline{x}_{Ic} + n_{Dc}\overline{x}_{Dc}}{n_{Ic} + n_{Dc}}. \tag{36}$$

These are gross exporter sales. They discipline the scale of the export opportunity but should not be interpreted as domestic value added or export surplus. Conditional on clearing the common cutoff,

$$\mathbb{E}[x_c(t) \mid t \geq t_{Xc}] = Q_c \kappa_1 t_{Xc}^a = \sigma f_{Xc} \kappa_1, \tag{37}$$

where the second equality uses the zero-profit condition. Therefore

$$t_{Xc} = p_{Xc}^{-1/k}, \qquad f_{Xc} = \frac{\overline{x}_{Xc}}{\sigma \kappa_1}, \qquad Q_c = \frac{\sigma f_{Xc}}{t_{Xc}^a}. \tag{38}$$

The two targeted cell moments, p_{Xc} and $\overline{x}_{Xc}$, together with the zero-profit restriction, recover t_{Xc}, f_{Xc}, and Q_c. The indirect share s_{Ic} is measured separately and enters the routing block. No numerical optimizer is involved, and cross-cell equality of f_{Xc} is not imposed. Exact agreement with participation and pooled sales is therefore an inversion check rather than validation of the behavioral assumptions.

D.5 Route capability and retained access

Conditional on exporting, route capability is independent of productivity in the baseline:

$$\Pr(I \mid X, c, t) = s_{Ic}, \qquad \Pr(D \mid X, c, t) = 1 - s_{Ic}. \tag{39}$$

When the indirect route is unavailable, a fraction θ of indirect relationships can switch to direct access. The retained share is

$$h_c(\theta) = 1 - (1-\theta)s_{Ic}, \qquad h_c(0) = 1 - s_{Ic}, \qquad h_c(1) = 1, \qquad h_c'(\theta) = s_{Ic} \geq 0. \tag{40}$$

A retained relationship is assumed to preserve both its cell-level revenue schedule A_c and its fitted fixed-cost shifter f_{Xc} after switching. Thus, θ captures both latent direct capability and the ability to redeploy the relationship without an additional revenue loss or switching cost. This is a strong counterfactual assumption and is why the complete $[0, 1]$ grid is reported.

At $\hat{\theta} = 0.258$, the free-entry-bracket-weighted retained-access rate is 93.2% before the shock and 85.2% afterward. The post state is therefore more exposed to removing intermediation.

D.6 Observed and counterfactual entry equilibria

For an active domestic firm, expected domestic operating profit is $\kappa_2 f_H$. From (31), expected export profit in cell c is $\kappa_2 f_{Xc} p_{Xc}$. Free entry therefore gives

$$f_e = S_H B, \qquad B = \kappa_2 f_H + \sum_c \omega_c \kappa_2 f_{Xc} p_{Xc}, \qquad \varphi_H = \left(\frac{B}{f_e}\right)^{1/k}. \tag{41}$$

Writing productivity relative to the domestic cutoff as $t = \varphi/\varphi_H$, cell revenue and profit

are

$$x_c(t) = Q_c(\varphi_H)t^a, \qquad \pi_c(t) = \frac{Q_c(\varphi_H)}{\sigma}t^a - f_{Xc}.$$

Given the equilibrium domestic cutoff φ_H, the reduced-form access shifter is recovered from

$$Q_c(\varphi_H) = \sigma A_c \varphi_H^a, \qquad A_c = \frac{Q_c(\varphi_H)}{\sigma\varphi_H^a} = \frac{f_{Xc}}{(t_{Xc}\varphi_H)^a}. \tag{42}$$

The final equality follows from the export zero-profit condition $Q_c(\varphi_H)t_{Xc}^a = \sigma f_{Xc}$.

In each observed state, λ_{AA} is measured. Equations (25) and (26) then recover Ω, $\Omega_{AA} = \lambda_{AA}\Omega$, $\Omega_{FA} = (1-\lambda_{AA})\Omega$, M, N_e, P_Y, and W. Under this closure, λ_{AA} allocates the total price-index aggregate between domestic and foreign blocks and is needed for the variety accounting; it does not alter the cutoff-based welfare ratio in (20), provided the implied domestic contribution remains positive.

For a no-intermediation counterfactual, hold $\{\sigma, \alpha, k, f_e, f_H\}$, A_c, f_{Xc}, E, and the state's observed Ω_{FA} fixed. At a candidate domestic cutoff φ_H, recompute $Q_c(\varphi_H)$ from (42), the export cutoff, and $p_{Xc}(\varphi_H)$. The equilibrium root solves

$$R(\varphi_H;\theta) = \varphi_H^{-k}\left[\kappa_2 f_H + \sum_c \omega_c h_c(\theta)\kappa_2 f_{Xc} p_{Xc}(\varphi_H)\right] - f_e = 0. \tag{43}$$

After solving (43), total Ω follows from the domestic cutoff condition. The domestic contribution is the residual $\Omega_{AA} = \Omega - \Omega_{FA}^{\text{full}}$, and $M, N_e, \lambda_{AA}, P_Y$, and W are recomputed. No entry, selection, mass, or price-index object is held fixed. At $\theta = 1$, $h_c = 1$ in every cell, so the root and all equilibrium objects coincide with the full model.

What is endogenous. This counterfactual re-solves Armenian entry, domestic selection, export participation, the active variety mass, and the Armenian price index. It does not solve for the wage, nominal income, foreign demand, the foreign price block, trade balance, or government revenue. It is therefore a conditional small-open-economy equilibrium, even though it contains general-equilibrium feedback within the domestic entry and

variety block.

Admissibility and numerical existence. The implementation enforces $\sigma > 1$, $k > a$, positive fixed costs, $0 < p_{Xc} < 1$, positive classified counts and sales, $0 < S_H < 1$, positive Armenian and foreign price-index contributions, and export cutoffs at or above the Pareto support. Every reported counterfactual has an interior solution to (43). A parameterization is treated as inadmissible if $\Omega_{AA} \leq 0$ or if no interior root exists.

D.7 Comparative statics

Foreign access and fixed costs. Combining (12) and (42), an interior cell $c$utoff satisfies

$$t_{Xc} = \left[\frac{f_{Xc}}{A_c \varphi_H^a}\right]^{1/a}. \tag{44}$$

Holding φ_H fixed,

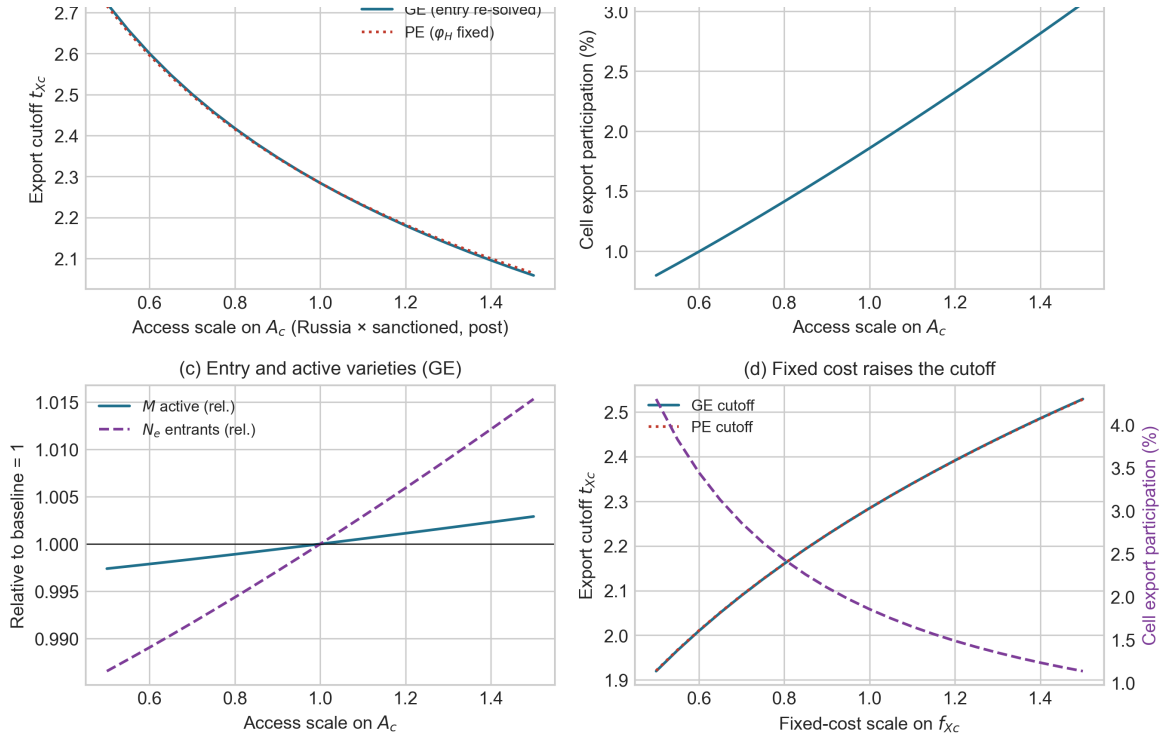
$$\left.\frac{\partial \ln t_{Xc}}{\partial \ln A_c}\right|_{\varphi_H} = -\frac{1}{a}, \qquad \left.\frac{\partial \ln p_{Xc}}{\partial \ln A_c}\right|_{\varphi_H} = \frac{k}{a}, \tag{45}$$

and the signs reverse for f_{Xc}. In the re-solved entry equilibrium, better access raises expected export surplus and φ_H. Since $t_{Xc} \propto A_c^{-1/a} \varphi_H^{-1}$, this selection response makes the cutoff expressed relative to φ_H fall slightly more than in the partial-equilibrium comparison. Figure D1 verifies these signs numerically for the post-state Russia–sanctioned cell.

Market-access comparative statics. Figure D1 illustrates the effects of varying the access composite and fixed export cost in the post-shock Russia–sanctioned cell. Halving the access composite raises the relative export cutoff from 2.284 to 2.723 and reduces participation from 1.858 to 0.796 percent, while increasing access by 50 percent lowers the cutoff to 2.059. The solid lines re-solve the domestic entry equilibrium, whereas the dotted lines

hold the domestic survival cutoff fixed. With endogenous entry, improved access raises expected export profits and tightens domestic selection, causing the export cutoff expressed relative to surviving firms to fall slightly more than when the domestic cutoff is held fixed. The final panel reports the corresponding responses to changes in the cell-specific fixed export cost.

Figure D1: Market access, participation, entry, and selection



Notes: Panels (a)–(c) scale the recovered foreign-access shifter for the Russia–sanctioned cell in the post state. Panel (d) scales its fixed export cost. Solid lines re-solve the domestic entry equilibrium; dotted lines hold φ_H fixed. Halving access raises the cutoff from 2.284 to 2.723 and lowers cell participation from 1.858% to 0.796%; raising access by 50% lowers the cutoff to 2.059.

Intermediation intensity and switching. The effects of indirect-route intensity and switching capability are evaluated by re-solving (43) for each value of θ, rather than by applying a partial-equilibrium derivative that holds export participation fixed. A higher indirect share places more foreign-market access at risk when the indirect route is removed, while a higher switching capability preserves more of that access. At $\theta = 1$, all indirect relation-

ships can switch and the no-intermediation equilibrium coincides with the full equilibrium.

Table D2 makes explicit which empirical results motivate each model object and which elements remain assumptions.

Table D2: Comparative statics and empirical counterparts

Model implication	Empirical counterpart	Status and exhibit
Higher A_c lowers t_{Xc} and raises p_{Xc}	Russia-relative changes in value and recorded unit values after 2022; estimated participation responses depend on the active-stock, entry-rate, and fixed-effect definition.	Reduced-form counterpart in Table 7; A_c is a reduced-form composite, not a separately estimated demand shock
Higher s_{Ic} puts more access at risk when I is removed	Stronger post-2022 intermediation in sanctioned and Russia-linked cells	Descriptive and regression evidence in Figure 3 and Table 2
Higher θ lowers the contribution and $G(1) = 0$	Some continuing indirect relationships become direct	Released transition proxy; suppression prevents point identification
Free entry converts export surplus into selection and price-index changes	Turnover and wage gains are concentrated among trading firms	Incidence evidence in Table 13 and Table 14; these quasi-rents are outside W

D.8 Calibration algorithm and moment map

The quantitative procedure is as follows.

1. Set $\sigma = 5$ and $\alpha = 0.68$. Map the pre-period employment-tail estimate into $k = 4.825124$ and verify $k > \sigma - 1$.

2. Normalize $f_H = f_e = 1$ and use mean positive domestic sales to convert monetary observations into model units.

3. For each of the twelve state–cells, compute p_{Xc} and $\overline{x}_{Xc}$ and apply (38) to recover t_{Xc}, f_{Xc}, and Q_c. Measure s_{Ic} separately for use in the retained-access equation.

4. Solve the observed free-entry condition and recover A_c. Combine the state-specific measured λ_{AA} with the cutoff condition to assemble the observed price-index blocks

and variety masses.

5. Compute $\hat{\theta}$ from released continuing pre-I relationships and solve (43) for each state over a dense $\theta \in [0, 1]$ grid.

6. Recompute every equilibrium object and verify the free-entry, price-index, domestic-mass, mode-share, endpoint, monotonicity, and reproducibility identities. All reported parameterizations satisfy these conditions.

Three accounting constructions of λ_{AA} are considered. The gross construction divides domestic sales by domestic sales plus gross imports and gives 0.825 before the shock and 0.766 afterward. The net baseline subtracts the annualized acquisition value associated with potential reexports from imports and gives 0.828 and 0.777. The wholesale-excluded construction additionally removes NACE 45–47 resale from domestic sales and gives 0.763 and 0.706. Net absorbed imports remain positive in both states. The baseline uses the net construction. Under the fixed-Ω_{FA} closure, these alternatives affect the domestic-variety accounting and admissibility checks but not the cutoff-based welfare ratio.

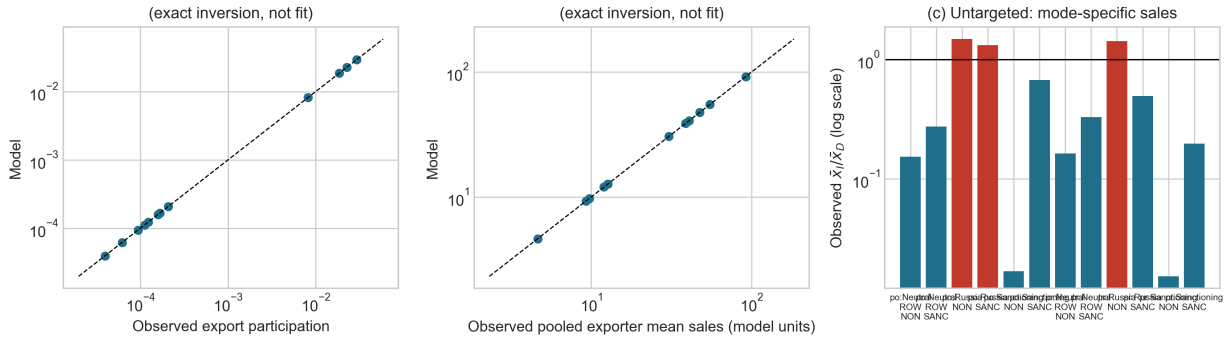
The transition calculation uses 77 released $I \to D$ relationships and 221 released $I \to I$ relationships, giving $\hat{\theta} = 0.258389$. The descriptive Wilson interval is $[0.211984, 0.310945]$. Because 95 relevant transition rows are suppressed, the interval does not restore point identification. Group-specific released shares range from zero to 0.392, and several groups retain suppressed rows.

D.9 Targeted moments and untargeted diagnostics

Figure D2 deliberately separates inversion checks from validation. Panels (a) and (b) place the twelve targeted participation and pooled-sales moments on the 45-degree line. This agreement is mechanical. Panel (c) reports the untargeted ratio of indirect to direct mean gross sales. The route-independence assumption predicts a ratio of one within each cell, whereas the observed ratio ranges from 0.015 to 1.490. It exceeds one in three cells, all

involving Russia. This dispersion is inconsistent with a universal ordering in which indirect exporters are always smaller and indicates that exact route–size independence is, at best, an approximation. Because the comparison uses gross sales and no sampling uncertainty is reported, it should be interpreted as a descriptive diagnostic rather than as a formal specification test.

Figure D2: Targeted inversion checks and untargeted mode-sales diagnostics



Notes: Panels (a)–(b) compare observed and model-implied targeted moments. Their exact agreement follows from (38). Panel (c) shows the observed ratio of indirect to direct mean gross sales on a log scale. A ratio of one is the baseline route-independence prediction. Red bars exceed one.

The direct share among classified exporters ranges from 0.707 to 0.980. In the Russia–sanctioned cell, the indirect share rises from 0.080 to 0.220 between the pre and post states; in the Russia–non-sanctioned cell it rises from 0.020 to 0.061. These measured route shares enter the baseline counterfactual by count.

As a robustness exercise, define a gross-sales-weighted indirect share,

$$s_{Ic}^{\text{sales}} = \frac{n_{Ic}\overline{x}_{Ic}}{n_{Ic}\overline{x}_{Ic} + n_{Dc}\overline{x}_{Dc}}. \tag{46}$$

Re-solving the model with this alternative reduces the contribution at $\hat{\theta}$ from 0.1680% to 0.1032%. This sensitivity is informative because panel (c) rejects exact route–size independence. It is not a formal bound: gross export sales contain pass-through acquisition value and need not be proportional to expected export surplus.

D.10 Welfare derivation, decomposition, and sensitivity

The contribution of intermediation to the post-2022 change is $G_{\text{post}}(\theta) - G_{\text{pre}}(\theta)$. It is not the total welfare effect of the war.

Exact price-index decomposition. Since $\Omega = \Omega_{AA}/\lambda_{AA}$ and (26) holds,

$$\Delta \ln W = \Delta \ln E + \frac{\alpha}{a}\Delta \ln M + \alpha \Delta \ln \varphi_H - \frac{\alpha}{a}\Delta \ln \lambda_{AA}. \tag{47}$$

The second term is the active-variety-mass margin, the third is the productivity/selection margin, and the fourth is the home-share accounting margin. Using $M = N_e \varphi_H^{-k}$ yields the equivalent entrant-mass representation

$$\Delta \ln W = \Delta \ln E + \frac{\alpha}{a}\Delta \ln N_e - \alpha \frac{k-a}{a}\Delta \ln \varphi_H - \frac{\alpha}{a}\Delta \ln \lambda_{AA}. \tag{48}$$

Equations (47) and (48) are algebraically identical but attach different labels to the same equilibrium adjustment. The numerical decomposition in Table D3 uses the active-mass representation in (47), avoiding the simultaneous use of M and N_e to label the same equilibrium adjustment.

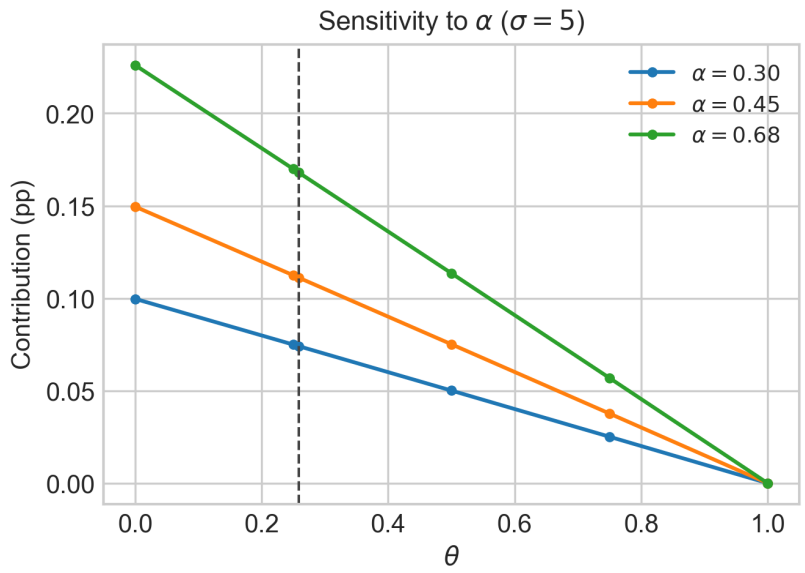
Table D3: Post-state welfare value of intermediation: exact decomposition

Component, no-I to full at $\hat{\theta}$	Basis points of $\ln W$
Active Armenian variety mass	$+5.54$
Productivity/selection	$+19.22$
Home-share accounting term	-5.54
Nominal expenditure	0.00
Numerical residual	0.00
Total	$+19.22$

Notes: Baseline $\alpha = 0.68$, $\sigma = 5$, $k = 4.825$, and $\hat{\theta} = 0.258$. Under the fixed-Ω_{FA} closure, the active-variety and home-share terms offset in this post-state comparison, so the total equals the productivity/selection term. Components sum to the log welfare ratio up to rounding.

External-parameter sensitivity. The baseline uses $\alpha = 0.68$. At $\hat{\theta}$ and $\sigma = 5$, the exact contribution is 0.0741% for $\alpha = 0.30$, 0.1111% for $\alpha = 0.45$, and 0.1680% for $\alpha = 0.68$. The log contribution scales exactly with α; the consumption-equivalent percentages differ from exact proportionality only because of the exponential transformation. Figure D3 displays this sensitivity over the full θ grid.

Figure D3: Sensitivity of the welfare contribution to the expenditure share



Notes: Exact consumption-equivalent contribution of intermediation to the pre–post change for $\alpha \in \{0.30, 0.45, 0.68\}$ and $\sigma = 5$. The vertical line marks $\hat{\theta} = 0.258$. All lines converge to zero at $\theta = 1$.

Varying σ requires updating $k = (\sigma - 1)\widehat{\zeta}_{\text{emp}}$ and recalibrating every cell. At $\alpha = 0.68$ and $\hat{\theta}$, the contribution is approximately 0.224%, 0.168%, and 0.134% for $\sigma = 4, 5, 6$, respectively, with $k = 3.62, 4.83, 6.03$. The model's qualitative conclusion is unchanged: the contribution is positive whenever switching is incomplete, decreases in θ, and remains small relative to the scale of gross rerouted trade.