The Value of Supplier Relationships: Measuring Supply-Chain Capital as an Intangible Asset

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Abstract

Supplier relationships are a quantitatively important yet largely unmeasured form of intangible capital. I measure their value from revealed preference: how firms choose to keep or replace their foreign suppliers when a tariff shock raises the cost of staying. The approach embeds costly supplier search in a dynamic discrete choice model of a firm's sourcing decisions, estimated on Turkish customs microdata, with the April 2020 Turkish import-tariff shock, which raised duties by up to 50 percentage points on thousands of products from specific origins, providing the identifying variation. In the model, a firm's relationship with a foreign origin carries *relationship-specific match capital* that accumulates with continued use; severing the relationship destroys this capital and forces costly re-formation through search. The differential response of relationship termination to the tariff across tenure, with young relationships breaking readily while mature ones resist, identifies the accumulated capital. I estimate that a two-year supplier relationship is worth close to a full year of its import value, of which about 94 percent is the incumbent match premium (the value of holding a known, matured match relative to a fresh draw), and only about 6 percent the one-time cost of finding and qualifying a replacement supplier. This magnitude places supplier relationships alongside brand and organizational capital as a first-order intangible asset, and implies that tariffs and other supply-chain disruptions destroy relationship capital well beyond their direct cost.

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Keywords: Supplier relationships, Intangible capital, Search frictions, Tariffs, Dynamic discrete choice, Supply chains

1 Introduction

A large and growing share of firm value consists of intangible capital (R&D, organizational know-how, brand equity, human capital), yet one important category remains largely unquantified: the value embedded in firms' supplier relationships. Firms accumulate knowledge about their suppliers over years of interaction: reliability, product quality, customization capabilities, informal routines, and logistical coordination that cannot be replicated overnight. This supplier relationship capital does not appear on balance sheets, is not captured by standard intangible capital measures such as capitalized R&D or SG&A, and is not separately valued in financial markets. Yet it is economically significant: when supply chains are disrupted, whether by tariffs, pandemics, or geopolitical shocks, the costliest consequence may not be the immediate price increase but the destruction of accumulated relationship-specific value that took years to build. This paper develops a structural approach to estimate supplier relationship capital as a form of intangible asset, using revealed-preference logic from firms' keep-versus-switch decisions when confronted with tariff-induced cost shocks.

In a frictionless world, supplier switching would be costless and supplier–customer relationships would have no intrinsic value. In reality, search frictions (Diamond, 1971), relation-specific investments (Grossman and Hart, 1986), input specificity (Nunn, 2007), and enforcement problems (Greif, 1993) are pervasive in global value chains. A growing body of evidence confirms that sourcing relationships are valuable and persistent (Macchiavello and Morjaria, 2015; Martin et al., 2026), yet this form of intangible capital remains entirely unmeasured: neither its magnitude nor its composition is known.

This paper aims to fill that gap by developing a structural model to value supplier relationship capital as an intangible asset. I ask three related questions. First, how valuable are established supplier relationships: what is the present discounted value a firm would sacrifice by severing an existing link? Second, what fraction of this value is the one-time cost of finding and qualifying a replacement supplier, versus the relationship-specific match capital (trust, customization, mutual adaptation) that makes the incumbent genuinely preferable? Third, at what tariff threshold do firms optimally abandon relationships of different ages, and what does this reveal about how relationship value accumulates over time?

I develop a structural dynamic discrete choice model in the tradition of Rust (1987) that embeds costly supplier search in the spirit of Grossman et al. (2024). An importer sources each input from a foreign origin, trading off the delivered cost (including tariffs), origin quality, and a *relationship-specific match capital* with two components: an innate component, revealed early in the relationship, and a component that accumulates through continued

use. Finding a new supplier requires paying a search cost and drawing a fresh match, so severing an existing relationship destroys its accumulated capital. As tariffs raise the cost of continuing a link, firms follow a revealed-preference keep-versus-switch rule, and the way relationship termination responds to the tariff, strongly for young relationships and weakly for mature ones, identifies how much capital relationships accumulate. Estimating the model on the Turkish customs data, I find that a two-year supplier relationship is worth close to a full year of its import value once the full distribution of tariff exposure is accounted for (roughly 57 percent under a single representative tariff), of which about 94 percent is the incumbent match premium (the value of preserving a known, established match) and only about 6 percent the cost of finding a replacement. Implementing this approach requires both large, heterogeneous, plausibly exogenous cost shocks and data rich enough to track sourcing relationships at high frequency.

I exploit Türkiye's April 2020 tariff shock, which imposed additional duties of up to 50% on more than 5,000 imported products. Tariffs provide a particularly clean instrument for recovering relationship value: unlike supply-side shocks such as natural disasters or supplier distress, which may alter partner reliability or production capacity, tariffs shift the buyer's effective purchase price by a known amount while leaving supplier fundamentals unchanged. The variation in tariff intensity across product-origin pairs is orthogonal to individual firm sourcing decisions. Turkish administrative data, including firm-level customs records, balance sheets, and domestic firm-to-firm invoice networks, allow me to observe the universe of importer-product-origin relationships at monthly frequency from 2014 to 2023.

I document several facts consistent with valuable and persistent supply-chain links that motivate and discipline the structural model. Importing firms typically work with a small number of origin-product suppliers over long durations. The hazard of relationship dissolution declines with tenure, even conditional on firm, product, and origin fixed effects. When tariffs increase, switching rates rise, but switching remains incomplete even at high tariff levels, and longer-tenured relationships prove more resistant to tariff-induced separation. When links do break, firms exhibit short-run contractions in import volumes that are attenuated when the firm has at least one ready-to-ship alternative origin, revealing the option value of maintaining backup relationships.

Guided by these revealed-preference patterns and disciplined by the empirical moments, I estimate the model using the Simulated Method of Moments (SMM), matching the tenure profile of relationship hazards, the differential tariff response by tenure, and origin market shares to their model-implied counterparts. The key parameters are the firm's tariff sensitivity, the ceiling and accrual speed of relationship-specific match capital, and the origin qualities. I

define relationship capital as the difference in a firm's value between holding an established relationship and being unmatched: the surplus a firm forgoes by severing the link and re-forming one from scratch. Because suppliers in this thick market re-pair with other buyers rather than wait, a dissolved match cannot be costlessly reconstituted: returning to an origin draws a new match, so relationship capital captures both the accumulated match value and the cost and uncertainty of replacing it through search. The framework also quantifies the tariff thresholds at which firms of different relationship ages sever links, the option value of maintaining backup suppliers, and the relationship capital a tariff destroys beyond its direct cost.

This paper makes three contributions. *First*, I contribute to the intangible capital literature by providing firm-level estimates of supplier relationship value, a largely unmeasured category of intangible assets, using revealed preference from tariff-induced switching decisions. While the literature has made progress in measuring R&D, software, and organizational capital (Corrado et al., 2009; Peters and Taylor, 2017; Eisfeldt and Papanikolaou, 2013), supplier and customer relationships remain difficult to quantify despite their economic importance. *Second*, I contribute to the international trade literature by quantifying how the value of established sourcing relationships shapes firms' responses to trade policy shocks, complementing recent work on supply-chain disruptions, trade elasticities, and the stickiness of sourcing relationships. *Third*, I contribute to the policy debate on supply chain resilience and the costs of protectionism. On the resilience side, I estimate the hedge value of maintaining backup supplier relationships, offering a risk-management interpretation of why firms may optimally maintain seemingly redundant sourcing options. On the cost side, I show that tariffs impose dynamic costs beyond the static price effects emphasized in prior work: tariffs that induce firms to abandon established suppliers destroy accumulated relationship capital that took years to build. Because this relationship-specific knowledge and trust cannot be instantly recreated, even temporary tariffs can have persistent effects on supply chain efficiency.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 describes the institutional background, data sources, and sample construction. Section 4 documents motivating facts on relationship persistence and tariff responses, and validates the tariff shock as a source of identification. Section 5 develops the structural model and discusses identification. Section 6 outlines the estimation strategy, and Section 7 presents the estimates and the implied relationship capital. Section 8 discusses interpretation, limitations, and policy implications. Section 9 concludes.

2 Literature Review

This paper lies at the intersection of four literatures: intangible capital measurement, supplier switching and search frictions in trade, tariffs and supply chain adjustment, and dynamic discrete choice methods in industrial organization. I review each in turn, highlighting the gaps this paper addresses.

2.1 Intangible Capital and Supplier Relationships

A large and growing literature documents that intangible assets account for a substantial share of firm value. Corrado et al. (2005, 2009) develop a framework for capitalizing investments in computerized information, innovative property, and economic competencies, finding that intangible investment rivals physical capital investment in the U.S. economy. Peters and Taylor (2017) construct firm-level measures of intangible capital from accounting data and show that incorporating intangible capital improves measures of Tobin's q and the empirical investment-q relation. Within this broader category, organizational capital, the firm-specific human capital embodied in key employees and organizational routines, has received particular attention (Eisfeldt and Papanikolaou, 2013; Lustig et al., 2011).

However, supplier and customer relationships remain a largely unmeasured category of intangible capital. Accounting standards require disclosure of acquired customer relationships in business combinations, but internally developed relationship capital is not recognized on balance sheets. Survey evidence suggests that practitioners view supplier relationships as strategically important assets (World Bank, 2020), yet systematic measurement remains elusive. This paper contributes to the intangible capital literature by providing revealed-preference estimates of supplier relationship capital, the first to isolate the component that accumulates with relationship tenure and to identify it from an exogenous tariff shock.

The theoretical foundations for why relationships have value are well established. Search frictions imply that finding suitable partners is costly (Stigler, 1961; Diamond, 1971). Once found, relationships may involve relation-specific investments that create bilateral monopoly and hold-up problems (Klein et al., 1978; Williamson, 1979; Grossman and Hart, 1986). Input specificity or scarcity means that not all suppliers are equally suitable (Joskow, 1987; Nunn, 2007; Barrot and Sauvagnat, 2016). Reputation and relational contracting help sustain cooperation in environments with limited formal enforcement (Klein and Leffler, 1981; Shapiro, 1983; Greif, 1993; Dixit, 2003; Acemoglu and Johnson, 2005). These frictions collectively imply that established relationships are valuable and that switching is costly.

Empirical work has documented the importance of relational contracting in developing-country supply chains. Macchiavello and Morjaria (2015) study Kenyan rose exporters and show that relationships are valuable and that their value increases with age; exporters sacrifice short-run profits to preserve relationships during a supply shock. Macchiavello and Morjaria (2021) extend this analysis to study how buyer competition affects relationship formation and surplus sharing. Antràs and Foley (2015) document how trade credit and relationship length covary in U.S. poultry exports, consistent with trust building over time. While these papers provide compelling evidence that relationships matter, they do not structurally estimate relationship value or its components as I do here.

2.2 Supplier Switching and Search Frictions in Trade

A second related literature studies supplier switching behavior and its determinants. Monarch (2022) is the most direct methodological predecessor to this paper. Using U.S.-China transaction-level trade data, Monarch estimates a dynamic discrete choice model of importer-exporter relationships and finds that switching costs are large, equivalent to a 24% price increase for the median product. A counterfactual exercise shows that halving switching costs would reduce import prices by 7.6%. My paper builds on Monarch's framework but differs in three key respects: (i) I use tariffs rather than price variation for identification, which addresses potential endogeneity concerns; (ii) I separately identify relationship surplus that accumulates with tenure from one-time switching costs; and (iii) I explicitly define and estimate relationship capital as the present discounted value of an established link.

Recent theoretical work has formalized the role of search and matching in global supply chains. Grossman et al. (2024) develop a model in which final goods producers search for intermediate input suppliers, with match-specific productivity draws determining the gains from trade, and tariffs disrupt supply chains by inducing costly relocation of sourcing. I adapt their search-based approach to a dynamic, firm-level setting suitable for structural estimation, retaining match-specific heterogeneity, costly search across origins, a reservation rule for accepting new matches, and tariffs that raise the cost of sourcing from an origin, while adding the relationship dynamics and tenure accumulation needed to value an existing link.

Methodologically, my model is a single-agent, partial-equilibrium analogue of *on-the-job search*. The buyer continues sourcing from an incumbent supplier while paying a fixed cost to generate outside supplier options, paralleling the way an employed worker may search for a better job while remaining employed (McCall, 1970; Burdett, 1978; Mortensen, 1986).

The incumbent supplier relationship plays the role of the current job, the match-specific component captures match quality, the search cost generates outside options, and exogenous separation captures relationship destruction. Two features connect the framework to specific strands of the search literature. First, match quality is not fixed: an innate component revealed early in the relationship is augmented by a component that accumulates with tenure. This links the model to search frameworks with tenure, experience, or match-capital accumulation (Bagger et al., 2014); the resulting match-quality-driven turnover also echoes Jovanovic (1979), though in my model accumulation is deterministic rather than Bayesian learning about match quality. Second, I abstract from equilibrium supplier competition and take the distribution of potential supplier matches as exogenous, unlike equilibrium search models in which offer distributions are determined by firm behavior and market competition (Burdett and Mortensen, 1998; Postel-Vinay and Robin, 2002). This single-agent structure is appropriate because I observe one side of the market, and the object of interest is the value of the buyer's incumbent relationship, not the equilibrium distribution of supplier offers. The relationship capital I measure is therefore the search-theoretic analogue of the value of an incumbent match relative to the no-incumbent search state.

The closest treatment within international trade is Eaton et al. (2025), who develop a two-sided search-and-matching model of U.S. apparel imports in which both buyers and suppliers exert search effort, matches form through random meetings, and Nash-in-Nash bargaining splits the resulting surplus. Their general-equilibrium framework delivers objects mine cannot, including aggregate welfare, matching congestion, and the division of surplus between the two sides, and, like this paper, it measures the value of international business relationships. My approach differs in three ways suited to the question at hand. First, their match value is fixed at formation and matches dissolve at an exogenous hazard that does not depend on relationship age, whereas the value in my model *accumulates with tenure*; this tenure profile is both my central object and my source of identification. Second, they recover relationship value by fitting the equilibrium to cross-sectional and life-cycle network moments and study tariffs as an out-of-sample counterfactual, whereas I identify it from firms' revealed responses to an in-sample, exogenous tariff shock. Third, I cast the resulting magnitude as an intangible asset comparable to brand or organizational capital. I view the single-agent model here as the credibly identified, partial-equilibrium complement to their more complete equilibrium treatment.

Empirical evidence consistently shows that supplier relationships are sticky. Martin et al. (2026) document that trade relationships exhibit declining hazard rates: the probability of dissolution falls with relationship age, even conditional on extensive controls. They interpret

this stickiness as evidence that relationships accumulate value over time. Bernard et al. (2018) study Norwegian firm-to-firm trade data and show that relationship-specific fixed costs rationalize observed patterns of buyer-seller matching. Heise (2019) uses U.S. importer-exporter data to study exchange rate pass-through over the relationship lifecycle, finding that pass-through increases as relationships mature. Fontaine et al. (2025) provide recent evidence on switching frictions using French firm-to-firm data, documenting patterns similar to those I observe in Türkiye.

Several papers study how firms adjust their supplier networks in response to shocks. Barrot and Sauvagnat (2016) show that firm-specific shocks propagate through production networks, with downstream firms experiencing output losses when key suppliers are disrupted by natural disasters. This propagation is stronger when inputs are more relationship-specific. Carvalho et al. (2021) document similar propagation following the 2011 Japanese earthquake. These papers demonstrate that supplier relationships matter for firm performance but do not structurally estimate relationship values.

2.3 Tariffs, Trade Policy, and Supply Chain Adjustment

A third literature studies how firms respond to tariff changes, providing the empirical foundation for my identification strategy. The U.S.-China trade war beginning in 2018 generated a large body of research. Amiti et al. (2019) and Amiti et al. (2020) show that U.S. tariffs on Chinese imports were almost entirely passed through to U.S. import prices, implying that U.S. firms and consumers bore the burden. Fajgelbaum et al. (2020) estimate that the tariffs reduced U.S. real income by $7.2 billion annually, with substantial heterogeneity across regions and sectors.

These papers focus on price and welfare effects rather than relationship dynamics. However, a growing literature documents that tariffs induce supply chain reconfiguration. Grossman et al. (2024) show that U.S. imports shifted from China to other Asian countries following the Trump tariffs, consistent with their model of costly relocation. Handley and Limão (2015) document that policy uncertainty associated with tariff threats reduces firm investment and trade. Benguria et al. (2022) study Chinese firms during the U.S.–China trade war, separating the direct tariff ("pain") channel from the trade-policy-uncertainty ("anxiety") channel and finding that both depressed firm investment and activity.

My paper contributes to this literature by using tariff variation to identify the structural parameters of a switching model. While most papers study tariff effects in reduced form, I use tariffs as cost shifters within a dynamic discrete choice framework to recover the value of

supplier relationships and its components. The Turkish setting offers advantages over U.S.-China trade war studies: Turkish administrative data provide richer firm-level information (balance sheets, domestic networks), and the April 2020 tariffs were imposed suddenly across a broad range of products, generating variation unrelated to individual firm characteristics.

Pankratz and Schiller (2024) use heat shocks at supplier locations to study supply chain adjustment. While their natural-experiment approach is compelling, heat shocks may affect supplier productivity, quality, or reliability, making it difficult to isolate demand-side valuations of relationships. Tariffs, by contrast, shift the buyer's effective cost without changing supplier fundamentals, providing cleaner identification of the buyer's willingness to pay for an established relationship.

A further distinction from the existing tariff literature concerns the nature of the costs I measure. Studies such as Amiti et al. (2019) and Fajgelbaum et al. (2020) estimate the static welfare costs of tariffs through price increases and consumption reallocation. My framework captures an additional, dynamic cost: tariffs that induce relationship dissolution destroy accumulated relationship capital, the information, trust, and match-specific surplus built over years of interaction. This destruction is not reversed when tariffs are removed, implying that temporary tariffs can have persistent effects on supply chain efficiency.

2.4 Dynamic Discrete Choice Methods

Finally, this paper contributes to the literature on structural estimation of dynamic discrete choice models. The foundational work of Rust (1987) established methods for estimating dynamic programming models from observed choices. Hotz and Miller (1993) developed conditional choice probability methods that reduce computational burden. These techniques have been widely applied in industrial organization to study entry, exit, and investment decisions.

Applications to international trade include Das et al. (2007), who estimate a model of export market entry with sunk costs, and Aw et al. (2011), who study the joint dynamics of R&D, exporting, and productivity. More recently, Monarch (2022) applies these methods to supplier switching, as discussed above. My paper extends this line of work by incorporating tariff shocks as observed cost shifters and by defining relationship capital as a model-implied intangible asset.

2.5 Positioning and Contribution

Table 1 summarizes how this paper relates to the closest antecedents. Relative to Monarch (2022), I use tariff variation for identification rather than price variation, which addresses endogeneity concerns arising from unobserved quality or match-specific shocks. I also separately identify the tenure-dependent match premium from the one-time replacement cost, allowing me to define relationship capital as a stock that accumulates over time. Relative to Grossman et al. (2024), I estimate the model structurally using micro data rather than calibrating to aggregate moments, and I focus on the value of existing relationships rather than the costs of forming new ones. Relative to Martin et al. (2026), I go beyond documenting stickiness to recover the economic magnitudes that generate observed persistence.

Table 1: Positioning Relative to Closest Papers

Paper	Structural DDC	Tariff Identification	Tenure Effects	Relationship Capital	Micro Data
Monarch (2022)	✓				✓
Grossman et al. (2024)		✓			
Martin et al. (2026)			✓		✓
Macchiavello and Morjaria (2015)			✓		✓
Eaton et al. (2025)				✓	✓
This paper	✓	✓	✓	✓	✓

This paper makes three distinct contributions. First, I provide structural estimates of supplier relationship *capital*: the present discounted value of an established link, decomposed into the accumulated, tenure-dependent match premium and the one-time cost of replacement. Unlike the single switching cost recovered by prior structural work, this isolates the tenure-accumulated component and identifies it from an exogenous tariff shock, quantifying a largely unmeasured category of intangible assets. Second, I advance the methodology for studying supply-chain dynamics by using a tariff shock as a clean, plausibly exogenous cost shifter within a dynamic discrete choice framework, in contrast to identification from prices, which are themselves endogenous to relationship quality and bargaining. Third, I contribute new evidence on how firms adjust their sourcing relationships in response to trade policy, with implications for understanding supply-chain resilience and the costs of protectionism.

3 Institutional Setting and Data

Estimating the value of supplier relationships requires data with three features: (i) high-frequency observations of sourcing decisions to measure relationship tenure and switching precisely, (ii) firm identifiers that allow linking trade flows to firm characteristics, and (iii) exogenous cost variation to identify relationship value from revealed preference. I begin by describing the April 2020 Turkish tariff shock and why it generates exogenous variation for identification. I then present the administrative data sources and explain how I construct the estimation sample.

3.1 The April 2020 Turkish Tariff Shock

In April 2020, Türkiye imposed additional ad valorem tariffs of up to 50% on more than 5,000 imported products. The tariff schedule features two dimensions of heterogeneity that are central to identification. The first is *cross-product heterogeneity*: tariff rates vary across Harmonized Tariff Schedule (HTS) codes, with rates ranging from 0% to 50% depending on the product category. The second is *cross-origin heterogeneity*: within each product category, tariff rates vary by source country due to Türkiye's network of preferential trade agreements. Countries exempt from the additional tariffs include EU members (through the Customs Union), EFTA states, and bilateral agreement partners such as South Korea, Chile, Israel, and several Balkan and North African countries.[1] Non-exempt countries, including China, the United States, Russia, India, and Brazil, and many others, face the full additional tariff rate.

This structure generates substantial variation in tariff exposure across firm-product-origin triplets. A Turkish importer sourcing a given product faces different tariff increases depending on which origin country it sources from, and importers of different products face different tariff schedules even from the same origin. I exploit this variation to identify the parameters of the structural model. Appendix Figure 14 maps this exposure across origins: roughly half of Chinese product lines were treated, while the United States and Russia faced narrower exposure and the EU origins were exempt.

[1]The full list of exempt countries includes: EU member states, EFTA members (Switzerland, Norway, Iceland, Liechtenstein), Israel, North Macedonia, Bosnia and Herzegovina, Morocco, Palestine, Tunisia, Egypt, Georgia, Albania, Chile, Serbia, Montenegro, Kosovo, Mauritius, Moldova, Faroe Islands, and South Korea.

3.1.1 Policy Context and Exogeneity

The tariffs were imposed in response to macroeconomic pressures rather than firm-level lobbying or industry-specific considerations. Türkiye's current account deficit had widened substantially in 2019. The tariff policy was part of a broader set of measures aimed at reducing import dependence and supporting the trade balance.

Several features of the policy support an exogeneity interpretation for the purpose of identifying switching behavior. *Timing*: The tariffs were announced and implemented rapidly in April 2020, with limited anticipation by firms. Figure 3 shows no evidence of pre-trends in import behavior prior to the policy change. *Aggregate motivation*: The product categories subject to tariffs were determined based on aggregate trade-balance considerations and existing trade agreement obligations, not firm-level characteristics or lobbying. *Origin variation from agreements*: The cross-country variation in tariff rates arises mechanically from pre-existing trade agreements (particularly the EU Customs Union) that were negotiated decades earlier for reasons unrelated to contemporary firm sourcing decisions. *Pre-determined import structures*: Firm-level tariff exposure is determined by the interaction of the tariff schedule with firms' pre-shock import portfolios, which were established before the policy was contemplated.

A potential concern is the coincident timing with the COVID-19 pandemic. I address this in two ways. First, I include origin-by-time fixed effects in reduced-form specifications, which absorb any supply-side disruptions that affected particular source countries (such as the early Chinese lockdown in February 2020). Second, because China alone accounts for over half of treated import value, excluding it is an important robustness check; the origin-by-time fixed effects above already absorb the China-specific disruptions, such as the early-2020 lockdown, that motivate this concern.

3.1.2 Scope and Magnitude

Table 2 summarizes the product coverage of the tariffs by Broad Economic Categories (BEC) classification. The policy affected products across capital goods, raw materials, and consumer goods, with only food and beverages largely exempt. Over one-third of all HTS product codes were subject to additional tariffs.

Table 2: Product Coverage by BEC Classification

	Capital Goods	Raw Materials	Food & Beverages	Consumer Goods
Treated Products	713	2,719	0	1,629
Non-treated Products	1,057	6,276	21	1,457

Table 3 shows the trade volume affected. Of total Turkish imports during 2018–2020, treated products account for approximately 7.5% by value. Over half of treated import value originates from China, reflecting both China's role as Türkiye's second-largest trading partner (after Germany, which is exempt through the Customs Union) and the concentration of tariffs on product categories where China is a major supplier.

Table 3: Trade Volume by Origin, 2018–2020 (Billion USD)

	China	Other Countries	Total
Total Imports	63.6	572.0	635.6
Treated Imports	30.2	22.6	52.8

Table 4 shows that the average effective tariff rate on treated products increased from 2.4% pre-shock to 7.6% post-shock, an increase of approximately 5 percentage points. For non-treated products, the average rate rose modestly from 2.8% to 3.8%, suggesting some compositional shift toward higher-taxed origins even among products not directly targeted by the policy. I calculate the effective tariff rate as total tariff payments divided by total import value; my calculations match government-reported tariff revenues with over 90% accuracy. Despite the modest average increase, there is substantial heterogeneity: some product-origin pairs experienced tariff increases of 30–50 percentage points, while others remained at zero due to trade agreement exemptions.

Table 4: Average Effective Tariff Rate

	Treated	Non-treated
Pre-Period	0.024	0.028
Post-Period	0.076	0.038

3.2 Data Sources

I combine several administrative datasets from Türkiye's Enterprise Information System (EIS), maintained by the Ministry of Industry and Technology. The richness of these data is the key advantage of the Turkish setting. The core dataset contains the universe of import transactions at the firm-product-origin-month level from 2014 to 2023. Monthly frequency is critical: it allows me to measure relationship tenure precisely and to capture switching dynamics that would be obscured in annual data. Firm identifiers link import transactions to balance sheets and, uniquely, to domestic firm-to-firm invoice records, enabling me to

observe whether firms substitute toward domestic suppliers when foreign relationships break. I construct the tariff dataset by digitizing the April 2020 Additional Import Tariff Act and merging it with Türkiye's trade agreement exemptions, yielding product-origin-month level tariff rate hikes that I match to each import transaction.

The core customs records contain the universe of Turkish import and export transactions at the firm-product-origin-day level from 2014 to 2023. For each transaction, I observe the importing firm identifier, product code (12-digit), origin country, transaction value (in USD, excluding duties), quantity, and unit of measurement. I aggregate transactions to the firm-product-origin-month level, which is the unit of observation for the structural estimation. Unit values (value divided by quantity) provide a measure of prices at the firm-product-origin-month level. While unit values are noisy proxies for true transaction prices due to quality and composition variation, they provide useful variation for the model, particularly when combined with tariff changes that shift delivered costs mechanically.

I link customs records to the Firm Tax Registry (FTR), which contains annual balance sheet and income statement data for all Turkish firms from 2006 onward. Key variables include total assets, fixed assets (property, plant, and equipment), cash holdings, total liabilities, sales revenue, cost of goods sold, and employment. For the baseline structural estimation, I use balance sheet data primarily to construct firm-level controls and to examine heterogeneity in switching behavior by firm characteristics. In extensions, balance sheet variables enter the model directly to study how financial constraints affect relationship dynamics.

A distinctive feature of the Turkish data is the availability of domestic firm-to-firm invoice data at monthly frequency from 2006 to 2022. These data record the buyer firm, seller firm, transaction value, and month for all domestic B2B transactions. This allows me to observe when importing firms substitute toward domestic suppliers following tariff increases and to construct the full input sourcing network for each firm. The domestic transaction data serve two purposes. First, they allow me to verify that the tariff shock induced real changes in sourcing behavior (substitution toward domestic suppliers), as shown in Figure 16. Second, in extensions, I can compare the dynamics of domestic versus foreign supplier relationships to assess whether relationship frictions differ by supplier location.

Finally, I construct the tariff dataset by digitizing the April 2020 Additional Import Tariff Act and merging it with Türkiye's trade agreement exemptions. The resulting dataset contains the additional ad valorem tariff hike for each product code by origin country and month from 2014 to 2023. For each firm-product-origin observation, I calculate the delivered cost as the unit value multiplied by one plus the additional tariff rate.

3.3 Sample Construction

3.3.1 Unit of Analysis

The unit of observation for the structural estimation is an *importer-product-month* triplet (m, j, t). For each such triplet, I observe which origin $x \in \mathcal{X}_j$ the firm sources from, where $\mathcal{X}_j$ is the set of origins with positive Turkish imports for product j during the sample period.

Following Monarch (2022), I define the "primary supplier" for each importer-product-month as the origin country accounting for the largest share of that firm's imports of that product in that month. When a firm imports a given product from multiple origins in the same month, I assign the primary supplier based on value; the definition can alternatively be based on quantity or transaction frequency.

3.3.2 Defining Relationships and Switches

A *relationship* is defined as a sequence of consecutive months in which the same origin is the primary supplier for a given importer-product pair. The relationship begins when the firm first sources from that origin (or when I first observe the firm importing that product) and ends when the firm switches to a different primary origin or stops importing the product entirely.

A *switch* occurs when the primary supplier for an importer-product pair changes from one month to the next:

$$\text{Switch}_{m,j,t} = \mathbf{1}\left[x_{m,j,t} \neq x_{m,j,t-1}\right], \tag{3.1}$$

where $x_{m,j,t}$ denotes the primary origin for importer m, product j, in month t.

Tenure $T_{m,j,t}$ measures the duration (in months) of the current relationship:

$$T_{m,j,t} = \begin{cases} 1 & \text{if } x_{m,j,t} \neq x_{m,j,t-1} \\ T_{m,j,t-1} + 1 & \text{if } x_{m,j,t} = x_{m,j,t-1} \end{cases} \tag{3.2}$$

Tenure resets to 1 whenever a switch occurs.

3.3.3 Sample Restrictions

I impose the following restrictions to construct the estimation sample. *Active importers*: I restrict to importer-product pairs with at least 12 months of positive imports during the sample period to ensure sufficient variation for identification. *Multi-origin products*: I restrict to products imported from at least two origins by some firm during the sample period,

ensuring that switching is feasible. *Tariff variation*: For the main identification strategy, I focus on product-origin pairs that experienced a change in tariff rates (due to the April 2020 shock), providing variation in delivered costs. *Balanced panel considerations*: For some specifications, I restrict to firms that were active importers both before and after April 2020 to ensure comparability across the shock.

3.4 Summary Statistics

Table 5 presents summary statistics for the estimation sample, which comprises 54,247 importing firms, 4,725 products, and 236 origin countries. Panel A describes firm and product characteristics. The median firm imports three distinct products (mean 11.4), and products are sourced from a broad set of origins economy-wide (the median product is imported from twelve distinct origins), yet the median importer sources a given product from a single origin at any time.

Panel B describes relationship characteristics, which display pronounced right-skewness. The average sourcing spell lasts 7.7 months, but the median is only one month: the data combine a large mass of transient, one-off purchases with a long tail of durable relationships. Among relationships active at the time of the shock, the average had been in place for 19.6 months.

Panel C reports tariff exposure. The average firm-level tariff exposure, calculated as the import-weighted average tariff increase across all firm-product-origin triplets, is 5.1 percentage points, with substantial heterogeneity (standard deviation of 8.9 percentage points). Approximately 19% of importer-product-origin observations experienced a non-zero tariff increase.

Table 5: Summary Statistics

	Mean	SD	p25	Median	p75
Panel A: Firm and Product Characteristics					
Products imported (per firm)	11.4		1	3	9
Origins per product (economy-wide)	15.9		6	12	22
Origins per firm-product	1.9		1	1	2
Panel B: Relationship Characteristics					
Spell duration (months)	7.7	18.0	1	1	6
Tenure at shock (months)†	19.6	23.5			
Monthly import value (USD)†	100,062	2,223,493			
Panel C: Tariff Exposure					
Firm-level Tariff Exposure (%)	5.13	8.94	0.0	0.35	6.40
Pre-shock Tariff Rate (%)	2.4				
Post-shock Tariff Rate (%)	7.6				

Notes: Panel A reports firm- and product-level characteristics; "origins per product" counts distinct origins supplying a product economy-wide. Panel B reports relationship-level characteristics for importer-product-origin spells. Panel C reports tariff exposure; firm-level exposure is the import-weighted average tariff increase across all products and origins. Distributional and persistence statistics use the all-origins relationship sample; rows marked † and the firm, product, and origin counts are computed on the primary-supplier sample.

4 Empirical Evidence

This section documents the empirical patterns in Turkish import data that motivate and discipline the structural model. I begin with two descriptive facts about supplier relationships: Fact 1 establishes that relationships are persistent and Fact 2 shows that this persistence increases with tenure, motivating the relationship surplus component. I then validate the April 2020 tariff shock as a source of identification before documenting two tariff-interaction facts: Fact 3 shows that tariffs induce switching but incompletely, and Fact 4 demonstrates that longer-tenured relationships are more "tariff-resistant," identifying the tenure-dependent component of relationship value.

4.1 Fact 1: Import Relationships Are Persistent

In a frictionless world with no switching costs or relationship-specific value, importers would constantly reallocate sourcing to the lowest-cost origin. Instead, I document that importer-origin relationships are highly persistent.

The average sourcing spell in the estimation sample lasts 7.7 months, but the distribution is highly skewed: the median spell is a single month, reflecting a large mass of transient, one-off purchases, yet 13.3% of spells exceed one year and 7.3% exceed two. Table 6 reports persistence statistics: 97.6% of importer-product-origin triplets that are active in month t remain with the same origin in month $t+1$. This monthly "staying rate" far exceeds what would be expected under random origin assignment.

Table 6: Relationship Persistence Statistics

Statistic	Value
Monthly staying rate (same origin t to $t+1$)	97.6%
Monthly termination rate	2.4%
Mean spell duration (months)	7.7
Median spell duration (months)	1
Share of spells $>$ 12 months	13.3%
Share of spells $>$ 24 months	7.3%
Monthly formation rate	15.4%
Value-weighted by import value	
Mean spell duration (months)	64.9
Survival past 12 months	80%
Survival past 24 months	70%
Number of relationship spells	3,834,112
Number of unique importers	51,272

Persistence is far more pronounced once relationships are weighted by import value, which emphasizes the economically important links: the value-weighted mean spell exceeds five years (about 65 months), and roughly 70% of value-weighted relationships survive beyond two years. The bulk of trade value therefore flows through durable relationships, even though most individual spells are short.

This persistence is not driven by a lack of alternatives. Table 7 shows that the median product is imported from twelve distinct origins by at least one Turkish firm, yet the median importer-product is sourced from a single origin over the sample period. Switching is feasible; it simply does not occur frequently.

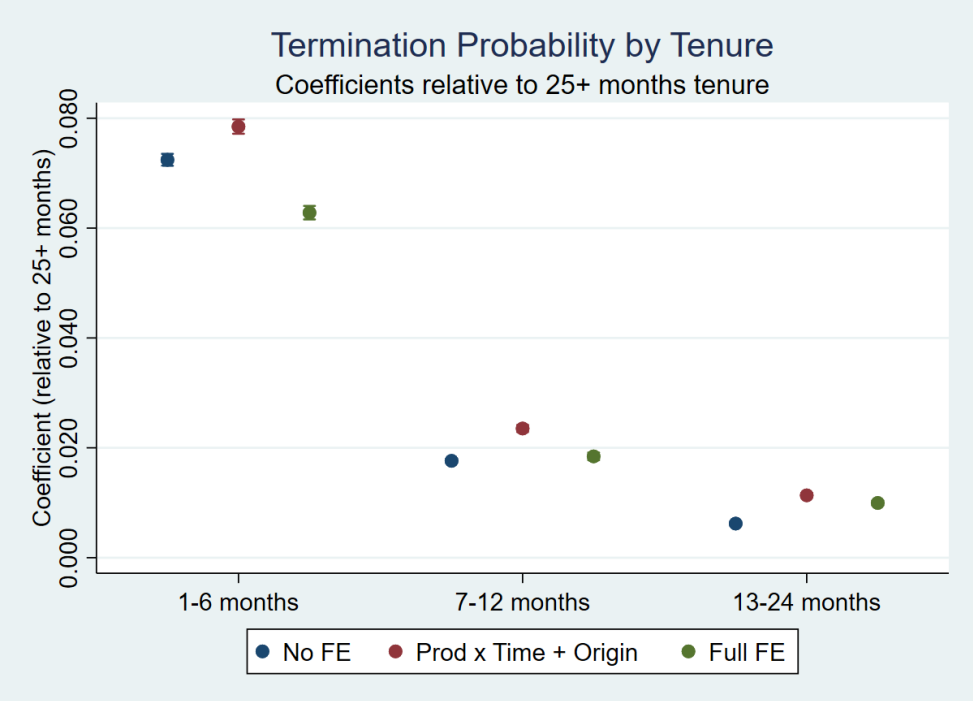
Table 7: Choice Set Statistics

	Mean	Median	p25	p75
Origins per product (across all firms)	15.9	12	6	22
Origins per product-firm (over sample)	1.9	1	1	2
Products per firm	11.4	3	1	9
Firms per product	124.3	35	11	97

4.2 Fact 2: Switching Hazards Decline with Tenure

Not only are relationships persistent on average, but persistence *increases* with relationship age. Figure 1 plots the tenure profile of origin switching: coefficients on tenure-bin dummies from linear probability regressions of the monthly switching indicator, expressed relative to relationships older than 25 months, under progressively richer fixed effects. The steep decline survives the controls.

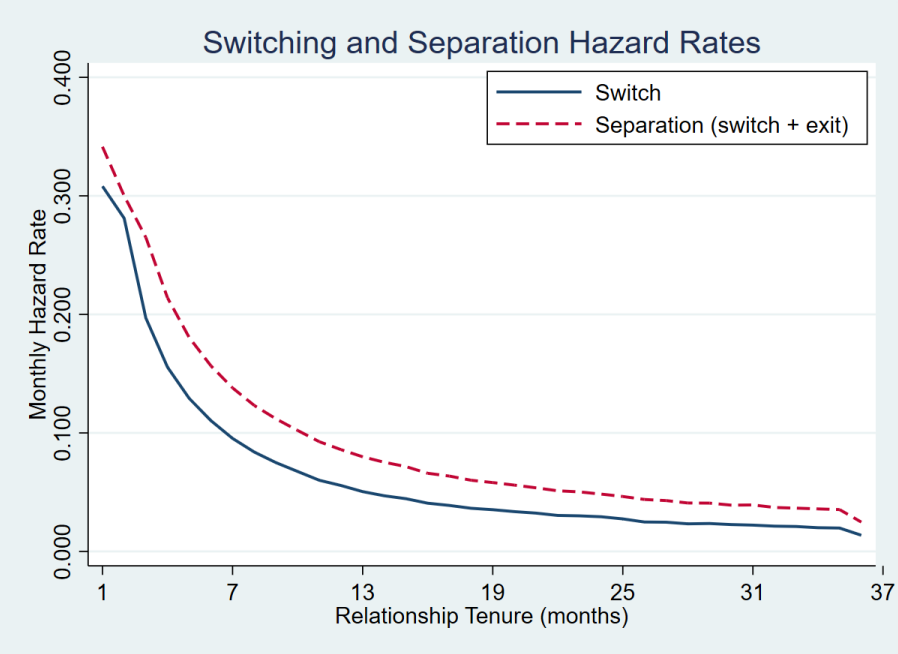
Figure 1: Origin Switching by Tenure Bin (Coefficients Relative to 25+ Months)



The monthly termination hazard falls steeply with tenure: it averages 6.9% during a relationship's first year, 1.4% in the second year, and 0.5% beyond two years, a roughly fourteen-fold decline. This pattern, which echoes findings in French data by Fontaine et al. (2025) and in U.S.-China data by Monarch (2022), is consistent with relationships that appreciate in value over time.

Figure 2 plots, at the more granular primary-supplier margin, the switching hazard alongside the broader separation hazard (switching plus exit from the product); the hazard levels are mechanically higher here than the all-origins origin-switching rate above, but the decomposition is the point. Both decline steeply with tenure, and the gap between them is exit: because separation conflates switching (the model's object) with the firm ceasing to import the product altogether, the structural estimation targets switching and absorbs the residual exit through a calibrated separation rate.

Figure 2: Switching and Separation Hazards by Tenure (Primary Supplier)



Notes: Monthly hazard rates by relationship tenure, primary-supplier sample. "Switch" is the hazard of changing primary supplier, so its level exceeds the all-origins origin-switching rate; "Separation" adds exit from the product (the firm ceasing to import it). Both decline steeply with tenure; their difference is the exit margin.

Table 8 confirms this pattern in a regression framework with fixed effects:

$$\text{Switch}_{m,j,t} = \alpha + \sum_{k=1}^{K} \gamma_k \cdot \mathbf{1}[T_{m,j,t-1} \in \text{Bin}_k] + \delta_{j,t} + \varepsilon_{m,j,t}, \tag{4.1}$$

where $T_{m,j,t-1}$ is tenure at the start of the period and $\delta_{j,t}$ are product-by-time fixed effects; the by-category specification additionally absorbs origin fixed effects. The coefficients γ_k trace out the tenure profile of switching, identified from the fixed effects rather than from added controls.

Table 8: Switching Hazard by Relationship Tenure and Product Category

	(1) Capital Goods	(2) Raw Materials	(3) Consumer Goods
Tenure $\leq$ 6 months	0.0846***	0.0752***	0.0799***
	(0.0009)	(0.0007)	(0.0012)
Tenure 7–24 months	0.0237***	0.0230***	0.0251***
	(0.0005)	(0.0003)	(0.0007)
Tenure $>$ 24 months	0.0115***	0.0114***	0.0120***
	(0.0003)	(0.0002)	(0.0005)
Observations	5,827,412	25,766,849	5,364,593

Monthly origin-switching indicator on lagged tenure-bin dummies. SE in parentheses.

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

Notes: Linear probability estimates of the monthly origin-switching (termination) indicator on lagged tenure-bin dummies (Bin 1: $\leq$ 6 months; Bin 2: 7–24; Bin 3: $>$ 24), estimated separately by broad economic category. Standard errors clustered at the firm level in parentheses. The switching hazard falls steeply with tenure in every category. ***$p < 0.01$.

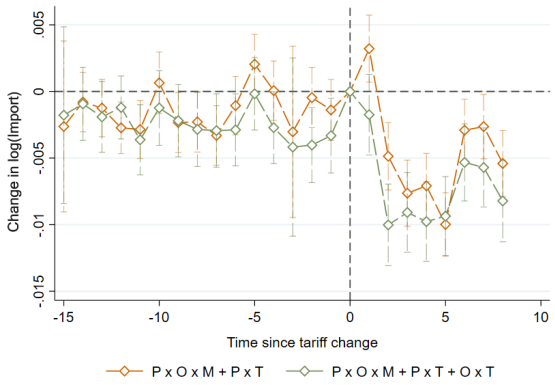
The declining hazard with tenure is a key moment for identification: it pins down the tenure surplus r_T in the structural model (its ceiling $\bar{r}$ and accrual speed κ).

4.3 Validating the Tariff Shock

Before turning to how the tariff shock interacts with sourcing relationships, I present reduced-form evidence that the April 2020 tariff shock induced meaningful changes in import behavior, confirming that it provides useful variation for identification.

Appendix Figure 15 shows that a 1 percentage point increase in the additional tariff rate raises average tariff payments by approximately 4%. Despite partial sourcing adjustments, firms cannot fully escape the tariff shock: this incomplete pass-through reflects firms' reluctance to abandon established supplier relationships, even when doing so would reduce tariff exposure.

Figure 3 plots coefficients from an event-study regression of log imports on tariff exposure. The specification includes product-by-time fixed effects to absorb demand shocks common to all origins of a given product, and product-by-origin fixed effects to absorb time-invariant differences across product-origin pairs. The figure shows no evidence of differential pre-trends prior to April 2020, supporting the identifying assumption that tariff changes are orthogonal to pre-existing trends in import demand. Following the shock, imports from high-tariff origins decline sharply and persistently, with the effect stabilizing at a magnitude implying that a 50 percentage point tariff increase reduces imports by approximately 25%.



Notes: The orange line plots monthly coefficients β_k; the green line adds origin×time fixed effects. The estimated specification is:

$$\log(\text{Import}_{p,o,t}) = \sum_{k=-15}^{+18} \beta_k \text{Tariff}_{p,o} \times \mathbf{1}_{t=k} + \delta_{p,t} + \varepsilon_{p,o,t}$$

where p indexes products, o indexes origins, and t indexes months relative to April 2020. $\delta_{p,t}$ are product-by-time fixed effects; the green line adds origin-by-time fixed effects.

Figure 3: Aggregate Response in Imports to the Tariffs

These patterns, at both the firm and aggregate levels, confirm that the tariff shock is both economically meaningful and exogenous, providing the cost variation needed to identify the value of supplier relationships. I now turn to how these tariff-induced sourcing adjustments interact with relationship characteristics.

4.4 Fact 3: Tariffs Increase Switching, but Incompletely

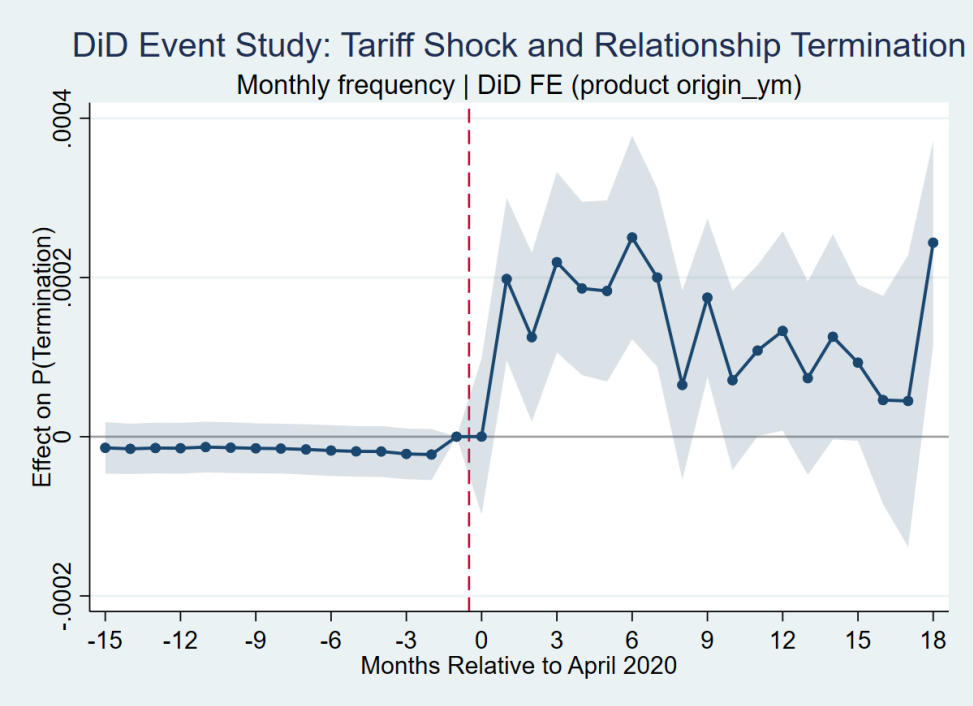
The April 2020 tariff shock provides a natural experiment for studying switching behavior. As documented in Section 3, the tariffs increased delivered costs for affected product-origin pairs by up to 50 percentage points. If relationships had no value and switching were costless, we would expect complete reallocation away from tariffed origins.

I estimate the marginal effect of the tariff change on switching:

$$\text{Switch}_{m,j,o,t} = \alpha + \beta \cdot \Delta\tau_{j,o} + \delta_j + \gamma_{o,t} + \varepsilon_{m,j,o,t}, \tag{4.2}$$

where $\Delta\tau_{j,o}$ is the change in tariff rate for product j from origin o following April 2020, δ_j are product fixed effects, and $\gamma_{o,t}$ are origin-by-time fixed effects. The coefficient β captures the marginal effect of tariffs on switching probability.

Figure 4: Difference-in-Differences Event Study: Tariff Shock and Relationship Termination



Notes: Event-study coefficients from a difference-in-differences regression of the monthly origin-termination indicator on tariff-shock exposure interacted with event time (months relative to April 2020), with product and origin-by-time fixed effects. Coefficients are flat and near zero before the shock (no differential pre-trends) and rise sharply afterward, confirming that the tariff raised relationship termination.

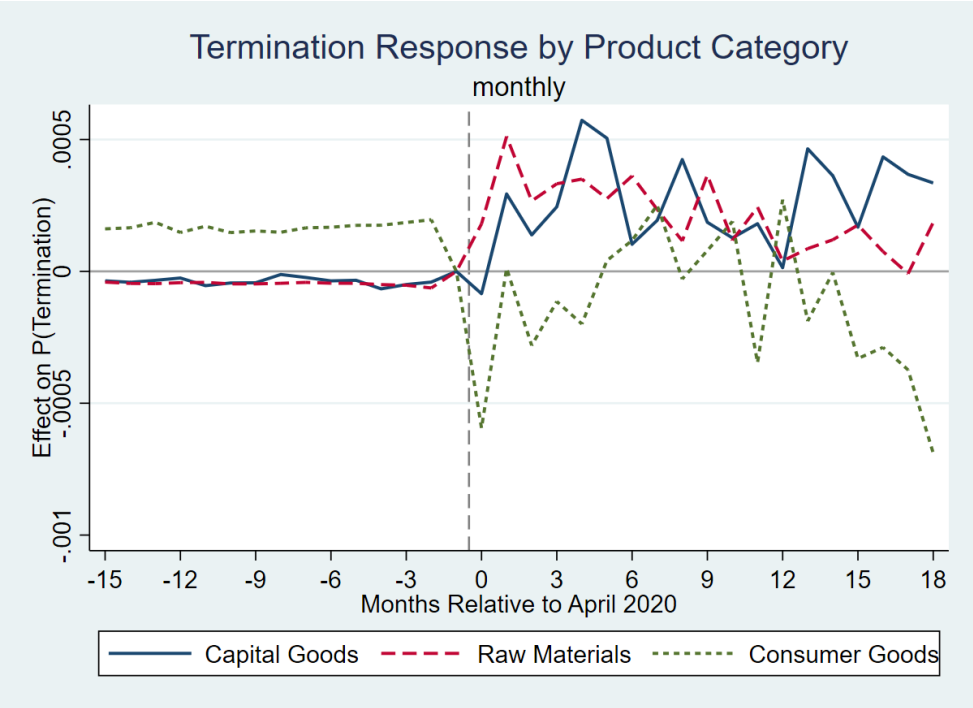
Two findings emerge. First, tariffs *do* increase switching. Figure 4 presents the difference-in-differences event study: relationship termination shows no differential pre-trends before April

2020 and rises sharply once the tariffs take effect. In the corresponding regression, which absorbs product-by-time shocks, a 10 percentage point tariff increase raises the monthly probability of switching origins by 0.2 to 0.3 percentage points, a few percent of the 6.5 percent baseline hazard (Table 9). This confirms that the tariff shock provides useful variation for identification.

Second, switching is *incomplete* even at high tariff levels: even among relationships facing increases of 30 to 50 percentage points, the large majority continue sourcing from the tariffed origin despite the substantial cost increase. This incomplete adjustment is the central puzzle the model addresses.

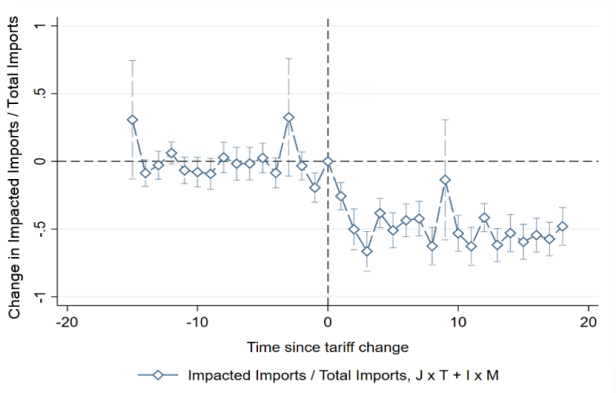
The tariff-induced rise in termination is broad-based across product types. Figure 5 re-estimates the event study separately by Broad Economic Category, and capital goods and raw materials both show clear post-shock increases, confirming that the effect is not driven by a single sector; consumer goods, a smaller and more heterogeneous segment, are noisier.

Figure 5: Termination Response to the Tariff by Product Category



Notes: Difference-in-differences event-study coefficients of monthly relationship termination on tariff-shock exposure interacted with event time (months relative to April 2020), estimated separately by Broad Economic Category. Capital goods and raw materials show clear post-shock increases; consumer goods are noisier. Differences across categories in the size of the response partly reflect differences in tariff exposure rather than relationship sensitivity alone.

Figure 6 illustrates this incomplete adjustment at the firm level: a 5 percentage point increase in tariffs reduces the impacted import ratio by approximately 2.5 percentage points, from 21% to 18.5%, indicating that firms shifted only part of their spending toward product–country pairs not subject to the additional tariff. This adjustment, whether through switching to untreated origins for the same product or substituting toward untreated products within treated origins, appears sustained over the 18 months following the shock. Firms also partially substitute toward domestic suppliers, a margin outside the model; Appendix C shows that domestic sourcing rises with tariff exposure.



Notes: The estimated specification is:

$$\frac{\text{Impacted Imports}_{i,j,t}}{\text{Total Imports}_{i,j,t}} = \sum_{k=-15}^{k=+18} \beta_k \text{ Firm Tariff }_i \times \mathbf{1}_{t=k} + \delta_{j,t} + \alpha_{i,m}$$

where i indexes firms, j indexes sectors, and t indexes months relative to April 2020. $\delta_{j,t}$ are sector-time fixed effects and $\alpha_{i,m}$ are firm-calendar month fixed effects.

Figure 6: Ratio of Imports from Impacted Product–Origin Pairs to Total Imports

Table 9: Switching Response to Tariffs

	(1)	(2)	(3)	(4)
Tariff change (pp)	-0.0005***	-0.0006***	0.0003***	0.0003***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Product, month FE	No	Yes	–	–
Product × month FE	No	No	Yes	Yes
Origin FE	No	No	No	Yes
Observations	2,430,873	2,430,773	2,426,350	2,426,129
Adj. R^2	0.000	0.016	0.029	0.031

Dependent variable: monthly origin-switching indicator, post-shock 12-month window.

Standard errors clustered at the firm level in parentheses.

$^{*}\,p < 0.10$, $^{**}\,p < 0.05$, $^{***}\,p < 0.01$

Notes: Linear probability estimates of the monthly origin-switching indicator on the post-shock tariff change. Each column adds fixed effects from left to right, as the lower panel of the table indicates. The coefficient is negative in columns (1)–(2), reflecting that the origins facing the largest tariff increases hold the most stable relationships; it turns positive and significant once product-by-month fixed effects compare origins within the same product and month (columns 3–4), absorbing this selection.

4.5 Fact 4: Longer Relationships Are More Tariff-Resistant

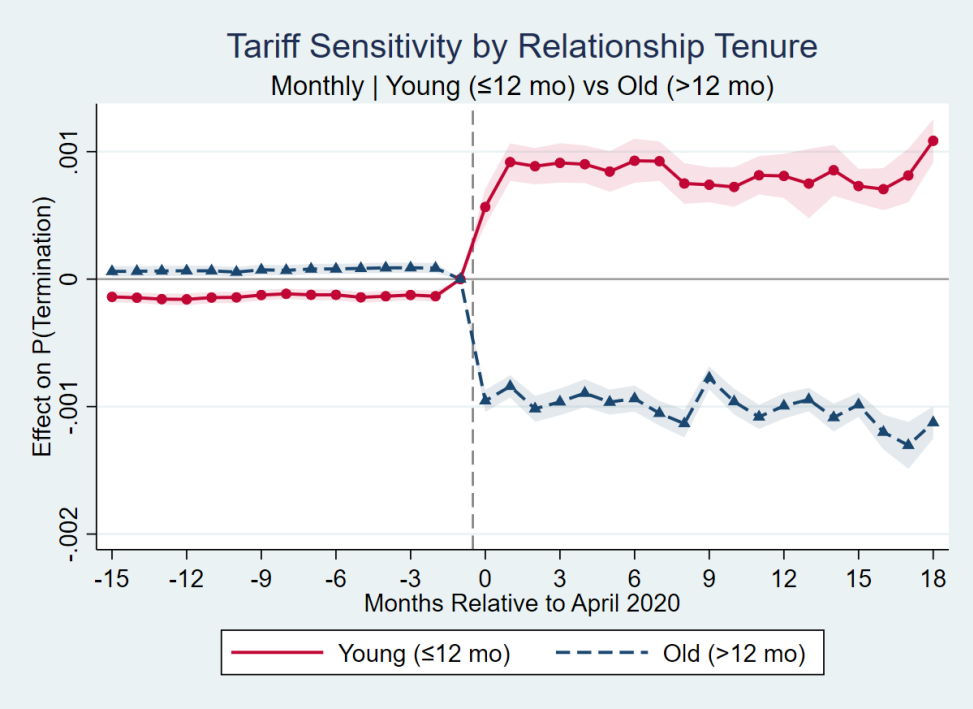
The declining hazard documented in Fact 2 could reflect either (i) tenure-dependent relationship value (relationships become more valuable over time) or (ii) selection (fragile relationships dissolve early, leaving only robust matches). The tariff shock helps distinguish these mechanisms by providing exogenous variation in the incentive to switch.

If the declining hazard reflects only selection, then conditional on surviving to a given tenure, relationships should respond similarly to tariff shocks regardless of age. If instead relationships accumulate value with tenure, then older relationships should be more resistant to tariff-induced switching: importers should require larger cost shocks to abandon longer-tenured relationships.

Figure 7 plots the tariff semi-elasticity of switching separately by tenure bins:

$$\text{Switch}_{m,j,o,t} = \alpha + \sum_k \beta_k \cdot \Delta\tau_{j,o} \times \mathbf{1}[T_{m,j,t-1} \in \text{Bin}_k] + \delta_{j,t} + \gamma_o + \varepsilon_{m,j,o,t}. \tag{4.3}$$

Figure 7: Tariff Sensitivity of Switching by Relationship Tenure



The results show that newer relationships are substantially more tariff-sensitive than older ones. A 10 percentage point tariff increase raises the monthly switching probability by

approximately 0.9 percentage points for relationships under six months old, but the effect falls steeply with tenure and is small and statistically indistinguishable from zero for relationships over two years old. This tenure-resistance pattern is identified from the difference-in-differences event study above (Figure 7), which absorbs product-by-time and product-by-origin fixed effects so that selection across origins does not drive the result.

This fact is central to identification. In the structural model, the tenure surplus r_T determines how much extra cost an importer is willing to bear to maintain a relationship of tenure T. The declining tariff sensitivity with tenure identifies the shape of $r_T = \bar{r}\left(1-(1-\kappa)^T\right)$: older relationships require larger cost shocks to induce switching, implying that r_T is increasing in T.

Table 10 summarizes the four facts and their roles in the structural model. Together, these facts indicate that import sourcing is characterized by valuable, persistent relationships that are costly to break. The tariff shock provides exogenous variation that allows me to quantify these frictions and estimate the value of established supplier relationships. The next section develops the structural model that rationalizes these patterns.

Table 10: Summary of Motivating Facts

Fact	Finding	Role in Model
1. Relationships are persistent	97.6% monthly staying rate; mean spell 7.7 months (13% exceed one year)	Motivates relationship capital
2. Hazards decline with tenure	Monthly termination falls from 6.9% (year 1) to 0.5% (beyond year 2)	Identifies tenure accrual ($\bar{r}$, κ)
3. Tariffs increase switching	10pp tariff $\rightarrow$ 0.2pp higher monthly switch probability	Provides cost variation for identification
4. Older relationships more tariff-resistant	0.9pp tariff response for young relationships, negligible beyond two years	Identifies the tenure premium separately from replacement cost

5 Model

The empirical evidence in Section 4 establishes that supplier relationships are persistent, that this persistence deepens with tenure, and that tariffs induce incomplete switching. These patterns are consistent with relationships that carry substantial value, but reduced-form methods alone cannot quantify that value or decompose it into its sources. This section develops a dynamic discrete choice model of supplier sourcing in the tradition of Rust (1987): instead of modeling an engine replacement decision, I model a firm's supplier replacement problem in the face of tariff hikes. Two features distinguish the model: (i) I use tariff variation for identification, which provides exogenous cost shifters that are orthogonal to supplier characteristics, and (ii) I introduce tenure-dependent relationship surplus that accumulates over time, separately from a one-time replacement cost. Together, these components yield a precise definition of relationship capital as a form of intangible asset.

I present the model for a single product to simplify notation. Under standard assumptions (CES demand with constant markups and Cobb-Douglas production technology), the firm's profit-maximizing supplier choice for each imported input is independent of its choices for other inputs, so that each importer-product pair constitutes a separate dynamic discrete choice problem.[2] This separability lets me treat each importer–product pair as a separate dynamic problem. In the baseline I estimate the model on the pooled sample, exploiting the full product-level distribution of tariff changes in the simulated moments; estimating the model separately by product category is left to future work.

5.1 Setup and Timing

Time is discrete and indexed by $t = 1, 2, \ldots$ (months). Importing firms are indexed by $m \in \{1, \ldots, M\}$. For a given imported product, firm m chooses a sourcing origin x from a finite set $\mathcal{X} = \{1, \ldots, X\}$, where each element represents a country of origin. Following Grossman et al. (2024), each firm works with a single supplier per origin for each product at a time. A *supplier* is thus a match within a country–product cell rather than the cell itself: any fresh draw, whether from a different origin or from the same origin after an exogenous separation, constitutes a new supplier. Relationships are nonetheless observed, and tariffs vary, at the country–product level, which is particularly well-suited to the tariff setting: a tariff increase on origin x incentivizes the firm to switch to an untaxed origin $x' \neq x$ rather

[2]Appendix A provides the formal derivation of this separability result, following Monarch (2022). The key insight is that with CES demand and Cobb-Douglas technology, log profits decompose additively across inputs, so choosing a cheaper supplier for input j affects profits by a fixed proportion regardless of supplier choices for other inputs.

than to a different supplier within the same country. The tariff shock therefore generates variation at exactly the level at which I observe relationships, providing clean identification of relationship value for each country–product pair.

Match quality. Each sourcing relationship carries a log-productivity $z = z_0 + r$ with two components. When a firm forms a relationship with an origin it draws a *match-specific* component $z_0 \sim \text{TrExp}(\theta; 0, \bar{z}_0)$, the quality it discovers about that particular supplier over the first months of trading, which is then *fixed for the life of the relationship.* Separately, the *tenure surplus* r accumulates over time as buyer and supplier customize processes, optimize logistics, and build trust, rising deterministically toward a long-run ceiling $\bar{r}$:

$$r_{t+1} = (1 - \kappa)\, r_t + \kappa\, \bar{r}, \qquad r_0 = 0, \quad \kappa \in (0, 1), \tag{5.1}$$

so a relationship of tenure T has tenure surplus $r_T = \bar{r}\Big(1 - (1 - \kappa)^T\Big)$ and log-productivity $z_T = z_0 + r_T$. Because the discovered draw z_0 persists, a firm that draws a good match keeps that advantage for as long as the relationship lasts; this retained, match-specific value is precisely what a firm forfeits when it switches.

Choices and timing. At the start of period t the firm observes its state, the current tariffs $\{\tau_{x,t}\}$, and i.i.d. Type-I extreme-value preference shocks, and chooses among X options: *stay* with the incumbent origin, or *search* a single alternative origin. Staying costs nothing and matures the relationship ($r \mapsto (1 - \kappa)r + \kappa\bar{r}$, with z_0 retained). Searching origin x' costs a fixed amount $f > 0$, returns a fresh draw $z_0' \sim \text{TrExp}(\theta; 0, \bar{z}_0)$, after which the firm accepts, switching to a new relationship $(x', z_0', 0)$, or rejects and keeps its incumbent; the search cost is sunk either way. In addition, with probability s each period the incumbent relationship is destroyed exogenously (supplier exit, a lapsed contract, force majeure), forcing the firm to re-form. The effective cost of switching is therefore *endogenous* (the search cost f plus the match value forfeited) rather than a fixed parameter.

State variables. The payoff-relevant state is

$$s_t = (x_{t-1},\, z_0,\, r_{t-1}) \in \mathcal{X} \times [0, \bar{z}_0] \times [0, \bar{r}], \tag{5.2}$$

the incumbent origin, its persistent match draw, and accumulated tenure surplus. A separate tenure counter is unnecessary, since r summarizes tenure through (5.1) while z_0 carries the retained match heterogeneity.

Tariffs. Let $\tau_{x,t} \geq 0$ denote the ad valorem tariff rate applied to imports from origin x at time t. I model the April 2020 tariff shock as an unanticipated, permanent change in

tariff rates: $\tau_{x,t} = 0$ for all affected product–origin pairs before April 2020, jumping to their new levels thereafter and remaining constant for the rest of the sample.[3] This treatment is appropriate because the tariffs were announced and implemented rapidly, leaving little scope for anticipation. Because firms treat the post-shock tariffs as permanent and known, no expectation formation over future tariff paths is required, and $\tau_{x,t}$ enters the model as a deterministic parameter rather than a stochastic state variable.

5.2 Per-Period Payoffs

When firm m sources from origin x through a relationship of quality $z = z_0 + r$ facing tariff $\tau_{x,t}$, it receives the *log-linear* per-period payoff

$$u(x, z, \tau_{x,t}) = \underbrace{\alpha_x}_{\text{origin quality}} + \underbrace{z}_{\text{match quality}} - \underbrace{\beta_\tau \ln(1 + \tau_{x,t})}_{\text{tariff cost}}. \tag{5.3}$$

Appendix A derives (5.3) as the log operating profit attributable to input x under CES demand and Cobb–Douglas production, so each term inherits a structural meaning.

Origin quality (α_x). A time-invariant index capturing average price, reliability, distance, and institutional compatibility of origin x, so explicit price data are not required.[4] It is identified from origin market shares; I normalize $\alpha_1 = 0$ for the modal origin.

Match quality ($z = z_0 + r$). Log-productivity enters with a unit coefficient (a normalization), since the cardinal scale of z is governed by the draw dispersion θ and the ceiling $\bar{r}$. This single object carries the model's state dependence. There is no separate one-time switching cost: its role is played by the *endogenous* cost of switching developed below: the search fee f plus the match value z_0+r a firm forfeits. And there is no imposed tenure-surplus function: its role is played by the accrued surplus, $z_T - z_0 = \bar{r}\big(1 - (1-\kappa)^T\big)$, which is increasing and concave in tenure by construction. Switching destroys the accumulated r and the persistent draw z_0, so the asymmetry between staying and switching (the source of state dependence) arises from the match-quality process itself rather than from a free parameter.

Tariff cost (β_τ). The coefficient $\beta_\tau > 0$ measures the sensitivity of sourcing to tariff-induced cost changes; $\ln(1+\tau_{x,t})$ approximates the log increase in delivered cost. Under Nash-in-Nash bargaining between buyer and supplier with short-term renewable contracts, the supplier absorbs part of any tariff, so pass-through is partial and β_τ is the structural pass-through

[3] Türkiye has not reversed the April 2020 tariffs as of 2023, the end of my sample period.

[4] This follows the discrete-choice tradition of absorbing unobserved quality in fixed effects (Berry, 1994); unit values enter as a robustness control.

elasticity (in the spirit of Grossman et al., 2024); I estimate it freely and read it as the relative tariff sensitivity in units of match quality. The identifying assumption is that tariff changes are exogenous to firm-level relationship states conditional on origin fixed effects.

Preference shocks ($\varepsilon_{x,t}$). I.i.d. Type-I extreme-value shocks over the choice set, observed by the firm but not the econometrician, delivering tractable logit choice probabilities.

5.3 The Dynamic Problem

The firm is forward-looking with monthly discount factor $\delta \in (0,1)$. Write $\bar{V}(x, z_0, r)$ for the expected (ex-ante) value of a relationship in state (x, z_0, r). The choice-specific values are as follows.

Stay. Continuing matures the relationship while retaining the innate match draw z_0; with probability s the relationship is instead destroyed exogenously and the firm re-forms:

$$v^{\text{stay}}(x, z_0, r) = u(x, z_0{+}r, \tau_x) + \delta\Big[(1-s)\,\bar{V}(x, z_0, g(r)) + s\,\bar{V}^{\text{reset}}(x)\Big], \quad g(r) = (1-\kappa)r + \kappa\bar{r}. \tag{5.4}$$

Search. Searching origin x' pays the fee f, returns a fresh draw $z_0' \sim \text{TrExp}(\theta; 0, \bar{z}_0)$, and the firm keeps the better of accepting or rejecting:

$$v^{\text{srch}}(x, z_0, r; x') = -f + \int_0^{\bar{z}_0} \max\left\{v^{\text{stay}}(x, z_0, r),\, W(x', z_0')\right\} \frac{\theta e^{-\theta z_0'}}{1 - e^{-\theta \bar{z}_0}}\, dz_0', \tag{5.5}$$

where $W(x', z_0') = u(x', z_0', \tau_{x'}) + \delta\Big[(1-s)\bar{V}(x', z_0', g(0)) + s\bar{V}^{\text{reset}}(x')\Big]$ is the value of accepting a fresh match, and $\bar{V}^{\text{reset}}(x) = -f + \mathbb{E}_{z_0'}\bar{V}(x, z_0', 0)$ is the value of forced re-formation in the same origin: the firm pays the search fee f and draws a fresh match. The fee in v^{srch} is paid for the current voluntary search draw, whereas the fee in $\bar{V}^{\text{reset}}$ is incurred only in future periods in which the relationship is destroyed exogenously, so search costs are never charged twice for the same event.

Reservation and acceptance. Because W is increasing in z_0', the firm accepts iff the draw clears a reservation threshold $z_0^\star(x, z_0, r; x')$ solving $W(x', z_0^\star) = v^{\text{stay}}$. The acceptance probability under the truncated draw is closed-form,

$$\Pi^a(x, z_0, r; x') \equiv \Pr(z_0' \geq z_0^\star) = \frac{e^{-\theta \max(z_0^\star, 0)} - e^{-\theta \bar{z}_0}}{1 - e^{-\theta \bar{z}_0}}, \qquad \Pi^a = 0 \text{ if } z_0^\star \geq \bar{z}_0. \tag{5.6}$$

A better incumbent (higher $z_0 + r$) or a less attractive target raises $z_0^\star$ and lowers Π^a: firms holding excellent matches search only speculatively and rarely switch, whereas a tariff on the incumbent lowers v^{stay}, lowers the bar, and raises acceptance.

Choice probabilities. With Type-I extreme-value shocks, the expected value is the log-sum over the X options, $\bar{V}(x, z_0, r) = \log\left(e^{v^{\text{stay}}} + \sum_{x' \neq x} e^{v^{\text{srch}}(\cdot; x')}\right) + \gamma_E$, and the probability of *initiating* search in x' is logit in the v's. The model distinguishes searching from switching: a firm that searches but rejects its draw is recorded as having stayed. The probabilities the data actually record are

$$P(\text{switch to } x' \mid x, z_0, r) = P(\text{search } x' \mid x, z_0, r) \cdot \Pi^a(x, z_0, r; x'), \tag{5.7}$$

$$P(\text{observed stay} \mid x, z_0, r) = P(\text{stay} \mid x, z_0, r) + \sum_{x' \neq x} P(\text{search } x' \mid x, z_0, r)\Big(1 - \Pi^a\Big). \tag{5.8}$$

This wedge between search and switching is the source of *incomplete* adjustment after a tariff shock, and the post-switch behavior it generates identifies the draw dispersion θ.

Solution. Given parameters and δ, I solve for $\bar{V}$ on a grid over (x, z_0, r) by value-function iteration; the operator is a contraction (Appendix B). The fresh-draw expectation is evaluated by equal-probability quadrature at the inverse-c.d.f. nodes of the truncated exponential. Exogenous separation s floors the hazard at every tenure, while the search-and-maturation mechanism shapes its steep decline with relationship age.

5.4 Why Dynamics Matter: The True Cost of Switching

A central implication of the model is that the value a firm sacrifices when it breaks a relationship far exceeds any single-period cost, and, crucially, that it grows with tenure even though no parameter is labeled a "switching cost." When a firm gives up an incumbent of quality $z = z_0 + r$, it loses three things: it must pay the search fee f to re-form; it surrenders the accumulated tenure surplus r, restarting at $r = 0$; and it forfeits the persistent draw z_0, replacing a known, above-reservation match with a random one. The first piece is a fixed friction; the second and third grow with tenure as r accumulates and as survival selects on z_0.

The effective cost of breaking a relationship is therefore *endogenous and tenure-dependent*, and it is precisely the relationship capital defined next. Older relationships are more costly to break not because the search friction itself is larger, but because the firm has more accumulated and innate match value at stake. This distinction (separating the fixed re-formation friction from the accumulated, match-specific intangible asset) is central to the paper, and it maps

directly to Fact 4 in Section 4: older relationships resist tariff-induced switching because they have more to lose.

5.5 Definition of Relationship Capital

I define *relationship capital* as the value of an established supplier relationship relative to having none:

$$RC(x, z_0, r) = \bar{V}(x, z_0, r) - \bar{V}(\emptyset), \tag{5.9}$$

where $\bar{V}(\emptyset) = -f + \max_{x \in \mathcal{X}} \mathbb{E}_{z_0'}\left[\bar{V}(x, z_0', 0)\right]$ is the value of a firm with no incumbent, which pays the search fee once and forms a fresh relationship in the most attractive origin. This is the dollar (utility) value the firm would lose if the relationship vanished and it were thrown back into search. Because the buyer captures only its share of the total match surplus, RC is the buyer-side value of the relationship and thus a lower bound on its joint buyer–supplier value (Eaton et al., 2025). The model is single-agent: it solves the buyer's problem, taking the distribution of potential matches as given. Implicit in the reset is that a severed supplier re-pairs with another buyer rather than idling, as in the two-sided search model of Eaton et al. (2025), so a dissolved match cannot be costlessly reconstituted: returning to an origin draws a new match. This re-matching motivates the no-memory reset; it is an interpretation of the buyer-side problem rather than a separately modeled bilateral game, and accommodating costly partial recall of a former supplier is a natural extension.

Decomposition. Relationship capital decomposes *exactly* into two microfounded components:

$$RC(x, z_0, r) = \underbrace{\left[f - \left(\mathbb{E}_{z_0'} \bar{V}(x^*, z_0', 0) - \mathbb{E}_{z_0'} \bar{V}(x, z_0', 0) \right) \right]}_{\text{search / replacement cost}} + \underbrace{\left[\bar{V}(x, z_0, r) - \mathbb{E}_{z_0'} \bar{V}(x, z_0', 0) \right]}_{\text{match premium}}. \tag{5.10}$$

The first term is the cost of *replacing* the relationship (the search fee f, net of the option to re-form in the best origin x^* rather than the incumbent) and is the structural counterpart of a reduced-form switching cost. The second is the premium from holding a matured, above-average match (z_0, r) rather than a random fresh draw (the counterpart of an accumulated tenure surplus), non-negative and, for a given match, increasing in tenure. Both are endogenous: the replacement cost depends on f, θ, and the attractiveness of alternatives, while the match premium depends on κ, $\bar{r}$, the retained draw z_0, and θ. Section 7 reports the empirical magnitudes and the split between the two.

5.6 Identification

The structural parameters are $(\beta_\tau, \bar{r}, \kappa, \{\alpha_x\}_{x=2}^{X}, f, s, \theta)$. I estimate $(\beta_\tau, \bar{r}, \kappa, \{\alpha_x\})$ by simulated method of moments and calibrate the search fee f, the separation rate s, and the draw dispersion θ, for the reasons given below.

Origin quality (α_x). Identified from the unconditional market shares of each origin; with one normalization, $X - 1$ free parameters.

Tariff sensitivity (β_τ). Identified from how switching responds to the April 2020 shock (product–origin pairs with larger tariff increases switch more), isolated by the difference-in-differences design of Fact 3. In the dynamic model the effect also operates through continuation values, as a tariff change alters the relative attractiveness of staying in all future periods.

Tenure-surplus ceiling and accrual ($\bar{r}, \kappa$). The ceiling $\bar{r}$ is the maximum match premium, $z_T - z_0 \to \bar{r}$, and is the microfounded magnitude of the tenure surplus. It is identified from *how steeply* switching declines with tenure (Fact 2) and from the tariff×tenure interaction (Fact 4): older relationships resisting tariff-induced switching reveal a larger $\bar{r}$. The accrual speed κ is identified by the curvature of that decline across tenure bins.

Calibrated primitives (f, s, θ). Three primitives are calibrated. The search fee f is not separately identified by switching-rate moments: terminations equal search × acceptance, so the moments pin the acceptance margin (governed by $\bar{r}$, θ, α) but not search *effort*. An over-identified specification that frees f returns $f \approx 0.86$ but with a near-flat objective that inflates the other standard errors; I therefore calibrate f at this data-preferred value and report a sensitivity band. The separation rate s is set to the mature-tenure hazard floor (the level below which the monthly hazard does not fall), and the draw dispersion θ is identified only by post-switch re-switching, a moment outside the baseline set, so I calibrate it and free it once that moment is available. None of the three materially affects the headline relationship-capital estimate, whose tenure component is governed by $\bar{r}$ and κ (Section 7 reports the f-sensitivity band).

Table 11 summarizes the strategy.

Table 11: Identification Summary

Parameter	Identified from	Variation used
α_x (origin quality)	Origin market shares	Cross-origin
β_τ (tariff sensitivity)	Switching response to tariffs	Tariff shock (April 2020)
$\bar{r}$ (tenure-surplus ceiling)	Hazard decline + tariff×tenure	Within-firm tenure
κ (accrual speed)	Curvature of the hazard decline	Tenure bins
f (search fee)	Calibrated (weakly identified)	—
s (separation rate)	Calibrated to the mature-hazard floor	—
θ (draw dispersion)	Calibrated (post-switch re-switching)	—

5.7 Discussion and Extensions

Price variation. The baseline model absorbs price differences into origin fixed effects α_x. This is appropriate if average price-quality ratios are stable over time within origins. In a robustness check, I include lagged unit values as an additional covariate:

$$u(x, z, \tau_{x,t}) = \alpha_x + z - \beta_\tau \ln(1 + \tau_{x,t}) - \beta_P \ln(p_{x,t-1}) \tag{5.11}$$

where $p_{x,t-1}$ is the lagged unit value from origin x. Because tariff variation is orthogonal to price levels by construction, this control does not affect the identification of β_τ.

Price bargaining and pass-through. The baseline model assumes full tariff pass-through: a tariff of τ increases delivered cost by factor $(1 + \tau)$. In practice, suppliers may absorb part of the tariff through price concessions, especially for valued long-term customers. If incumbent suppliers offer better price concessions than new suppliers, the effective cost increase from tariffs is smaller for continuing relationships, which would attenuate the estimated tariff sensitivity.

I assess this channel by examining whether unit values (excluding tariffs) decline for incumbent suppliers after tariff increases. If suppliers offer concessions, the structural interpretation changes: some of what I attribute to relationship surplus may reflect bargaining power rather than relationship-specific productivity. However, the policy-relevant quantity, the value of maintaining the relationship, remains well-defined.

Firm heterogeneity. The baseline model assumes homogeneous parameters across firms within a product category. In extensions, I allow parameters to vary with observable firm characteristics:

$$f^m = \bar{f} + f^{\text{size}} \cdot \log(\text{Assets}_m) + f^{\text{cash}} \cdot \text{CashRatio}_m \tag{5.12}$$

This specification tests whether larger firms or firms with more financial slack face lower search costs, as financially flexible firms may find it easier to absorb the cost of finding and qualifying new supplier relationships.

Multiple products. The baseline pools products and exploits product-level tariff variation in the moments. Estimating the model separately by product category, allowing parameters to differ across differentiated versus commodity inputs and aggregating to a firm-level relationship-capital measure that reflects each firm's import basket, is a natural extension left to future work.

Relationship memory and backup suppliers. The baseline resets a switching firm to a fresh draw z_0' at $r = 0$. An extension lets prior experience with an origin lower the cost of returning to it, either by restoring part of the accumulated capital r or by reducing the search fee f for an already-vetted origin. Both channels confer a *hedge value* on maintaining a "backup" relationship: a firm with experience in an unshocked alternative can redeploy to it more cheaply after a tariff shock than a firm sourcing only from the shocked origin. Quantifying this hedge value is a natural counterfactual application of the estimated model.

Within-origin supplier switching. Because foreign supplier identities are unobserved, an origin change is the empirical unit of switching; replacing one supplier with another in the same origin is invisible in customs data. The match draw z_0 is therefore best read as the importer's effective match with the *origin*, and a hidden within-origin re-search margin is a direct extension.

General equilibrium. The model is partial-equilibrium and single-agent: it holds the distribution of potential matches fixed and solves one buyer's problem. It therefore abstracts from the matching congestion and supplier-entry responses that arise when many buyers re-source at once, which a two-sided equilibrium model captures (Eaton et al., 2025). The relationship-capital estimate should accordingly be read as a partial-equilibrium object.

The model thus delivers the objects needed to quantify supplier relationship capital from revealed preference: the search technology (f, θ) and the match-quality process $(\kappa, \bar{r})$, which together generate an *endogenous, tenure-dependent* cost of switching, and the relationship-capital measure $RC(x, z_0, r)$ combining the avoided replacement cost with the accumulated

match premium. The tariff shock supplies the exogenous cost variation that identifies these objects: firms that maintain relationships despite large tariff increases reveal high relationship value, and the tenure-dependence of that response separates the fixed re-formation friction from the accumulated intangible asset.

6 Estimation

6.1 Simulated Method of Moments

I estimate the model by the simulated method of moments. The estimated parameter vector is $\theta = (\beta_\tau, \bar{r}, \kappa, \{\alpha_x\}_{x=2}^{X})$; the search fee f, the separation rate s, and the draw dispersion are calibrated (Section 5.6). The estimator minimizes the weighted distance between empirical moments computed from the Turkish customs data and their simulated counterparts:

$$\hat{\theta} = \arg\min_{\theta} \left[m^{data} - m(\theta)\right]' W \left[m^{data} - m(\theta)\right] \tag{6.1}$$

where $m(\theta)$ is computed by forward-simulating a panel of importer–product relationships through the pre- and post-shock regimes and applying the empirical moment definitions. The weighting matrix W is diagonal, with entries equal to the reciprocal sampling variance of each moment, capped so that the most precisely-measured moments do not dominate the objective. The monthly discount factor is calibrated at $\delta = 0.995$ (about a 6% annual rate) rather than estimated.[5]

Origin set. The structural choice set comprises the five origins that dominate Türkiye's manufacturing imports and span the tariff treatment: China, Russia, and the United States, which faced the April 2020 increases, and Germany and Italy, which are exempt through the EU Customs Union and serve as untreated comparison origins (energy and precious-metal flows are excluded). Tariff exposure enters at the product–origin level: China is treated according to the full product-level distribution of its increases (0–50 percentage points), the United States and Russia at their narrower average increases, and the European origins at zero. Origin-share moments are measured over these five groups, with China the modal origin to which the others are normalized.

[5]Results are robust to alternative values in the range $\delta \in [0.95, 0.999]$. As $\delta \to 1$, forward-looking considerations become more important, amplifying the role of the match premium in the switching decision.

6.2 Moment Selection

I target nine moments that provide identification for the key structural parameters. I now define each moment condition formally.

Moment Group 1: Switching rates by relationship tenure (3 moments). The first group captures how switching rates vary with the age of the sourcing relationship. For each tenure bin $k = 1, 2, 3$, I compute:

$$m_k^{\text{tenure}} = \frac{1}{N_k} \sum_{(m,t):T_{m,t-1} \in \text{Bin}_k} \mathbf{1}[x_{m,t} \neq x_{m,t-1}] \tag{6.2}$$

where N_k is the number of observations in tenure bin k. The three bins are: Bin 1: $T \leq 12$ months (new relationships), Bin 2: $T \in (12, 24]$ months (medium-tenure), and Bin 3: $T > 24$ months (established relationships). These bins aggregate the first year, whereas the reduced-form hazard figures in Section 4 split it more finely: the SMM bins favor precision, while the figures illustrate the steep early-tenure decline. These moments are crucial for identifying the tenure surplus r_T (its ceiling $\bar{r}$ and accrual speed κ). A steep decline in switching rates with tenure requires a larger tenure surplus to rationalize why established relationships are more persistent. The shape of the hazard profile across tenure bins identifies the tenure-surplus parameters relative to the normalized $r_0 = 0$.

Moment Group 2: Tariff × tenure difference-in-differences slopes (2 moments). The second group is the primary source of identification for the tariff sensitivity β_τ. Rather than target raw switching rates by tariff bin, which conflate the tariff response with selection (the largest-increase origins, notably China, hold disproportionately stable, long-tenured relationships), I target the difference-in-differences slopes that the empirical analysis isolates (Fact 4): the marginal effect of the tariff change on switching, estimated separately for young and established relationships in the post-shock window. I compute the OLS slope coefficient of switching probability on the tariff change, separately for young and established relationships:

$$m^{\text{young}} = \frac{\text{Cov}\left(\mathbf{1}[\text{switch}_{m,t}],\, \Delta\tau_m \mid T_{m,t-1} \leq 12\right)}{\text{Var}\left(\Delta\tau_m \mid T_{m,t-1} \leq 12\right)} \tag{6.3}$$

$$m^{\text{old}} = \frac{\text{Cov}\left(\mathbf{1}[\text{switch}_{m,t}],\, \Delta\tau_m \mid T_{m,t-1} > 12\right)}{\text{Var}\left(\Delta\tau_m \mid T_{m,t-1} > 12\right)} \tag{6.4}$$

Each coefficient measures the marginal effect of tariffs on switching within a tenure group, netting out differences in baseline switching rates already captured by the tenure-bin moments. If relationships carried no accumulated value, the two slopes would be equal. A smaller slope for established relationships implies that older relationships have more at stake, identifying the

tenure-surplus ceiling $\bar{r}$ separately from the overall tariff sensitivity β_τ. The model counterpart is computed by indirect inference: I feed the model the full product-level distribution of April 2020 tariff changes (China spanning 0–50 percentage points, the United States and Russia at their narrower exposures, and the exempt European origins at zero), simulate the pooled panel, and run the identical young/old switching regressions on the simulated data.

Moment Group 3: Origin market shares (4 moments). The third group captures the unconditional popularity of each origin:

$$m_x^{\text{share}} = \frac{1}{N} \sum_{m,t} \mathbf{1}[x_{m,t} = x] \tag{6.5}$$

for each origin $x \in \mathcal{X}$. These moments identify the origin fixed effects α_x; origins with higher α_x attract more importers on average. China is normalized to $\alpha_{\text{China}} = 0$.

A note on the overall rate. I do *not* target the unconditional monthly termination rate. In the data it conflates origin-switching (the model's object) with exit (a firm ceasing to import the product), which the model abstracts from; and matching its high level would require a separation rate above the mature-tenure hazard, contradicting the low long-tenure switching that identifies the match premium. The level of switching is instead disciplined jointly by the tenure-bin moments, the tariff×tenure slopes, and the calibrated separation rate. The separation rate s captures only this residual relationship-destruction hazard at the mature-tenure floor, not product exit, which lies outside the model.

Table 12 summarizes the moment conditions and their identifying roles.

Table 12: Summary of Moment Conditions

Group	Moment	Count	Identifies
1. Switching by tenure	$P(\text{switch} \mid T \in \text{Bin}_k)$, 3 bins	3	$\bar{r}, \kappa$
2. Tariff × tenure (DiD)	OLS slope of switch on $\Delta\tau$, by $T \lessgtr 12$	2	β_τ; $\bar{r}$ vs. β_τ
3. Origin shares	$P(x_t = x)$, $x = 2, \ldots, X$	$X - 1$	α_x
Total		$X + 4$	

Notes: The targeted moments and their identifying roles. With $X = 5$ origins there are nine moments and seven estimated parameters $(\beta_\tau, \bar{r}, \kappa, \{\alpha_x\}_{x=2}^{X})$, yielding two overidentifying restrictions. I do not target raw switching rates by tariff bin, which conflate the tariff response with selection; β_τ is identified from the difference-in-differences slopes in Group 2. The search fee f, separation rate s, and draw dispersion are calibrated (Section 5.6).

6.3 Identification

The seven estimated parameters are over-identified by the nine targeted moments. Identification relies on distinct sources of variation. The tariff sensitivity β_τ is identified from the difference-in-differences slopes of switching on the tariff change (the young/old split of Fact 4) rather than from raw switching rates by tariff bin, which conflate the tariff response with selection, since the origins facing the largest increases hold disproportionately stable relationships. The April 2020 shock provides the quasi-experimental variation, as some origins faced increases up to 50 percentage points while the exempt European origins faced none. The tenure-surplus ceiling $\bar{r}$ and accrual speed κ are identified from the *gradient* of the switching hazard with respect to relationship age (a steeper decline with tenure requires a larger and faster-accruing match premium) and from the tariff×tenure slopes, which reveal that older relationships resist tariff-induced switching. The origin qualities α_x are identified from unconditional market shares. The level of switching that a constant separation rate and the calibrated search fee leave unexplained pins down the remaining hazard floor.

6.4 Simulation Procedure

For each candidate parameter vector θ, I solve and simulate the model in three steps. First, I solve for the value function $\bar{V}(x, z_0, r)$ on a discretized grid over the origin x, the innate match draw z_0, and the accumulated capital r, iterating the stay-versus-search choice-specific values of Section 5 (each a log-sum over the X options) until $\max |\bar{V}^{(n+1)} - \bar{V}^{(n)}| < 10^{-8}$. Second, I forward-simulate a panel of importer–product relationships through the pre- and post-shock tariff regimes, drawing fresh matches from the truncated exponential and applying the reservation rule of Section 5 to determine acceptance. Third, I apply the empirical moment definitions to the simulated panel to obtain $m(\theta)$, holding the simulation draws fixed across candidate parameters (common random numbers) so that the objective is smooth.

6.5 Optimization

I minimize the SMM objective function using a combination of global and local search. First, I generate 500 starting points from a Sobol sequence spanning the parameter space. From each starting point, I run the Nelder-Mead simplex algorithm to find a local minimum, then refine each solution using sequential quadratic programming (SQP) with bound constraints. Finally, from the overall best solution, I run one additional SQP refinement to ensure convergence. This multi-start approach guards against convergence to local minima, which can arise when

the objective function is nonconvex. I impose bounds $\beta_\tau \in [0, 15]$, $\bar{r} \in [0, 3]$, $\kappa \in (0, 1)$, and $\alpha_x \in [-5, 3]$ during optimization.

6.6 Inference

Standard errors are the asymptotic simulated-method-of-moments (sandwich) errors, $\widehat{\text{Avar}}(\hat{\theta}) = (G'WG)^{-1}(G'W\Omega WG)(G'WG)^{-1}$, where $G = \partial m(\theta)/\partial\theta$ is the moment Jacobian evaluated at $\hat{\theta}$ by central finite differences with common random numbers, W is the inverse-variance weighting matrix, and Ω is the diagonal matrix of squared data-moment standard errors. The objective is well-conditioned at the optimum (Section 7).

With more moments than parameters, I test the overidentifying restrictions using Hansen's J-statistic:

$$J = N \cdot \left[m^{data} - m(\hat{\theta})\right]' W^* \left[m^{data} - m(\hat{\theta})\right] \tag{6.6}$$

Under correct specification, $J \sim \chi^2_{K-p}$ where K is the number of moments and p is the number of parameters. A large J-statistic indicates model misspecification.

6.7 Myopic Benchmark

To assess how much forward-looking behavior matters, I also re-solve and simulate the model at a low monthly discount factor, $\delta = 0.5$, a "myopic" benchmark that heavily discounts continuation values relative to the dynamic baseline ($\delta = 0.995$). Comparing the myopic and dynamic models isolates the role of forward-looking behavior: with continuation values heavily discounted, the model must rationalize the observed persistence through larger contemporaneous payoffs, overstating both the tariff sensitivity and the match premium. Figure 12 in the Results section shows that most of relationship capital is the discounted value of *future* relationship benefits, which a myopic firm does not internalize.

6.8 Robustness Checks

Several additional robustness checks are natural within this framework: finer tenure bins (1–3, 4–6, 7–12, 13–24, 25+ months) to allow more flexible tenure effects; alternative discount factors $\delta \in \{0.95, 0.99, 0.999\}$ to gauge how forward-looking behavior shapes the decomposition; lagged log unit values as an additional covariate to absorb price levels; and re-estimation excluding China, to confirm the results are not driven by China-specific factors coinciding with COVID-19. The estimated decomposition, dominated by the accumulated match premium, is identified by the tenure gradient of the tariff response rather than by the overall level of

switching, and so is unlikely to be overturned by these variations. The sensitivity of the headline magnitude to the calibrated search fee is reported directly in Figure 13.

7 Results

7.1 Baseline Estimates

Table 13 presents the baseline estimates from SMM on the Turkish customs moments. The tariff sensitivity is $\hat{\beta}_\tau = 1.195$ (s.e. 0.053), indicating a significant but moderate switching response to tariffs. The tenure-surplus ceiling is $\hat{\bar{r}} = 0.529$ (0.019), the maximum match premium a relationship accumulates, and the accrual speed is $\hat{\kappa} = 0.147$ (0.023), implying that roughly half of the ceiling is reached within four to five months and most within a year. The four origin qualities range from -0.20 to -0.40 relative to the modal origin, China, and are precisely estimated (standard errors below 0.013). The objective is well-conditioned (condition number of $J'WJ$ below 1,500).

Table 13: Baseline Parameter Estimates

Parameter	Estimate	Std. Error
Estimated		
β_τ (tariff sensitivity)	1.195	(0.053)
$\bar{r}$ (tenure-surplus ceiling)	0.529	(0.019)
κ (match-quality accrual speed)	0.147	(0.023)
$\alpha_2, \ldots, \alpha_5$ (origin qualities)	-0.20 to -0.40	(< 0.013)
Calibrated		
f (search fee)	0.86	—
s (separation rate)	0.005	—
θ (match-draw dispersion)	5.0	—
δ (monthly discount factor)	0.995	—

Notes: Simulated method of moments on the Turkish customs moments. Standard errors are asymptotic SMM sandwich errors. China is the normalized origin ($\alpha_1 = 0$). The model targets nine moments and estimates seven parameters (two over-identifying restrictions); the search fee, separation rate, and draw dispersion are calibrated (Section 5.6). The search fee is calibrated at the value an over-identified specification prefers when f is freed. The April 2020 shock is fed to the model as the full product-level distribution of origin tariff changes (China spanning 0–50 percentage points), and the moments are computed on the pooled simulated panel exactly as in the data.

The origin qualities are all negative relative to the modal origin, reflecting its dominant pre-shock market position.

7.2 Model Fit

Figure 8 displays the fit between the targeted moments and their model-implied counterparts. The model reproduces the steep tenure decline in switching, the differential tariff response by tenure (the young and old tariff slopes), and the graded origin market shares. It slightly over-predicts the switching hazard at the longest tenures (a structural feature discussed below) but matches the shape of the decline and the cross-origin shares closely.

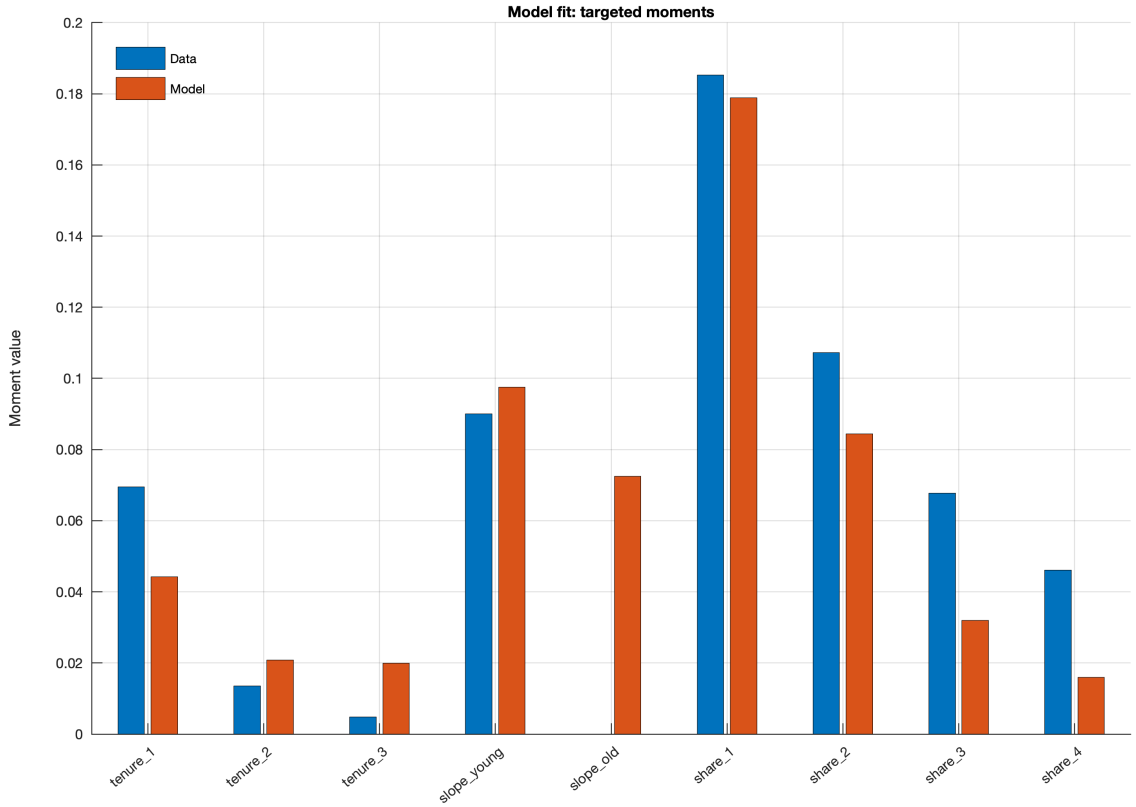


Figure 8: Moment Fit: Targeted vs. Model-Implied Moments

Notes: Data bars show the targeted empirical moments; model bars show the model-implied moments at the estimated parameters. The model fits nine moments with seven estimated parameters.

7.3 Model-Implied Switching Hazard

Figure 9 plots the model-implied switching hazard against relationship tenure. The hazard falls steeply from about 13% in the first month to roughly 2% by month six, where it plateaus, the negative duration dependence documented in Fact 2. The plateau lies slightly above the

data's mature-tenure hazard: a constant logit choice with an ever-present option to draw a fresh good match cannot fully suppress switching among the most selected, long-lived relationships, so the model captures the *shape* of the decline while modestly over-predicting its *level* at long tenures (placed beside the empirical hazard for comparison). Because the model over-predicts switching among these mature, highly selected relationships, it *under*-states their relationship capital (a relationship that breaks less often than the model implies has more at stake), so the headline $RC(24)$ is, if anything, a conservative lower bound.

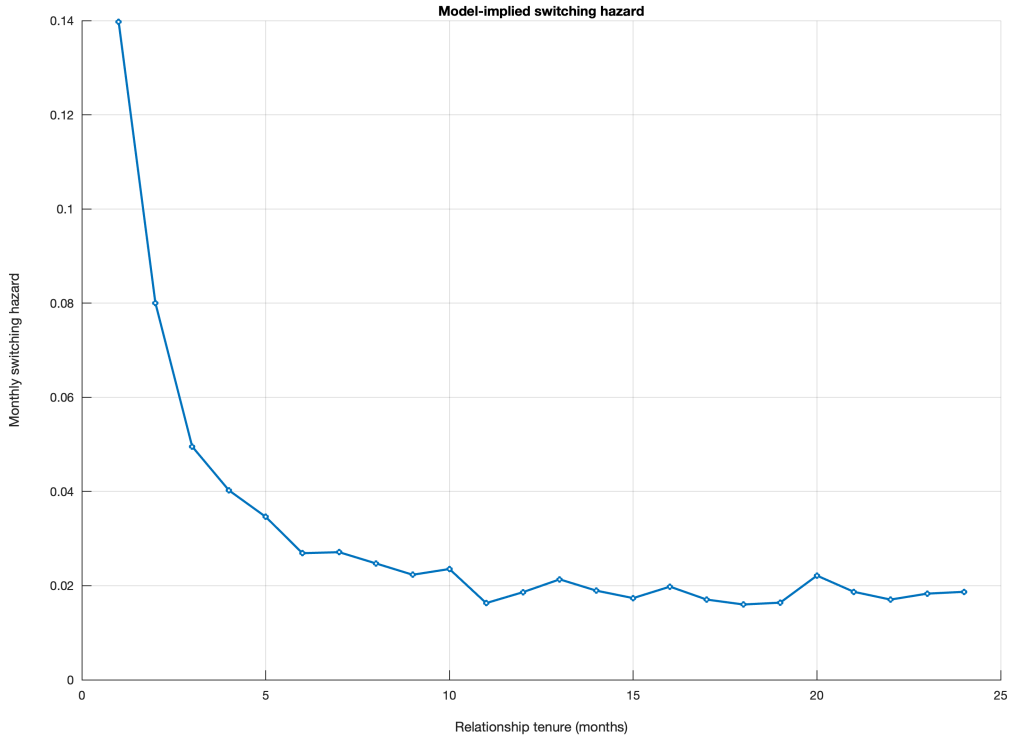


Figure 9: Model-Implied Switching Hazard by Tenure

Notes: The figure shows the probability of switching suppliers as a function of relationship tenure at the estimated parameters. Horizontal dashed lines indicate targeted moments for tenure bins. The declining hazard reflects both switching costs and accumulated tenure surplus.

This declining hazard pattern is a key feature that distinguishes my model from static frameworks. In a static model, switching rates would be constant across tenure. The observed decline indicates that relationships become more valuable over time, either because of accumulated relationship-specific surplus or because of selection (low-quality matches dissolve early).

7.4 Economic Magnitudes

I report relationship capital in three ways: in utility units, as a share of annual import value, and in money, using the tariff coefficient β_τ as the bridge between utils and observables.

Conversion to import value. A one-percentage-point tariff lowers the *monthly* flow payoff by approximately $\beta_\tau \cdot 0.01/(1+\tau)$ utils and raises the firm's *annual* duty bill by about $V \cdot 0.01$, where V is annual import value. Equating the two at the model's monthly frequency, one utility unit is worth $V(1+\tau)/(12\beta_\tau)$, so relationship capital as a share of annual imports is $RC(1+\tau)/(12\beta_\tau)$; evaluated at the pre-shock tariff ($1+\tau \approx 1$), this is the $RC/(12\beta_\tau)$ I report.

Relationship capital by tenure. Table 14 and Figure 10 report RC across tenure. A newly formed relationship is already worth about **68% of its annual import value**: it embodies an accepted, above-reservation match and spares the firm the cost of finding a replacement. Relationship capital then rises to **about 100% of annual imports by 24 months** (essentially a full year's import value) as the match matures, and is essentially flat thereafter (about 94% at 36 months). For a given relationship, capital rises monotonically with tenure as r accumulates toward $\bar{r}$; the cross-sectional average reported here also reflects the changing composition of surviving matches, so it levels off, and edges down slightly, once accumulation saturates. The increment from formation to maturity (roughly 32 percentage points) is the pure tenure premium, generated by the accumulated tenure surplus r.

Decomposition. Relationship capital is overwhelmingly a *match premium.* At 24 months, 94% of RC is the value of holding a matured, above-average match rather than a random fresh draw, and only 6% is the search/replacement cost. This reflects a thick import-sourcing market (the median product is supplied from twelve origins) in which finding *a* new supplier is comparatively inexpensive, so a relationship's value resides in the specific, accumulated match rather than in the cost of re-forming one. This premium is not the deterministic tenure increment alone; it combines the accumulated tenure component, the value of the retained innate match, and the survival selection of good matches. The pure tenure increment (the rise from formation to maturity) is about 32 percentage points. This contrasts with the larger sunk costs of export-market *entry* discussed below.

Table 14: Relationship Capital by Tenure

Tenure	RC (utils)	% imports	$ median (k)	$ mean (k)	yrs profit	match %
0 mo	9.80	68.4	15.7	820.2	4.56	91
6 mo	13.85	96.6	22.3	1159.7	6.44	94
12 mo	14.26	99.5	22.9	1194.0	6.63	94
24 mo	14.53	101.4	23.4	1216.6	6.76	94
36 mo	13.55	94.5	21.8	1134.0	6.30	94

Notes: Relationship capital $RC(x, z_0, r)$ averaged over the survived match distribution at each tenure, at the baseline estimates. "% imports" is $RC/(12\beta_\tau)$; dollar columns scale this by the median ($23,000) and mean ($1.2 million) annual import value (USD, the currency of customs records); "yrs profit" is illustrative only, assuming a 15% gross margin; "match %" is the match-premium share of RC.

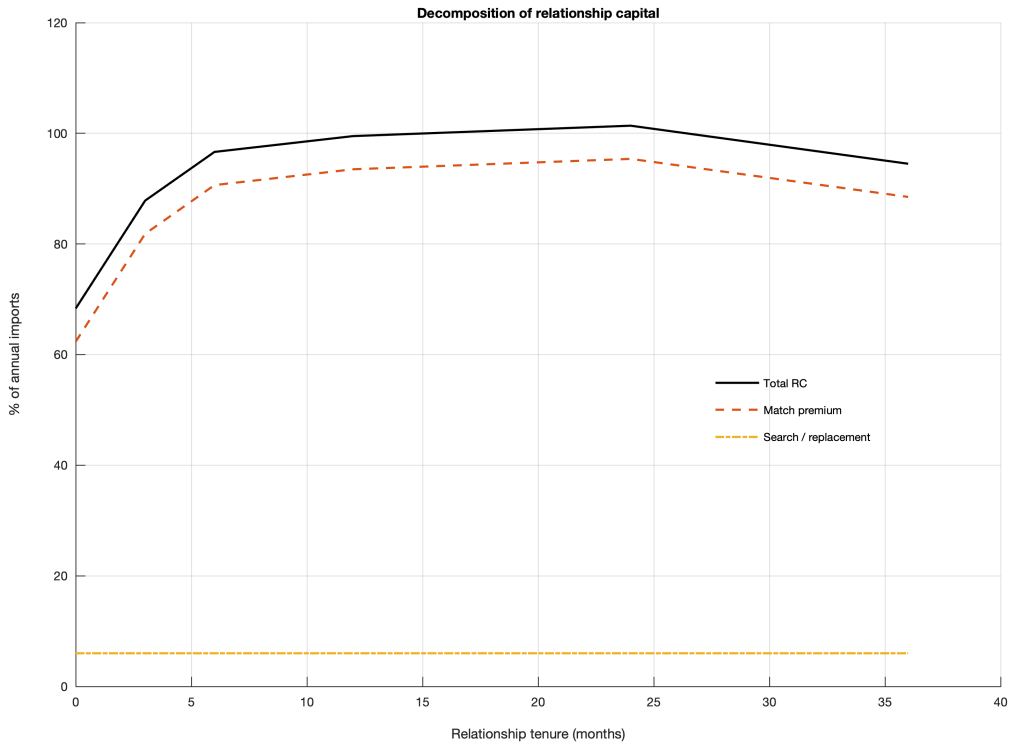


Figure 10: Decomposition of Relationship Capital by Tenure

Notes: Relationship capital by tenure (% of annual imports) at the baseline estimates, split into the match premium (the value of holding a matured, above-average match relative to a fresh draw) and the search/replacement cost. The match premium accounts for about 94% of RC throughout.

Dollar magnitudes. Import values are recorded in U.S. dollars. At the median relationship (annual import value $\approx$ \$23,000), $RC(24)$ is about **\$23,400**; at the right-skewed mean ($\approx$ \$1.2 million) it is about **\$1.22 million**.[6]

Tariff shield. Another way to express relationship capital, in the units of the tariff experiment itself, is the size of the tariff increase a relationship can absorb before the firm abandons it. Figure 11 raises a hypothetical tariff on the reference origin and traces, by tenure, the level at which the monthly probability that a surviving relationship switches origin crosses one-half. A young relationship (three months) withstands a tariff increase of about 119 percentage points before the median firm switches; an established one (a year or more) withstands about 140. The shield widens with tenure, the revealed-preference counterpart of the accumulating match capital in Figure 10: a matured match is substantially more productive than a fresh alternative, so it takes a very large tariff to erode that advantage. The implied threshold exceeds even the fifty-percentage-point maximum actually imposed on the most heavily treated Chinese products, and is many times the sample-average increase of about five percentage points. That firms tolerate tariff disadvantages far beyond the realized shock before severing is the same fact, stated in tariff rather than import-value units, as a relationship worth close to a full year of trade.

[6]Illustratively, at an assumed 15% gross margin this is on the order of six to seven years of profit on the imported input. Because supplier (exporter) margins are not observed in our data, we emphasize the import-value benchmark rather than a profit multiple.

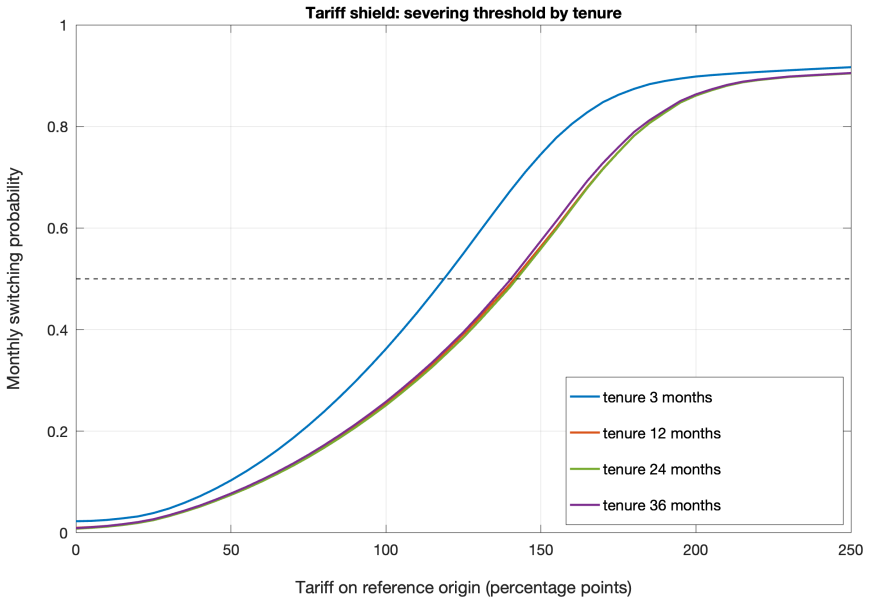


Figure 11: Tariff Shield: Severing Threshold by Tenure

Notes: For each tenure, the curve traces the model-implied monthly probability that a surviving relationship switches origin as the tariff on the reference origin rises, holding the pre-shock distribution of match quality fixed. The "shield" is the tariff at which this probability reaches one-half (dashed line). Older relationships, having accumulated more match capital, resist higher tariffs before severing.

Comparison to the literature. A relationship worth on the order of a full year's trade value sits at the upper end of the range of measured intangible assets, but well within it. Das et al. (2007) estimate the sunk cost of *forming* a new export relationship at 18–41% of annual export value; relationship capital, which adds the accumulated match premium to this re-formation cost, is substantially larger. Brand capital is estimated at roughly 30% of firm market value (Belo et al., 2014); aggregate intangible investment rivals tangible investment (Corrado et al., 2009); and organizational capital frequently exceeds physical capital (Eisfeldt and Papanikolaou, 2013; Peters and Taylor, 2017). Supplier relationship capital thus joins brand, organizational, and customer capital as a quantitatively major intangible asset, measured here, for the first time, for buyer–supplier relationships in international trade.

Sensitivity to the calibrated search fee. Because the search fee f is calibrated, Figure 13 traces $RC(24)$ and its decomposition as f ranges over $[0.1, 1.0]$. A higher f raises both the level of relationship capital and the search-cost share, but the match premium remains the dominant component throughout, so the headline $RC(24)$, on the order of a full year's import value, is driven by the accumulated match rather than by the calibrated search fee. The

Das–Roberts–Tybout evidence, if anything, points toward a higher search cost and thus a larger relationship value.

7.5 Comparison with the Myopic Benchmark

To assess the importance of forward-looking behavior, Figure 12 compares relationship capital under the dynamic baseline ($\delta = 0.995$) with a myopic benchmark ($\delta = 0.5$). Dynamics are central to its magnitude: most of relationship capital is the present value of a *future* stream of match-quality and avoided-search benefits, so a myopic firm values an established relationship far less: its RC profile lies well below the dynamic one at every tenure. A purely static model that ignored continuation values would be forced to rationalize the observed persistence through implausibly large contemporaneous payoffs, overstating tariff sensitivity and the tenure surplus alike. The dynamic model instead attributes persistence to the option value of an appreciating, hard-to-replace match.

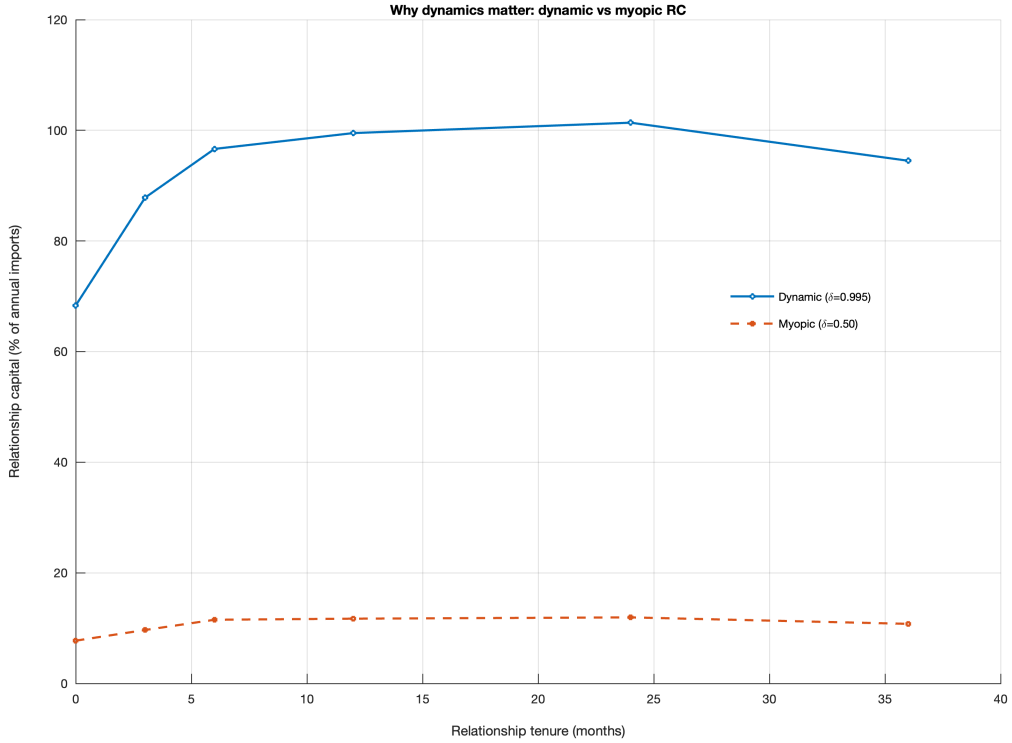


Figure 12: Relationship Capital: Dynamic vs. Myopic

Notes: Relationship capital by tenure (% of annual imports) under the dynamic baseline ($\delta = 0.995$) and a myopic benchmark ($\delta = 0.5$). The gap shows that the bulk of relationship capital is the discounted value of future relationship benefits, absent under myopia.

7.6 Sensitivity Analysis

Because the search fee f is the one calibrated parameter that bears directly on relationship capital, I assess how the estimate responds to it. Figure 13 traces the level of $RC(24)$ and its match/search decomposition as f ranges over $[0.1, 1.0]$.

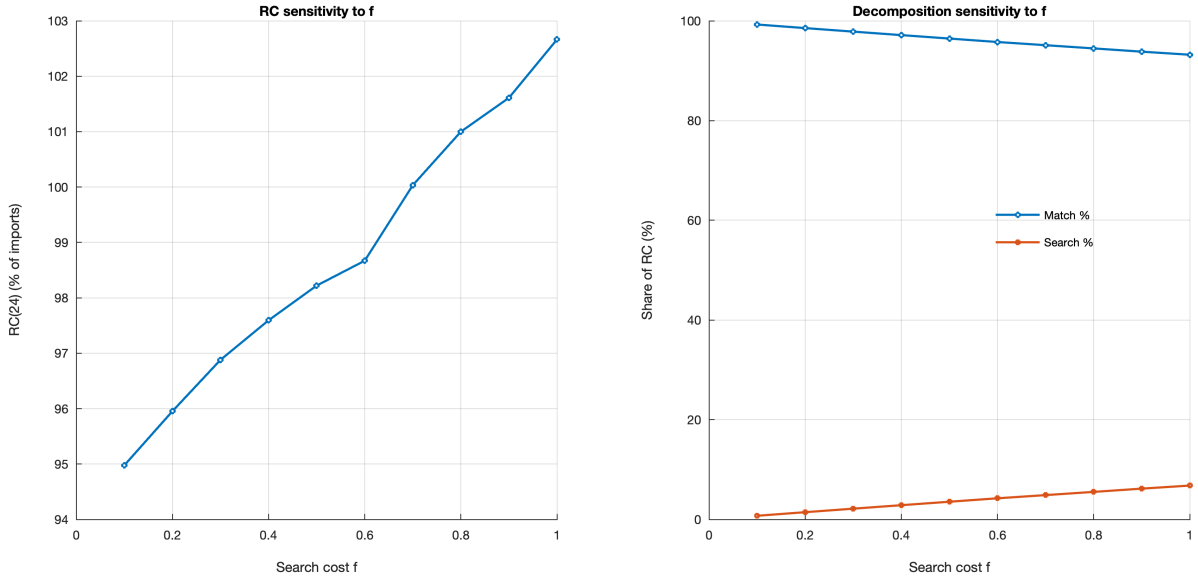


Figure 13: Sensitivity of Relationship Capital to the Calibrated Search Fee

Notes: Left panel: $RC(24)$ as a percentage of annual imports as the search fee f varies over $[0.1, 1.0]$. Right panel: the match-premium and search-cost shares of RC. A higher f raises both the level of relationship capital and the search-cost share, but the match premium remains the dominant component throughout.

A higher search fee raises both the level of relationship capital and the search-cost share of its decomposition, but the match premium remains the dominant component across the entire range, and $RC(24)$ stays close to a full year of annual import value. Since the formation-cost evidence of Das, Roberts, and Tybout (2007) points toward a higher search cost, the baseline calibration is, if anything, conservative about the magnitude of relationship capital.

A second robustness concern is how the April 2020 shock is mapped into the model. The baseline feeds the model the *full distribution* of product-level tariff changes within each origin, from the roughly half of Chinese products left untouched up to the fifty-percentage-point tail, computing the tariff-response regressions on the simulated panel exactly as in the data (indirect inference). A more conservative alternative summarizes each treated origin by a single representative tariff change. Because the high-tariff tail generates switching at a smaller per-point elasticity, the full-distribution baseline matches the differential tariff slope at a lower tariff sensitivity ($\hat{\beta}_\tau \approx 1.20$) than the single-tariff alternative ($\hat{\beta}_\tau \approx 2.2$), and implies a

correspondingly larger relationship capital. The two treatments bracket the estimate: $RC(24)$ lies between roughly 57% (single representative tariff) and 100% (full exposure distribution) of annual import value, with the match-premium share stable near 94% throughout. The baseline adopts the full-distribution figure as the more realistic mapping of the shock.

7.7 Product Heterogeneity

The baseline results pool all products within a given origin. However, relationship capital likely varies across product categories, because the sources of the replacement cost and the tenure surplus differ across input types. Which categories carry the most relationship capital is ultimately an empirical question: the by-category tariff response in Figure 5 already points to meaningful heterogeneity, and estimating the model separately by Broad Economic Category (BEC) would quantify it.

Capital goods (machinery, equipment, transport) involve high supplier specificity: qualification and certification processes are lengthy, production runs are customized to buyer specifications, and after-sales support creates ongoing dependence. These features raise the relationship-specific surplus, but the same specificity can also magnify the disruption from a tariff on a critical input, so the net effect on observed switching is ambiguous a priori.

Raw materials and intermediate inputs (metals, chemicals, textiles) are more standardized and substitutable across origins. Commodity-like inputs trade on well-defined quality grades, reducing the importance of relationship-specific knowledge. This tends to reduce relationship-specific value, but deep, liquid markets also make replacement cheaper, so the balance is again an empirical matter.

Consumer goods combine brand and quality-matching considerations, which build relationship-specific value, with typically wide supplier availability, and may be more or less tariff-elastic than intermediate inputs depending on demand conditions. The relative importance of the replacement cost versus tenure surplus may also differ: brand and quality matching may generate more of the tenure-dependent component, as importers learn over time which suppliers reliably meet consumer expectations.

Estimating the model separately by BEC category would resolve these ambiguities and reveal where relationship capital is concentrated in the economy, and the product-level estimates would aggregate to firm-level relationship capital reflecting each firm's import basket. I leave this by-category estimation to future work.

8 Discussion

8.1 Interpretation of Relationship Capital

The accumulated component of relationship-specific match capital (the part that builds with the duration of a relationship) can reflect several economic mechanisms: *quality verification*, as importers resolve uncertainty about a supplier through repeated transactions; *customization*, as suppliers adapt production to buyer specifications, improving fit and reducing adjustment costs; *relational contracting*, as trust accumulated through repeated interaction sustains informal agreements that would be impossible with new partners; and *logistical coordination*, as joint routines make the supply chain more efficient over time. What unites these mechanisms is that the resulting value is *relationship-specific*: it resides in the particular buyer–supplier pairing rather than in either party alone. That is precisely why severing the relationship destroys it: the buyer retains the abstract knowledge that the supplier was reliable, but not the co-built adaptation, which dissolves when the pairing ends and the supplier re-matches elsewhere, so re-forming requires rebuilding from scratch.

This interpretation implies that relationship-specific capital should be largest for differentiated, specification-intensive inputs and smallest for commodities, a prediction that estimating the model separately by product category would test directly, and one consistent with the steeper tenure profiles observed for more complex goods.

8.2 Policy Implications

The composition of relationship capital shapes the welfare effects of trade policy. First, because the bulk of relationship capital is accumulated match value rather than a one-time search cost, a tariff that induces a firm to abandon an established supplier destroys relationship-specific value built over years, not merely a replaceable transaction cost. Second, standard welfare calculations of tariff costs capture the static price effect but miss this destruction: a two-year relationship is worth close to a full year of its import value from that supplier, and this loss does not appear in conventional deadweight-loss accounting. Third, relationship capital is likely concentrated in the most specific, differentiated inputs, so uniform tariffs are disproportionately destructive there: a tariff on highly customized capital goods destroys more accumulated intangible capital per dollar of trade than the same tariff on substitutable commodities. Fourth, firms with prior experience sourcing from alternative origins face a lower effective cost of replacing a tariffed supplier, which provides a risk-management rationale for maintaining diversified sourcing even when concentration on a single low-cost origin appears optimal in the short run. Throughout, these magnitudes

are buyer-side private values, not welfare measures: translating them into welfare effects would require additional assumptions about supplier surplus, tariff revenue, pass-through, and general-equilibrium reallocation, which the single-agent model does not provide.

9 Conclusion

This paper develops a structural approach to measuring supplier relationship capital, a quantitatively important but largely unmeasured category of intangible assets. Embedding costly supplier search in a dynamic discrete choice model and estimating it on Turkish customs microdata, using the April 2020 tariff shock as exogenous cost variation, I measure the value of an established supplier relationship and decompose it into the incumbent match premium and the cost of replacing the relationship through search. I estimate that a two-year supplier relationship is worth close to a full year of its import value once the full distribution of tariff exposure is accounted for (roughly 57% under a single representative tariff), of which about 94% is the incumbent match premium: the value of preserving a known, established match rather than re-drawing a fresh supplier. The differential response of relationship termination to the tariff across tenure, with young relationships breaking readily while mature ones resist, identifies this capital separately from the direct cost of the tariff.

This magnitude places supplier relationships alongside brand and organizational capital as a first-order intangible asset, and it carries a direct implication for trade policy: conventional welfare calculations capture the static price effects of tariffs but miss the destruction of accumulated relationship capital, which is not reversed when the tariff is removed. Beyond the headline value, the framework quantifies the tariff thresholds at which firms of different relationship ages sever links, the option value of maintaining backup suppliers, and the aggregate relationship capital a shock destroys; it extends naturally to heterogeneity across product categories, where relationship capital is likely concentrated in the most specific, differentiated inputs. By recovering the magnitude and composition of an intangible asset that firms build but balance sheets do not record, the framework provides a tool for evaluating the dynamic costs of trade policy and supply-chain disruptions.

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A Production Structure and Separability

A key modeling choice is to treat the supplier decision for each input independently and to abstract from the firm's quantity and pricing decisions. This appendix provides the micro-foundation for these simplifications, following Monarch (2022).

CES demand and constant-markup pricing. Firm m produces a differentiated final good and faces CES demand:

$$Q^m = B_t (p^m)^{-\sigma} \tag{A.1}$$

where B_t is a demand shifter common to all firms and $\sigma > 1$ is the elasticity of substitution. Under CES demand, the optimal price is a constant markup over marginal cost: $p^m = \frac{\sigma}{\sigma-1} MC^m$. Substituting back into the profit function yields:

$$\pi_t^m = \frac{1}{\sigma} B_t \left(\frac{\sigma}{\sigma - 1} \right)^{1-\sigma} (MC^m(X_t^m))^{1-\sigma} \tag{A.2}$$

where $X_t^m = (x_{1,t}^m, \ldots, x_{J,t}^m)$ is the vector of supplier origins chosen by the firm for its J imported inputs. Because the markup is constant, quantity and final-good price are pinned down once marginal cost is determined. The firm's only strategic choice is which suppliers minimize MC^m; no separate quantity or pricing decision enters the supplier-choice problem.

Cobb-Douglas technology and multiplicative cost. The firm produces using labor and J imported inputs with Cobb-Douglas technology:

$$Q^m = \varphi^m \cdot (L^m)^{\alpha} \left[\prod_{j=1}^{J} (I_j^m)^{\gamma_j} \right]^{1-\alpha}, \qquad \sum_{j=1}^{J} \gamma_j = 1 \tag{A.3}$$

where φ^m is firm-level TFP and γ_j is input j's cost share within the intermediate bundle. Standard cost minimization yields a unit cost function that is *multiplicative* across inputs:

$$MC^m(X_t^m) = \frac{1}{\varphi^m} \, w^{\alpha} \left[\prod_{j=1}^{J} \left(\bar{p}_{x_j^m, j}^m \right)^{\gamma_j} \right]^{1-\alpha} \tag{A.4}$$

where $\bar{p}_{x_j^m, j}^m$ is the effective price of input j from origin x_j^m (inclusive of tariffs).

Separability of supplier choices across inputs. Combining equations (A.2) and (A.4) and taking logarithms:

$$\ln \pi_t^m = \underbrace{\ln A_t^m + (\sigma - 1) \ln \varphi^m}_{\text{does not depend on } x_j} + \sum_{j=1}^{J} \underbrace{(1-\alpha)(1-\sigma)\gamma_j \ln \bar{p}^m_{x_j^m, j}}_{\text{depends only on input } j\text{'s supplier}} \tag{A.5}$$

where A_t^m collects demand, markup, and wage terms common across inputs. This additive decomposition is the key result: choosing a cheaper or higher-quality supplier for input j affects profits by a fixed proportion, regardless of what the firm does for any other input $k \neq j$. Consequently, the profit-maximizing supplier choice for each input is independent, and we can estimate the model one input at a time. Each importer-product pair (m, j) is a separate dynamic discrete choice problem.

B Properties of the Dynamic Program

Notation. I state and prove the properties for the single-component formulation (relationship state (x, z) with maturation $g(z) = (1-\kappa)z + \kappa\bar{z}$) for notational economy. They extend *verbatim* to the additive baseline of the main text, where the state is (x, z_0, r) with z_0 a fixed coordinate and r maturing by $g(r) = (1-\kappa)r + \kappa\bar{r}$: every argument below (bounded reward, monotone interpolation, exponential draw, threshold acceptance, contraction) applies with $z \mapsto (z_0, r)$ and $g(z) \mapsto g(r)$. Exogenous separation $s \in [0, 1)$ enters the stay value (5.4) as a δ-weighted convex combination of bounded continuation values and so preserves the contraction. Concretely, in the additive model the accepted-match value is $W(x', z_0') = u(x', z_0', \tau_{x'}) + \delta\Big[(1-s)\bar{V}(x', z_0', g(0)) + s\bar{V}^{\text{reset}}(x')\Big]$ and the reservation threshold is $z_0^\star(x, z_0, r; x')$; the lemmas below are written for the scalar representative z, with the understanding that W and the threshold carry these arguments.

Fix the parameters and a tariff vector $\boldsymbol{\tau}$. After discretization the state space is the finite set $\mathcal{S} = \{(x, z) : x \in \mathcal{X},\ z \in \{z_1, \ldots, z_N\}\}$, $|\mathcal{S}| = XN$, and $B(\mathcal{S})$ denotes the bounded real functions on $\mathcal{S}$ under the sup norm $\|V\|_\infty = \max_s |V(s)|$, a complete metric space. The fresh draw is $z' \sim \text{Exp}(\theta)$ truncated to $[0, \bar{z}]$. Linear interpolation onto the grid is written $\mathcal{I}$; it is a

linear operator that is *monotone* ($V \le V' \Rightarrow \mathcal{I}V \le \mathcal{I}V'$ pointwise) and *reproduces constants* ($\mathcal{I}(V + c\mathbf{1}) = \mathcal{I}V + c$). Define the choice-specific value maps, for $V \in B(\mathcal{S})$,

$$\begin{aligned} v_{\text{stay}}(x, z; V) &= u(x, z, \tau_x) + \delta\,(\mathcal{I}V)\Big(x, g(z)\Big), \qquad g(z) = (1-\kappa)z + \kappa\bar{z}, \\ W(x', z'; V) &= u(x', z', \tau_{x'}) + \delta\,(\mathcal{I}V)\Big(x', g(z')\Big), \\ v_{\text{srch}}(x, z, x'; V) &= -f + \mathbb{E}_{z'}\Big[\max\{v_{\text{stay}}(x, z; V),\, W(x', z'; V)\}\Big], \end{aligned}$$

and the Bellman operator $T : B(\mathcal{S}) \to B(\mathcal{S})$,

$$(TV)(x, z) = \log\Big(e^{\,v_{\text{stay}}(x,z;V)} + \textstyle\sum_{x' \neq x} e^{\,v_{\text{srch}}(x,z,x';V)}\Big). \tag{B.1}$$

(The additive Euler constant γ_E of the log-sum shifts every value by $\gamma_E/(1-\delta)$ and cancels in all choice probabilities and in every relationship-capital difference; I omit it, matching the code.) Because u is bounded on the finite grid and V is bounded, each $v_{\text{stay}}, v_{\text{srch}}$ is finite and T maps $B(\mathcal{S})$ into itself.

B.1 The exponential change of variable

Lemma B.1. *If $a \sim G(a) = a^\theta$ on $(0, 1]$ with $\theta > 1$ and $z \equiv -\ln a$, then $z \sim \text{Exp}(\theta)$, with density $\theta e^{-\theta z}$ on $[0, \infty)$ and mean $1/\theta$. Restricting the draw to the model's support $[0, \bar{z}]$ yields the truncated exponential with density $\theta e^{-\theta z}/(1 - e^{-\theta\bar{z}})$ on $[0, \bar{z}]$ and survival function $\Pr(z' \ge t) = (e^{-\theta t} - e^{-\theta\bar{z}})/(1 - e^{-\theta\bar{z}})$.*

Proof. For $v \ge 0$, $\Pr(z \le v) = \Pr(-\ln a \le v) = \Pr(a \ge e^{-v}) = 1 - G(e^{-v}) = 1 - (e^{-v})^\theta = 1 - e^{-\theta v}$, the $\text{Exp}(\theta)$ cdf; differentiate for the density, and the mean of $\text{Exp}(\theta)$ is $1/\theta$. Conditioning on $\{z \le \bar{z}\}$ divides the density by $\Pr(z \le \bar{z}) = 1 - e^{-\theta\bar{z}}$, giving the truncated density and, by integration, the stated survival function. □

B.2 Existence, uniqueness, and convergence of VFI

Proposition B.2 (Contraction)**.** *T in* (B.1) *is a contraction on $\Big(B(\mathcal{S}), \|\cdot\|_\infty\Big)$ with modulus δ. It therefore has a unique fixed point $\bar{V}$, and value function iteration $V^{(k+1)} = TV^{(k)}$ converges to it from any start, with $\|V^{(k)} - \bar{V}\|_\infty \le \delta^k \|V^{(0)} - \bar{V}\|_\infty$.*

Proof. I verify Blackwell's sufficient conditions. *(i) Monotonicity.* If $V \le V'$ then $\mathcal{I}V \le \mathcal{I}V'$ (monotone interpolation), so $v_{\text{stay}}(\cdot; V) \le v_{\text{stay}}(\cdot; V')$ and $W(\cdot; V) \le W(\cdot; V')$; the pointwise maximum, its expectation, and the $\log\sum\exp$ in (B.1) are each coordinatewise nondecreasing,

hence $TV \le TV'$. *(ii) Discounting.* For a constant $c \ge 0$, $\mathcal{I}(V + c\mathbf{1}) = \mathcal{I}V + c$, so $v_{\text{stay}}(\cdot; V + c\mathbf{1}) = v_{\text{stay}}(\cdot; V) + \delta c$ and likewise W and (through the max and expectation) v_{srch} increase by exactly δc. Since $\log(\sum_i e^{a_i+\delta c}) = \delta c + \log(\sum_i e^{a_i})$, we get $T(V + c\mathbf{1}) = TV + \delta c\,\mathbf{1}$. By Blackwell's theorem $\|TV - TV'\|_\infty \le \delta\|V - V'\|_\infty$. As $\delta < 1$ and $B(\mathcal{S})$ is complete, the Banach fixed-point theorem gives a unique $\bar{V}$ and the stated geometric convergence. □

B.3 Monotonicity in match quality

Lemma B.3 (Monotonicity)**.** *The fixed point $\bar{V}(x, \cdot)$ is strictly increasing in z for every origin x.*

*Proof.*Let $\mathcal{M} \subset B(\mathcal{S})$ be the closed cone of functions nondecreasing in z within each origin. I show $T(\mathcal{M}) \subseteq \mathcal{M}$. Take $V \in \mathcal{M}$. Then g is increasing and $\mathcal{I}V(x, \cdot)$ is nondecreasing, so $z \mapsto v_{\text{stay}}(x, z; V) = u(x, z, \tau_x) + \delta\mathcal{I}V(x, g(z))$ is nondecreasing (u is increasing in z with unit slope). The term $W(x', z'; V)$ does not depend on the incumbent z, so $z \mapsto v_{\text{srch}}(x, z, x'; V) = -f + \mathbb{E}_{z'} \max\{v_{\text{stay}}(x, z; V), W(x', z'; V)\}$ is nondecreasing (the max is nondecreasing in its first argument and expectation preserves the order). Finally log$\sum$exp is coordinatewise nondecreasing, so $TV(x, \cdot)$ is nondecreasing: $T(\mathcal{M}) \subseteq \mathcal{M}$. Starting VFI at $V^{(0)} = 0 \in \mathcal{M}$ keeps every iterate in $\mathcal{M}$, and $\mathcal{M}$ is closed, so the limit $\bar{V} \in \mathcal{M}$. Strictness: $u(x, z, \tau_x) = \alpha_x + z - \beta_\tau \ln(1 + \tau_x)$ has slope 1 in z and enters v_{stay} undiscounted, so v_{stay} is strictly increasing; hence so is $TV(x, \cdot)$ and its fixed point. □

B.4 Reservation threshold and closed-form acceptance

Proposition B.4 (Reservation rule)**.** *For each state (x, z) and target $x' \neq x$, the optimal accept/reject policy is a threshold: there is a reservation $z^\star(x, z; x')$ such that the firm accepts the draw iff $z' \ge z^\star$, where $z^\star$ uniquely solves $W(x', z^\star; \bar{V}) = v_{stay}(x, z; \bar{V})$ when an interior solution exists (otherwise $z^\star \in \{0, \bar{z}\}$). Under the truncated draw the acceptance probability is closed-form,*

$$\Pr(\textit{accept} \mid \textit{search } x') = \Pr(z' \ge z^\star) = \begin{cases} 1, & z^\star \le 0, \\ \dfrac{e^{-\theta z^\star} - e^{-\theta \bar{z}}}{1 - e^{-\theta \bar{z}}}, & 0 < z^\star < \bar{z}, \\ 0, & z^\star \ge \bar{z}. \end{cases} \tag{B.2}$$

Proof.$W(x', z'; \bar{V}) = u(x', z', \tau_{x'}) + \delta\,\bar{V}(x', g(z'))$ is strictly increasing and continuous in z' (u strictly increasing in z'; $\bar{V}(x', \cdot)$ increasing by Lemma B.3 and g increasing). The firm

accepts iff $W(x', z'; \bar{V}) \geq v_{\text{stay}}(x, z; \bar{V})$, a right ray $\{z' \geq z^\star\}$ by monotonicity, with $z^\star$ the unique crossing point when interior. The acceptance probability is the truncated survival $\int_{z^\star}^{\bar{z}} \theta e^{-\theta z'}/(1 - e^{-\theta \bar{z}})\, dz' = (e^{-\theta z^\star} - e^{-\theta \bar{z}})/(1 - e^{-\theta \bar{z}})$ by Lemma B.1, with the boundary values at $z^\star \leq 0$ and $z^\star \geq \bar{z}$. □

A numerical check at the estimates confirms the construction: $\max |W(x', z^\star) - v_{\text{stay}}| = 5.7 \times 10^{-14}$ over all interior thresholds, and $\bar{V}(x, \cdot)$ is strictly increasing in z (minimum grid slope $7.1 \times 10^{-3} > 0$), consistent with Lemma B.3.

B.5 Shape of the tenure surplus

Lemma B.5 (Tenure surplus)**.** *With $\kappa \in (0, 1)$, the tenure surplus $s(T) = \bar{r}\big(1 - (1 - \kappa)^T\big)$ satisfies $s(0) = 0$, is strictly increasing and strictly concave in T, and converges to the finite ceiling $\bar{r}$.*

*Proof.*Treat $T \geq 0$ as continuous. Then $s'(T) = -\bar{r}(1 - \kappa)^T \ln(1 - \kappa) > 0$ since $\ln(1 - \kappa) < 0$, and $s''(T) = -\bar{r}(1 - \kappa)^T \big(\ln(1 - \kappa)\big)^2 < 0$. As $T \to \infty$, $(1 - \kappa)^T \to 0$, so $s(T) \to \bar{r}$. □

B.6 Relationship-capital decomposition

Proposition B.6 (RC decomposition)**.** *Let $x^* = \arg\max_x \mathbb{E}_{z'} \bar{V}(x, z')$ and $\bar{V}(\emptyset) = -f + \mathbb{E}_{z'} \bar{V}(x^*, z')$. Then for every (x, z),*

$$RC(x, z) = \underbrace{\Big[f - \big(\mathbb{E}_{z'} \bar{V}(x^*, z') - \mathbb{E}_{z'} \bar{V}(x, z')\big)\Big]}_{SC(x)\ \textit{(search/replacement)}} + \underbrace{\Big[\bar{V}(x, z) - \mathbb{E}_{z'} \bar{V}(x, z')\Big]}_{MP(x,z)\ \textit{(match premium)}}. \tag{B.3}$$

Moreover $SC(x) \leq f$ with equality iff $x = x^*$, and $MP(x, z)$ is increasing in z with $MP \geq 0$ iff $\bar{V}(x, z) \geq \mathbb{E}_{z'} \bar{V}(x, z')$.

*Proof.*Add and subtract $\mathbb{E}_{z'} \bar{V}(x, z')$ in $RC = \bar{V}(x, z) - \bar{V}(\emptyset)$: $RC = [\bar{V}(x, z) - \mathbb{E}_{z'} \bar{V}(x, z')] + [\mathbb{E}_{z'} \bar{V}(x, z') - \bar{V}(\emptyset)]$. The second bracket equals $\mathbb{E}_{z'} \bar{V}(x, z') - (-f + \mathbb{E}_{z'} \bar{V}(x^*, z')) = f - (\mathbb{E}_{z'} \bar{V}(x^*, z') - \mathbb{E}_{z'} \bar{V}(x, z')) = SC(x)$. Since x^* maximizes $\mathbb{E}_{z'} \bar{V}(\cdot, z')$ the parenthesized gap is ≥ 0, so $SC(x) \leq f$, with equality iff $x = x^*$. Monotonicity of MP in z follows from Lemma B.3. □

Two consequences used in the text. First, SC does not depend on z and equals exactly the calibrated f at the modal origin, so the decomposition's split between replacement cost and

match premium is governed by f relative to MP, hence reported with a sensitivity band over f. Second, MP carries all the z- (tenure-) dependence and is the model's intangible asset.

B.7 Nesting the reduced form

Proposition B.7 (Nesting). *Take $\theta \to \infty$ and $\bar{z} \to 0$, so that match quality is degenerate at $z \equiv 0$ and the draw is a point mass at 0, and set $f = \beta_X$. Then*

$$v_{stay}(x) = \alpha_x - \beta_\tau \ln(1+\tau_x) + \delta \bar{V}(x,0), \quad v_{srch}(x,x') = -\beta_X + \max\{v_{stay}(x),\, W(x',0)\}. \tag{B.4}$$

On the set of targets with $W(x',0) \geq v_{stay}(x)$, $v_{srch}(x,x') = \alpha_{x'} - \beta_\tau \ln(1+\tau_{x'}) - \beta_X + \delta \bar{V}(x',0)$, and the conditional choice probabilities over $\{stay\} \cup \{search\ x'\}$ coincide with a reduced-form multinomial logit over origins with switching cost β_X and no tenure surplus. Off that set ($W(x',0) < v_{stay}(x)$) the search option retains the rejection floor $v_{srch} = -\beta_X + v_{stay}(x) > -\beta_X + W(x',0)$, so the microfoundation places strictly more probability on the search option than the reduced form places on the corresponding switch. The two models coincide exactly iff no targeted alternative is value-reducing.

Proof. As $\bar{z} \to 0$ the grid collapses to $z = 0$, so $g(0) = 0$ and match quality is constant; as $\theta \to \infty$ the draw $z' \sim \text{Exp}(\theta)$ concentrates at 0, so $\mathbb{E}_{z'} \max\{v_{\text{stay}}, W(x',z')\} = \max\{v_{\text{stay}}(x), W(x',0)\}$. Substituting $f = \beta_X$ gives the displayed values. On $\{W(x',0) \geq v_{\text{stay}}(x)\}$ the maximum equals $W(x',0) = \alpha_{x'} - \beta_\tau \ln(1+\tau_{x'}) + \delta \bar{V}(x',0)$, so $v_{\text{srch}}(x,x')$ is the reduced-form value of switching to x' at cost β_X, while $v_{\text{stay}}(x)$ is the reduced-form value of staying with no tenure surplus; identical choice-specific values imply identical logit CCPs. Off that set the maximum equals $v_{\text{stay}}(x)$, giving the stated floor, which strictly exceeds the reduced-form switch value $-\beta_X + W(x',0)$; hence the CCPs differ. Equality for all targets holds iff $W(x',0) \geq v_{\text{stay}}(x)$ for every x'. □

C Supplementary Figures and Tables

This appendix collects reduced-form evidence and a model object that support, but are not central to, the main results: the pass-through of the tariff into duties paid (Figure 15), firms' substitution toward domestic suppliers (Figure 16), summary statistics for the reduced-form figures (Table 15), the cross-origin distribution of tariff exposure (Figure 14), and the estimated value function (Figure 17).

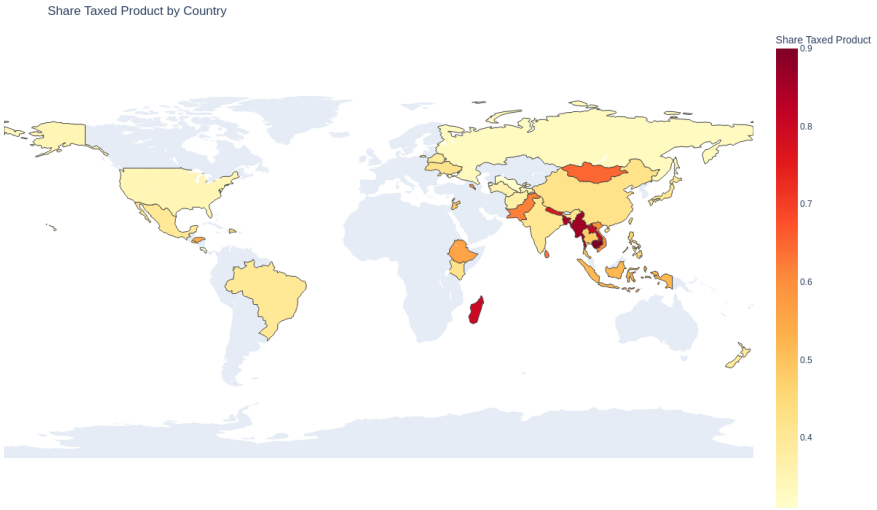
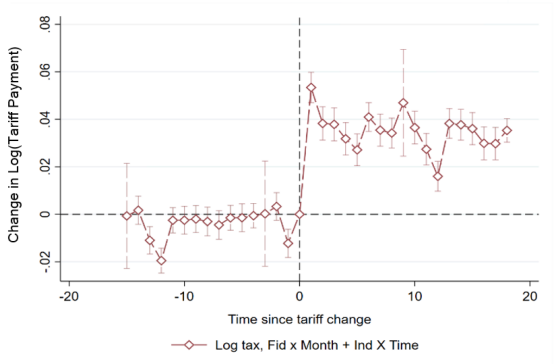


Figure 14: Tariff Exposure by Origin: Share of Product Lines Treated

Notes: Share of each origin country's exported product lines subject to the April 2020 Turkish additional tariff. Exposure is highly heterogeneous across origins: roughly half of Chinese product lines are treated (up to the 50-percentage-point ceiling), while the United States and Russia face narrower exposure and EU origins are exempt through the Customs Union. This cross-origin and within-origin variation is what the multi-product (full-distribution) specification exploits.



Notes: The estimated specification is:

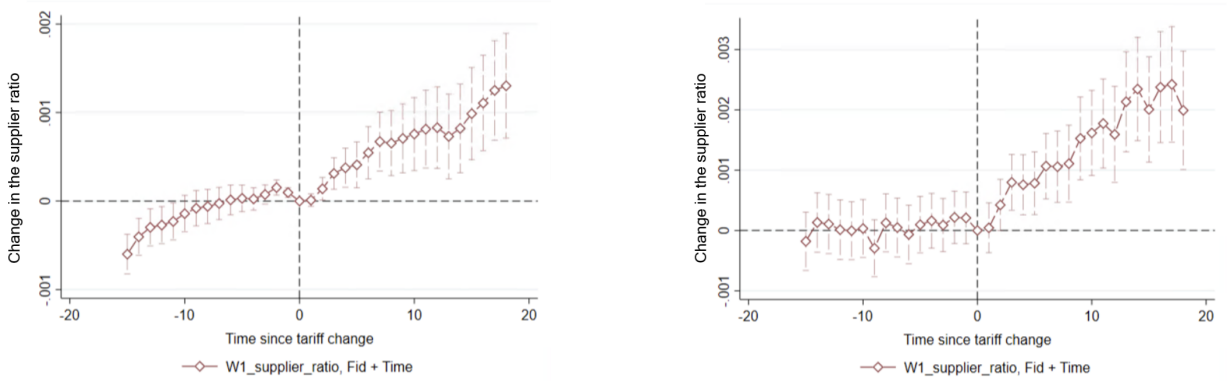
$$\log(\text{Tariff Payments}_{i,t}) = \sum_{k=-15}^{k=+18} \beta_k \text{ Firm Tariff }_i \times \mathbf{1}_{t=k} + \delta_{j,t} + \alpha_{i,m}$$

where i indexes firms, j indexes sectors, and t indexes months relative to April 2020. $\delta_{j,t}$ are sector-time fixed effects and $\alpha_{i,m}$ are firm-calendar month fixed effects.

Figure 15: Effect of Tariff Exposure on Log Tariff Payments

When relationships break, importers partially substitute toward domestic suppliers. Figure 16 shows that a 5 percentage point increase in tariff exposure raises the domestic supplier ratio

by 0.01 (relative to a mean of 1.10) and increases the cumulative number of domestic suppliers by approximately 0.6, implying that firms add about one new domestic supplier for every 10 percentage point increase in the import tariff.



Balanced Sample Unbalanced Sample

Notes: Table 15 provides summary statistics. For any firm j and periods $i =$ 01-2018 through 12-2021, the measures are defined as:

$$\text{Cumulative \# of Suppliers}_t = \sum_{i=1}^{t} \text{\# of Unique Suppliers}_i$$

$$\text{Supplier Ratio}_t = \frac{\text{Cumulative \# of Suppliers}_t}{\text{Cumulative \# of Suppliers}_{t=\text{04-2020}}}$$

Figure 16: Number of Domestic Suppliers as a Cumulative Ratio

Table 15: Summary Statistics for Reduced-Form Figures

	N	Mean	SD	Median	p75
Panel A: Tariff Exposure (Figure 6)					
Impacted Import Share (%)	850,949	21.1	36.3	0.0	25.0
Firm Tariff (%)	850,949	4.34	7.55	0.66	5.16
Firm Tariff, Conditional on > 0 (%)	663,560	5.56	8.14	1.78	7.48
Panel B: Domestic Sourcing (Figure 16)					
Supplier Ratio	2,107,864	1.10	0.53	1.00	1.35
Cumulative No. of Suppliers	2,115,446	66.09	137.83	30	73
Cumulative No. of Suppliers (at April 2020)	2,115,446	61.56	121.94	30	69
Firm Tariff (%)	2,114,640	5.13	8.94	0.35	6.40
Firm Tariff, Conditional on > 0 (%)	1,357,236	7.99	10.08	3.47	11.68
Import Intensity	2,114,640	0.29	0.29	0.17	0.49
Domestic Purchases Ratio	2,114,640	1.12	1.34	0.80	1.35

Notes: Panel A reports distributional statistics for the tariff exposure variables used in Figure 6. Panel B reports statistics for the domestic sourcing variables used in Figure 16. Supplier ratio is the cumulative number of unique domestic suppliers normalized by its April 2020 value. Import intensity is the share of imported intermediates in total intermediate purchases.

Figure 17 displays the estimated value function $V(x, T)$ across origins and tenure levels. First, value increases with tenure for all origins, reflecting the accumulated tenure surplus. Second, origins with lower tariffs (e.g., Germany, pre-shock China) have higher values. Third, the value function is relatively flat across high tenure levels, as the calibrated logarithmic specification implies diminishing returns to additional tenure.

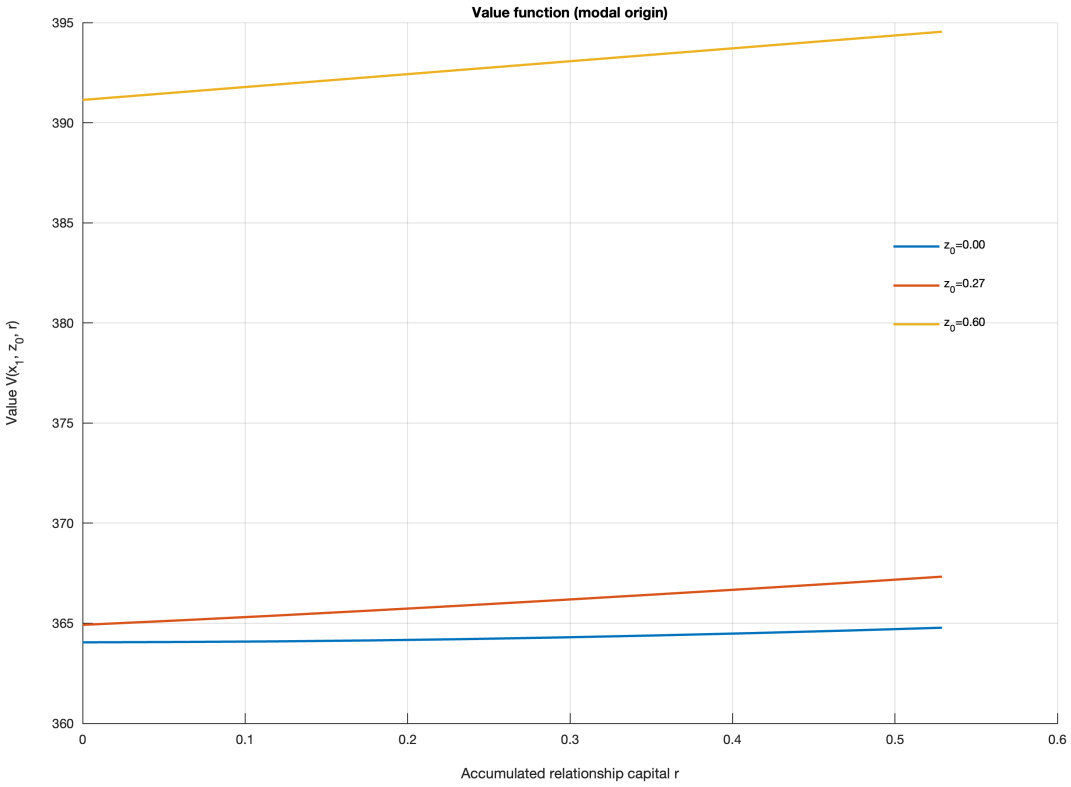


Figure 17: Estimated Value Function

Notes: The figure shows the value function $V(x, T)$ as a function of current supplier origin x and relationship tenure T. Higher values indicate more valuable states. Germany (Origin 2) has the highest value due to its tariff exemption through the EU Customs Union; nonetheless, firms with high-tenure China relationships may optimally stay due to accumulated surplus and switching costs. Value increases with tenure across all origins.