Pass-through Beyond the Border: Oligopoly, Networks, and Tariffs*

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Abstract

We develop a multisector open-economy framework that maps border price shocks into US producer and consumer prices through imported inputs, domestic production networks, and competition with foreign suppliers. The framework accommodates pass-through in either levels or logs and maps directly to public data on input-output linkages, trade, and prices. We apply it to the 2025 US tariffs. Allowing firms to respond to the prices of competing imported varieties substantially improves the model's fit to producer prices, and the resulting model is also consistent with the consumer-price response. Aggregating the estimated price effects across the full consumption basket, the January–October 2025 tariff increases imply a first-order contribution of 0.91 percentage points to headline PCE inflation, including 0.10 percentage points from the foreign-competition channel.

Keywords: Tariffs, inflation, import prices, indirect imports
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1 Introduction

Foreign goods enter the domestic economy as final consumption goods purchased by consumers, as intermediate inputs that propagate through the production network, and as competitors whose prices shape the pricing decisions of domestic firms. We build a framework that tracks these forces jointly, and we apply it to the 2025 U.S. tariffs.

We build a multisector open-economy model with oligopolistically competitive retailers and intermediate-goods producers. The model incorporates marginal-cost pass-through in levels, propagation through production networks, and the response of domestic firms to changes in the prices of their foreign competitors. These correlated mechanisms offer an explanation for the wide range of estimates in the literature on the pass-through into domestic producer and consumer prices. By making such mechanisms explicit, we can jointly identify their importance using industry-level price data.

Our framework also delivers a comprehensive mapping from border price changes to domestic producer and consumer prices. We construct model-implied price responses for virtually all PPI and PCE categories, tracing foreign price shocks through imported inputs, domestic production linkages, competition, and final consumption. This broad coverage is useful for two reasons. First, it improves identification by providing a large amount of observations with high variation in the underlying predicted pass-through. Second, all sectors' price responses aggregate directly into a partial-equilibrium contribution to consumer-price inflation.

The model is based on an assignment problem with discrete firm choice, which implies pass-through in levels but also allows us to easily compare it with an assumption of pass-through in logs. Firms and retailers choose prices under Bertrand competition, thus allowing foreign prices to affect domestic companies both via marginal costs and via their reference price. We derive a first-order industry-level mapping from foreign price shocks to domestic producer prices that depends on three objects: a markup/pass-through term, an oligopolistic competition term, and a network amplification term. A more general version of the model with terms summarizing firm-level correlations between marginal cost exposure and firm level pass-through is also derived in the Appendix and tested in the empirical section.

Why do we include oligopolistic competition, production networks, and different pass-through assumptions in the same framework? All these channels are highly correlated to each other and inherently amplify border price effects into the domestic economy. Neglecting any of them distorts the estimated contributions of the others. For instance, Sangani (2026) shows how partial marginal cost pass-through estimates in logs are often in line with estimates of full pass-through in levels. At the same time, marginal cost changes are amplified when sectors are inter-connected. When bringing the model to the data we want to understand whether observed prices align to model-implied prices because marginal costs are high, because pass-through is high, or because competition is low.

The model delivers a first-order closed-form solution that maps exactly to available public data. Relative prices in the PCE index are a function of concorded imported final goods and domestic final goods, correctly scaled by distribution margins. In turn, domestic final goods are a function of (unobserved but estimable) industry-level pass-through forces which regulate how much each industry is sensitive to its own marginal costs or the price of its competitors. Both forces are then recursively amplified by the domestic network structure of production.

Taking the model to the data requires several concordance steps between different classification systems, which we consider a contribution in its own right. We move from the legal tariff schedule at the HS-10-by-country-of-origin level, to duties actually collected at the border, to BEA Detail commodities, to 273 PPI series, and then through the PCE bridge to all NIPA expenditure categories, carrying regional-industry input-output linkages and the distribution margin that separates producer from purchaser prices. The full mapping is reproducible with public data from the BEA input-output accounts and Trade in Value Added dataset (TiVA), Census trade records, and BLS price indices.

We then apply the model to the 2025-26 US tariff episode. First, we verify that tariffs were fully passed-through to US border prices, a fact already established by several other papers (Fajgelbaum and Khandelwal, 2026; Gopinath and Neiman, 2026; Amiti et al., 2026). We can thus treat the (instrumented) observed tariff change as the model's foreign price shock in every step that follows.

We then estimate the price response horizon by horizon, using local projections (Jordà, 2005) in a difference-in-differences design following Dube et al. (2025), with item and date fixed effects so that identification comes from cross-sectional differences in model-implied exposure. Because the regressor is a predicted price change rather than a tariff rate, its long-run coefficient is a test of the model: a value of one implies that observed prices moved by the amount the model predicts.

Our central result is a sequence of tests where a model-implied relative price response is compared to observed relative price movements. When we consider producer prices in 2025, a version of the model in which a tariff reaches domestic firms only through their own costs delivers a model pass-through of 2.946, meaning that observed price variation moves three times as much as model implied prices. Adding propagation through the domestic input-output network lowers the coefficient to 2.314. When we allow the same tariff to raise the price of the imported varieties that domestic firms compete against, the coefficient further lowers to 1.173. Carrying this estimate to consumer prices delivers a pass-through of 0.929. In short, we find evidence of full pass-through of our model-implied price increases, once we account for network amplification and competition effects. We cannot significantly distinguish between a model with log pass-through versus a model with full pass-through in levels.

We discipline the competition channel by estimating a common conditional pass-through parameter using a generalized methods of moments (GMM) estimator. The estimator requires the model to match both the scale of the producer-price long-term response and its cross-sectional shape. During the 2025 tariff episode, this yields a partial pass-through sensitivity to marginal cost of 0.655, which implies a (significant) sensitivity to competitor prices of $1 - 0.655 = 0.345$. The estimate is also robust to allowing for within-industry covariance between firms' import exposure and their pass-through, or changing the pass-through assumption from levels to logs. Applying the same model to the 2018–19 tariff episode provides similar results, that is a partial sensitivity to competitor prices of 0.303.

Because the model maps the tariff schedule into the full PCE expenditure system, the same category-level objects used to estimate pass-through also aggregate into a first-order contribution to aggregate PCE inflation when weighted using expenditure weights. Cumulated over the February to October 2025 tariff escalation window, the three channels sum to 0.91 percentage points of headline PCE, of which the network-adjusted competition increment contributes 0.1. The network adjustment of marginal costs and competition forces adds a total of 0.2 p.p. under a scenario of pass-through in levels, and 0.4 p.p. under pass-through in logs. Although this exercise is in first-order partial-equilibrium, its advantage is that it only requires knowledge of one estimated production-side parameter, one estimated pass-through coefficient, and observed weights.

In the final part of the paper, we show how we can further decompose the aggregate contribution of the tariff shock to headline PCE along a number of dimensions. Specifically, we decompose the 2025 tariff impact according to the tariff round, the tariffed commodities, the sourcing countries, and consumption categories. In calculating especially this last decomposition, our framework allows us to deal with the fact that the products and countries on which tariffs are imposed do not coincide with the consumption categories in which their effects are ultimately recorded. Imported inputs, production networks, and distribution margins can all alter this decomposition. Quantitatively, the decomposition uncovers a number of facts. We find tariff effects were temporally concentrated between March and May 2025 (0.6 p.p), and China accounted for two fifths of the aggregate contribution between January and October 2025. Additionally, price increases were concentrated in certain commodities such as electrical machinery and vehicles and in particular expenditure categories such as new motor vehicles, garments and furniture.

Our contribution is therefore threefold. First, we provide a unified mapping from the legal tariff schedule into border prices and then into the full consumption basket accounting for both domestic production networks and the presence of oligopolistic domestic pricing. Second, we estimate and test that mapping dynamically in producer and then consumer prices. Finally, we combine the estimated mapping together with observed expenditure weights to decompose the contribution of a tariff schedule to observed aggregate PCE inflation.

Related Literature. Our paper contributes to three strands of research.

The first is the empirical literature on tariff pass-through. A large body of work studies the 2018–19 US tariff episode. Amiti, Redding and Weinstein (2019), Fajgelbaum et al. (2020), and Cavallo et al. (2021) find that the tariffs were largely passed through to US import prices at the border, with limited absorption by foreign exporters, and our border estimates reproduce that finding for 2025. A related set of papers studies how these border-price increases affected downstream domestic prices. Cavallo et al. (2021) trace tariff effects into retail prices for selected product categories, and Flaaen and Pierce (2024) estimate pass-through to producer prices in manufacturing. More recent work studies the 2025 episode. Minton and Somale (2025) and Minton, Ray and Somale (2026) develop real-time methods for detecting tariff effects in consumer prices using public data. Cavallo, Llamas and Vazquez (2025) use high-frequency retail microdata matched to product-level tariff rates and countries of origin to measure short-run retail-price effects. Hacıoğlu-Hoke, Malladi and Feler (2026) document the gradual retail-price response using item-level spending data and information on countries of production. Amiti et al. (2026) study the incidence of the 2025 tariffs at the border, and Fajgelbaum and Khandelwal (2026) and Gopinath and Neiman (2026) analyze the broader short-run effects and incidence of the recent tariff increases.

Relative to this literature, our contribution is to provide a framework that clarifies which downstream price response is being estimated. A tariff can affect consumer prices through imported final goods, through imported intermediate inputs, through domestic input-output propagation, and through the pricing response of domestic competitors. Empirical designs that include different subsets of these channels need not estimate the same object. Our framework maps tariff shocks from product-country cells to producer industries and PCE expenditure categories, separates final-import from domestic-production exposure, and then asks which additional pricing channels are needed to reconcile the model-implied price response with observed PPI and PCE price changes.

The consumer-price mapping builds on Barbiero and Stein (2025), which introduced an input-output-based mapping from border-price shocks to the PCE consumption basket, alongside related early work by Minton and Somale (2025). We extend that approach from an accounting exercise to a framework in which the same mapping is used to identify pass-through, production-network propagation, and oligopolistic responses to observed tariff shocks.

Subsequent work has developed complementary approaches to measuring the consumer-price effects of the 2025 tariffs. Minton, Ray and Somale (2026) extend the real-time PCE approach of Minton and Somale (2025), while Amiti, Heise and Weinstein (2026) estimate direct-import, imported-input, and strategic-complementarity channels using matched import, producer-price, and CPI data. That paper is the closest to ours in the set of channels it considers, and our object and empirical design differ from it in several respects. We propagate imported-input shocks through the domestic input-output network. We estimate dynamic pass-through with a local-projection difference-in-differences design and we estimate a model-consistent parameter that regulates marginal cost and competitors' price pass-through via GMM. Our PCE mapping spans the consumption basket, allowing the cross-sectional categories used for identification to aggregate directly to an economy-wide first-order contribution to PCE inflation. This distinction matters for aggregation: because the model maps the tariff schedule into the full PCE expenditure system, the same category-level objects used to estimate pass-through also aggregate, with observed expenditure weights, into a first-order contribution to aggregate PCE inflation.

The second strand is the literature on production networks, inflation, and shock propagation. Baqaee and Farhi (2019) and Baqaee and Rubbo (2023) develop general-equilibrium frameworks for studying how shocks propagate through input-output linkages and affect aggregate outcomes. La'O and Tahbaz-Salehi (2022) study optimal monetary policy in production networks. Related work emphasizes that supply-chain shocks can affect inflation with delays and through heterogeneous downstream exposure; Minton and Wheaton (2023), for example, document delayed inflation in supply chains. Silva (2024) studies how sectoral shocks, including changes in border prices, map to a first-order to consumer price changes in a general framework for small open economies. We build on the first-order network approximation logic in this literature, but focus on a partial-equilibrium object that is directly useful for tariff and import-price scenarios: the mapping from a vector of border price shocks to predicted PPI and PCE price changes, accounting for oligopolistic competition and heterogeneous firm exposure. We also show how to construct that mapping from public US national-accounts data, including BEA input-output tables, import-use matrices, the Make table, and the PCE bridge.

The third strand is the literature on markup adjustment, imperfect competition, and pass-through. Classic contributions such as Feenstra (1989) and Goldberg and Knetter (1997) show that pass-through is generally incomplete under imperfect competition. Atkeson and

Burstein (2008) emphasize strategic complementarities in oligopolistic markets, where firms' price responses depend on the prices of their competitors. More recently, Sangani (2026) argues that much of the evidence that appears to be incomplete pass-through in percentages is consistent with complete pass-through in levels. That distinction is central here: under pass-through in levels, a cost increase raises prices dollar for dollar, so percentage pass-through is attenuated by the cost share of price. We find that accounting for pass-through in levels is not by itself enough to reconcile the model with the producer-price response, which is why the foreign-competition channel is estimated rather than assumed away.

The closest paper in this strand is Amiti, Itskhoki and Konings (2019), who show that aggregate pass-through depends not only on average exposure to international shocks but also on the covariance between firm-level exposure and markup adjustment. We build on that insight and change the object of measurement, while also adding network effects to that framework. Rather than estimating exchange-rate pass-through into a sectoral price index, we condition on post-border foreign price changes and trace their effect through domestic producer and consumer prices, which separates two forces that a sectoral exchange-rate exercise combines: foreign price shocks reach domestic firms through imported-input costs, and they also reach them by raising the prices of foreign competitors. We embed both forces in an input-output system. In the appendix extension, we also allow the domestic price response to depend on the covariance between firms' exposure to the relevant shock and their pass-through.

2 Model

Notation. There is a set $\mathcal{I}$ of industries. There is also a set $\mathcal{E}$ of expenditure categories.

We use i and j, and occasionally k, to index industries. We use e to index expenditure categories.

Each industry i contains a discrete number of firms $\mathcal{N}_i$. The number of firms comprises a set of domestic firms $\mathcal{D}_i$ and a single foreign firm F_i, so that $|\mathcal{N}_i| = |\mathcal{D}_i| + 1$. We use f, g, h to index firms.

Each expenditure category e also contains a discrete number of firms $\mathcal{N}_e$. In contrast to industries, all firms within expenditure categories are domestic. As in the industry case, we use f, g, h to index firms within expenditure categories as well.

2.1 Intermediate Input Producers

2.1.1 Procurement

To generate pass-through in levels in intermediate-input markets, we model a procurement assignment problem for an industry entity that requires a continuum of varieties to be completed by a discrete number of firms to produce an aggregate good. This aggregated good serves as a reference for the oligopolistic competition setup that follows. Our setup thus belongs to the class of *shift-invariant* demand systems analyzed in Sangani (2026). Here, we provide a microfoundation for the possibility of incomplete pass-through in levels within intermediate-input markets.

The problem of the industry entity is to choose what varieties to assign to firms. Each variety is assigned to a single firm, but firms may complete more than one variety. Thus, for each variety, this is a discrete choice problem of choosing the firm that produces it.

A well-known result in the discrete choice literature is that this problem can be written either as a standard discrete choice maximization problem or as an expected minimization problem with additional entropy-regularized cost. To ease exposition, we proceed with the second route. For additional details on the exact mathematical foundation of this duality, see Section 1.3 in Galichon (2026).

The industry entity i chooses variety shares to allocate to each firm f (π_{fi}) that minimize an expected cost problem with an additional entropy-regularized procurement cost as follows:

$$p_i^{eff} = \min_{\pi_{fi} \in \Delta_i} \left\{ b_i + \sum_f \pi_{fi}(p_{fi} - z_{fi}) + \sigma_i \sum_f \pi_{fi} \log \pi_{fi} \right\}, \tag{1}$$

where $\Delta_i = \{\pi_{fi} : \sum_f \pi_{fi} = 1\}$ is the simplex set.

p_i^{eff} represents the *effective price index* of industry i. b_i captures a baseline cost of satisfying an industry-i variety. An example is a common physical or administrative cost of completing an industry i requirement: handling, distribution, assembly, etc. It is common across all alternatives. Its sole role is to pin down the level of the effective price index, as defined below, and ensure that it is positive. In contrast, z_{fi} is a firm-specific *deterministic* advantage in serving industry-i varieties, measured in money units. We can think of it as quality, reliability, and delivery speed, among others. σ_i represents the elasticity of substitution across varieties/firms within an industry.

The solution to the entropy-regularized problem delivers *variety-shares* π_{fi}

$$\pi_{fi} = \frac{\exp\left(\frac{z_{fi}-p_{fi}}{\sigma_i}\right)}{\sum_{g\in i}\exp\left(\frac{z_{gi}-p_{gi}}{\sigma_i}\right)} \tag{2}$$

Importantly, π_{fi} is not a quantity; it is an assignment share. It tells us the share of industry i varieties, orders, or procurements assigned to firm f.

Replacing equation (2) into the effective price problem delivers the *effective cost index of industry* i as

$$p_i^{eff} = b_i - \sigma_i \log\left[\sum_{f\in i}\exp\left(\frac{z_{fi}-p_{fi}}{\sigma_i}\right)\right]. \tag{3}$$

The effective cost index depends on z_{fi} and b_i as well as on p_{fi}. As a result, it is more akin to a *quality-adjusted price* than to a standard price index. Using this definition, we can rewrite the assignment share as

$$\pi_{fi} = \exp\left(\frac{z_{fi}-b_i+p_i^{eff}-p_{fi}}{\sigma_i}\right) \tag{4}$$

The quantity produced by firm f in industry i is:

$$q_{fi} = \pi_{fi}q_i, \tag{5}$$

where q_i is the real composite output of industry i from the supply-side.

Sales/Revenues of firm f in industry i are then

$$R_{fi} = p_{fi}q_{fi} = p_{fi}\pi_{fi}q_i. \tag{6}$$

Remark 1. *Under the logit structure, we have*

$$p_i^{eff}q_i \neq \sum_{f\in i} p_{fi}q_{fi}. \tag{7}$$

Remark 1 highlights that we cannot separate a quantity and a price index as we can under constant elasticity of substitution (CES) aggregation.

Using the definition of sales, we can construct sales shares for each firm in the industry

(s_{fi}) as :

$$s_{fi} = \frac{R_{fi}}{\sum\limits_{g\in i} R_{gi}} = \frac{p_{fi}\pi_{fi}}{\sum\limits_{g\in i} p_{gi}\pi_{gi}} = \frac{p_{fi}\exp\left(\frac{z_{fi}-p_{fi}}{\sigma_i}\right)}{\sum\limits_{g\in i} p_{gi}\exp\left(\frac{z_{gi}-p_{gi}}{\sigma_i}\right)}. \tag{8}$$

Remark 2. *Under the logit structure, sales shares are no longer homogeneous of degree 0 in prices.*

Remark 2 highlights a key property of shift-invariant models: sales shares are no longer homogeneous of degree zero in firms' prices within the industry.

For future reference, it will prove useful to define the sales share of the foreign firm (s_{Fi}) as a separate entity:

$$\sum_{f\in\mathcal{D}_i} s_{fi} + s_{Fi} = 1. \tag{9}$$

2.1.2 Within Industry Competition

Each domestic firm $f \in \mathcal{D}_i$ solves the following program:

$$\Pi_{fi} = \max_{p_{fi}} \quad (p_{fi} - mc_{fi})\pi_{fi}q_i \quad \text{s.t} \quad (2). \tag{10}$$

Note that we assume Bertrand competition in what follows, since firms choose prices directly.

At this point, we need to make the following assumption:

Assumption 1. *Firms consider their effect on the variety share π_{fi}, but not the impact of their pricing decisions on the inputs they source.*

Assumption 1 rules out input market power and allows us to focus on the role of competition across firms. This is a strong assumption that we are forced to make given our data availability. The implication of this assumption is that we can take firms' marginal costs as given when making the pricing decision.

The solution to this problem delivers the pricing condition:

$$p_{fi} = mc_{fi} + \mu_{fi}, \tag{11}$$

where $\mu_{fi} = \frac{\sigma_i}{1-\pi_{fi}}$ is firm f's markup. Importantly, the price level p_{fi} is linear in the markup and the marginal cost (μ_{fi}, mc_{fi}). Markups can react in *levels* in our setup, so incomplete pass-through in levels is a possibility.

The production function of firms is constant returns to scale and takes the following form

$$q_{fi} = q_{fi}(\ell_{fi}, x_{fi}, x^*_{fi}; a_{fi}), \tag{12}$$

where ℓ_{fi} is labor demand, x_{fi} is a domestic intermediate input bundle, x^*_{fi} is an imported intermediate input and a_{fi} is a firm-specific productivity.

The domestic intermediate input bundle is a composite of industry-specific bundles $x_{fi,j}$

$$x_{fi} = x_{fi}(\{x_{fi,j}\}_{j\in\mathcal{I}}). \tag{13}$$

The industry-specific bundles are themselves an aggregation across *domestic* firms within each industry

$$x_{fi,j} = x_{fi,j}(\{x_{fi,gj}\}_{g\in\mathcal{D}_j}). \tag{14}$$

The imported intermediate input bundle is a composite of industry-specific import bundles $x^*_{fi,j}$:

$$x^*_{fi} = x^*_{fi}(\{x^*_{fi,j}\}_{j\in\mathcal{I}}). \tag{15}$$

The price of each industry-specific import bundles is p^*_j and is taken as given.

Given our setup, marginal costs satisfy

$$mc_{fi}(w, p^x_{fi}, p^{x^*}_{fi}; a_{fi}), \tag{16}$$

where w is the wage, p^x_{fi} is the price of the domestic intermediate input bundle, $p^{x^*}_{fi}$ is the price of the imported intermediate input bundle and a_{fi} is firm's productivity. Note that for now we leave both prices of intermediate input bundles as firm-industry specific.

2.2 Final Demand

2.2.1 Assignment Problem

We model final consumers in a manner similar to that of input markets. We consider a discrete set of expenditure categories $e \in \mathcal{E}$. Within each expenditure category e there is a continuum of varieties $\omega \in [0, c_e]$. A discrete number of firms $\mathcal{N}_e$ produce these varieties. The household's problem is to decide the share of varieties to buy from each firm in each category. For each category e, the household problem is then:

$$p_e^{eff} = \min_{\pi_{fe} \in \Delta_e} \left\{ b_e + \sum_f \pi_{fe}(p_{fe} - z_{fe}) + \sigma_e \sum_f \pi_{fe} \log \pi_{fe} \right\}, \tag{17}$$

where $\Delta_e = \{\pi_{fe} : \sum_f \pi_{fe} = 1\}$ is the simplex set.

As before, the solution to this problem delivers:

$$\pi_{fe} = \frac{\exp\left(\frac{z_{fe} - p_{fe}}{\sigma_e}\right)}{\sum_{g \in e} \exp\left(\frac{z_{ge} - p_{ge}}{\sigma_e}\right)}, \tag{18}$$

which is the share of varieties that households buy from firm f in category e. The demand for a firm's output is thus

$$c_{fe} = \pi_{fe} c_e. \tag{19}$$

2.2.2 Retailers

We model the problem of firms within each category as a Bertrand competition. The problem of each retailer is thus

$$\Pi_{fe} = \max_{p_{fe}} \, (p_{fe} - m_{fe}) \pi_{fe} c_e \quad \text{s.t.} \quad (18) \tag{20}$$

This delivers the pricing condition:

$$p_{fe} = mc_{fe} + \frac{\sigma_e}{1 - \pi_{fe}}. \tag{21}$$

The retailers production function is constant returns to scale

$$c_{fe} = c_{fe}(\ell_{fe}, \{x_{fe,gj}\}_{g \in \mathcal{D}_j, j \in \mathcal{I}}, \{x^*_{fe,j}\}_{gj \in \mathcal{I}}; a_{fe}), \tag{22}$$

where ℓ_{fe} is labor usage, $x_{fe,gj}$ is domestic intermediate input demand, $x^*_{fe,j}$ is imported intermediate input demand and a_{fe} is a productivity.

The production function delivers a marginal cost function for the retailers

$$mc_{fe} = mc_{fe}(w, \{p_{gj}\}_{g \in \mathcal{D}_j, j \in \mathcal{I}}, \{p^*_j\}_{j \in \mathcal{I}}; a_{fe}) \tag{23}$$

2.3 Market Clearing

Total sales of firm f in industry i must satisfies the following market clearing condition

$$p_{fi}q_{fi} = \sum_{j\in\mathcal{I}}\sum_{g\in\mathcal{D}_j} p_{fi}x_{gj,fi} + \sum_{e\in\mathcal{E}}\sum_{h\in e} p_{fi}x_{he,fi}, \tag{24}$$

where the right hand side is demand by intermediate producing firms plus demand by retailers.

Total labor payments of the household satisfies:

$$w\bar{L} = \sum_{j\in\mathcal{I}}\sum_{g\in\mathcal{D}_j} w\ell_{gj} + \sum_{e\in\mathcal{E}}\sum_{h\in e} w\ell_{he}. \tag{25}$$

2.4 Price Indices Definitions

2.4.1 Industry level price indices

We define the sales weighted average price index change of industry i as

$$\mathrm{d}\log p_i = \sum_{f\in\mathcal{D}_i} s_{fi}\mathrm{d}\log p_{fi} + s_{Fi}\mathrm{d}\log p_{Fi}. \tag{26}$$

This index is observed in the data but it does not correspond to any market price in the usual sense.

The *observed* price index change of industry i, $\mathrm{d}\log p_i$, is linked to the effective price change as

$$\mathrm{d}p_i^{eff} = \frac{R_i}{q_i}\mathrm{d}\log p_i \tag{27}$$

Define domestic sales as $R_i^d = \sum_{f\in\mathcal{D}_i} R_{fi}$ and domestic sales shares as

$$s_{fi}^d = \frac{R_{fi}}{R_i^d}. \tag{28}$$

Let the industry-level variable costs be

$$VC_i^d = \sum_{g\in\mathcal{D}_i} mc_{gi}q_{gi}; \qquad VC_i = \sum_{g\in i} mc_{gi}q_{gi}, \tag{29}$$

where VC_i^d is variable costs across domestic firms and VC_i is the industry's total variable costs, inclusive of those of the foreign firm.

We also define the domestic price index of industry i as a domestic-sales weighted average across domestic firms $\mathcal{D}_i$

$$\mathrm{d}\log p_i^d = \sum_{f\in\mathcal{D}_i} s_{fi}^d \mathrm{d}\log p_{fi} \tag{30}$$

Equation (30) defines the producer price index (PPI) of industry i as in the data.

2.4.2 Consumer's price indices

We define the price index change in a category e as

$$\mathrm{d}\log p_e = \sum_{f\in e} s_{fe}\mathrm{d}\log p_{fe}, \tag{31}$$

where $s_{fe} = \frac{p_{fe}c_{fe}}{\sum\limits_{g\in e} p_{ge}c_{ge}}$ is the expenditure share on firm f within category e.

Using this definition, we further define the consumer price index change as in the data:

$$\mathrm{d}\log p^C = \sum_{e\in\mathcal{E}} s_e \mathrm{d}\log p_e, \tag{32}$$

where $s_e = \frac{\sum\limits_{g\in e} p_{ge}c_{ge}}{\sum\limits_{e\in\mathcal{E}}\sum\limits_{g\in e} p_{ge}c_{ge}}$ is the expenditure share in category e.

2.5 The Transmission of Import Prices

In this section, we derive the key equations that we bring to the data. To do so, we consider a first-order approximation around an initial equilibrium.

2.5.1 Pass-through

The change in the price of a firm f-industry i can be written as a function of both marginal cost changes and changes in competitors' prices. The following proposition characterizes this result in levels:

Proposition 1 (Pass-through in levels)**.** *Up to a first-order approximation, the level change in the price of firm f in industry i can be written as*

$$\mathrm{d}p_{fi} = (1-\pi_{fi})\mathrm{d}mc_{fi} + \pi_{fi}\mathrm{d}p_{-f,i}, \tag{33}$$

where

$$\mathrm{d}p_{-f,i} = \sum_{h \in i \setminus f} \tilde{\pi}_{hi} \mathrm{d}p_{hi} \qquad \textit{and} \qquad \tilde{\pi}_{hi} = \frac{\pi_{hi}}{\sum\limits_{g \in i \setminus f} \pi_{gi}}, \tag{34}$$

is the competitor's price index for firm f and $\tilde{\pi}_{hi}$ is the variety share of firm h in industry i within varieties performed by domestic firms.

Proof. See Appendix B.1. □

Proposition 1 shows that changes in the firm's price can be decomposed between an own marginal cost change and a competitors' price index. The complete pass-through in level is achieved whenever $\pi_{fi} = 0$ and corresponds to the case analyzed in Sangani (2026). In this case, the fraction of varieties a particular firm performs is negligible relative to the aggregate, an intuition similar to that in monopolistic competition models. By varying π_{fi}, we can nest different cases from the literature, but under pass-through in levels.

The next proposition rewrites the firm-level pass-through in percentage changes[1] :

Proposition 2 (Pass-through in percentage changes)**.** *Up to a first-order approximation, the percentage change in the price of firm f in industry i can be written as*

$$\mathrm{d}\log p_{fi} = (1 - \alpha_{fi})(1 - \pi_{fi})\mathrm{d}\log mc_{fi} + \pi_{fi}\frac{p_{-f,i}}{p_{fi}}\mathrm{d}\log p_{-f,i}, \tag{35}$$

where

$$1 - \alpha_{fi} = \frac{mc_{fi}}{p_{fi}} \in [0, 1] \tag{36}$$

is the share of price due to marginal costs.

Proof. See Appendix B.2. □

Proposition 2 shows that when there is complete pass-through in levels, $\pi_{fi} = 0$, there is still incomplete pass-through in percentage changes since $1 - \alpha_{fi} \leq 1$. More generally, $\pi_{fi} \neq 1$. Thus, the presence of oligopolistic competition when firms face a logit-demand structure adds an additional mechanism through which changes in marginal costs can affect firm prices captured by the competitor's price channel $\pi_{fi}\frac{p_{-f,i}}{p_{fi}}\mathrm{d}\log p_{-f,i}$.

We are now ready to examine how changes in import prices affect PPI. In our model, changes in import prices enter into two places: (i) through marginal cost, as an input in

[1]Note that to write $\mathrm{d}\log mc_{fi} = \mathrm{d}\log mc_i$ we require all firms to have the same initial marginal cost. This can still lead to different market and variety shares provided that there is heterogeneity in z_{fi}.

the production function, and (ii) as changes in the price of competitors in an industry (as it contains $\mathrm{d}\log p_{Fi}$). The following proposition introduces a perturbation $(\mathrm{d}\log mc_{fi}, \mathrm{d}\log p_{Fi})$ and provides an expression for industry level PPI changes:

Proposition 3. *Changes in the producer price index after a perturbation* $(\mathrm{d}\log mc_{fi}, \mathrm{d}\log p_{Fi})$ *satisfy*

$$\mathrm{d}\log p_i^d = \frac{1}{\left(1-(1-\pi_{Fi})\left(\sum_{f\in\mathcal{D}_i}\tilde{\pi}_{fi}(1-\rho_{fi})\right)\right)}\left(\upsilon_i^d\left(\sum_{f\in\mathcal{D}_i}\tilde{\delta}_{fi}\rho_{fi}\mathrm{d}\log mc_{fi}\right)\right), \tag{37}$$
$$+\frac{1}{\left(1-(1-\pi_{Fi})\left(\sum_{f\in\mathcal{D}_i}\tilde{\pi}_{fi}(1-\rho_{fi})\right)\right)}\left(\frac{(1-\pi_{Fi})\left(\sum_{f\in\mathcal{D}_i}\tilde{\pi}_{fi}(1-\rho_{fi})\right)}{(1-s_{Fi})}s_{Fi}\mathrm{d}\log p_{Fi}\right)$$

where

$$\tilde{\delta}_{fi}=\frac{mc_{fi}q_{fi}}{VC_i^d};\qquad \upsilon_i^d=\frac{VC_i^d}{R_i^d};\qquad \rho_{fi}=\frac{(1-\pi_{fi})^2}{1-\pi_{fi}+\pi_{fi}^2}\in[0,1]$$
$$\tilde{\pi}_{fi}=\frac{\pi_{fi}}{\sum\limits_{h\in\mathcal{D}_i}\pi_{hi}};\qquad 1-\pi_{Fi}=\sum_{f\in\mathcal{D}_i}\pi_{fi}$$

Proof. See Appendix B.3. □

There are some parameters that deserve discussion from the proposition. The parameter υ_i^d represents the share of domestic variable costs in domestic revenues; this is the industry level counterpart of $1-\alpha_{fi}$. The parameter ρ_{fi} captures a "firm cost pass-through in levels" as it is an increasing function of $(1-\pi_{fi})$, the level marginal cost firm's pass-through we found in Proposition 1.

The term $\sum\limits_{f\in\mathcal{D}_i}\tilde{\delta}_{fi}\rho_{fi}\mathrm{d}\log mc_{fi}$ is an industry-level shifter in marginal cost changes of all firms appropriately weighted. This industry level component have two sources of firm-level heterogeneity (beyond the idiosyncratic cost shifters): (i) initial cost shares of each firm in total industry costs $(\tilde{\delta}_{fi})$ and (ii) the cost pass-through in levels parameters (ρ_{fi}). The industry-level marginal cost shifter thus places more weight on larger firms (in terms of costs) and firms with higher cost pass-through in levels. This will play an important role in our empirical application. The own-cost pass-through in percentage changes at the industry level is thus the numerator $\upsilon_i^d\sum\limits_{f\in\mathcal{D}_i}\tilde{\delta}_{fi}\rho_{fi}\mathrm{d}\log mc_{fi}$.

The second row shows the effect of an increase in foreign competition, captured by a change in the foreign firm's price, $\mathrm{d}\log p_{Fi}$. This effect can be understood by looking at two elasticities. The first elasticity is how domestic prices react to a change in the industry-level price; this effect is captured by $\frac{(1-\pi_{Fi})}{1-s_{Fi}} \sum\limits_{f\in\mathcal{D}_i} \tilde{\pi}_{fi}(1-\rho_{fi})$ that depends on variety shares π_{fi}, foreign sales shares s_{Fi}, and cost pass-through ρ_{fi}. Of course, the pass-through of the industry price index on the producer price index will be larger whenever the competitors' effect is stronger (higher $1-\rho_{fi}$), (ii) sales to foreigners are larger (higher s_{Fi}) and (iii) varieties assigned to domestic firms are an important fraction $(1-\pi_{Fi})$. The second elasticity is the elasticity of the industry price index with respect to the foreign firm's price. This elasticity is simply $s_{Fi}\mathrm{d}\log p_{Fi}$, the first-order effect of the foreign firm price on the aggregate industry price index.

The total effect of both perturbations also needs to account for the fact that changes in the producer price index affect the industry-level price index, which in turn affects the producer price index, and so on. The first term multiplying both perturbations can be written as

$$\frac{1}{1-(1-\pi_{Fi})\left(\sum_{f\in\mathcal{D}_i}\tilde{\pi}_{fi}(1-\rho_{fi})\right)} = \sum_{t=0}^{\infty}\left((1-\pi_{Fi})\left(\sum_{f\in\mathcal{D}_i}\tilde{\pi}_{fi}(1-\rho_{fi})\right)\right)^t$$

and thus captures all these higher-order rounds.

We conclude this subsection by noting that Proposition 3 also delivers a corollary for the change in prices of expenditure categories. The sole difference between the models is that $\pi_{Fe}=0$ for all e, as there is no foreign competition in retailers. The following corollary captures this:

Corollary 1. *Changes in the price index of category e, $\mathrm{d}\log p_e$, after a change in firm level marginal costs $(\mathrm{d}\log mc_{fe})$ satisfy*

$$\mathrm{d}\log p_e = \frac{1}{\left(1-\sum\limits_{f\in e}\pi_{fe}(1-\rho_{fe})\right)}\upsilon_e\left(\sum_{f\in e}\delta_{fe}\rho_{fe}\mathrm{d}\log mc_{fe}\right) \tag{38}$$

where

$$\delta_{fe}=\frac{mc_{fe}c_{fe}}{VC_e}; \qquad \upsilon_e=\frac{VC_e}{R_e}; \qquad \rho_{fe}=\frac{(1-\pi_{fe})^2}{1-\pi_{fe}+\pi_{fe}^2}\in[0,1]$$

2.5.2 The Role of Industry Level Input-Output Networks

The preceding section provided a perturbation on the space $(\mathrm{d}\log mc_{fi}, \mathrm{d}\log p_{Fi})$. In our model, firms' marginal costs depends of firms' prices in other industries as well. We now provide an extension where we perturb intermediate import prices $\mathrm{d}\log p_i^*$ and the price of foreign firms $\mathrm{d}\log p_{Fi}$ and study how this propagates through the producer price index.

To characterize the producer price index response we make the following aggregation assumption:

Assumption 2 (Aggregation of input expenditure shares)**.** *For every pair of industries i, j,*

$$\sum_{f\in D_i} \widetilde{\delta}_{fi}\rho_{fi}\Omega_{fi,j}\omega_{fi,gj} = \rho_i^d\Omega_{i,j}s_{gj}^d \qquad \text{for every } g \in D_j,$$
$$\sum_{f\in D_i} \widetilde{\delta}_{fi}\rho_{fi}\Omega^*_{fi,j} = \rho_i^d\Omega^*_{i,j},$$

where

$$\rho_i^d \equiv \sum_{f\in D_i} \widetilde{\delta}_{fi}\rho_{fi},$$

is the cost-weighted average industry level-pass-through and we defined firm- and industry-level expenditure shares as:

$$\omega_{fi,gj} \equiv \frac{p_{gj}x_{fi,gj}}{p^x_{fi,j}x_{fi,j}}, \quad \Omega_{fi,j} \equiv \frac{p^x_{fi,j}x_{fi,j}}{VC_{fi}}, \quad \Omega^*_{fi,j} \equiv \frac{p^*_j x^*_{fi,j}}{VC_{fi}} \quad (\textit{Firm-level shares})$$
$$\Omega_{i,j} \equiv \sum_{f\in D_i} \tilde{\delta}_{fi}\Omega_{fi,j}, \quad \Omega^*_{i,j} \equiv \sum_{f\in D_i} \tilde{\delta}_{fi}\Omega^*_{fi,j}, \quad (\textit{Industry-level shares})$$

Assumption 2 is important because it allows us to use producer price indices as the relevant price that enters the computation of industry-level marginal costs.

Economically, we restrict the joint distribution of firm-level pass-through ρ_{fi} and firms' input expenditures. The domestic restriction requires that sourcing patterns and pricing responses across firms in an industry must be such that PPI correctly measures the domestic input-cost-pressure relevant for buyers' prices. There are two things that determine how much a supplier matters for a given industry i. First, how much firms buy from that supplier $(\Omega_{fi,j}\omega_{fi,gj})$. Second, how strongly buying firms pass costs into their prices (ρ_{fi}). Our restriction imposes that the resulting supplier weights must equal the supplier's share in its own industry's PPI.

The importing restriction says that firms more exposed to imported inputs are not systematically stronger nor weaker at passing costs into prices.

With Assumption 2 at hand, we can derive the following result (details are in Appendix A.1):

Proposition 4 (Producer price indices and input-output networks)**.** *Consider a perturbation of imported input prices* ($\mathrm{d}\log \boldsymbol{p}^*$) *and foreign competitors prices* ($\mathrm{d}\log \boldsymbol{p}_F$) *keeping constant wages* $\mathrm{d}\log w = 0$*. The response of producer price indices is such that*

$$\mathrm{d}\log \boldsymbol{p}^d = \underbrace{\boldsymbol{\Phi}^* \mathrm{d}\log \boldsymbol{p}^*}_{\textit{Imported-Input Cost Channel}} + \underbrace{\boldsymbol{\Phi}^F \mathrm{d}\log \boldsymbol{p}_F}_{\textit{Foreign Competition Channel}}, \tag{39}$$

where

$$\boldsymbol{\Phi}^* = \boldsymbol{G}\boldsymbol{\Upsilon}^d\boldsymbol{\rho}^d\boldsymbol{\Omega}^* \tag{40}$$

$$\boldsymbol{\Phi}^F = \boldsymbol{G}(\boldsymbol{I}-\boldsymbol{S}_F)^{-1}(\boldsymbol{I}-\boldsymbol{\Pi}_F)(\boldsymbol{I}-\boldsymbol{\rho}^d)\boldsymbol{S}_F \tag{41}$$

$$\boldsymbol{G} = (\boldsymbol{I}-\boldsymbol{\Upsilon}^d\boldsymbol{\rho}^d\boldsymbol{\Omega}^d - (\boldsymbol{I}-\boldsymbol{\Pi}_F)(\boldsymbol{I}-\boldsymbol{\rho}^d))^{-1} \tag{42}$$

and

$$\boldsymbol{\Upsilon}^d = diag(\boldsymbol{\upsilon}^d); \quad \boldsymbol{\rho}^d = diag(\{\rho_i^d\}_{i\in\mathcal{I}}); \quad \boldsymbol{S}_F = diag(\boldsymbol{s}_F); \quad \boldsymbol{\Pi}_F = diag(\boldsymbol{\pi}_F),$$

are diagonal matrices and

$$\rho_i^d = \sum_{f\in\mathcal{D}_i} \tilde{\delta}_{fi}\rho_{fi},$$

is a cost-weighted average industry level-pass-through.

Proof. See Appendix B.4. □

Proposition 4 provides an industry level counterpart to Proposition 3. While Proposition 3 required detailed firm-level information, Proposition 4 only requires industry level data. Moreover, Proposition 4 decomposes changes in industry level producer price indices into an imported-input cost channel and a foreign-competition channel, while the earlier proposition was agnostic about the particular sources of variation on marginal costs.

Although it is heavy on notation, Proposition 4 provides a natural extension to our earlier results. There are two key differences. First, note that the higher order terms now take a matrix form as now producer price indices are linked across sectors via marginal costs. This production network structure is captured in $\boldsymbol{\Upsilon}^d\boldsymbol{\rho}^d\boldsymbol{\Omega}^d$ in the propagation matrix $\boldsymbol{G}$, where $\boldsymbol{\Omega}^d$ captures the exposure of industries to producer price indices in all other industries. The remaining objects in $\boldsymbol{G}$ are just the natural extension to matrices of the higher order rounds in Proposition 3. Apart from this modification, the first-round effect of foreign competition on producer price indices is identical to the one Proposition 4.

Second, Proposition 4 directly links the effect of imported intermediate input prices on producer price indices, which is captured by the matrix $\mathbf{\Phi}^*$. This matrix has a first-round component and a propagation component ($\boldsymbol{G}$). As we already explained the propagation component, we focus on the first-round effect. This first-round effect combines two components: (i) the own marginal cost exposure to imported intermediate inputs $\mathbf{\Omega}^*$, (ii) the cost pass-through in percentage changes matrix $\mathbf{\Upsilon}^d\boldsymbol{\rho}^d$. Intuitively, a rise in imported intermediate input prices raises industry's marginal cost by Ω_i^* (the ith row of the $\mathcal{I}\times\mathcal{I}$ matrix $\mathbf{\Omega}^*$). This marginal cost change then translates into a change in the producer price index of the industry of $\upsilon_i^d\rho_i^d$. This change in the producer price index of industry i then affect both producer price indices in all the other industries as well as the industry price level (inclusive of foreign firms), which in turn affect industries' marginal costs and so on. The matrix $\mathbf{\Phi}^*$ captures these transmission mechanisms.

3 From Model Objects to Data

This section maps each model object to official US public data. The mapping is a contribution in its own right: it bridges customs records, input–output tables and price series that use different classification systems with no published concordance linking the entire chain. Two inputs have to be in hand before the price response of Proposition 4 can be evaluated: the border shock and the mapping into prices. Section 3.1 builds the input–output and bridge objects that turn a border shock into a predicted price change. Section 3.2 builds the border shock itself. Section 3.3 verifies that an observed tariff change can stand in for an unobserved border price change.

3.1 Mapping Economic Objects to PPI and PCE Data

We map the model to data using the Bureau of Economic Analysis (BEA) Input–Output accounts, which record intermediate input flows, import penetration, and final demand at the commodity level. Because the 2025 tariffs were country-specific, we first disaggregate imports by source region, combining Census trade composition at the product level with the BEA Trade in Value Added (TiVA) tables, which report region-level import totals by end use.[2]

[2]Appendix D.4 describes the region disaggregation procedure, which uses iterative proportional fitting to reconcile the two sources, and Appendix D.2 describes how we extend the 2017 Detail Benchmark tables to 2024.

Proposition 4 requires four matrices that we construct from the BEA Use, Make, and Import tables. The domestic and imported input coefficient matrices $\boldsymbol{\Omega}^d$ and $\boldsymbol{\Omega}^*$ govern, together with the Leontief inverse, how cost shocks propagate round by round through the production network. They are built by subtracting the Import matrix from the Use table to isolate domestic flows (and retaining it for foreign flows), normalizing by gross output, and converting from industry to commodity space via the Make table. The markup-adjustment matrix $\boldsymbol{\Upsilon}^d$ is the ratio of variable cost to revenue for each commodity and scales how much of a cost shock passes through to prices.[3] The foreign-competitor share $\boldsymbol{S}_F$ is each commodity's import penetration ratio—imports divided by total domestic supply—and measures the initial market presence of foreign varieties. The remaining parameters of Proposition 4—the cost pass-through $\boldsymbol{\rho}^d$ and the foreign variety share $\boldsymbol{\Pi}_F$—are not observed in the accounts. We pin $\boldsymbol{\Pi}_F$ with the following restriction:

Assumption 3. $\pi_{fi} = s_{fi}, \quad \forall f, i,$

so that a firm's variety share equals its observed sales share and $\boldsymbol{\Pi}_F = \boldsymbol{S}_F$; we describe our estimation of $\boldsymbol{\rho}^d$ below in Section 4.3.

To carry predicted producer-price responses to consumer prices, we use the BEA's PCE bridge, which maps each commodity into potentially several NIPA expenditure categories, as we use the TiVA import shares to split each category's cost into a domestically sourced and an imported component. Category-specific wholesale, retail, and transportation margins then dilute the border shock as it reaches consumer prices.[4]

Linking the tariff schedule to these objects requires a three-step concordance: we use the HS-10-to-NAICS correspondence in the customs records to aggregate border price changes to the NAICS-6 level, then use the NAICS-to-BEA concordance and the Make matrix to assign each NAICS-by-country cell to a BEA commodity, and finally match BEA commodities to PPI series at the NAICS level. This chain maps approximately 95 percent of import value onto a BEA commodity.[5] Of the 402 Detail commodities, 273 can be matched to an observed PPI series—252 to a unique series and 21 to an average of multiple series. Commodities that lack a PPI series are not discarded: they remain in the input–output network and transmit tariff-induced cost changes to commodities that do have observed prices. Commodities with zero imports enter with zero predicted price change and serve as the comparison group in the

[3] Under an alternative log-pass-through convention, $\boldsymbol{\Upsilon}^d = \boldsymbol{I}$ and percentage marginal-cost changes pass through one for one. Appendix E.2 reports all results under this alternative.

[4] The margin dilution differs depending on whether pass-through is measured in logs or in levels; Appendix E.2 reports consumer-price results under both conventions.

[5] The unmatched 5 percent consists overwhelmingly of special-provision and low-value-shipment lines carrying no NAICS stamp at entry. We exclude them rather than reallocate them; Appendix D.3 reports coverage by base year.

regressions that follow.

3.2 The Border Shock and the Instrument

With the input–output and bridge mappings in hand, the remaining object is the border price shock $\mathrm{d}\log \boldsymbol{p}^*$. The model treats the imported-input cost channel and the foreign-competition channel as generated by different primitives. To operationalize both from a single observed series we impose the following restriction:

Assumption 4. $\mathrm{d}\log p_i^* = \mathrm{d}\log p_{Fi} = \mathrm{d}\log(1+\tau_i)$, $\forall i$, *where* $(1+\tau_i)$ *represents the ad-valorem tariff applied to industry* i.

This assumption embeds two restrictions. First, it requires that tariffs pass through fully into duty-inclusive border prices, such that foreign exporters do not absorb part of the duty by cutting their pre-tariff prices. Section 3.3 tests this directly. Second, it equates the change in the imported input price in response to an industry-level tariff to the change in the foreign producer price the industry competes against. While the model allows for segmentation of these two markets, we lack data to distinguish them.

We construct the realized tariff shock from duties actually paid at the border (the *effective* rate), and we use the *statutory* schedule as an instrument. Both of these schedules are available from official Foreign Trade Census data. For every HS-10 product-level code p from country of origin c in month m, we compute the effective tariff rate by dividing the total duties paid by the total value of imports, and we compute the statutory observed tariff rate by dividing the total duties paid by dutiable values:[6]

$$\tau^{\text{eff}}_{cp,m} = \frac{\text{Duties Paid}_{cp,m}}{\text{Import Value}_{cp,m}} \qquad \tau^{\text{stat}}_{cp,m} = \frac{\text{Duties Paid}_{cp,m}}{\text{Dutiable Value}_{cp,m}} \tag{43}$$

The effective rate is therefore the tariff schedule diluted by duty-free, exempt trade and by incomplete clearance; it is the rate importers actually paid. The statutory rate is the schedule as applied only to the share of import value that is exemption-free; it tracks the legal rate more closely but can still diverge from the enacted schedule when collection lags behind legislation. The gap between the two is the main identification concern: exemption qualifications can shift endogenously with firms' import decisions.

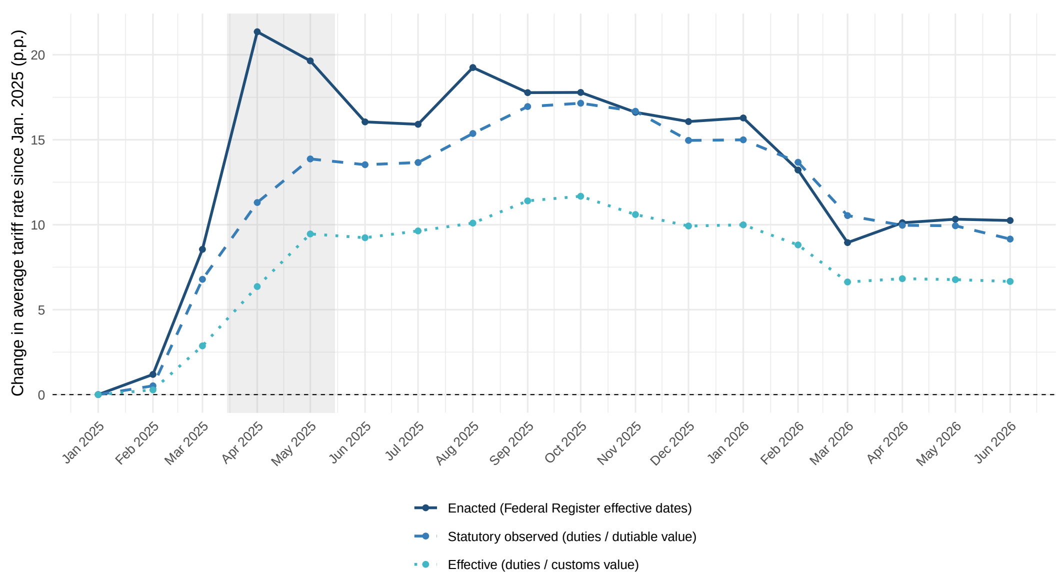
We compare these two rates to a third tariff schedule: the *enacted* rate. This rate is sourced from the official Federal Register and USITC and records official law changes at their effective date of implementation, rather than at the first month in which a statutory rate

[6]When a rate is not observed in a certain month, we carry forward the last observed rate.

is observed. Figure 1 shows the comparison of the three series since January 2025. Each series is aggregated on fixed 2024 import–value shares so that the series are not affected by substitution away from heavily tariffed product-country combinations. Statutory rates track the enacted schedule closely except in April and May 2025. At this time, a 125% tariff on China was officially held in place for 34 days and then paused retroactively. Because it was paused before most ships landed, few importers actually paid it. The gap between statutory and effective rates is much larger.

We use the statutory tariff rate as the main instrument rather than the enacted rate for two reasons. First, the local projection requires a well-measured monthly shock, and a large but largely unpaid tariff distorts estimates. Second, the gap between the enacted and statutory series is concentrated on country-product combinations that trade infrequently and are more likely to be unobserved in any given month, which generates timing discrepancies between the legislative effective date and the first observed rate at the border. Because our interest is in tariff effects at a high level of industry aggregation, most of the identifying variation comes from country-products whose statutory rates are always observable.[7]

Figure 1: Monthly Tariff Shock: Enacted, Statutory Observed and Effective



Notes: Change since January 2025 in the average tariff rate, aggregated across HS-10 product × country-of-origin pairs on import weights fixed at their 2024 values. The three lines' measurement is described in the main text. Shading spans April to May 2025, the window of the China increase that was imposed and then paused retroactively.

[7]Appendix E.5 re-estimates pass-through using the enacted schedule rate as the instrument and describes how the April–May episode is handled. Since the two series agree on the size of the tariff and disagree primarily on when it happens, that comparison is run on a cumulated tariff over a window. On that basis, the two instruments agree (Table E.1).

3.3 Border Pass-Through

We test full tariff pass-through into border prices at the individual import record level. We define a record k as a unique HS-10 product-by-country-of-origin combination. Let v_{kt} denote the duty-inclusive unit value of record k, and let $\Delta_h \log v_{k,t+h} \equiv \log v_{k,t+h} - \log v_{k,t-1}$. For each horizon h we run a local projection in differences, following Dube et al. (2025):

$$\Delta_h \log v_{k,t+h} \;=\; \alpha_k + \delta_{c(k),t} + \beta_h \,\Delta \log\big(1+\hat{\tau}^{\text{eff}}_{k,t}\big) + \sum_{\substack{m=-(h-1)\\ m\neq 0}}^{12} \kappa_{h,m}\,\Delta \log\big(1+\tau^{\text{stat}}_{k,t-m}\big) + \varepsilon_{k,t+h}, \quad (44)$$

where the effective tariff change at t is instrumented by its statutory counterpart. We include product-by-origin fixed effects α_k as well as origin-by-month fixed effects $\delta_{c(k),t}$, which absorb the bilateral exchange rate and any other country-level response. Lags and leads of the statutory path control for the serially correlated nature of the 2025 tariff waves. Standard errors are two-way clustered by HS-8 product and by country of origin.

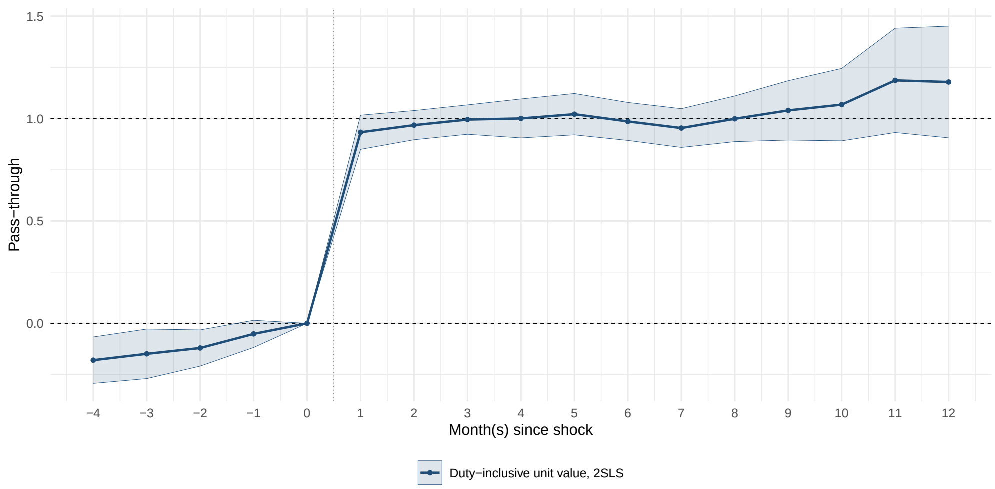
Figure 2 plots $\hat{\beta}_h$. Pass-through is complete on impact and stays complete: 0.93 in the month after the shock and 0.99 by the third month, inside a narrow band around one for the rest of the year.[8]

Because tariffs pass through fully at the border, we can treat the observed tariff change $\mathrm{d}\log(1+\tau)$ as the empirical counterpart of the model's foreign-price shock $\mathrm{d}\log \boldsymbol{p}^*$.[9] We next ask whether the model maps that shock into domestic producer prices.

[8]The estimation includes three million import records at the first horizon and 1.9 million at the twelfth. Restricting attention to records that trade continuously across the whole twelve months leaves the path unchanged (Appendix C).

[9]The tariff is also the sharper of the two available measures: declared unit values carry compositional and reporting noise that the tariff rate does not, so using the tariff instead of the unit value reduces measurement error in the shock and raises the power of our regressions. Appendix E.5 considers the duty-inclusive unit value as an alternative treatment for our main specification.

Figure 2: Border Pass-through of Tariffs into Import Unit Values, 2025



Notes: $\hat{\beta}_h$ from (44), estimated on monthly import records at the HS-10 product $\times$ country-of-origin level. The dependent variable is the log change in the duty-inclusive unit value from $t-1$ to $t+h$. The dashed line at one marks complete pass-through of the duty into the border price. Month 0 is the reference period. Shading gives 95% confidence bands, two-way clustered by HS-8 product and country of origin. Sample is unbalanced so it narrows from 3.0 million records at $h=1$ to 1.9 million at $h=12$.

4 Producer-Price Evidence

We now turn to understanding how the model's mapping of the border shock into domestic producer prices holds up in the data. To do so, we build three nested versions of the model's predicted response by successively activating the channels of the model. At each step, we assess how well the additional channel does in explaining the observed changes in the data. This allows us to understand the importance of imported-input costs alone, network propagation, and foreign competition.

4.1 Model-Implied Producer-Price Responses

The object we take to the data is the model's own producer-price response, evaluated on measured input–output matrices and the observed tariff change. Under Proposition 4 it is

$$\Delta \log \boldsymbol{p}^M(\boldsymbol{\rho}^d) = \left[\boldsymbol{I} - \left(\boldsymbol{I} - \boldsymbol{\rho}^d\right)\left(\boldsymbol{I} - \boldsymbol{S}_F\right) - \boldsymbol{\rho}^d \boldsymbol{\Upsilon}^d \boldsymbol{\Omega}^d\right]^{-1} \left[\boldsymbol{\rho}^d \boldsymbol{\Upsilon}^d \boldsymbol{\Omega}^* + \left(\boldsymbol{I} - \boldsymbol{\rho}^d\right) \boldsymbol{S}_F\right] \Delta \log(1+\tau) \tag{45}$$

where the border shock is replaced by the observed tariff change under the assumption of Section 3.2. Two objects in (45) govern how much a border shock is amplified before it reaches a producer price: the domestic network $\boldsymbol{\Omega}^d$ and the conditional own-cost pass-through parameter $\boldsymbol{\rho}^d$. Our empirical strategy compares observed price changes with three nested versions of $\Delta \log \boldsymbol{p}^M$, obtained by successively activating those two objects.[10]

First-round imported-input cost response. Setting $\boldsymbol{\rho}^d = \boldsymbol{I}$ and setting the off-diagonal elements of $\boldsymbol{\Omega}^d$ to zero gives

$$\Delta \log \boldsymbol{p}^{M,\mathrm{fr}} = \boldsymbol{\Upsilon}^d \boldsymbol{\Omega}^* \Delta \log(1+\tau). \tag{46}$$

Each industry responds only to the import prices it directly purchases, with no round-by-round propagation through other industries. This object is most comparable to a naive import-share calculation of tariff exposure.

Network-adjusted cost response. Here, we consider the full matrix $\boldsymbol{\Omega}^d$ but still set $\boldsymbol{\rho}^d = \boldsymbol{I}$:

$$\Delta \log \boldsymbol{p}^{M,\mathrm{net}} = \left(\boldsymbol{I} - \boldsymbol{\Upsilon}^d \boldsymbol{\Omega}^d\right)^{-1} \boldsymbol{\Upsilon}^d \boldsymbol{\Omega}^* \Delta \log(1+\tau). \tag{47}$$

The inverse matrix $\left(\boldsymbol{I} - \boldsymbol{\Upsilon}^d \boldsymbol{\Omega}^d\right)^{-1}$ captures the propagation of these cost changes through the domestic production network. The gap between equation (46) and equation (47) quantifies network propagation: the extent to which an import price shock is magnified as it passes through successive rounds of domestic intermediate-input purchases beyond each industry's first-round imported-input exposure.

Network-adjusted costs plus foreign competition. Imposing a common conditional own-cost pass-through $\boldsymbol{\rho}^d = \bar{\rho}\, \boldsymbol{I}$ in (45) gives

$$\Delta \log \boldsymbol{p}^M(\bar{\rho}) = \left[\boldsymbol{I} - (1-\bar{\rho})\,(\boldsymbol{I} - \boldsymbol{S}_F) - \bar{\rho}\, \boldsymbol{\Upsilon}^d \boldsymbol{\Omega}^d\right]^{-1} \left[\bar{\rho}\, \boldsymbol{\Upsilon}^d \boldsymbol{\Omega}^* + (1-\bar{\rho})\, \boldsymbol{S}_F\right] \Delta \log(1+\tau). \tag{48}$$

As $\bar{\rho}$ falls below one, the foreign-competition channel becomes active through $\boldsymbol{S}_F$ in addition to the imported-input cost channel through $\boldsymbol{\Omega}^*$.[11] At the industry level, each producer price becomes a weighted average of its own marginal-cost response and the foreign-competitor price change:

$$d \log p_i^d = \upsilon_i^d \tilde{\rho}_i^d \; \mathbb{E}_{\tilde{\boldsymbol{\delta}}_i}[\mathrm{d} \log \boldsymbol{mc}_i] + (1-\tilde{\rho}_i^d) d \log p_{Fi} \;, \tag{49}$$

[10] The headline empirics report pass-through in levels, following the model. However, pass-through in logs ($\boldsymbol{\Upsilon}^d = \boldsymbol{I}$) is carried through every exercise and reported in Appendix E.2.

[11] Unlike the first two measures, this measure has a free parameter. In Section 4.3, we describe how we estimate $\bar{\rho}$.

where $\tilde{\rho}_i^d = \rho_i^d/(\rho_i^d + (1-\rho_i^d)s_{Fi})$. How much domestic prices move relative to marginal cost depends on the sales share of foreign competitors within i and the tariff hike in i.[12] The conditional own-cost pass-through parameter ρ_i^d depends on market structure and the elasticity of substitution between products.

Because $\bar{\rho}$ enters (48) inside the network inverse, it reshapes which commodities the network treats as exposed rather than scaling the predicted response by a common factor. The foreign-competition channel and network propagation therefore interact rather than adding up, which is the property the estimator in Section 4.3 exploits. Appendix A.3 shows that the mapping can still be split into additive components, none of which is a common rescaling of the others.

4.2 Local-Projection Pass-Through

We test how each of these predicted responses compares to the actual data using local projections following Jordà (2005) in the difference-in-differences design of Dube et al. (2025). For each horizon $h \in \{1, \ldots, H\}$ with $H = 12$ we estimate

$$\begin{aligned} \Delta_h \log p_{i,t+h} \;=\; & \alpha_i + \delta_t + \beta_h \,\Delta \log p_{i,t}^{M} + \sum_{\substack{k=-(h-1) \\ k\neq 0}}^{H} \kappa_{h,k}\, \Delta \log p_{i,t-k}^{M,\text{stat}} + \lambda_h \,\Delta \log w_{i,t-1} \\ & + \sum_{k=0}^{H} \psi_{h,k}\, o_{i,t-k} + \varepsilon_{i,t+h}, \end{aligned} \tag{50}$$

where $\Delta_h \log p_{i,t+h} \equiv \log p_{i,t+h} - \log p_{i,t-1}$ is the cumulated log-price change from $t-1$ to $t+h$, $\Delta \log p_{i,t}^{M}$ is the model-implied price response of item (or industry) i from Section 4.1, $\Delta \log p_{i,t}^{M,\text{stat}}$ is its statutory counterpart, and $\Delta \log w_{i,t-1}$ is one lag of wage growth. Each predicted response is instrumented with its counterpart constructed from statutory rates. The leads and lags account for the serially correlated nature of the 2025 tariff waves, while item and date fixed effects isolate the cross-sectional variation in tariff exposure, absorbing general equilibrium forces and category-specific pre-trends. In this section, we estimate the projection on the PPI panel, where i is a NAICS commodity; in the next section, we estimate it on the PCE panel, where i is a NIPA expenditure category. We consider shocks between 2024 and August 2025, the last month for which the effect can be projected over the following 12

[12] Appendix A.2 analyzes the role of the within-industry covariance between firm-level pass-through and import exposure. It provides conditions under which this covariance reduces to a single industry-level parameter γ_i. In the strategy of this section, however, these parameters are absorbed by our estimated $\bar{\rho}$. Our generalized methods of moments (GMM) moment conditions exploit cross-sectional variation in import exposure that would otherwise be attributed to γ, rendering a separate parameter unnecessary.

months, and we hold the sample fixed across all 12 horizons.[13] Standard errors are clustered by item.

The regressor is a price change predicted by the model, not a tariff rate, so β_h is a test of the prediction rather than a pass-through elasticity: $\beta_h = 1$ says that by horizon h observed prices have moved by the amount the model predicts, $\beta_h > 1$ says the model understates the pressure, and $\beta_h < 1$ says pass-through is incomplete through the lens of the model.

4.3 Estimating Strategic Complementarities

As discussed, the first two predicted responses contain no free parameters: they follow from the input–output tables and the observed tariff change. However, the third introduces $\bar{\rho}$, the average conditional own-cost pass-through, which we do not observe. We estimate it by generalized method of moments (GMM), requiring that the long term residuals from equation (50) satisfy two model-implied conditions.

Let $\tilde{\cdot}$ denote residuals after projecting on the fixed effects and controls of equation (50), and let $y_{i,t+h_{\text{ref}}}$ be the h_{ref}-month forward log price change. The residual at the reference horizon implied by the model under $\bar{\rho}$ is $u_{i,t}(\bar{\rho}) = \tilde{y}_{i,t+h_{\text{ref}}} - \widetilde{\Delta \log p_{i,t}^{M}}(\bar{\rho})$. We impose two moment conditions on it:

$$\underbrace{\mathbb{E}\Big[\widetilde{\Delta \log p_{i,t}^{M,\text{stat}}}(\bar{\rho})\, u_{i,t}(\bar{\rho})\Big]}_{\text{correct } \textit{scale}} = 0, \qquad \underbrace{\mathbb{E}\Bigg[\left(\frac{\partial \widetilde{\Delta \log p_{i,t}^{M,\text{stat}}}}{\partial \bar{\rho}}\right) u_{i,t}(\bar{\rho})\Bigg]}_{\text{correct } \textit{tilt}} = 0. \tag{51}$$

The first moment requires that the model predict the right overall *magnitude* of price pressure: a unit of predicted price pressure should move producer prices one-for-one. The second moment requires that the model predict the right cross-sectional *shape*: lowering $\bar{\rho}$ raises predicted pressure more for commodities exposed to foreign competition than for those exposed only through input costs, and the second moment asks that this reallocation match the data. The parameter is thus identified from the model's implied cross-sectional pattern of tariff pressure, not chosen to force the aggregate pass-through to one.

The identification assumption this requires is a conditional-mean restriction, $\mathbb{E}\big[u_{i,t}(\bar{\rho}_0) \mid \mathcal{Z}\big] = 0$, where $\mathcal{Z}$ is the exogenous statutory information set. In other words, no force outside equation (45) can move prices in a way that lines up either with the statutory tariff variation or with the way the network redistributes it across commodities.[14]

This design has two advantages over estimating $\bar{\rho}$ directly from the interaction of sales

[13] This gives us 5,145 observations and 258 items.

[14] Appendix F relaxes these restrictions and shows that the estimated $\bar{\rho}$ is stable.

shares and tariff shocks, $\mathbf{S}_F \, d\log(1+\boldsymbol{\tau})$, as in Amiti, Redding and Weinstein (2019) and Flaaen and Pierce (2024). First, the network nature of our model implies that strategic complementarities interact with marginal costs and the structure of the economy nonlinearly; neglecting network spillovers is a SUTVA violation. Second, we do not allow the sensitivity of prices to sales shares to be completely decoupled from the sensitivity to marginal cost. While our model allows—to some extent—for nonhomogeneity of the two sensitivities via pass-through in levels, we still impose the restriction that a high sensitivity to $\boldsymbol{S}_F$ implies a lower sensitivity to marginal cost via $\boldsymbol{\Omega}^*$.

Table 1 presents the GMM estimate and inference statistics. The two conditions pin down $\hat{\bar{\rho}} = 0.655$ (95% confidence set $[0.433, 0.886]$). This means that a producer's pricing decision places about two-thirds of the weight on its own marginal cost and the remaining third on the price of the imported varieties it competes with.[15] We directly test what happens when we shut down the foreign competition channel by setting $\bar{\rho} = 1$; this benchmark is rejected at the 1% level ($S = 10.35$, $p = 0.006$). This shows how without strategic complementarities, the model cannot match both the overall magnitude and the cross-sectional pattern of price changes.

Table 1: GMM Estimate of the Common Conditional Own-Cost Pass-through $\bar{\rho}$

Quantity	Estimate
$\bar{\rho}$	0.655
95% confidence set	[0.433, 0.886]
β_9 at $\bar{\rho} = 1$	2.314 (0.537)
β_9 at $\hat{\bar{\rho}}$	1.173 (0.271)
$J = S(\hat{\bar{\rho}})$, p (1 df)	1.56 [0.211]
$S(\bar{\rho} = 1)$, p (2 df)	10.35 [0.006]
First-stage F at $\hat{\bar{\rho}}$	10315.4
Observations	5,145
Items (clusters)	258

Notes: One common average marginal cost pass-through $\bar{\rho}$ estimated from the two moments of (51), at reference horizon 9. $\hat{\bar{\rho}}$ minimises the item-clustered criterion (F.6) on a 0.02 grid over [0.02, 1], and the 95% confidence set collects the values that criterion does not reject, $\{\bar{\rho} : S(\bar{\rho}) \leq \chi^2_{2,0.95} = 5.99\}$. The rows β_9 at $\bar{\rho} = 1$ and at $\hat{\bar{\rho}}$ are local-projection coefficients with item-clustered standard errors in parentheses. $J = S(\hat{\bar{\rho}})$ tests $\beta_9 = 1$ against $\chi^2_{1,0.95} = 3.84$, and $S(\bar{\rho} = 1)$ tests that restriction jointly with $\bar{\rho} = 1$ itself against $\chi^2_{2,0.95}$; p-values in brackets.

[15] This estimate is in line with estimates of the same weight using firm and competitor prices: Amiti, Itskhoki and Konings (2019) estimate that a typical firm places roughly 0.6 of the weight on its own costs, which lies within our confidence set, and 0.4 on competitors' prices.

In Appendix F, we consider two extensions of our model, both with implications for the estimate $\bar{\rho}$. First, we consider the covariance term between firm-level pass-through and import exposure ($\mathbb{C}^*$), which arises from aggregating firm pricing rules within an industry. In our baseline estimation, we implicitly set it to zero; however, Appendix F.2 estimates both $\bar{\rho}$ and $\mathbb{C}^*$. The procedure returns $\hat{\bar{\rho}} = 0.719$ and again rejects $\bar{\rho} = 1$.[16] Second, we run a robustness specification where we let ρ vary with market concentration (see Appendix F.4). This results in a median industry-level ρ_j of 0.652, which is close to our baseline estimate, albeit with large standard errors.

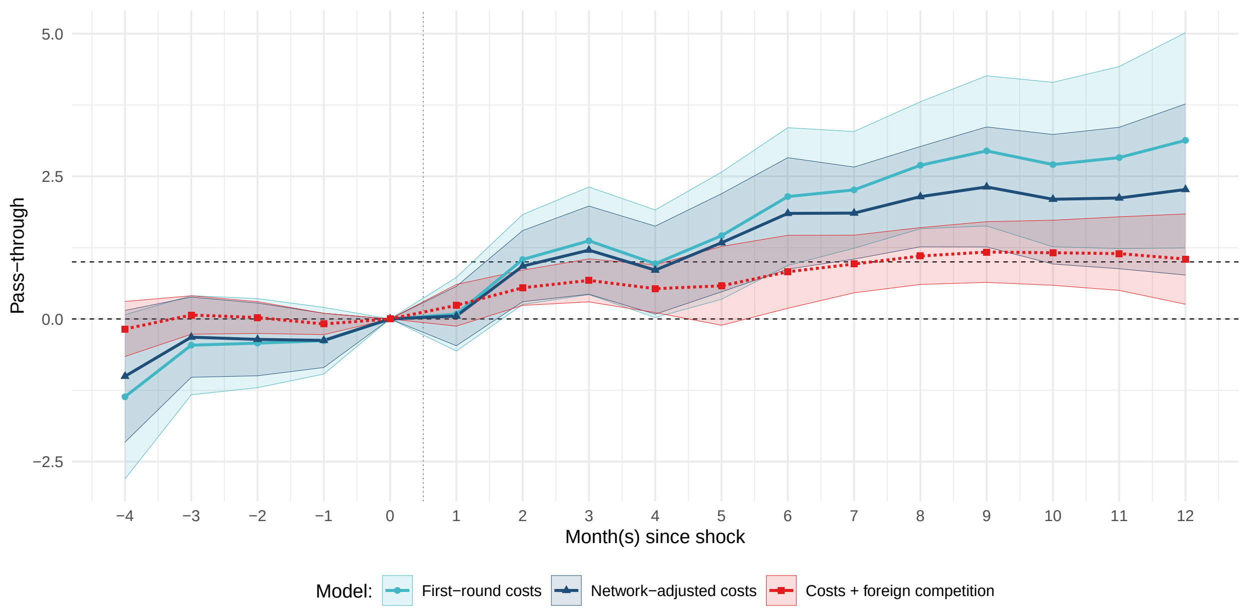
4.4 Pass-Through Results

Figure 3 summarizes the nested local projection exercise. We evaluate each model of predicted price response in turn, taking horizon 9 as the reference for the long-term pass-through. For the first-round cost response we get $\hat{\beta}_9 = 2.946$ (0.672), and once domestic network propagation is added we get $\hat{\beta}_9 = 2.314$ (0.537). Both are rejected against $\beta_9 = 1$ ($p = 0.004$ and $p = 0.014$, respectively). The finding that both coefficients exceed one implies that neither of these models can account for full price movements. Network propagation raises the model-implied response, but the parameter-free models still predict substantially less producer-price pressure than appears in the data. Switching on the foreign-competition channel at $\hat{\bar{\rho}}$ brings the producer-price coefficient to $\beta_9 = 1.173$ (0.271), which is within one standard error of one; the restriction $\beta_9 = 1$ is not rejected (see Table 1). In other words, once the competition channel is switched on at the estimated strength, the model's predicted price response matches the data. Of the distance between the first-round response and one-for-one pass-through, network propagation covers about a third and the foreign-competition channel a further three-fifths.

The movement of domestic prices by more than own-cost exposure implies is also a feature of the 2018–19 evidence. Amiti, Redding and Weinstein (2019) and Fajgelbaum et al. (2020) find that the domestic prices of import-competing goods rose alongside the tariffed import prices, and Flaaen and Pierce (2024) document the same protective effect in industry-level US manufacturing producer prices. Amiti, Heise and Weinstein (2026) report it for the 2025 episode in matched import and producer prices. Our β_h multiplies a model-implied price change rather than a tariff rate, so the coefficients are not directly comparable, but the direction is the same. In our setting, prices move more than the model predicts even after accounting for network propagation.

[16] The covariance wedge is weakly identified in the joint estimation. Conditioning on a negative covariance (per the findings of Amiti, Itskhoki and Konings (2019)) strengthens rather than eliminates the foreign-competition channel (Appendix F.3).

Figure 3: PPI Tariff Pass-through — First-Round Costs, Network-Adjusted Costs, and Foreign Competition, 2025 Episode



Notes: $\hat{\beta}_h$ from (50) for the 2025 episode, producer prices, pass-through in levels; item i is a BEA industry. Each line uses a different model-implied exposure from (49) and is estimated in its own regression: the first-round imported-input cost response and the network-adjusted cost response, both at $\rho = 1$, and the network-adjusted response with the foreign-competition channel evaluated under $\rho = \hat{\bar{\rho}}$. Dashed lines mark zero and complete pass-through. Bands are 95% confidence intervals clustered by item.

Switching on the foreign-competition channel also improves fit and pre-trend behavior. First, fit: the partial R^2 goes from 0.0023 for the first-round response, 0.0022 with network propagation added and 0.0033 at $\hat{\bar{\rho}}$.[17] Second, pre-trend: under the network-adjusted cost measure there is some evidence that producer prices were already moving against the schedule before it took effect; rebuilding the predicted response at $\hat{\bar{\rho}}$ flattens the pre-period. The industries the foreign-competition-augmented model predicts to move most are not the ones already drifting upward before the tariffs were introduced.

Robustness In Appendix E, we run a number of robustness exercises. First, we report the results of analyzing the 2018–2019 tariffs instead of the 2025 tariffs. The earlier episode presents more identification issues: the specification fails the pre-trend test at every horizon, and standard errors are roughly two and a half times as large. The episode is too noisy to discipline $\bar{\rho}$, but qualitatively we get similar results in the local projections: including

[17]The partial R^2 values are small in magnitude because item and date fixed effects and the control block absorb almost all of the variance of monthly producer-price changes; only the comparison across the three measures is informative.

the network brings the coefficient on the first-round measure down somewhat, while the full-model coefficient including the foreign-competition channel is $\beta_9 = 1.248$. The criterion is minimized at $\hat{\bar{\rho}} = 0.697$, close to the 2025 estimate, but the confidence set [0.238, 1.000] is wide enough that $\bar{\rho} = 1$ is not rejected. We next modify the predicted price response to reflect pass-through in logs. We then consider alternative specifications: allowing positive and negative tariff changes to enter with separate coefficients, restricting the PCE panel to goods categories, using the legally-enacted tariff schedule in constructing the instrument, and using the statutory tariff schedule in constructing the treatment.

4.5 Why Strategic Complementarities Amplify the 2025 Tariff Shock

Including strategic complementarities lowers the estimated pass-through coefficient towards one by raising the model-implied response to tariffs. This may sound counterintuitive because strategic complementarity is usually the force that attenuates shocks to marginal costs: a firm that cares about its rivals' prices absorbs part of a cost increase in its margin instead of passing it on (Atkeson and Burstein, 2008). In this model, however, tariffs directly affect both marginal costs and competitors' prices. Whether strategic complementarities raise or lower the model-implied response relative to the price-taking benchmark depends on the changes in the full tariff schedule and is episode specific.

To illustrate this, we start by rewriting the industry-level pass-through equation (49) so that the two forces appear separately,

$$d\log p_i^d = \upsilon_i^d \ \mathbb{E}_{\tilde{\boldsymbol{\delta}}_i}[d\log \mathbf{mc}_i] + (1-\tilde{\rho}_i)\big[d\log p_{Fi} - \upsilon_i^d \ \mathbb{E}_{\tilde{\boldsymbol{\delta}}_i}[d\log \mathbf{mc}_i]\big] \ . \tag{52}$$

The first term is the own-cost response. The second is the foreign-competition channel, weighted by $1-\tilde{\rho}_i$, which rises as ρ falls. The sign of this second term depends on the relative strength of two price changes: the price change of the imported varieties industry i competes against and the change in i's own marginal cost.

To understand this equation, we start by describing the simple case of a shock that reaches industry i through its costs only. In other words, its inputs become more expensive, while the imported goods it competes with do not. In this case, the bracketed term is negative, and lowering ρ away from one lowers the predicted price response, since the firm holds its price closer to its unchanged rivals'.

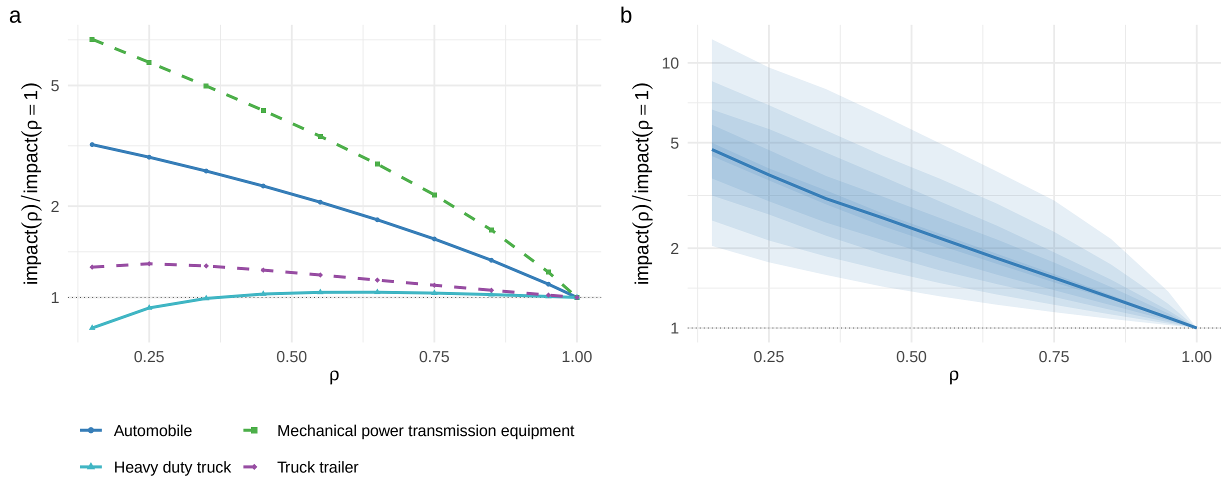
The 2025 tariff changes, however, mostly did not affect industries only through their marginal costs. Rather, tariffs were primarily applied at the country-level, with widespread effects felt in all industries. Thus, for most commodities, the imported varieties a domestic producer competes with became more expensive, and the bracketed term was positive. This implies that the foreign-competition channel adds to the own-cost term instead of offsetting it, such that lowering ρ *raises* the predicted impact. This is the protectionist effect that Amiti, Redding and Weinstein (2019) and Flaaen and Pierce (2024) document for the 2018–19 tariffs, here operating on top of network cost propagation rather than on its own.

Figure 4 illustrates how the amplification varies across manufacturing commodities. Both panels plot how the predicted price impact (normalized by the price impact at $\rho = 1$) varies with ρ. Panel (a) zooms in on four specific commodities. To start, consider automobiles and heavy duty trucks. Both have the same 4-digit NAICS industry code, and both draw on the same steel- and aluminum-intensive input basket. However, the April 2025 Section 232 tariff action covered finished automobiles and carved heavy duty trucks out, such that only automobiles faced an increase in foreign competitor prices.[18] Thus, the automobile price response rises as ρ falls, while the truck price response falls with ρ. The panel also shows two additional commodities: mechanical power transmission equipment, which has among the highest amplification from the foreign competitor price channel, and truck trailers, which has among the lowest. Panel (b) pools all 232 manufacturing commodities and shows quantile bands of amplification.[19]

[18] Over the estimation window, the cumulated foreign-competitor price change is 13.4 percentage points for automobiles and 1.6 for trucks.

[19] Of all the manufacturing commodities, heavy duty trucks are the only commodity whose predicted response falls with ρ.

Figure 4: ρ-sensitivity of the predicted PPI impact — 2025 Episode



Notes: Both panels plot the predicted PPI impact at ρ, normalized by the same commodity's impact at $\rho = 1$. The vertical axis is logarithmic. Impacts are cumulated over January–October 2025 under pass-through in levels, on Detail BEA commodities with commodity-specific source-region import weights (Appendix D.4). Panel (a) shows automobiles (336111), heavy duty trucks (336120), mechanical power transmission equipment (333613), and truck trailers (336212). Panel (b) shows all 232 manufacturing commodities, with the cross-commodity median and nested quantile bands at the 5–95, 15–85, 25–75, 35–65, and 45–55 percentile ranges.

5 Consumer-Price Evidence

The producer-price results establish that the model's predicted response matches observed price movements, and that the foreign-competition channel is needed to close the gap between exposure and observed prices. We now carry the model-implied producer response through the retail layer to consumer prices in order to test tariff pass-through into PCE.

5.1 Mapping Producer Prices into PCE Categories

Each expenditure category sources from multiple domestic and imported commodities. Let $\boldsymbol{\Theta}^d = [\theta^d_{ej}]_{e\in\mathcal{E},\, j\in\mathcal{I}}$ and $\boldsymbol{\Theta}^* = [\theta^*_{ej}]_{e\in\mathcal{E},\, j\in\mathcal{I}}$ denote expenditure-category sourcing matrices, where θ^d_{ej} (θ^*_{ej}) is the cost share of domestic (imported) commodity j in the marginal cost of expenditure category e. The retailer marginal-cost vector is then

$$\mathrm{d}\log \mathbf{mc}^r = \boldsymbol{\Theta}^d \mathrm{d}\log \boldsymbol{p}^d + \boldsymbol{\Theta}^* \mathrm{d}\log \boldsymbol{p}^*. \tag{53}$$

The matrix $\boldsymbol{\Theta}^d$ captures retailers' exposure to domestically produced commodities, whose prices already reflect imported-input shocks propagated through the domestic production network. The matrix $\boldsymbol{\Theta}^*$ captures retailers' exposure to imported finished commodities.

Because all firms within an expenditure category are domestic retailers, there is no foreign-competitor-price term at this layer and no unobserved competition parameter to estimate.

Under Corollary 1, the expenditure-category price vector satisfies $\mathrm{d}\log \boldsymbol{p} = \boldsymbol{\Upsilon}^r \mathrm{d}\log \mathbf{mc}^r$, where $\boldsymbol{\Upsilon}^r$ is the diagonal markup-adjustment matrix. We can then use the latter expression and equation (53) to define the model-implied PCE effect as:

$$\Delta \log \boldsymbol{p}^{M,PCE}(\bar{\rho}) = \underbrace{\boldsymbol{\Upsilon}^r \boldsymbol{\Theta}^d \Delta \log \boldsymbol{p}^M(\bar{\rho})}_{\text{Domestic-production}} + \underbrace{\boldsymbol{\Upsilon}^r \boldsymbol{\Theta}^* \Delta \log(1+\tau)}_{\text{Final-import}}. \tag{54}$$

Equation (54) decomposes the consumer-price response into two channels: a final-import channel, in which imported finished commodities enter retailer costs without passing through the domestic production network, and a domestic-production channel, in which border-price changes propagate through domestic producer prices and the input-output network into retailer costs. The key result of equation (54) is that, conditional on competition effects in domestic-production, all objects in the right-hand side are observable in the data. We can thus construct the model-implied price response $\Delta \log p^M_{e,t}(\bar{\rho})$ of expenditure category e, which enters the projection (50) in place of the producer-side response. We estimate the same pass-through regardless of the channel in equation (54).

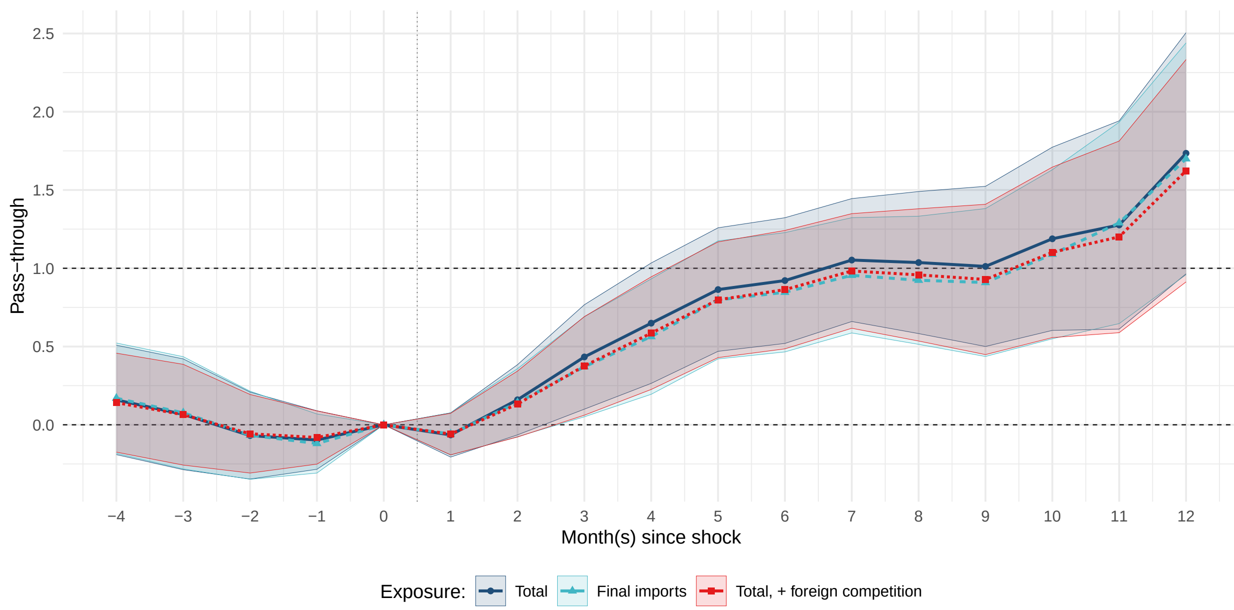
5.2 PCE Pass-Through

We estimate the local projection (50) on the PCE panel, replacing the producer-side response with the expenditure-category response from equation (54). Similar to the successive simplifications we considered when calculating predicted PPI response, we now consider three versions of building equation (54): only the final-import component, the total of the domestic-production and final-import components, and a version of this total, with the domestic-production component calculated using the previously estimated $\hat{\bar{\rho}} = 0.655$.

The results in Figure 5 shows that the model-implied response matches the magnitude of the realized consumer-price response. Zooming in on nine months after the shock, we find $\hat{\beta}_9 = 1.012$ (0.261) for the model estimated with $\rho = 1$ (dark blue line) and $\hat{\beta}_9 = 0.929$ (0.245) for the model estimated with $\hat{\bar{\rho}}$ (red line). In both cases, coefficients are statistically indistinguishable from full pass-through in both cases.

Figure 5 also shows that the PCE pass-through estimates are driven almost entirely by the final-import component of tariff exposure; replacing total exposure with the final-import exposure component produces very similar dynamic coefficients. This implies that we cannot take Figure 5 as an "out-of-sample" test for how well the model-implied domestic-production price fits the data. However, the result should not be read as evidence that the domestic-

Figure 5: PCE Tariff Pass-through — Total and Final-Import Exposure, 2025 Episode



Notes: $\hat{\beta}_h$ from (50) for the 2025 episode, PCE consumer prices, pass-through in levels; item i is a NIPA expenditure category. Total exposure and its final-import component are estimated in separate regressions and overlaid; the third line rebuilds the domestic-production component of total exposure at the $\hat{\bar{\rho}}$ of Section 4.3. Estimator and controls as in Section 4.2, with the contemporaneous exposure term only. Dashed lines mark zero and complete pass-through. Bands are 95% confidence intervals clustered by item.

production channel is negligible either. It instead indicates that the PCE specification has limited independent variation with which to separately identify the domestic-production channel.

There is a simple reason for this. The final-import component preserves the sharp cross-sectional differences in final import content across expenditure categories. The domestic-production component, by contrast, is filtered through the domestic input-output network and then mapped into aggregate NIPA categories, after being shrunk further by retailers, wholesalers, and transportation margins. This procedure is economically important for measuring total exposure, but it also compresses the relevant cross-sectional variation. For this reason, producer-price data, which are closer to the domestic production network and available at a less aggregated industry level, provide a more suitable setting for assessing the domestic-production channel.

6 From Pass-through to Aggregate Contribution

The estimates in the last section exploited cross-sectional variation. By themselves, they do not answer the question of how much tariff changes map to aggregate PCE inflation. Rather, this requires combining the in-sample estimated parameters with the aggregate model-implied exposure to the 2025 tariff rounds.

We compute the model-implied exposure under two estimated parameters: $\bar{\rho}$, which regulates strategic complementarities, and $\hat{\beta}^r$, the pass-through at the retail level estimated in the previous section.[20]. Although we use level pass-through in our baseline empirical specification, our methodology does not allow us to reject a log pass-through model as opposed to a levels pass-through model. Therefore, we also show results with the ratio of total costs over sales $\boldsymbol{\Upsilon}^r$ and $\boldsymbol{\Upsilon}^d$ as implied by the data (pass-through in levels) and $\boldsymbol{\Upsilon^r} = \boldsymbol{I}; \boldsymbol{\Upsilon^d} = \boldsymbol{I}$ (pass-through in logs).

To simplify the math, recall the definition of $\tilde{\rho}$ from equation (49): $\tilde{\rho}_i^d = \rho_i^d/(\rho_i^d + (1 - \rho_i^d)s_{Fi})$, which we collect in the diagonal matrix $\tilde{\boldsymbol{\rho}} \equiv \text{diag}(\tilde{\rho}_i^d)$. Then, we can rewrite the model-implied PCE effect in equation (54) under the estimated pass-through in Figure 5 as:

$$\Delta \log \boldsymbol{p}^{M,PCE}(\hat{\bar{\rho}}, \hat{\beta}^r) = \hat{\beta}^r \, \boldsymbol{\Upsilon}^r \Big[\boldsymbol{\Theta}^* + \boldsymbol{\Theta}^d \big[\boldsymbol{I} - \hat{\tilde{\boldsymbol{\rho}}} \boldsymbol{\Upsilon}^d \boldsymbol{\Omega}^d\big]^{-1} \big[\hat{\tilde{\boldsymbol{\rho}}} \boldsymbol{\Upsilon}^d \boldsymbol{\Omega}^* + (\boldsymbol{I} - \hat{\tilde{\boldsymbol{\rho}}})\big]\Big] \Delta \log(1 + \boldsymbol{\tau}). \quad (55)$$

Equation (55) is equation (48) carried through the retail layer. We split the above equation into five channels, summarizing the impact of tariffs via:

- **Final imports**: foreign final goods purchased by consumers. This component is proportional to the share $\boldsymbol{\Theta}^*$.

- **Imported inputs, first round**: domestic goods price increase, under a monopolistic-competition model without network amplification. This component is proportional to $\boldsymbol{\Theta}^d \boldsymbol{\Upsilon}^d \boldsymbol{\Omega}^*$.

- **Imported inputs, supply-chain rounds**: domestic goods price increase, under a monopolistic-competition model with network amplification, and net of the first-round effect above.

- **Competition, own market**: domestic goods price increase, under an oligopolistic-competition model without network amplification, and net of the effects equivalent to a monopolistic-model.

[20] Another potential parameter would be the pass-through into domestic prices, estimated in Figure 3. Since the estimation of $\bar{\rho}$ partly targets the scale of this parameter, we assume it is 1 (the average long term level observed in Figure 3 under $\hat{\bar{\rho}}$)

- **Competition, supply-chain rounds**: domestic goods price increase from the additional network rounds the competition channel above generates, net of the imported-inputs supply-chain rounds.

Appendix A.3 derives the five components above from (55).

All components carry the estimated pass-through $\hat{\beta}^r$ at horizon 9, estimated in Figure 5 (0.929 under level pass-through, 0.755 for log pass-through). Therefore, results are interpretable as the 9-month-ahead effect of tariff increases. We focus on the cumulated tariff effects paid between January and October 2025, as this coincides with the period in which tariffs were *increasing*.[21] After computing the cumulated effect for each category in $\Delta \log \boldsymbol{p}^{M,PCE}$, we aggregate using 2024 PCE weights.

Figure 6 reports the aggregate contribution and splits it into the five channels. Panel (a) shows how over the analyzed time frame, the contributions sum to 0.91 percentage points of headline PCE, under the assumption of pass-through in levels. Final imports account for more than half of the aggregate PCE effect. Network adjusted costs, on the other hand, account for around one third of the total predicted PCE effect. The foreign competition channel added 0.10, which is not negligible but smaller in magnitude than the other two channels. Panel (b) shows that the predicted effect from the log pass-through model is 0.2 p.p. higher than under level pass-through. The difference comes almost fully from the higher predicted network effect, which arises because log pass-through implies double marginalization across the supply chain.

Heterogeneity. An useful aspect of our model is that it allows us to decompose Figure 6 further across different dimensions. We explore some dimensions in Appendix G that we briefly outline here.

Tariffs Timing (Figure G.1) The bulk of the total effect was generated between March and May, with some other relatively small increases from July to October.

Tariffed Commodities (Figure G.2). The top 3 tariffed commodities contributing to aggregate effects were Electrical Machinery, Vehicles, and Machinery. For the majority of commodities, the final imports channel was their more important contribution to PCE followed by the imported inputs: supply-chain rounds. This highlights the crucial role of the production network.

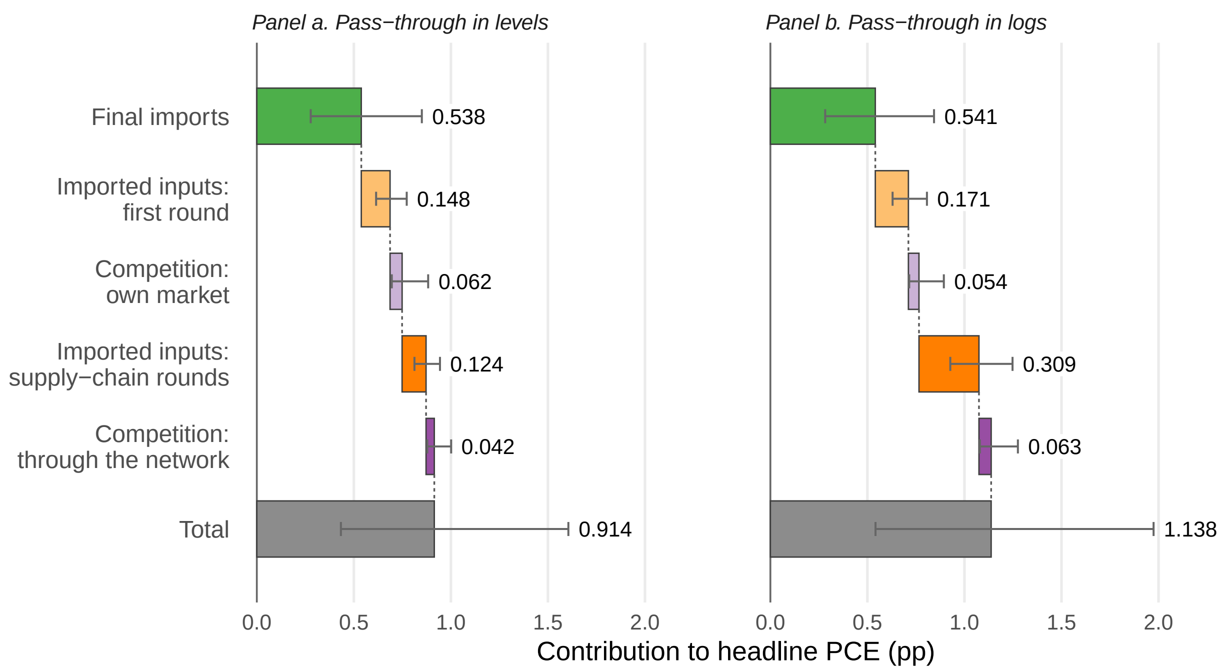
Sourcing Country (Figure G.3). China, Vietnam and India were the countries that contributed the most to aggregate PCE according to our estimates. As with the tariffs timing

[21] It is possible to apply the same parameters beyond October 2025. This is because we do not find any statistically different effects between tariff increases and decreases in sample (see Figure E.4 in the Appendix). However, we do not know the full effects of tariff decreases yet and most of our variation comes from tariff increases, as of the time of the writing.

exercise, tariffs on final imports accounted for around two-thirds of the contribution of each country, with significant heterogeneity across countries.

Consumption Categories (Figure G.4). The final consumption categories that contributed the most to aggregate effects were new motor vehicles, garments and food and non-alcoholic beverages. Across these categories, the most important effect was final imports, followed by the supply chain rounds through imported inputs and competition effects in the own market. Additionally, there were twenty-eight categories with individual contributions below one percent that together accounted for a quarter of the total contribution. These are mostly services, which are fully exposed to higher costs of materials and competition effects.

Figure 6: Contribution of the January–October 2025 Tariff Increases to Headline PCE



Notes: First-order contribution of the effective tariff increases from January to October 2025 to headline PCE inflation, in percentage points, cumulated over the episode. The five components are defined in Appendix A.3 and main body of the text. Panel a is pass-through in levels, with $\hat{\bar{\rho}} = 0.655$, 95% set $[0.433, 0.886]$, and $\hat{\beta}^r = 0.929$ $[0.479, 1.467]$; panel b is pass-through in logs, with $\hat{\bar{\rho}} = 0.679$ $[0.438, 0.945]$ and $\hat{\beta}^r = 0.755$ $[0.394, 1.177]$. Whiskers are the contribution intervals over $\hat{\bar{\rho}}$'s set and $\hat{\beta}^r$'s interval jointly.

7 Conclusion

This paper develops and estimates a framework that maps border price shocks through domestic production networks and oligopolistic pricing into producer and consumer prices. Applied to the 2025 US tariffs, the data confirm essentially complete pass-through at the border. A model in which tariffs affect domestic producers only through their own costs substantially understates the subsequent PPI response even after input-output propagation is taken into account. Allowing domestic firms to respond to higher prices of competing imported varieties closes most of this gap, and estimating the strength of this channel from the scale and cross-sectional pattern of producer-price responses gives $\hat{\bar{\rho}} = 0.655$. The resulting model is consistent with both producer- and consumer-price responses.

Because the framework maps the tariff schedule into the full PCE expenditure system, the same estimated model can also be aggregated using observed expenditure weights in order to calculate the contribution of tariffs to PCE. On this basis, the January–October 2025 tariff increases, treated as permanent, imply a first-order contribution of 0.91 percentage points to headline PCE inflation, including 0.10 percentage points from the oligopolistic competition channel.

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A Model Details

A.1 Price indices

A.1.1 Intermediate input price indices

$$p^x_{fi}(\{p^x_{fi,j}\}_{j\in\mathcal{I}}) = \min_{\{x_{fi,j}\}_{j\in\mathcal{I}}} \left\{ \sum_{j\in\mathcal{I}} p^x_{fi,j} x_{fi,j} \quad \text{s.t.} \quad x_{fi}(\{x_{fi,j}\}_{j\in\mathcal{I}}) \geq 1 \right\}, \tag{A.1}$$

$$p^x_{fi,j}(\{p_{gj}\}_{g\in\mathcal{D}_j}) = \min_{\{x_{fi,gj}\}_{g\in\mathcal{D}_j}} \left\{ \sum_{g\in\mathcal{D}_j} p_{gj} x_{fi,gj} \quad \text{s.t.} \quad x_{fi,j}(\{x_{fi,gj}\}_{g\in\mathcal{D}_j}) \geq 1 \right\}, \tag{A.2}$$

Both aggregators define price indices as a function of firms' prices:

$$p^x_{fi,j} = p^x_{fi,j}(\{p_{gj}\}_{g\in\mathcal{D}_j}), \tag{A.3}$$

which is the price paid by firm f in industry i for inputs from j and

$$p^x_{fi} = p^x_{fi}(\{p^x_{fi,j}\}_{j\in\mathcal{I}}), \tag{A.4}$$

is the *domestic* intermediate input bundle paid by firm f in industry i.

Up to a first-order approximation both price indices (equations A.3 and A.4) satisfies

$$\mathrm{d}\log p^x_{fi,j} = \sum_{g\in\mathcal{D}_j} \frac{p_{gj} x_{fi,gj}}{p^x_{fi,j} x_{fi,j}} \mathrm{d}\log p_{gj} = \sum_{g\in\mathcal{D}_j} \omega_{fi,gj} \mathrm{d}\log p_{gj} \tag{A.5}$$

$$\mathrm{d}\log p^x_{fi} = \sum_{j\in\mathcal{I}} \frac{p^x_{fi,j} x_{fi,j}}{p^x_{fi} x_{fi}} \mathrm{d}\log p^x_{fi,j} = \sum_{j\in\mathcal{I}} \omega_{fi,j} \mathrm{d}\log p^x_{fi,j} \tag{A.6}$$

In the main text, we showed the assumption we needed to empirically implement our model with the available data. We repeat the assumption here so that this appendix is self-contained.

Assumption A.1 (Aggregation of input expenditure shares)**.** *For every pair of industries i, j,*

$$\sum_{f\in D_i} \widetilde{\delta}_{fi} \rho_{fi} \Omega_{fi,j} \omega_{fi,gj} = \rho^d_i \Omega_{i,j} s^d_{gj} \qquad \textit{for every } g \in D_j,$$

$$\sum_{f\in D_i} \widetilde{\delta}_{fi} \rho_{fi} \Omega^*_{fi,j} = \rho^d_i \Omega^*_{i,j},$$

where

$$\rho_i^d \equiv \sum_{f \in D_i} \widetilde{\delta}_{fi} \rho_{fi}.$$

As before, $\omega_{fi,gj}$ is supplier gj's share of firm fi's expenditure on domestic inputs from industry j.

$\Omega_{fi,j}$ and $\Omega^*_{fi,j}$ are expenditures on domestic and imported inputs from industry j as shares of firm fi's total variable costs, which we define as:

$$\Omega_{fi,j} \equiv \frac{p^x_{fi,j} x_{fi,j}}{VC_{fi}}, \quad \Omega^*_{fi,j} \equiv \frac{p^*_j x^*_{fi,j}}{VC_{fi}}$$

The corresponding industry-level total-variable-cost shares are $\Omega_{i,j}$ and $\Omega^*_{i,j}$ are:

$$\Omega_{i,j} \equiv \sum_{f \in D_i} \frac{p^x_{fi,j} x_{fi,j}}{VC_i^d} \equiv \sum_{f \in D_i} \tilde{\delta}_{fi} \Omega_{fi,j}, \quad \Omega^*_{i,j} \equiv \sum_{f \in D_i} \tilde{\delta}_{fi} \Omega^*_{fi,j},$$

where we define $\tilde{\delta}_{fi} = VC_{fi}/VC_i^d$. All shares and pass-through coefficients are evaluated at the initial equilibrium.[22]

Assumption A.1 allows input expenditure shares and marginal-cost changes to differ across firms, but still allows us to use the producer price index for other industries as the relevant price that enters marginal cost calculations. Holding wages and productivity fixed, each firm's marginal-cost change satisfies

$$\mathrm{d}\log mc_{fi} = \sum_j \Omega_{fi,j} \sum_{g \in D_j} \omega_{fi,gj} \, \mathrm{d}\log p_{gj} + \sum_j \Omega^*_{fi,j} \, \mathrm{d}\log p^*_j.$$

Multiplying by $\widetilde{\delta}_{fi} \rho_{fi}$ and summing across domestic firms yields

$$\begin{aligned}
&\sum_{f \in D_i} \widetilde{\delta}_{fi} \rho_{fi} \, \mathrm{d}\log mc_{fi} \\
&\quad = \sum_j \sum_{g \in D_j} \left(\sum_{f \in D_i} \widetilde{\delta}_{fi} \rho_{fi} \Omega_{fi,j} \omega_{fi,gj} \right) \mathrm{d}\log p_{gj} + \sum_j \left(\sum_{f \in D_i} \widetilde{\delta}_{fi} \rho_{fi} \Omega^*_{fi,j} \right) \mathrm{d}\log p^*_j \\
&\quad = \rho_i^d \left(\sum_j \Omega_{i,j} \, \mathrm{d}\log p_j^d + \sum_j \Omega^*_{i,j} \, \mathrm{d}\log p^*_j \right),
\end{aligned}$$

[22] If a firm purchases no domestic inputs from industry j, its joint expenditure share $\Omega_{fi,j}\omega_{fi,gj}$ is defined to be zero.

where the last equality uses the assumption and the definition $\mathrm{d}\log p_j^d = \sum_{g \in D_j} s_{gj}^d \,\mathrm{d}\log p_{gj}$.

Thus, the marginal-cost term entering the industry pricing equation is unchanged, even though individual firms need not experience the same marginal-cost change.

A.2 Channels of Sectoral PPI Changes

We provide more details about equation (37) in Proposition 3.

Equation (37) shows how domestic price indices react to a change in the foreign price $\mathrm{d}\log p_{Fi}$ and firms' marginal costs $\mathrm{d}\log mc_{fi}$. We can rewrite it as[23]:

$$d\log p_i^d = \frac{\upsilon_i^d \left(\rho_i^d \, d\log mc_i + \mathbb{C}\mathrm{ov}_{\tilde{\boldsymbol{\delta}}_i}\big(\boldsymbol{\rho}_i, d\log \mathbf{mc}_i\big)\right) + (1-\rho_i^d) s_{Fi} d\log p_{Fi}}{\rho_i^d + (1-\rho_i^d) s_{Fi}}, \tag{A.7}$$

where $\mathrm{d}\log mc_i = \mathbb{E}_{\tilde{\boldsymbol{\delta}}_i}[\mathrm{d}\log \boldsymbol{mc}_i]$, $\rho_i^d = \mathbb{E}_{\tilde{\boldsymbol{\delta}}_i}[\boldsymbol{\rho}_i]$. Note we also introduce expectation operators such that $\mathbb{E}_\omega[x] = \sum_i \omega_i x_i$ and $\mathbb{C}\mathrm{ov}_\omega[x,y] = E_\omega[xy] - \mathbb{E}_\omega[x]\,\mathbb{E}_\omega[y]$.

There are three channels that can generate a wedge between industry-level price changes $d\log p_i^d$ and marginal cost changes $d\log \boldsymbol{mc}_i$:

1. **Markup assumption (levels vs logs).** Captured by υ_i^d, which attenuates the pass-through of marginal cost shocks.

2. **Foreign-competition channel.** When $0 < \rho_i^d < 1$, firms respond to movements in the reference price, which itself depends on foreign competitors through s_{Fi}.

3. **Within-industry exposure heterogeneity.** Captured by the covariance term $\mathbb{C}\mathrm{ov}_{\tilde{\boldsymbol{\delta}}_i}\big(\boldsymbol{\rho}_i, d\log \mathbf{mc}_i\big)$, which reflects the interaction between firm-level pass-through and firm-level exposure to shocks.

The covariance term is the analogue of the aggregate markup-adjustment term in Amiti, Itskhoki and Konings (2019). In their exchange-rate setting, firms differ both in their exposure to the exchange-rate shock and in the extent to which they absorb cost shocks through markups. In our setting, we condition directly on border price changes and decompose firms' exposure into imported-input marginal-cost exposure and foreign-competitor price exposure. The covariance term captures whether the domestic firms most exposed to the foreign cost shock are also the firms with high pass-through.[24]

[23] We approximate this equation under the assumption that $\pi_{Fi} \approx s_{Fi}$ and $\tilde{\pi}_{fi} \approx \tilde{\delta}_{fi}$.

[24] Amiti, Itskhoki and Konings (2019) write the covariance in terms of markup adjustment, whereas we write it in terms of own-cost pass-through. Since these objects are complements, the sign convention differs mechanically.

Since we already analyzed both the markup assumption and the foreign-competition channels in the main text, in this appendix we study in more detail the covariance channel. The goal of this is to be able to take this channel to industry-level data without access to firm-level data. It turns out this boils down to imposing assumptions on a covariance matrix that reduces the number of parameters to be estimated.

A.2.1 Covariance channel

We approximate firm-level marginal cost of firms within an industry as

$$d \log \mathrm{mc}_{fi} = \sum_j \Omega^d_{fi,j} d \log p^d_j + \sum_j \Omega^*_{fi,j} d \log p^*_j, \tag{A.8}$$

Using (A.8), the covariance term can be written as

$$\begin{aligned} \mathbb{C}\mathrm{ov}_{\tilde{\boldsymbol{\delta}}_i}\big(\boldsymbol{\rho}_i, d\log \mathbf{mc}_i\big) &= \sum_j \mathbb{C}\mathrm{ov}_{\tilde{\boldsymbol{\delta}}_i}\big(\boldsymbol{\rho}_i, \boldsymbol{\Omega}^d_{i,j}\big) d\log p^d_j + \sum_j \mathbb{C}\mathrm{ov}_{\tilde{\boldsymbol{\delta}}_i}\big(\boldsymbol{\rho}_i, \boldsymbol{\Omega}^*_{i,j}\big) d\log p^*_j && \text{(A.9)} \\ &= \sum_j \mathbb{C}^d_{ij} d\log p^d_j + \sum_j \mathbb{C}^*_{ij} d\log p^*_j, && \text{(A.10)} \end{aligned}$$

where

$$\mathbb{C}^*_{ij} = \sum_{f \in \mathcal{D}_i} \tilde{\delta}_{fi} \left(\rho_{fi} - \rho^d_i\right) \Omega^*_{fi,j}. \tag{A.11}$$

Define the exposure-weighted pass-through among firms exposed to input j:

$$\rho^*_{ij} \equiv \frac{\sum_{f \in \mathcal{D}_i} \tilde{\delta}_{fi} \rho_{fi} \Omega^*_{fi,j}}{\sum_{f \in \mathcal{D}_i} \tilde{\delta}_{fi} \Omega^*_{fi,j}} = \frac{\sum_{f \in \mathcal{D}_i} \tilde{\delta}_{fi} \rho_{fi} \Omega^*_{fi,j}}{\Omega^*_{ij}}. \tag{A.12}$$

Then (A.11) can be rewritten as

$$\mathbb{C}^*_{ij} = \Omega^*_{ij} \left(\rho^*_{ij} - \rho^d_i\right). \tag{A.13}$$

Restrictions. We now impose the following identification assumptions:

1. *Within industry i, the difference between exposure-weighted pass-through and average pass-through is constant across input sectors:*

$$\rho^*_{ij} - \rho^d_i = \gamma_i \qquad \forall j. \tag{A.14}$$

2. $\mathbb{C}^d = \mathbf{0}$

Under the first assumption, (A.13) simplifies to

$$\mathbb{C}^*_{ij} = \gamma_i \Omega^*_{ij}. \tag{A.15}$$

The first restriction implies that within industry i, firms that are more exposed to imported inputs systematically have pass-through that differs from the industry average by a constant amount γ_i, independently of which input sector generates the exposure.

When $\gamma_i > 0$, firms that are more exposed to import costs also tend to have higher pass-through, amplifying the effect of foreign shocks. When $\gamma_i < 0$, the opposite holds. This is simply a plausible assumption to allow for limited degrees of freedom in the nonparametric estimation. [25] The second restriction is also necessary to reduce degrees of freedom. Since $\mathbb{C}^d$ affects prices indirectly, this assumption should not have a large impact.

Under such restrictions equation (A.7), in vector form, becomes

$$d\log \mathbf{p}^d = \Big[I-(I-\boldsymbol{\rho}^d)(I-\boldsymbol{S}_F)-\boldsymbol{\rho}^d\boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^d\Big]^{-1}\Big[\left(\boldsymbol{\rho}^d+\boldsymbol{\gamma}\right)\boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^*+(I-\boldsymbol{\rho}^d)\,\boldsymbol{S}_F\Big]d\log \mathbf{p}^* \tag{A.16}$$

Equation (A.16) implies that a covariance term would possibly amplify or attenuate the effects of marginal costs increases, in accordance to an estimated diagonal matrix $\boldsymbol{\gamma}$ that summarizes how the distribution of markups and affected firms within the industries are affected by the tariffs. Effectively, under our restriction assumption, the matrix $\boldsymbol{\gamma}$ can further disentangle the link between predicted and observed marginal costs.

The issue with this equation is that both the matrix $\boldsymbol{\rho}$ and $\boldsymbol{\gamma}$ are unobserved. Therefore this is a system with N equations and $2N$ parameters. In practice, we aim at parameterizing such values with industry observable characteristics such as HHI index, markup size, foreign shares, and others. Of course equation (A.16) also implies that any model estimating ρ without accounting for the potential impact of γ would be biased.

Note that this channel cannot be active in the intermediate sector unless $\boldsymbol{\rho}^d \neq I$. Under the normalization $\boldsymbol{\rho}^d = \boldsymbol{I}$, the covariance wedge $\mathbb{C}^*$ collapses to zero. This is because if the average ρ^d_i in an industry is 1, then all $\rho_{fi} = 1$ for all firms f in i. But this implies that the covariance term between ρ_{fi} and the marginal cost changes is zero.

Retail-side covariance wedge. A related covariance wedge may arise in the final-demand layer. Unlike domestic producers, retailers do not compete with foreign retailers. Imported finished goods have already crossed the border when they enter this layer and are purchased as inputs by domestic retailers. There is therefore no retail analogue of the foreign-competition

[25] We have also allowed for $\mathbb{C}$ to be a free diagonal matrix and our non-parametric estimation has shown that the cost share is strongly correlated to the diagonal elements.

channel governed by $\boldsymbol{\rho}^d$. Retailers may nevertheless differ both in their own-cost pass-through and in their exposure to domestic and imported commodities.

To make this distinction explicit, recall from the main text that retailer-level marginal-cost changes satisfy

$$\mathrm{d}\log \mathrm{mc}_{fe} = \sum_j \theta^d_{fe,j}\,\mathrm{d}\log p^d_j + \sum_j \theta^*_{fe,j}\,\mathrm{d}\log p^*_j. \tag{A.17}$$

Under the approximation $\pi_{fe} \approx \delta_{fe}$, define the cost-weighted average own-cost pass-through within expenditure category e as

$$\rho^r_e \equiv \sum_{f\in e} \delta_{fe}\rho_{fe}. \tag{A.18}$$

Corollary 1 can then be rewritten as

$$\mathrm{d}\log p_e = \upsilon_e \left[\mathrm{d}\log \mathrm{mc}_e + \frac{\mathbb{C}\mathrm{ov}_{\boldsymbol{\delta}_e}\left(\boldsymbol{\rho}_e, \mathrm{d}\log \mathbf{mc}_e\right)}{\rho^r_e}\right]. \tag{A.19}$$

Using equation (A.17), define the two retail-side covariance matrices by

$$\mathbb{C}^{r,d}_{ej} \equiv \frac{\mathbb{C}\mathrm{ov}_{\boldsymbol{\delta}_e}\left(\boldsymbol{\rho}_e, \boldsymbol{\theta}^d_{e,j}\right)}{\rho^r_e}, \tag{A.20}$$

$$\mathbb{C}^{r,*}_{ej} \equiv \frac{\mathbb{C}\mathrm{ov}_{\boldsymbol{\delta}_e}\left(\boldsymbol{\rho}_e, \boldsymbol{\theta}^*_{e,j}\right)}{\rho^r_e}. \tag{A.21}$$

The general retail-price equation is therefore

$$\mathrm{d}\log \boldsymbol{p} = \boldsymbol{\Upsilon}^r \left[\left(\boldsymbol{\Theta}^d + \mathbb{C}^{r,d}\right)\mathrm{d}\log \boldsymbol{p}^d + \left(\boldsymbol{\Theta}^* + \mathbb{C}^{r,*}\right)\mathrm{d}\log \boldsymbol{p}^*\right]. \tag{A.22}$$

Let $\boldsymbol{\Phi}^{d,*}$ denote the mapping from imported prices into domestic producer prices under the chosen producer-side specification:

$$\mathrm{d}\log \boldsymbol{p}^d = \boldsymbol{\Phi}^{d,*}\mathrm{d}\log \boldsymbol{p}^*. \tag{A.23}$$

Under the baseline specification of full pass-through and no covariance wedge,

$$\boldsymbol{\Phi}^{d,*} = \left(\boldsymbol{I} - \boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^d\right)^{-1}\boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^*. \tag{A.24}$$

Substituting equation (A.23) into equation (A.22) yields

$$\mathrm{d}\log \boldsymbol{p} = \boldsymbol{\Upsilon}^r \left[\left(\boldsymbol{\Theta}^d + \mathbb{C}^{r,d}\right)\boldsymbol{\Phi}^{d,*} + \boldsymbol{\Theta}^* + \mathbb{C}^{r,*}\right]\mathrm{d}\log \boldsymbol{p}^*. \tag{A.25}$$

Equation (A.25) makes clear that retailer heterogeneity can affect both the domestic-production channel, through $\mathbb{C}^{r,d}$, and the final-import channel, through $\mathbb{C}^{r,*}$.

Final-import restriction. The two retail-side covariance matrices cannot be estimated unrestrictedly from expenditure-category price variation alone. As a baseline empirical specification, we therefore impose

$$\mathbb{C}^{r,d} = \mathbf{0}, \qquad \mathbb{C}^{r,*} = \mathbf{\Gamma}^r \mathbf{\Theta}^*, \qquad \mathbf{\Gamma}^r = \operatorname{diag}\left(\{\gamma_e^r\}_{e\in\mathcal{E}}\right). \tag{A.26}$$

Under this restriction, equation (A.25) becomes

$$\mathrm{d}\log \boldsymbol{p} = \mathbf{\Upsilon}^r \left[\mathbf{\Theta}^d \mathbf{\Phi}^{d,*} + \left(\boldsymbol{I} + \mathbf{\Gamma}^r\right) \mathbf{\Theta}^*\right] \mathrm{d}\log \boldsymbol{p}^*. \tag{A.27}$$

This restriction is not a theoretical implication of the model. It is a parsimonious normalization that isolates the covariance between retailer-level own-cost pass-through and final-import exposure, which is the component that generates the sharpest cross-sectional variation across expenditure categories.

Alternative sourcing-substitution specification. As an alternative, suppose that retailers within an expenditure category differ in whether they source a given commodity domestically or internationally, but not in their total exposure to that commodity:

$$\theta^d_{fe,j} + \theta^*_{fe,j} = \theta_{e,j} \qquad \text{for all } f \in e. \tag{A.28}$$

Under this assumption,

$$\mathbb{C}^{r,d} = -\mathbb{C}^{r,*}. \tag{A.29}$$

Combining equation (A.29) with the proportionality restriction

$$\mathbb{C}^{r,*} = \mathbf{\Gamma}^r \mathbf{\Theta}^* \tag{A.30}$$

gives

$$\begin{aligned} \mathrm{d}\log \boldsymbol{p} &= \mathbf{\Upsilon}^r \left[\left(\mathbf{\Theta}^d - \mathbf{\Gamma}^r \mathbf{\Theta}^*\right) \mathbf{\Phi}^{d,*} + \left(\boldsymbol{I} + \mathbf{\Gamma}^r\right) \mathbf{\Theta}^*\right] \mathrm{d}\log \boldsymbol{p}^* \\ &= \mathbf{\Upsilon}^r \left[\mathbf{\Theta}^d \mathbf{\Phi}^{d,*} + \mathbf{\Theta}^* + \mathbf{\Gamma}^r \mathbf{\Theta}^* \left(\boldsymbol{I} - \mathbf{\Phi}^{d,*}\right)\right] \mathrm{d}\log \boldsymbol{p}^*. \end{aligned} \tag{A.31}$$

This alternative specification gives $\mathbf{\Gamma}^r$ a different interpretation. Retailers with higher own-cost pass-through are disproportionately exposed to imported rather than domestically sourced versions of the same commodities. The same wedge therefore raises the final-import contribution and correspondingly lowers the contribution of domestic sourcing.

A.3 Decomposition of Estimated Model-implied Effects

This appendix derives equation (55) and the five components of Figure 6.

Let $\tilde{\boldsymbol{\rho}} \equiv \operatorname{diag}(\tilde{\rho}_i^d)$, with $\tilde{\rho}_i^d$ as in equation (49). Because $\boldsymbol{S}_F$ is diagonal, so is $\boldsymbol{D} \equiv \bar{\rho}\boldsymbol{I} + (1-\bar{\rho})\boldsymbol{S}_F$, and $\boldsymbol{D}^{-1}\bar{\rho} = \tilde{\boldsymbol{\rho}}$. Equation (48)'s left bracket is therefore $\boldsymbol{D}\big[\boldsymbol{I} - \tilde{\boldsymbol{\rho}}\boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^d\big]$ and its right bracket is $\boldsymbol{D}\big[\tilde{\boldsymbol{\rho}}\boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^* + (\boldsymbol{I} - \tilde{\boldsymbol{\rho}})\big]$, so the two $\boldsymbol{D}^{-1}$ cancel. Substituting this into equation (53) and attaching the retail-layer pass-through gives equation (55). The five components are $\hat{\beta}^r\boldsymbol{\Upsilon}^r\boldsymbol{C}\,\Delta\log(1+\boldsymbol{\tau})$ with

$$\boldsymbol{C}^{\text{Fin}} = \boldsymbol{\Theta}^* \tag{A.32}$$

$$\boldsymbol{C}_1^{\text{Cost}} = \boldsymbol{\Theta}^d\boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^* \tag{A.33}$$

$$\boldsymbol{C}_N^{\text{Cost}} = \boldsymbol{\Theta}^d\Big[\big(\boldsymbol{I} - \boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^d\big)^{-1} - \boldsymbol{I}\Big]\boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^* \tag{A.34}$$

$$\boldsymbol{C}_1^{\text{Comp}} = \boldsymbol{\Theta}^d\big(\boldsymbol{I} - \tilde{\boldsymbol{\rho}}\big)\big(\boldsymbol{I} - \boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^*\big) \tag{A.35}$$

$$\begin{aligned}\boldsymbol{C}_N^{\text{Comp}} = \boldsymbol{\Theta}^d\Big\{&\Big[\big(\boldsymbol{I} - \tilde{\boldsymbol{\rho}}\boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^d\big)^{-1} - \boldsymbol{I}\Big]\big[\tilde{\boldsymbol{\rho}}\boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^* + (\boldsymbol{I} - \tilde{\boldsymbol{\rho}})\big] \\ &- \Big[\big(\boldsymbol{I} - \boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^d\big)^{-1} - \boldsymbol{I}\Big]\boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^*\Big\}.\end{aligned} \tag{A.36}$$

B Proofs

B.1 Proof of Proposition 1

Start from the pricing condition

$$p_{fi} = mc_{fi} + \frac{\sigma_i}{1-\pi_{fi}}. \tag{B.1}$$

Differentiating this expression

$$\mathrm{d}p_{fi} = \mathrm{d}mc_{fi} + \frac{\mu_{fi}}{1-\pi_{fi}}\mathrm{d}\pi_{fi}.$$

Differentiating the share, we get

$$
\begin{aligned}
\mathrm{d}\pi_{fi} &= -\frac{\pi_{fi}}{\sigma_i}\left(\mathrm{d}p_{fi} - \sum_{g\in i}\pi_{gi}\mathrm{d}p_{gi}\right) \\
\mathrm{d}\pi_{fi} &= -\frac{\pi_{fi}}{\sigma_i}(1-\pi_{fi})\left(\mathrm{d}p_{fi} - \sum_{g\in i\setminus f}\tilde{\pi}_{gi}\mathrm{d}p_{gi}\right) \\
\mathrm{d}\pi_{fi} &= -\frac{\pi_{fi}}{\sigma_i}(1-\pi_{fi})\left(\mathrm{d}p_{fi} - \mathrm{d}p_{-f,i}\right),
\end{aligned}
$$

where we defined the competitors' price index of firm f as

$$
\mathrm{d}p_{-f,i} = \sum_{g\in i\setminus f}\tilde{\pi}_{gi}\mathrm{d}p_{gi}, \tag{B.2}
$$

with $\tilde{\pi}_{gi} = \frac{\pi_{gi}}{\sum_{h\in i\setminus f}\pi_{hi}}$.

Replacing into the differentiated pricing condition

$$
\begin{aligned}
\mathrm{d}p_{fi} &= \mathrm{d}mc_{fi} - \frac{\mu_{fi}}{1-\pi_{fi}}\frac{\pi_{fi}}{\sigma_i}(1-\pi_{fi})\left(\mathrm{d}p_{fi} - \mathrm{d}p_{-f,i}\right) \\
\mathrm{d}p_{fi} &= \mathrm{d}mc_{fi} - \frac{\pi_{fi}}{1-\pi_{fi}}\left(\mathrm{d}p_{fi} - \mathrm{d}p_{-f,i}\right)
\end{aligned}
$$

Rearranging, we get

$$
\mathrm{d}p_{fi} = (1-\pi_{fi})\mathrm{d}mc_{fi} + \pi_{fi}\mathrm{d}p_{-f,i}, \tag{B.3}
$$

which is the expression in the main text.

B.2 Proof of Proposition 2

Divide the final expression of Proposition 1 by p_{fi} and rearrange to get

$$
\mathrm{d}\log p_{fi} = (1-\pi_{fi})\frac{mc_{fi}}{p_{fi}}\mathrm{d}\log mc_{fi} + \pi_{fi}\frac{p_{-f,i}}{p_{fi}}\mathrm{d}\log p_{-f,i}. \tag{B.4}
$$

B.3 Proof of Proposition 3

Start from the definition of the producer price index

$$\mathrm{d}\log p_i^d = \sum_{f\in\mathcal{D}_i} s_{fi}^d \mathrm{d}\log p_{fi}$$

$$\mathrm{d}\log p_i^d = \sum_{f\in\mathcal{D}_i} s_{fi}^d (1-\alpha_{fi}) \left[\rho_{fi}\mathrm{d}\log mc_{fi} + (1-\rho_{fi})\frac{R_i}{mc_{fi}q_i}\mathrm{d}\log p_i\right]$$

$$\begin{aligned}
\mathrm{d}\log p_i^d = & \left(\sum_{g\in\mathcal{D}_i} s_{gi}^d(1-\alpha_{gi})\right)\left(\sum_{g\in\mathcal{D}_i}\frac{s_{gi}^d(1-\alpha_{gi})}{\left(\sum_{g\in\mathcal{D}_i} s_{gi}^d(1-\alpha_{gi})\right)}\rho_{gi}\right)\sum_{f\in\mathcal{D}_i}\frac{s_{fi}^d(1-\alpha_{fi})\rho_{fi}}{\sum_{g\in\mathcal{D}_i} s_{gi}^d(1-\alpha_{gi})\rho_{gi}}\mathrm{d}\log mc_{fi} \\
& + \left[\sum_{f\in\mathcal{D}_i}\frac{s_{fi}^d}{mc_{fi}}(1-\alpha_{fi})(1-\rho_{fi})\right]\frac{R_i}{q_i}\mathrm{d}\log p_i
\end{aligned}$$

$$\mathrm{d}\log p_i^d = \frac{VC_i^d}{R_i^d}\rho_i^d\sum_{f\in\mathcal{D}_i}\gamma_{fi}\mathrm{d}\log mc_{fi} + \left[\sum_{f\in\mathcal{D}_i}\frac{s_{fi}^d}{mc_{fi}}(1-\alpha_{fi})(1-\rho_{fi})\right]\frac{R_i}{q_i}\mathrm{d}\log p_i$$

$$\mathrm{d}\log p_i^d = \frac{VC_i^d}{R_i^d}\rho_i^d\sum_{f\in\mathcal{D}_i}\gamma_{fi}\mathrm{d}\log mc_{fi} + \frac{R_i}{R_i^d}\left(\sum_{f\in\mathcal{D}_i}\pi_{fi}(1-\rho_{fi})\right)\mathrm{d}\log p_i$$

$$\mathrm{d}\log p_i^d = \frac{VC_i^d}{R_i^d}\rho_i^d\sum_{f\in\mathcal{D}_i}\gamma_{fi}\mathrm{d}\log mc_{fi} + \frac{R_i}{R_i^d}(1-\pi_{Fi})\left(\sum_{f\in\mathcal{D}_i}\tilde{\pi}_{fi}(1-\rho_{fi})\right)\mathrm{d}\log p_i$$

We first solve for $\mathrm{d}\log p_{fi}$ as a function of marginal costs and the industry price index. To do so, recall that the level change in the markup is

$$\mathrm{d}\mu_{fi} = -\mu_{fi}\frac{\pi_{fi}}{\sigma_i(1-\pi_{fi})}\left(\mathrm{d}p_{fi} - \sum_{g\in i}\pi_{gi}\mathrm{d}p_{gi}\right) = -\frac{\pi_{fi}}{(1-\pi_{fi})^2}\left(\mathrm{d}p_{fi} - \mathrm{d}p_i^{eff}\right),$$

where we use the definition of the change in the effective price index

$$\mathrm{d}p_i^{eff} = \sum_{g\in i}\pi_{gi}\mathrm{d}p_{gi}. \tag{B.5}$$

Replacing the change in the markup into the pricing condition

$$\begin{aligned}
\mathrm{d}p_{fi} &= \mathrm{d}mc_{fi} + \mathrm{d}\mu_{fi} \\
\mathrm{d}p_{fi} &= \mathrm{d}mc_{fi} - \frac{\pi_{fi}}{(1-\pi_{fi})^2}\left(\mathrm{d}p_{fi} - \mathrm{d}p_i^{eff}\right) \\
\mathrm{d}p_{fi} &= \frac{1}{1+\frac{\pi_{fi}}{(1-\pi_{fi})^2}}\mathrm{d}mc_{fi} + \frac{\frac{\pi_{fi}}{(1-\pi_{fi})^2}}{1+\frac{\pi_{fi}}{(1-\pi_{fi})^2}}\mathrm{d}p_i^{eff}.
\end{aligned}$$

This implies

$$\mathrm{d}p_{fi} = \rho_{fi}\mathrm{d}mc_{fi} + (1-\rho_{fi})\mathrm{d}p_i^{eff}, \tag{B.6}$$

where

$$\rho_{fi} = \frac{1}{1+\frac{\pi_{fi}}{(1-\pi_{fi})^2}} = \frac{(1-\pi_{fi})^2}{(1-\pi_{fi})^2+\pi_{fi}} = \frac{(1-\pi_{fi})^2}{1-\pi_{fi}+\pi_{fi}^2}$$

We can link the effective price index to the industry price index change $\mathrm{d}\log p_i$:

$$\begin{aligned}
\mathrm{d}p_i^{eff} &= \sum_{f\in i} p_{fi}\pi_{fi}\mathrm{d}\log p_{fi}, \\
&= \sum_{f\in i} \frac{p_{fi}q_{fi}}{q_i}\mathrm{d}\log p_{fi}, \\
&= \frac{R_i}{q_i}\sum_{f\in i} \frac{p_{fi}q_{fi}}{R_i}\mathrm{d}\log p_{fi}, \\
\mathrm{d}p_i^{eff} &= \frac{R_i}{q_i}\mathrm{d}\log p_i.
\end{aligned}$$

Using this equality and expressing the pricing condition in percentage terms

$$\begin{aligned}
\mathrm{d}p_{fi} &= \rho_{fi}\mathrm{d}mc_{fi} + (1-\rho_{fi})\frac{R_i}{q_i}\mathrm{d}\log p_i, \\
\mathrm{d}\log p_{fi} &= \rho_{fi}(1-\alpha_{fi})\mathrm{d}\log mc_{fi} + (1-\rho_{fi})\frac{R_i}{p_{fi}q_i}\mathrm{d}\log p_i.
\end{aligned}$$

Multiplying by s^d_{fi} and adding across domestic firms we get

$$\mathrm{d}\log p^d_i = \sum_{f\in\mathcal{D}_i} s^d_{fi}\left(\rho_{fi}(1-\alpha_{fi})\mathrm{d}\log mc_{fi} + (1-\rho_{fi})\frac{R_i}{p_{fi}q_i}\mathrm{d}\log p_i\right)$$
$$\mathrm{d}\log p^d_i = \sum_{f\in\mathcal{D}_i} s^d_{fi}\rho_{fi}(1-\alpha_{fi})\mathrm{d}\log mc_{fi} + \sum_{f\in\mathcal{D}_i} s^d_{fi}(1-\rho_{fi})\frac{R_i}{p_{fi}q_i}\mathrm{d}\log p_i$$
$$\mathrm{d}\log p^d_i = \sum_{f\in\mathcal{D}_i} \frac{p_{fi}q_{fi}}{R^d_i}\rho_{fi}(1-\alpha_{fi})\mathrm{d}\log mc_{fi} + \sum_{f\in\mathcal{D}_i} \frac{p_{fi}q_{fi}}{R^d_i}(1-\rho_{fi})\frac{R_i}{p_{fi}q_i}\mathrm{d}\log p_i$$
$$\mathrm{d}\log p^d_i = \sum_{f\in\mathcal{D}_i} \frac{mc_{fi}q_{fi}}{R^d_i}\rho_{fi}\mathrm{d}\log mc_{fi} + \sum_{f\in\mathcal{D}_i} \pi_{fi}(1-\rho_{fi})\frac{R_i}{R^d_i}\mathrm{d}\log p_i$$
$$\mathrm{d}\log p^d_i = \frac{VC^d_i}{R^d_i}\sum_{f\in\mathcal{D}_i} \frac{mc_{fi}q_{fi}}{VC^d_i}\rho_{fi}\mathrm{d}\log mc_{fi} + \sum_{f\in\mathcal{D}_i} \pi_{fi}(1-\rho_{fi})\frac{R_i}{R^d_i}\mathrm{d}\log p_i$$
$$\mathrm{d}\log p^d_i = \upsilon^d_i\sum_{f\in\mathcal{D}_i} \tilde{\delta}_{fi}\rho_{fi}\mathrm{d}\log mc_{fi} + (1-\pi_{Fi})\sum_{f\in\mathcal{D}_i} \tilde{\pi}_{fi}(1-\rho_{fi})\frac{1}{s^d_i}\mathrm{d}\log p_i$$

Now, we use the definition of $\mathrm{d}\log p_i = s^d_i\mathrm{d}\log p^d_i + s_{Fi}\mathrm{d}\log p_{Fi}$, to get

$$\mathrm{d}\log p^d_i = \upsilon^d_i\sum_{f\in\mathcal{D}_i} \tilde{\delta}_{fi}\rho_{fi}\mathrm{d}\log mc_{fi} + (1-\pi_{Fi})\sum_{f\in\mathcal{D}_i} \tilde{\pi}_{fi}(1-\rho_{fi})\frac{1}{s^d_i}\left(s^d_i\mathrm{d}\log p^d_i + s_{Fi}\mathrm{d}\log p_{Fi}\right).$$

Rearranging, we get

$$\begin{aligned}\mathrm{d}\log p^d_i = {} & \frac{1}{\left(1-(1-\pi_{Fi})\left(\sum_{f\in\mathcal{D}_i}\tilde{\pi}_{fi}(1-\rho_{fi})\right)\right)}\left(\upsilon^d_i\left(\sum_{f\in\mathcal{D}_i}\tilde{\delta}_{fi}\rho_{fi}\mathrm{d}\log mc_{fi}\right)\right), \\ & + \frac{1}{\left(1-(1-\pi_{Fi})\left(\sum_{f\in\mathcal{D}_i}\tilde{\pi}_{fi}(1-\rho_{fi})\right)\right)}\left(\frac{(1-\pi_{Fi})\left(\sum_{f\in\mathcal{D}_i}\tilde{\pi}_{fi}(1-\rho_{fi})\right)}{(1-s_{Fi})}s_{Fi}\mathrm{d}\log p_{Fi}\right),\end{aligned} \tag{B.7}$$

which is the expression in the main text.

B.4 Proof of Proposition 4

From the earlier section, we have an expression for the PPI change of an industry i:

$$\mathrm{d}\log p^d_i = \upsilon^d_i\sum_{f\in\mathcal{D}_i} \tilde{\delta}_{fi}\rho_{fi}\mathrm{d}\log mc_{fi} + (1-\pi_{Fi})\sum_{f\in\mathcal{D}_i} \tilde{\pi}_{fi}(1-\rho_{fi})\frac{1}{s^d_i}\left(s^d_i\mathrm{d}\log p^d_i + s_{Fi}\mathrm{d}\log p_{Fi}\right) \tag{B.8}$$

Given our assumptions, we have $\mathrm{d}\log mc_{fi} = \mathrm{d}\log mc_i$ for all $f \in \mathcal{D}_i$. Moreover, we defined:

$$\rho_i^d = \mathbb{E}_{\tilde{\boldsymbol{\delta}}_i}(\boldsymbol{\rho}_i) = \sum_{f\in\mathcal{D}_i} \tilde{\delta}_{fi}\rho_{fi},$$

as the industry level pass-through of marginal cost to industry prices in levels, weighted according to domestic cost-shares $\tilde{\boldsymbol{\delta}}_i = \{\delta_{fi}\}_{f\in\mathcal{D}_i}$.

Using these results, we can write equation (B.8) as

$$\mathrm{d}\log p_i^d = \upsilon_i^d\rho_i^d \mathrm{d}\log mc_i + (1-\pi_{Fi})(1-\mathbb{E}_{\tilde{\boldsymbol{\pi}}_i}(\boldsymbol{\rho}_i))(\mathrm{d}\log p_i^d + (1-s_{Fi})^{-1}s_{Fi}\mathrm{d}\log p_{Fi}), \quad \text{(B.9)}$$

which follows since $\sum_{f\in\mathcal{D}_i} \tilde{\pi}_{fi} = 1$ and $\mathbb{E}_{\tilde{\boldsymbol{\pi}}_i}(\boldsymbol{\rho}_i) = \sum_{f\in\mathcal{D}_i} \tilde{\pi}_{fi}\rho_{fi}$ denotes the expected marginal cost pass-through in levels when weighted according to domestic variety shares $\tilde{\boldsymbol{\pi}}_i = \{\tilde{\pi}_{fi}\}_{f\in\mathcal{D}_i}$.

To arrive at the proposition in the main text, we assume that $\mathbb{E}_{\tilde{\boldsymbol{\pi}}_i}(\boldsymbol{\rho}_i) \approx \mathbb{E}_{\tilde{\boldsymbol{\delta}}_i}(\boldsymbol{\rho}_i) = \rho_i^d$. Hence, industry level marginal cost pass-through in levels when weighted according to either domestic variety shares or domestic cost shares are not too dissimilar. This assumption allows us to write:

$$\mathrm{d}\log p_i^d = \upsilon_i^d\rho_i^d \mathrm{d}\log mc_i + (1-\pi_{Fi})(1-\rho_i^d)(\mathrm{d}\log p_i^d + (1-s_{Fi})^{-1}s_{Fi}\mathrm{d}\log p_{Fi}). \quad \text{(B.10)}$$

Equation (B.10) in vector form is

$$\mathrm{d}\log \boldsymbol{p}^d = \boldsymbol{\Upsilon}^d\boldsymbol{\rho}^d \mathrm{d}\log \boldsymbol{mc} + (\boldsymbol{I}-\boldsymbol{\Pi}_F)(\boldsymbol{I}-\boldsymbol{\rho}^d)(\mathrm{d}\log \boldsymbol{p}^d + (\boldsymbol{I}-\boldsymbol{S}_F)^{-1}\boldsymbol{S}_F\mathrm{d}\log \boldsymbol{p}_F), \quad \text{(B.11)}$$

where

$$\boldsymbol{\Upsilon}^d = diag(\boldsymbol{\upsilon}^d); \quad \boldsymbol{\rho}^d = diag(\{\rho_i^d\}_{i\in\mathcal{I}}); \quad \boldsymbol{S}_F = diag(\boldsymbol{s}_F); \quad \boldsymbol{\Pi}_F = diag(\boldsymbol{\pi}_F).$$

Up to a first-order approximation, marginal cost changes are only a function of input price changes:

$$\mathrm{d}\log mc_{fi} = \sum_j \Omega_{fi,j}\mathrm{d}\log p_j^d + \sum_j \Omega^*_{fi,j}\mathrm{d}\log p_j^*. \quad \text{(B.12)}$$

Under Assumption A.1, this can be written omitting the firm subscript

$$\mathrm{d}\log mc_i = \sum_j \Omega_{i,j}\mathrm{d}\log p_j^d + \sum_j \Omega^*_{i,j}\mathrm{d}\log p_j^*, \quad \text{(B.13)}$$

or in vector form

$$\mathrm{d}\log \boldsymbol{mc} = \boldsymbol{\Omega}^d \mathrm{d}\log \boldsymbol{p}^d + \boldsymbol{\Omega}^* \mathrm{d}\log \boldsymbol{p}^*, \tag{B.14}$$

with $\boldsymbol{\Omega}^d = \{\Omega_{i,j}\}_{i,j\in\mathcal{I}}$ and $\boldsymbol{\Omega}^* = \{\Omega^*_{i,j}\}_{i,j\in\mathcal{I}}$.

Replacing (B.14) into (B.11), we get

$$\mathrm{d}\log \boldsymbol{p}^d = \boldsymbol{\Upsilon}^d \boldsymbol{\rho}^d \left(\boldsymbol{\Omega}^d \mathrm{d}\log \boldsymbol{p}^d + \boldsymbol{\Omega}^* \mathrm{d}\log \boldsymbol{p}^*\right) + (\boldsymbol{I} - \boldsymbol{\Pi}_F)(\boldsymbol{I} - \boldsymbol{\rho}^d)(\mathrm{d}\log \boldsymbol{p}^d + (\boldsymbol{I} - \boldsymbol{S}_F)^{-1} \boldsymbol{S}_F \mathrm{d}\log \boldsymbol{p}_F).$$

Solving for $\mathrm{d}\log \boldsymbol{p}^d$ we get

$$\begin{aligned}\mathrm{d}\log \boldsymbol{p}^d &= (\boldsymbol{I} - \boldsymbol{\Upsilon}^d \boldsymbol{\rho}^d \boldsymbol{\Omega}^d - (\boldsymbol{I} - \boldsymbol{\Pi}_F)(\boldsymbol{I} - \boldsymbol{\rho}^d))^{-1} \boldsymbol{\Upsilon}^d \boldsymbol{\rho}^d \boldsymbol{\Omega}^* \mathrm{d}\log \boldsymbol{p}^*, \\ &\quad + (\boldsymbol{I} - \boldsymbol{\Upsilon}^d \boldsymbol{\rho}^d \boldsymbol{\Omega}^d - (\boldsymbol{I} - \boldsymbol{\Pi}_F)(\boldsymbol{I} - \boldsymbol{\rho}^d))^{-1} (\boldsymbol{I} - \boldsymbol{S}_F)^{-1} (\boldsymbol{I} - \boldsymbol{\Pi}_F)(\boldsymbol{I} - \boldsymbol{\rho}^d) \boldsymbol{S}_F \mathrm{d}\log \boldsymbol{p}_F.\end{aligned}$$

Letting

$$\boldsymbol{\Phi}^* = \boldsymbol{G} \boldsymbol{\Upsilon}^d \boldsymbol{\rho}^d \boldsymbol{\Omega}^*, \tag{B.15}$$

$$\boldsymbol{\Phi}^F = \boldsymbol{G} (\boldsymbol{I} - \boldsymbol{S}_F)^{-1} (\boldsymbol{I} - \boldsymbol{\Pi}_F)(\boldsymbol{I} - \boldsymbol{\rho}^d) \boldsymbol{S}_F, \tag{B.16}$$

$$\boldsymbol{G} = (\boldsymbol{I} - \boldsymbol{\Upsilon}^d \boldsymbol{\rho}^d \boldsymbol{\Omega}^d - (\boldsymbol{I} - \boldsymbol{\Pi}_F)(\boldsymbol{I} - \boldsymbol{\rho}^d))^{-1}, \tag{B.17}$$

we arrive at

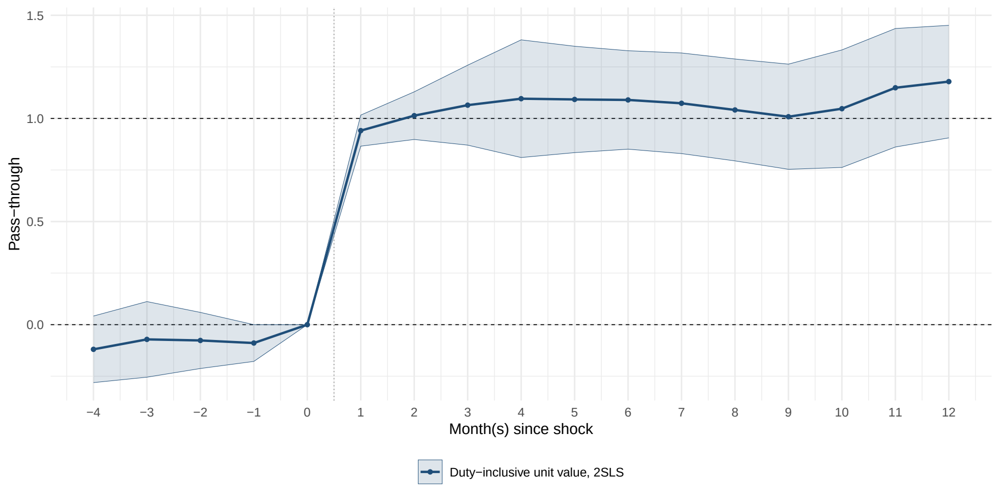
$$\mathrm{d}\log \boldsymbol{p}^d = \boldsymbol{\Phi}^* \mathrm{d}\log \boldsymbol{p}^* + \boldsymbol{\Phi}^F \mathrm{d}\log \boldsymbol{p}_F, \tag{B.18}$$

which is the expression in the main text.

C Border Pass-through on a Balanced Panel

We now explore the border pass-through on a balanced panel. Recall that Figure 2 in the main text estimates pass-through at each horizon on every import record available, which encompasses an unbalanced sample. Figure C.1 re-estimates that figure but restricting attention to records that trade continuously across the whole twelve months. As we can see from the figure, restricting the sample does not change the main message that pass-through is immediate.

Figure C.1: Border Pass-through of Tariffs into Import Unit Values, Balanced Panel



Notes: As Figure 2, on a balanced panel. The dashed line at one marks complete pass-through of effective tariffs into the border price. At $h = 12$ the estimate coincides with Figure 2 by construction. Shading gives 95% confidence bands, two-way clustered by HS-8 product and country of origin.

D Data Construction and Concordances

This appendix describes the construction of the empirical objects used in the paper. Tariffs are observed at the HS-10 product-by-country level, the production network in BEA industry and commodity classifications, producer prices in NAICS-based PPI series, and consumer prices in NIPA expenditure categories. We therefore construct concordances that place the tariff shock, input-output relationships, and price outcomes on common commodity and expenditure-category indices.

For the 2018–19 episode, we use the 2017 BEA Detail input-output accounts. For the 2025 episode, we use 2024 BEA annual and Trade in Value Added (TiVA) accounts, available at the Summary level, and disaggregate them using within-block shares from the 2017 Detail Benchmark accounts. Appendix D.2 describes this procedure.

D.1 Input-output and expenditure matrices

The empirical implementation requires the domestic-input matrix $\boldsymbol{\Omega}^d$, the imported-input matrix $\boldsymbol{\Omega}^*$, the foreign-competitor share $\boldsymbol{S}_F$, the expenditure-category sourcing matrices $\boldsymbol{\Theta}^d$ and $\boldsymbol{\Theta}^*$, and the markup-adjustment matrices $\boldsymbol{\Upsilon}^d$ and $\boldsymbol{\Upsilon}^r$.

Domestic and imported intermediate inputs. The matrices $\boldsymbol{\Omega}^d$ and $\boldsymbol{\Omega}^*$ are defined on BEA commodities. The entry Ω^d_{ij} is the value of domestically produced commodity j used per dollar of variable cost of commodity i, while Ω^*_{ij} is the corresponding imported-input share.[26] We construct both from the BEA Use and Import matrices and convert industry flows to a commodity basis using the Make matrix.

At $\rho = 1$, the network-adjusted imported-input response is

$$\left(\boldsymbol{I} - \boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^d\right)^{-1}\boldsymbol{\Upsilon}^d\boldsymbol{\Omega}^*\mathrm{d}\log\boldsymbol{p}^*. \tag{D.1}$$

For $\rho < 1$, the same objects enter the full producer-price mapping in equation (45).

Foreign competitors. The diagonal entry s_{Fi} of $\boldsymbol{S}_F$ is commodity i's own-market import share, measured as imports divided by domestic supply. As in the main text, we impose $\pi_{fi} = s_{fi}$ at the initial equilibrium, so observed sales shares provide the empirical counterpart of the model's variety shares.

[26] Normalising by variable cost rather than by gross output is what makes $\boldsymbol{\Upsilon}^d = \boldsymbol{I}$ the log-pass-through case below; the product $\boldsymbol{\Upsilon}^d\boldsymbol{\Omega}$ is the same object under either convention.

Final-import and domestic sourcing. Let $\boldsymbol{\Theta}^* = [\theta^*_{ej}]$ and $\boldsymbol{\Theta}^d = [\theta^d_{ej}]$, with rows indexing NIPA expenditure categories and columns BEA commodities. We construct both from the BEA PCE bridge and commodity-level import penetration. The first records imported finished-goods content; the second records domestically produced commodity content.

At $\rho = 1$, the consumer-price sensitivity to border prices is the sum of

$$\boldsymbol{\Delta}^{\text{Final}} = \boldsymbol{\Upsilon}^r \boldsymbol{\Theta}^* \tag{D.2}$$

and

$$\boldsymbol{\Delta}^{\text{Dom}} = \boldsymbol{\Upsilon}^r \boldsymbol{\Theta}^d \left(\boldsymbol{I} - \boldsymbol{\Upsilon}^d \boldsymbol{\Omega}^d\right)^{-1} \boldsymbol{\Upsilon}^d \boldsymbol{\Omega}^*. \tag{D.3}$$

The first is the final-import channel. The second captures imported inputs propagated through domestic production before reaching expenditure categories. For $\rho < 1$, the producer block is replaced by equation (45).

Markup adjustment. Under pass-through in levels,

$$\Upsilon^d_{ii} = v^d_i = \frac{VC^d_i}{R^d_i},$$

so a one-dollar increase in marginal cost passes through one for one in the price-taking limit, while its percentage effect is scaled by the initial variable-cost share. Under pass-through in logs, percentage marginal-cost changes pass through one for one and $\boldsymbol{\Upsilon}^d = \boldsymbol{I}$. The retail matrix $\boldsymbol{\Upsilon}^r$ is constructed analogously from the producer-value and distribution-margin components of the PCE bridge: under levels its denominator is full purchaser value, and under logs only the variable-cost part of each distribution margin enters it.

D.2 Detail-level matrices outside Benchmark years

The BEA publishes Detail input-output tables only in Benchmark years, with 2017 the latest available for our application. Annual accounts through 2024 are available at the Summary level. For the 2025 exercise, we therefore preserve observed 2024 Summary totals while allocating each Summary cell across its Detail constituents using 2017 shares.

Let $x^D_{ab,2017}$ be a Detail cell and $X^S_{AB,2017}$ its corresponding Summary cell. Define

$$\lambda_{ab} = \frac{x^D_{ab,2017}}{X^S_{AB,2017}}.$$

The reconstructed 2024 Detail cell is

$$\widehat{x}^{D}_{ab,2024} = \lambda_{ab} X^{S}_{AB,2024}.$$

The resulting Detail table aggregates exactly to the published 2024 Summary accounts. The assumption is therefore not that 2017 input-output levels remain unchanged, but only that within-Summary-block Detail shares remain fixed after 2017.

D.3 From tariff lines to BEA commodities

Customs data are observed monthly at the HS-10 product-by-country level and include a NAICS-based import classification. We first map the customs NAICS code to a BEA industry, moving to coarser NAICS levels when necessary. We then use the BEA Make matrix to convert industries into commodities.

For each episode, we construct fixed import-composition weights $a_{i,kc}$ giving the share of commodity i's imports accounted for by HS-10 product k from country c. The commodity-level border shock is

$$\mathrm{d}\log p^{*}_{i,t} = \sum_{k,c} a_{i,kc}\,\mathrm{d}\log(1+\tau_{kc,t}). \tag{D.4}$$

Weights are based on 2017 trade for the 2018–19 episode and 2024 trade for the 2025 episode and are held fixed within each episode.

Approximately 95 percent of import value can be assigned to a BEA commodity. Records without a usable producing-industry classification are excluded rather than reallocated. Commodities with no matched imports remain in the system with zero border exposure.

D.4 Resolving imports by source region

Country-specific tariffs require source-region shares at the Detail commodity level. Census trade data provide detailed source composition but do not distinguish end use; the TiVA tables distinguish end use but only at the Summary level. We combine the two using iterative proportional fitting.

Let t_{jg} be region g's share of Detail commodity j's total imports, $B(j)$ its Summary block, and m_{Bg} region g's published import share for that block and end use. We construct Detail shares r_{jg} satisfying

$$\sum_g r_{jg} = 1, \tag{D.5}$$

$$\sum_{j \in B} \omega_j r_{jg} = m_{Bg}, \tag{D.6}$$

where ω_j is commodity j's share of the block's import value. The solution has the form

$$r_{jg} = t_{jg} a_j b_{B(j),g}.$$

We apply this procedure separately to final imports, imported intermediates, and own-market imports. For intermediate inputs, the regional split is also allowed to vary with the using industry. By construction, aggregation back to the Summary level reproduces the published TiVA regional totals exactly.

D.5 Matching PPI series to BEA commodities

Producer-price outcomes are BLS PPI industry series, while model exposure is indexed by BEA commodity. We match the two through their common NAICS classifications.

Starting at the most detailed NAICS level, we retain a match only when the resulting PPI outcome can be assigned uniquely to one BEA commodity. Ambiguous matches are reconsidered at progressively coarser NAICS levels. When several PPI series jointly represent one commodity and no unique parent series is available, we use their unweighted average.

The procedure produces PPI outcomes for 273 BEA commodities: 252 matched to a single series and 21 to an average of multiple series.

Table D.1: Coverage of the PPI-to-BEA Match

Match	Number of BEA commodities
Single PPI series	252
Average of multiple PPI series	21
Total PPI outcomes	**273**

Notes: Commodities without an observed PPI remain in the input-output system and transmit shocks through the network but do not enter the producer-price regressions as outcomes.

D.6 Additional data

Prices. Consumer-price outcomes are monthly BEA PCE price indexes at the NIPA expenditure-category level. Producer-price outcomes are monthly BLS PPI series matched as described above. Short gaps in individual PPI series are interpolated when adjacent observations are available; longer gaps remain missing.

Concentration. For Appendix F.4, we construct BEA-commodity Herfindahl–Hirschman indexes from firm sales using Economic Census and NETS data mapped through NAICS. The 2025 specification uses the 2022 sales HHI.

Oil and wages. The local projections control for oil and wage movements outside the model. Oil exposure combines each commodity's petroleum input share with the monthly crude-oil price change. Wage growth is measured at the industry level from BLS data.

E Robustness of the Pass-through Estimates

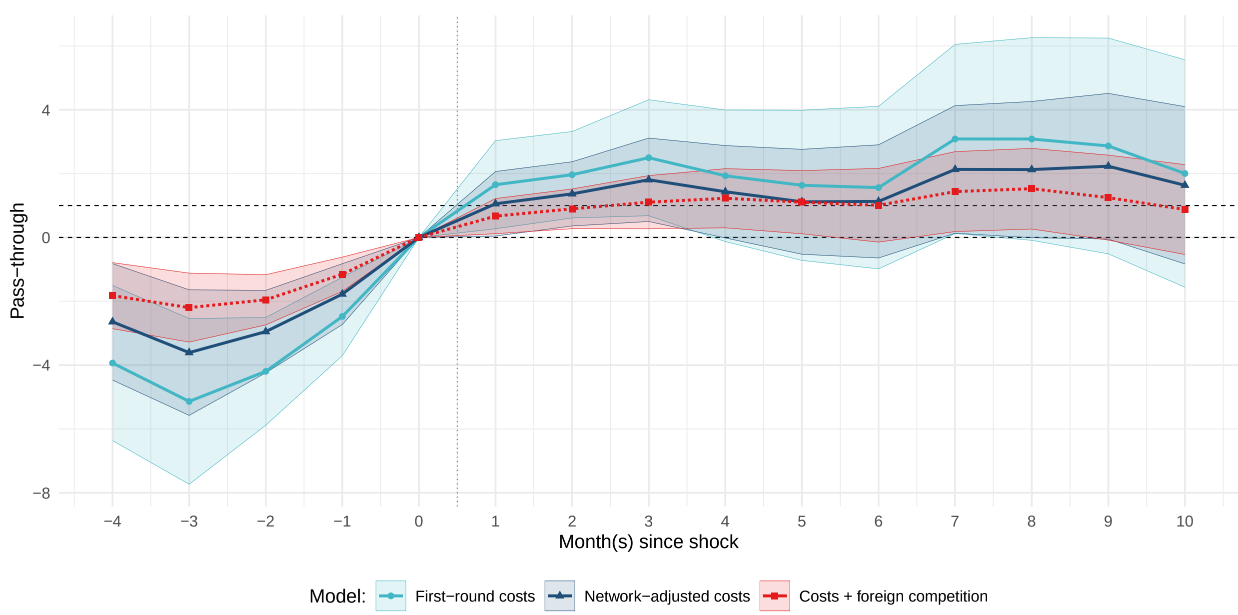
In this appendix, we investigate the robustness of our pass-through estimates. Each exercise below changes one feature of the baseline local-projection specification while leaving the remaining construction, controls, fixed effects, and inference unchanged.

E.1 The 2018–19 episode

We apply the producer-price specification to the 2018 tariff episode using 2017 input-output matrices and 2017 trade weights. We construct the three exposure measures as in the 2025 exercise. The treatment window ends in May 2019, the last month before the June 2019 escalation, that applies a 25% increase on the same goods affected by tariffs in 2018.

Figure E.1 shows the results. Applying the same criteria in the main text, we get an estimate of $\hat{\bar{\rho}} = 0.697$. Note that contrary to the 2025, there are clear pre-trends in all specifications.

Figure E.1: PPI Tariff Pass-through — 2018–19 Episode

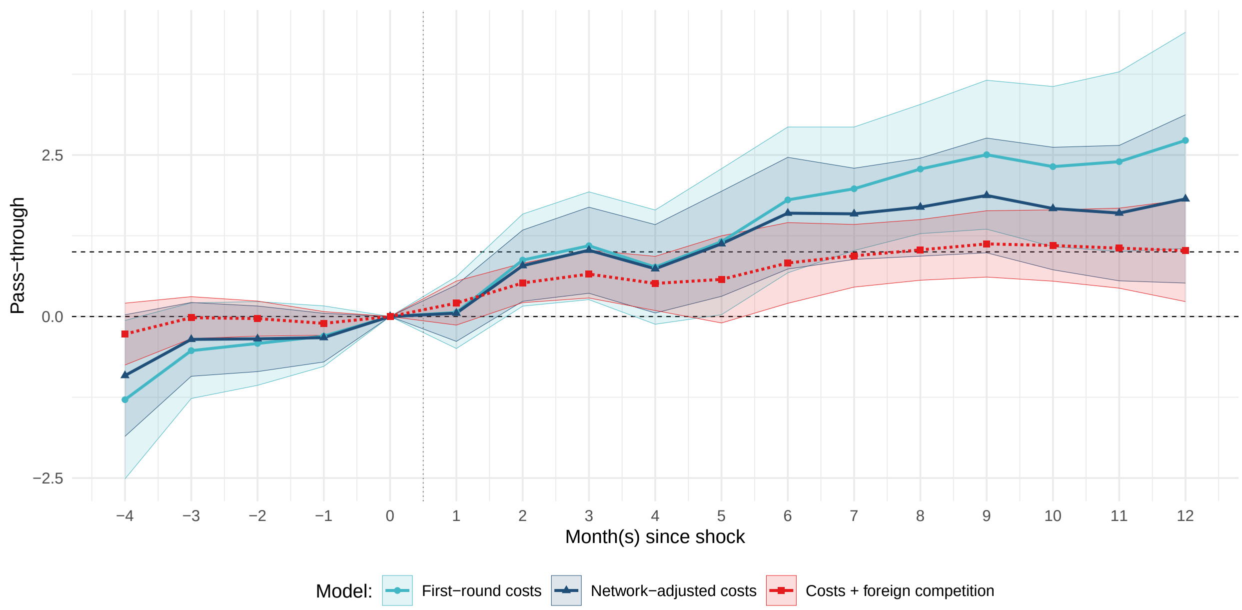


Notes: As Figure 3, applied to the 2018–19 episode using 2017 input-output relationships and import weights. The foreign-competition line is built at $\hat{\bar{\rho}} = 0.697$, and at the reference horizon it gives $\beta_9 = 1.248$ (0.679) against 2.232 (1.164) for the network-adjusted arm. Horizons are drawn to $h = 10$, the deepest one whose outcome window closes before March 2020. Bands are 95% confidence intervals clustered by industry.

E.2 Pass-through in logs

We rebuild all model-implied exposures under pass-through in logs and re-estimate the baseline local projections. Figure E.2 shows the results for PPI, while Figure E.3 shows the PCE results. We can observe that the model in logs estimated here behave similarly to that under levels for both PPI and PCE responses.

Figure E.2: PPI Tariff Pass-through — Pass-through in Logs



Notes: As Figure 3, with exposures rebuilt under pass-through in logs ($\boldsymbol{\Upsilon}^d = \boldsymbol{I}$).

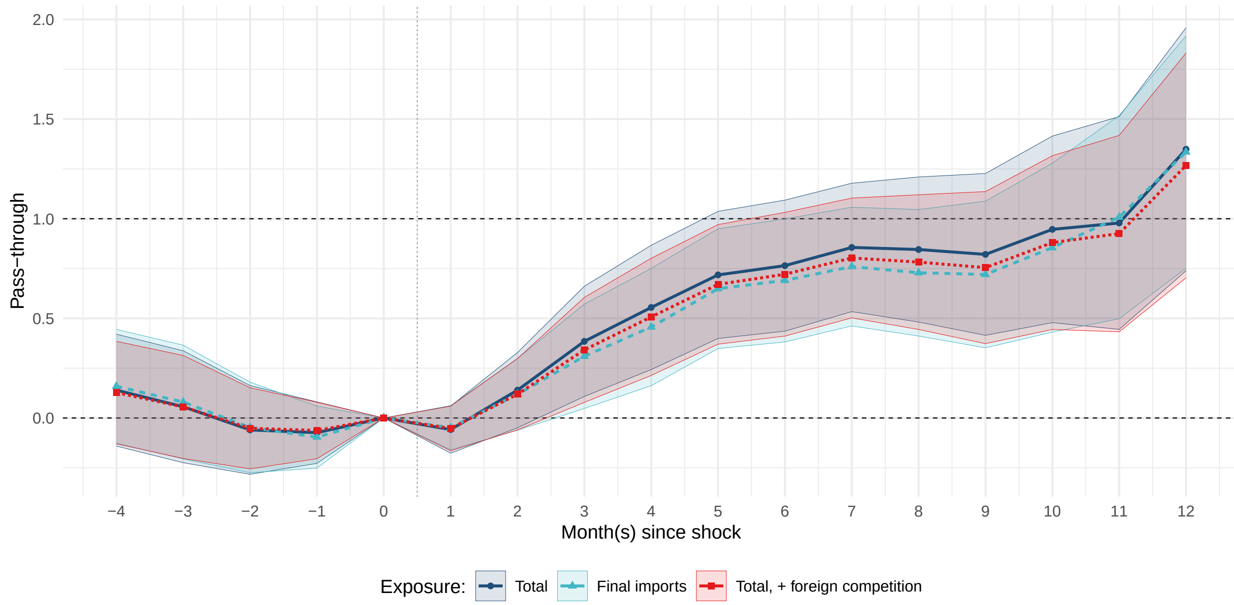
E.3 Sign-symmetry of the tariff-path controls

We also studied whether allowing tariff changes in both lead and lag controls to have difference coefficients changes our estimates of the pass-through to PCE. Figure E.4 shows that allowing for a sign-split reduces the estimated pass-through but we cannot reject that on average the two estimates are statistically different from each other.

E.4 Goods-only PCE

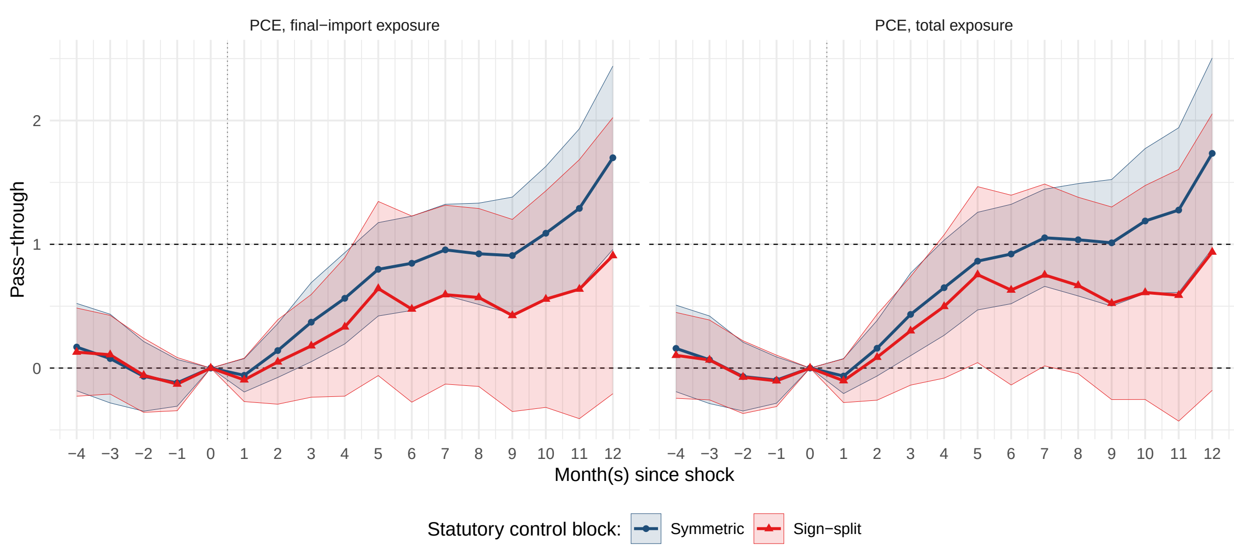
Figure E.5 shows our estimates coefficients when we restrict attention only to good categories in PCE. We can see that the pass-through tend to be faster and higher for goods than for the all goods sample, although they cannot be statistically distinguish from each other.

Figure E.3: PCE Tariff Pass-through — Pass-through in Logs



Notes: As Figure 5, with exposures rebuilt under pass-through in logs ($\boldsymbol{\Upsilon}^d = \boldsymbol{I}$).

Figure E.4: PCE Tariff Pass-through — Sign-symmetric vs. Sign-split Control Block



Notes: As Figure 5, with one panel per exposure measure. The alternative specification enters positive and negative statutory leads and lags separately; the treatment itself is not split. Bands are 95% confidence intervals clustered by item.

Figure E.5: PCE Tariff Pass-through — All Items vs. Goods Only

Notes: As Figure 5, with one panel per exposure measure. The alternative sample contains goods expenditure categories only. Bands are 95% confidence intervals clustered by item.

E.5 Alternative measures of the tariff shock

Finally, we study two alternatives to the baseline shock construction. First, we use the legally enacted tariff schedule as the instrument. Second, we consider the duty-inclusive border unit value as the treatment. Table E.1 shows the results and confirm that our baseline results are not driven by the way we constructed the shock.

Table E.1: Cumulated Pass-through under Alternative Measures of the Tariff Shock

	$h = 6$	$h = 9$	$h = 12$
Panel A. The instrument: statutory observed vs. enacted schedule			
Statutory observed	0.552	0.833	1.247
	(0.267)	(0.342)	(0.455)
Enacted schedule	0.678	0.843	0.976
	(0.294)	(0.359)	(0.486)
First stage, statutory	0.794	0.797	0.820
First stage, enacted	0.733	0.911	0.891
Hansen J, p-value	0.400	0.948	0.197
Panel B. The treatment: tariff cost index vs. duty-inclusive border price			
Tariff cost index	0.552	0.833	1.247
	(0.267)	(0.342)	(0.455)
Duty component of the border price	0.536	0.832	1.263
	(0.258)	(0.344)	(0.464)
Duty-inclusive border price	0.683	1.161	1.347
	(0.325)	(0.459)	(0.432)
First stage, cost index	0.794	0.797	0.820
First stage, duty component	0.818	0.798	0.810
First stage, ex-tariff component	-0.176	-0.226	-0.050
First stage, duty-inclusive	0.642	0.572	0.759
Items	273	272	272

Notes: One observation per producer-price item. The dependent variable is the log price change from December 2024 to the indicated horizon and the treatment is the corresponding cumulated tariff or border-price dose. Panel A changes the instrument; Panel B changes the treatment. Exposure is constructed on Detail BEA commodities using fixed 2024 source-region weights. Heteroskedasticity-robust standard errors are reported.

F Robustness of the Strategic-Complementarity Estimate

The baseline estimates impose a common conditional own-cost pass-through parameter $\bar{\rho}$ and abstract from within-industry covariance between firm-level pass-through and imported-input exposure. This appendix considers three extensions: joint estimation of $\bar{\rho}$ and a common covariance wedge, estimation of $\bar{\rho}$ conditional on that wedge, and a specification in which ρ varies with market concentration.

F.1 Estimation

To save on notation, let

$$y_{i,t} = \Delta_{h_{\text{ref}}} \log p_{i,t+h_{\text{ref}}}$$

and let $\widetilde{x}$ denote the residual from projecting x on the fixed effects and controls in equation (50). For a given parameter vector θ, define

$$u_{i,t}(\theta) = \widetilde{y}_{i,t} - \widetilde{\Delta \log p}_{i,t}^{M}(\theta). \tag{F.1}$$

We use as instruments the statutory model-implied responses. Their parameter derivatives are

$$z_{0,i,t}(\theta) = \widetilde{\Delta \log p}_{i,t}^{M,\text{stat}}(\theta), \tag{F.2}$$

$$z_{k,i,t}(\theta) = \left(\frac{\partial \widetilde{\Delta \log p}_{i,t}^{M,\text{stat}}(\theta)}{\partial \theta_k} \right), \qquad k = 1, \ldots, p, \tag{F.3}$$

with moments conditions.

$$g_k(\theta) = \sum_{i,t} z_{k,i,t}(\theta) u_{i,t}(\theta).$$

We use continuously updated GMM with an item-clustered covariance matrix,

$$\widehat{\boldsymbol{V}}(\theta) = \sum_c \boldsymbol{G}_c(\theta) \boldsymbol{G}_c(\theta)', \tag{F.4}$$

$$\boldsymbol{G}_c(\theta) = \sum_{(i,t)\in c} \boldsymbol{z}_{i,t}(\theta) u_{i,t}(\theta), \tag{F.5}$$

and criterion

$$S(\theta) = \boldsymbol{g}(\theta)' \widehat{\boldsymbol{V}}(\theta)^{-1} \boldsymbol{g}(\theta). \tag{F.6}$$

We use test inversion to obtain confidence sets. Let $\mathcal{S}_{0.95}$ be the set of parameter values the criterion does not reject,

$$\mathcal{S}_{0.95} = \left\{\theta : S(\theta) \leq \chi^2_{K,0.95}\right\}, \tag{F.7}$$

where K is the number of moments. We restrict the parameter search to $\bar{\rho} \in [0.1, 1]$ with steps equal to 0.02

F.2 Joint estimation of $\bar{\rho}$ and the covariance wedge

Under

$$\mathbb{C}^d = \mathbf{0}, \qquad \mathbb{C}^* = \mathbf{\Gamma}\mathbf{\Omega}^*,$$

and common parameters $\rho_i = \bar{\rho}$ and $\gamma_i = \bar{\gamma}$, producer exposure becomes

$$\boldsymbol{Z}(\bar{\rho}, \bar{\gamma}) = \Big[\boldsymbol{I} - (1-\bar{\rho})(\boldsymbol{I} - \boldsymbol{S}_F) - \bar{\rho}\,\mathbf{\Upsilon}^d\mathbf{\Omega}^d\Big]^{-1}\Big[(\bar{\rho}+\bar{\gamma})\mathbf{\Upsilon}^d\mathbf{\Omega}^* + (1-\bar{\rho})\boldsymbol{S}_F\Big]. \tag{F.8}$$

We estimate $(\bar{\rho}, \bar{\gamma})$ using the scale moment and the two parameter-derivative moments. Since $\bar{\gamma} = \rho^* - \bar{\rho}$, where ρ^* is an exposure-weighted average of firm-level pass-throughs, its structural range is bounded

$$-\bar{\rho} \leq \bar{\gamma} \leq 1 - \bar{\rho}. \tag{F.9}$$

However, when searching for the optimal $\bar{\gamma}$ we do not impose this restriction. In particular, we allow $\bar{\gamma} \in [-4,\ 4]$.

Table F.1: Joint Estimation of $\bar{\rho}$ and the Covariance Wedge

Parameter	Estimate	95% projected set
$\bar{\rho}$	0.719	[0.403, ≥1.000]
$\bar{\gamma}$	0.716	[-0.88, 2.64]
$\hat{\bar{\rho}} + \hat{\bar{\gamma}}$, admissible in $[0,1]$	1.435	
J (1 df), p	0.01	0.925
$S(\hat{\bar{\rho}}, 0)$, p (3 df)	2.76	0.430

Notes: $\bar{\rho}$ and $\bar{\gamma}$ are estimated jointly using the scale moment and their two derivative moments, with exposure (F.8). Confidence sets are projections of the non-rejected region (F.7) and are conservative; an end marked $\geq$ sits on the edge of the searched region, $\bar{\rho} \in [0.10,\ 1]$ and $\bar{\gamma} \in [-4,\ 4]$. The implied exposure-weighted pass-through is $\bar{\rho} + \bar{\gamma}$, whose structural range is $[0,1]$ and is not imposed. J tests the single over-identifying restriction against χ^2_1, and $S(\hat{\bar{\rho}}, 0)$ — the criterion with the wedge switched off at the jointly estimated $\hat{\bar{\rho}}$ — is read against $\chi^2_{3,0.95} = 7.81$. Producer prices, 2025 episode, pass-through in levels, $h = 9$.

Table F.1 shows the result of the joint estimation. Here, $\hat{\bar{\rho}} = 0.719$ is close to the baseline estimate. The covariance wedge is weakly identified: its confidence set contains zero and its unconstrained point estimate lies outside its structural range. We therefore interpret this exercise as a robustness check on $\bar{\rho}$, rather than as a separate estimate of $\bar{\gamma}$.

F.3 $\bar{\rho}$ conditional on the covariance wedge

We next fix $\bar{\gamma}$ at alternative values and re-estimate $\bar{\rho}$ using the same moment system. Table F.2 shows the results. Across the reported values of $\bar{\gamma}$, the estimate of $\bar{\rho}$ remains close to the headline estimate. In particular, admissible nonpositive covariance wedges imply somewhat lower $\bar{\rho}$, strengthening the foreign-competition channel.

Table F.2: $\hat{\bar{\rho}}$ under Imposed Values of the Covariance Wedge

Imposed $\bar{\gamma}$	$\hat{\bar{\rho}}$	S at $\hat{\bar{\rho}}$	95% set for $\bar{\rho}$	$\hat{\bar{\rho}} + \bar{\gamma}$
-1.00	—	8.59	(empty)	$---$
-0.50	0.600	5.08	[0.46, 0.76]	0.10
-0.20	0.620	3.16	[0.44, 0.84]	0.42
0.00	0.640	2.02	[0.42, 0.88]	0.64
0.50	0.680	0.20	[0.44, 0.96]	1.18
1.00	0.760	0.30	[0.52, $\geq$1.00]	1.76

Notes: $\bar{\gamma}$ is fixed at each listed value and $\bar{\rho}$ is re-estimated on a 0.02 grid using the same three moments as in Table F.1. The column S at $\hat{\bar{\rho}}$ is the criterion with $\bar{\rho}$ concentrated out, read against $\chi^2_{3,0.95} = 7.81$, so it tests the imposed wedge; the 95% set for $\bar{\rho}$ collects the values that same criterion does not reject at the given wedge. The column $\hat{\bar{\rho}} + \bar{\gamma}$ reports the implied exposure-weighted pass-through, admissible in $[0, 1]$ by (F.9). Producer prices, 2025 episode, pass-through in levels, $h = 9$.

F.4 Allowing ρ to vary with market concentration

We finally allow ρ to vary across commodities with effective market concentration:

$$\rho_j = 1 - \alpha_0 - \alpha_1(1 - s_{Fj})HHI_j. \tag{F.10}$$

Here HHI_j is the sales Herfindahl index and $(1 - s_{Fj})HHI_j$ measures domestic concentration after accounting for the foreign market share.

We estimate (α_0, α_1) using the scale moment and the two corresponding derivative moments. Table F.3 shows the results of this exercise.

The estimates, $\hat{\alpha}_0 = 0.295$ and $\hat{\alpha}_1 = 0.899$, imply a median commodity-level ρ_j of 0.652, close to the common-ρ estimate. The estimated concentration gradient has the sign predicted by the model, but its confidence intervals includes zero. We therefore view this specification

Table F.3: ρ Parameterized by Effective Concentration

Parameter	Estimate	95% projected set
α_0	0.295	[0.00, 0.60]
α_1	0.899	[-0.90, 1.35]
Implied ρ_j, 10th pct	0.498	
median	0.652	
90th pct	0.690	
J (1 df), p	1.28	0.258
S at $\alpha_1 = 0$ (one common ρ), p (3 df)	1.93	0.587
S at $\alpha_1 = 1$ (microfoundation), p (3 df)	1.47	0.688
Largest α_1 keeping every $\rho_j \geq 0.10$	0.960	
Active commodities	222	
with $(1 - s_F)\, HHI > 0$	222	

Notes: Commodity-level pass-through is parameterized according to equation (F.10). HHI_j is the 2022 sales Herfindahl index and s_{Fj} the foreign sales share, so the gradient α_1 is identified off the commodities with a strictly positive effective index. Confidence sets are projections of the non-rejected region (F.7) and are conservative. J tests the single over-identifying restriction against χ^2_1; the two S rows are the profiled criterion with the stated restriction imposed, read against $\chi^2_{3,0.95} = 7.81$. The row *Largest* α_1 *keeping every* $\rho_j \geq 0.10$ is arithmetic rather than statistical, evaluated at $\hat{\alpha}_0$, and records how close the estimate sits to the grid floor. Producer prices, 2025 episode, pass-through in levels, $h = 9$.

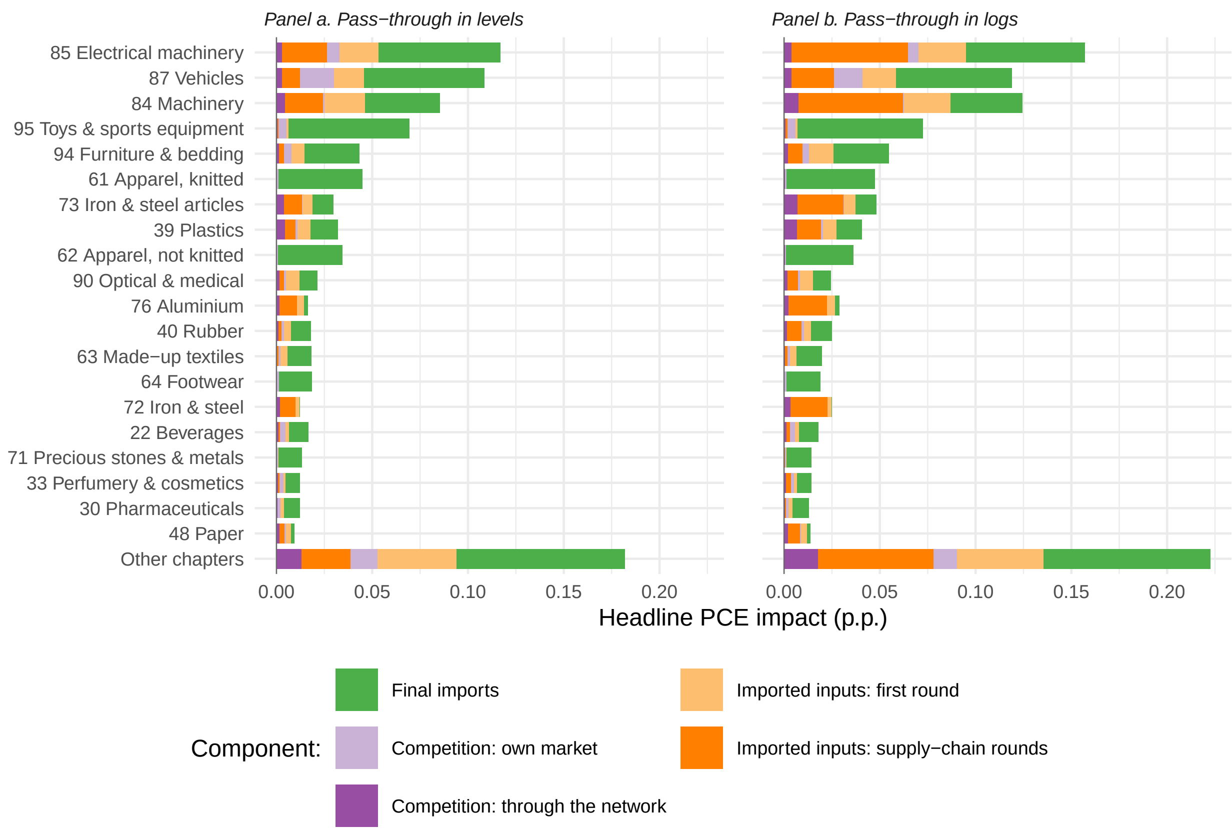
as consistent with, rather than independently identifying, the model's market-structure mechanism.

G Heterogeneity on the Contribution to Headline PCE

Figure G.1: Contribution by Month of Tariff Change

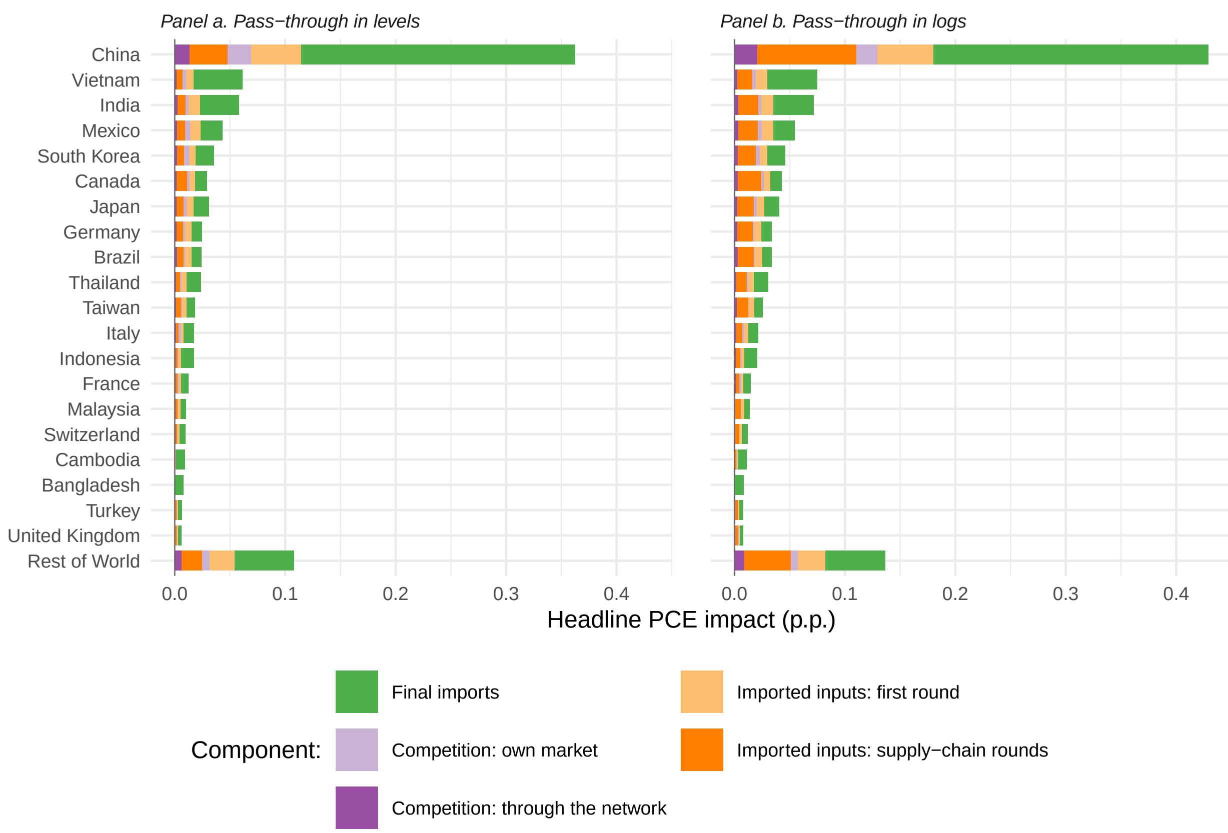
Notes: The five components of Figure 6, in percentage points, split by the calendar month in which the tariff changed. Bars sum to the total of that figure by construction. Pass-through in levels.

Figure G.2: Contribution by Tariffed Commodity (HS2 Chapter)



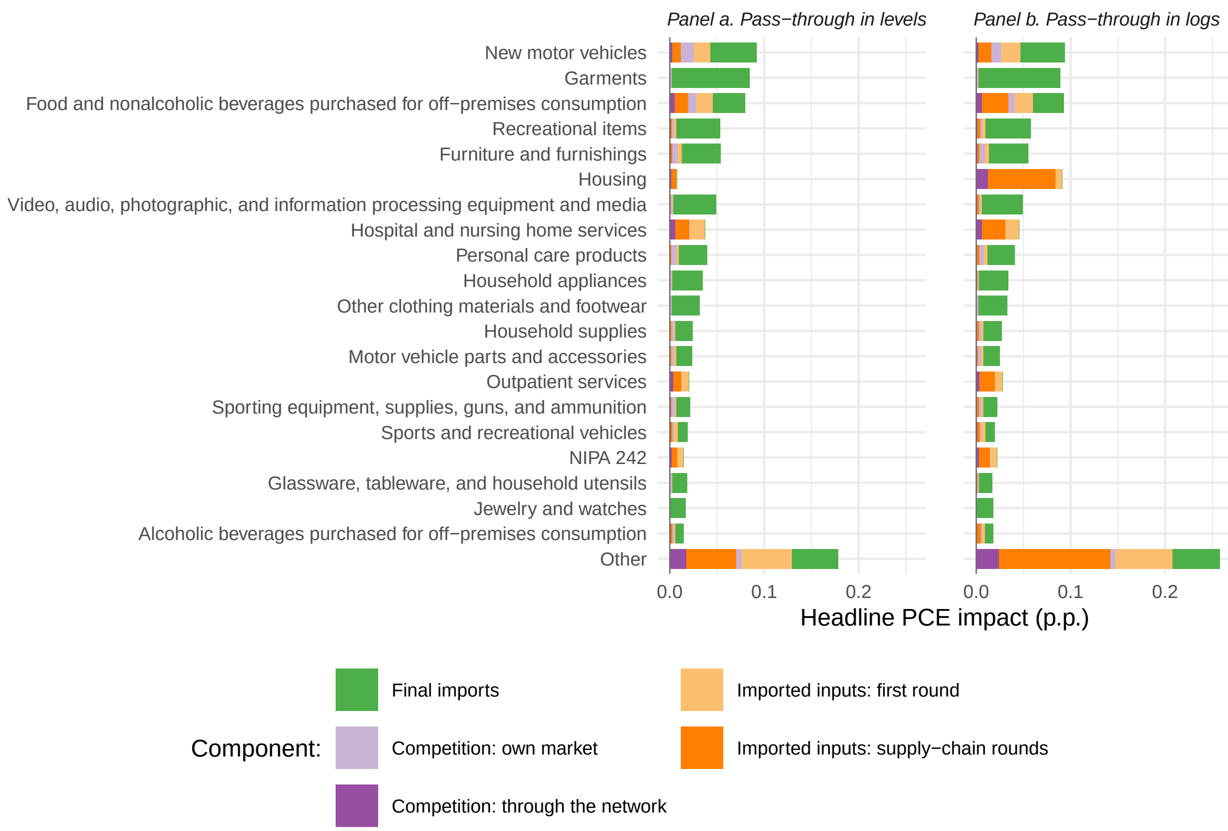
Notes: The five components of Figure 6, in percentage points, split by the HS2 chapter on which the tariff was levied. The twenty chapters largest in absolute value are shown separately and the remainder is collected in *Other chapters*, ordered by signed total in both panels. Negative segments are reported as such. Panels are the two pass-through conventions of Figure 6.

Figure G.3: Contribution by Source Country



Notes: The five components of Figure 6, in percentage points, split by country of origin. Bars sum to the total of that figure and not to tariff rates. The twenty countries largest in absolute value are shown separately and the remainder is collected in *Rest of World*. Panels are the two pass-through conventions of Figure 6.

Figure G.4: Contribution by Consumption Category



Notes: The five components of Figure 6, in percentage points, split by the category on which the affected price change is spent rather than by where the tariff was levied. Categories are the Detail NIPA groups of Section 5.1; the twenty largest in absolute value are shown separately and the remainder is collected in *Other*. Panels are the two pass-through conventions of Figure 6.