Aggregation Bias in Import Price Pass-Through

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Abstract

We show that the estimated degree of import price pass-through depends critically on how import cost shocks are measured. Using Swedish firm-level data, we construct a novel network-adjusted measure of effective import prices that captures both direct exposure to imported inputs and indirect exposure through production networks. Conventional aggregate import price indices average across heterogeneous sourcing structures and ignore upstream linkages, thereby providing a noisy proxy for the marginal cost shocks relevant for firms pricing decisions. We show that this aggregation bias substantially attenuates standard pass-through estimates. When import costs are measured using aggregate import price indices, pass-through appears incomplete and gradual. In contrast, the network-adjusted measure implies substantially stronger transmission, with domestic prices adjusting close to one-for-one with import costs within one year. These findings remain robust under an instrumental variable strategy based on exogenous oil supply news shocks from Kanzig (2021). Overall, the results suggest that the transmission of international cost shocks to domestic prices is stronger and more complete than previously documented once firms effective exposure to imported inputs is properly measured.

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1 Introduction

In this paper, we show that the estimated degree of import price pass-through depends critically on how import cost shocks are measured. A large empirical literature finds that pass-through from international cost shocks to domestic prices is incomplete and gradual, even over relatively long horizons, as in McCarthy (1999), Campa and Goldberg (2005), Nakamura and Zerom (2010), Burstein and Gopinath (2014), and Gopinath (2015). These findings have motivated explanations based on nominal rigidities, variable markups, local distribution costs, and strategic complementarities in pricing decisions. We argue that an important part of the measured incompleteness of pass-through instead reflects aggregation bias in standard measures of import prices. Aggregate import price indices average across firms with heterogeneous sourcing structures and ignore the propagation of shocks through production networks, thereby providing only a noisy proxy for the marginal cost shocks relevant for firms pricing decisions. Using Swedish firm-level data and a novel network-adjusted measure of effective import prices, we show that pass-through is substantially stronger and approaches full transmission within one year once import cost shocks are measured at a granular and network-consistent level.

Our paper contributes to several strands of the literature. First, we contribute to the empirical literature on international price pass-through. Existing studies based on aggregate shocks and aggregate import price measures consistently document incomplete and sluggish pass-through to domestic prices. We show that part of this result reflects attenuation bias arising from the use of aggregate import price proxies. In this respect, our paper is related to contributions emphasizing the role of measurement in pass-through estimation. Gopinath and Itskhoki (2010) and Gopinath et al. (2010) show that aggregation across adjustment states and invoicing regimes attenuates estimated pass-through, while Gagnon et al. (2014) and Nakamura and Steinsson (2012) document important biases in measured import price indices due to product turnover and replacement. More broadly, Redding and Weinstein (2020) and Hottman et al. (2016) show that aggregation can obscure economically meaningful heterogeneity in price data. Our contribution is to show that aggregation across heterogeneous input structures and the omission of production-network linkages constitute an additional and quantitatively important source of attenuation bias in pass-through regressions.

Second, our analysis relates to the literature on production networks and shock propagation. Acemoglu et al. (2012) and Carvalho and Tahbaz-Salehi (2019) emphasize the role of input-output linkages in transmitting shocks across the economy, while empirical evidence from Barrot and Sauvagnat (2016), Boehm et al. (2019), Dedola et al. (2021), Lafrogne-Joussier et al. (2023), and Huneeus (2023) shows that international cost shocks propagate through domestic supply chains. We contribute to this literature by showing that production networks are not only important for the propagation of shocks, but also for correctly measuring firms effective exposure to imported inputs and therefore for identifying pass-through.

The central idea of the paper is that firms face highly heterogeneous import cost shocks even within narrowly defined industries. Firms differ in their imported input composition, sourcing locations, and position within domestic production networks. Consequently, the effective marginal cost shocks relevant for pricing decisions differ substantially across firms and sectors. Conventional aggregate import price indices smooth over this heterogeneity by imposing a representative exposure that few firms actually face. Moreover, imported inputs affect firms not only directly, through their own purchases of foreign goods, but also indirectly through upstream suppliers that themselves rely on imported inputs. Ignoring these channels weakens the correlation between observed import price indices and the true marginal cost shocks relevant for price setting.

To address this issue, we construct a network-adjusted measure of effective import prices that combines granular import price information with the input-output structure of the Swedish economy. The measure captures both direct exposure to imported inputs and indirect exposure operating through domestic production networks. We then estimate dynamic pass-through using local projections at the firm-product level. Our baseline results show that pass-through estimates depend critically on how import cost shocks are measured. When import prices are proxied using conventional aggregate indices, pass-through appears incomplete and sluggish, consistent with the existing literature. In contrast, when using the network-adjusted measure, domestic prices respond much more strongly and cumulative pass-through approaches unity within approximately twelve months. These findings imply that a significant fraction of the missing pass-through documented in prior work reflects attenuation bias due to mismeasurement of cost shocks.

We also document that pass-through is asymmetric. Firms respond substantially more strongly to increases in import costs than to decreases, and this asymmetry becomes considerably more pronounced when import costs are measured using the network-adjusted specification. In addition, we show that improved measurement sharpens several well-known heterogeneity patterns in the data. Within industries, the relationship between pass-through and firm size becomes markedly more pronounced when cost shocks are measured using firm-specific exposure. Across industries, sectors characterized by stronger reliance on intermediate inputs and greater market concentration exhibit larger pass-through responses. Finally, section 4.4 implements an instrumental variable strategy based on exogenous oil supply news shocks from Kanzig (2021). The IV results confirm the baseline findings and continue to show substantially larger pass-through estimates when import costs are measured using the network-adjusted specification.[1]

Taken together, our findings suggest that the transmission of international cost shocks to domestic prices is substantially stronger and more complete than previously documented. More broadly, they highlight that accurately measuring firms exposure to imported inputs is essential for understanding inflation dynamics in economies characterized by fragmented global value chains and layered production networks.

The remainder of the paper proceeds as follows. Section 2 introduces the logic behind the aggregation bias and justifies the need of a more precise measure of Pass-Through. Section 3 describes the data and the construction of the network-adjusted import price measure. Section 4 presents the pass-through results. Section 5 concludes.

2 Aggregation Bias in Import Price Pass-Through

A large empirical literature studies how international cost shocks transmit to domestic prices and consistently finds incomplete and gradual pass-through. Classic contributions such as McCarthy (1999), Nakamura and Zerom (2010), and Burstein and Gopinath (2014) document that changes in exchange rates or import prices are only partially reflected in domestic prices, even over relatively long horizons. These findings have motivated a broad set of theoretical explanations. Prominent mechanisms include nominal price rigidities that slow price adjustment, variable markup behavior that leads firms to absorb part of the cost change in margins, local distribution costs that dilute the effect of import prices on final prices, and strategic complementarities in pricing decisions across competing firms.

While these mechanisms undoubtedly shape pricing behavior, an important issue concerns how the underlying cost shocks are measured in empirical work. Most empirical studies approximate firms' marginal cost shocks using aggregate variables, such as exchange rate

[1] A large literature studies heterogeneity in pass-through across firms and sectors, emphasizing the roles of market power, firm size, sourcing strategies, and pricing complementarities; see for example Amiti et al. (2014), Amiti et al. (2019), Auer and Schoenle (2016), Auer (2016), Garetto (2016), and Chatterjee et al. (2013). In this paper, we abstract from these mechanisms in the main analysis to focus on measurement. Section C.5 shows that the network-adjusted measure nevertheless sharpens several well-known heterogeneity patterns documented in this literature.

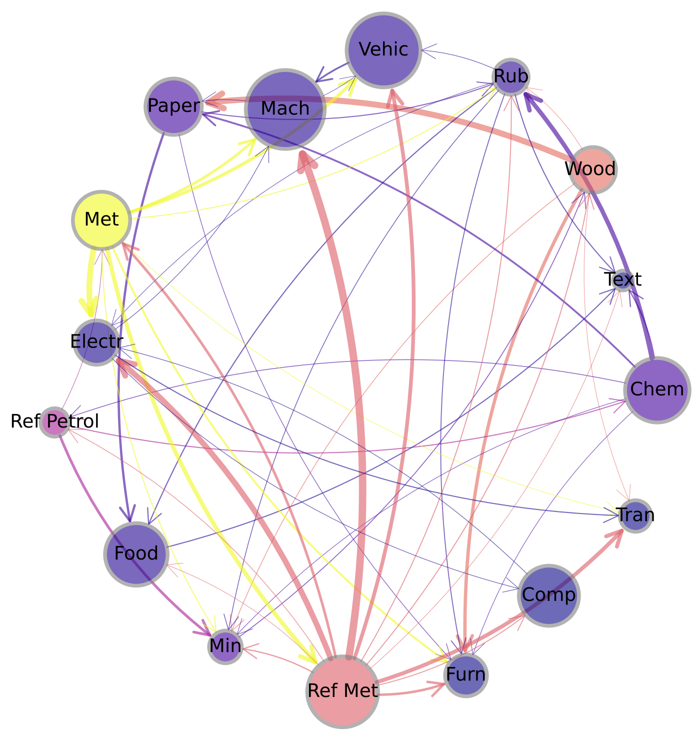
movements or sector-level import price indices. These measures are convenient and widely available, but they implicitly assume that firms within a sector are exposed to similar foreign cost shocks. In practice, however, firms differ substantially in their sourcing structures, import intensity, and supplier relationships. Even within narrowly defined industries, firms may rely on very different sets of imported inputs, sourced from different countries and subject to distinct price dynamics. As a consequence, the effective cost shocks faced by individual firms can deviate significantly from the aggregate indices typically used in empirical regressions.

This heterogeneity is further amplified by the presence of production networks. Firms are not only exposed to the imported inputs they purchase directly, but also indirectly through domestic suppliers that themselves rely on foreign intermediate goods. Figure 1 illustrates the structure of these inter-industry linkages in Sweden and highlights the substantial heterogeneity in exposure across sectors once production networks are taken into account. Industries differ markedly in the extent to which they depend on upstream sectors that are themselves exposed to imported inputs, implying that the transmission of international cost shocks is inherently heterogeneous across the economy. Ignoring these network linkages and relying instead on aggregate import price indices therefore masks economically meaningful variation in firms effective marginal cost shocks and can lead to substantial attenuation bias in estimated pass-through coefficients.

This heterogeneity is further amplified by the presence of domestic production networks. Firms rarely use imported inputs in isolation. Instead, imported goods often enter production chains where intermediate inputs are exchanged across industries before reaching final consumers. In such environments, firms are exposed to foreign cost shocks both directly, through their own imported inputs, and indirectly, through upstream suppliers that themselves rely on imported goods. Standard aggregate import price indices do not capture these indirect exposure channels. By construction, they average across sectors and ignore the propagation of cost shocks through input output linkages. As a result, they may provide only a coarse approximation to the true marginal cost pressures faced by firms.

From an econometric perspective, this discrepancy generates a measurement problem in pass-through regressions. Let $\Delta p_{i,j,t+h}$ denote the cumulative change in the price charged by firm i for product j between period t and horizon $t+h$. Suppose that the economically relevant shock is the effective import cost shock faced by sector s, denoted by $\Delta C_{s,t}$. This variable captures the change in foreign input costs relevant for firms in sector s, once one accounts for differences in input composition and the propagation of shocks through domestic production networks.

Figure 1: The Netowrk Structure in Sweden



Notes: The figure reports the netowrk at 2-digits sector level for Sweden.

The population relationship between prices and the true marginal cost shock can be written as

$$\Delta p_{i,j,t+h} = \alpha_{i,j} + \alpha_t + \beta_h^C \Delta C_{s,t} + u_{i,j,t+h}, \tag{1}$$

where $\alpha_{i,j}$ are firm product fixed effects, α_t are time fixed effects, and $u_{i,j,t+h}$ is an error term orthogonal to the true cost shock. The coefficient β_h^C therefore captures the pass-through of the effective import cost shock to domestic prices.

In practice, however, the econometrician typically does not observe $\Delta C_{s,t}$. Empirical work instead relies on aggregate proxies such as exchange rate changes or aggregate import price indices. Let this observable proxy be denoted by ΔX_t. The estimated regression then takes the form

$$\Delta p_{i,j,t+h} = \alpha_{i,j} + \alpha_t + \beta_h^X \Delta X_t + \varepsilon_{i,j,t+h}. \tag{2}$$

Because ΔX_t is only an imperfect proxy for the true cost shock, the coefficient estimated in this regression does not directly recover the structural pass-through parameter. Instead, the estimated coefficient corresponds to the linear projection of price changes on the observable proxy. After removing fixed effects, the resulting coefficient can be written as

$$\beta_h^X = \frac{\text{Cov}(\widetilde{\Delta p}_{i,j,t+h}, \widetilde{\Delta X}_t)}{\text{Var}(\widetilde{\Delta X}_t)}. \tag{3}$$

Substituting the true model into this projection shows that the estimated coefficient depends on how strongly the proxy ΔX_t co-moves with the true marginal cost shock $\Delta C_{s,t}$. In particular, the estimated pass-through coefficient can be written as

$$\beta_h^X = \frac{\text{Cov}(\widetilde{\Delta C}_{s,t}, \widetilde{\Delta X}_t)}{\text{Var}(\widetilde{\Delta X}_t)} \beta_h^C = \xi_s \beta_h^C, \tag{4}$$

where $\xi_s \in (0, 1)$ measures the extent to which the aggregate proxy captures the true variation in sector specific cost shocks.[2]

Whenever the aggregate proxy only imperfectly tracks firms effective import cost shocks, the covariance between ΔX_t and $\Delta C_{s,t}$ is smaller than the variance of the proxy itself, implying $\xi_s < 1$. In that case the estimated pass-through coefficient will be mechanically attenuated toward zero.

Intuitively, aggregate import price indices average across firms that differ in import intensity, input composition, and exposure to upstream suppliers that themselves rely on imported inputs. As a result, these indices capture only part of the marginal cost variation relevant for firms pricing decisions.

This observation has an important implication for the pass-through literature. Estimates based on aggregate import price indices may understate the true responsiveness of domestic prices to international cost shocks. Part of the incomplete pass-through documented in the literature may therefore reflect measurement error in the cost shock variable rather than purely pricing frictions.

The analysis in this paper addresses this issue by developing a granular and network-adjusted measure of import cost exposure that better approximates $\Delta C_{s,t}$. By combining information on import price movements with the input-output structure of the economy, the resulting measure captures both direct exposure to imported inputs and indirect exposure operating through upstream production networks. Incorporating these channels allows us to

[2]Appendix Section B provides the formal derivation of this attenuation result.

reduce aggregation bias in pass-through regressions and obtain a more accurate estimate of the magnitude and dynamics of import price transmission to domestic prices.

3 Data

Our empirical analysis draws on a rich set of high-frequency firm-level data from Sweden. The core dataset is PRISMA, a confidential administrative source maintained by Statistics Sweden, which contains micro-level data underlying the official PPI, with different markets (import, export and domestic prices). It records monthly price observations at the firm-product level for a representative sample of Swedish firms, covering the period 1990-2024. Each observation is indexed by a firm identifier and an 8-digit Combined Nomenclature (CN) product code, which allows us to track the evolution of individual product prices across firms with a high degree of precision. Prices are reported in Swedish kronor (SEK), ensuring consistency over time and facilitating the analysis of price dynamics at the micro level.

PRISMA is complemented by metadata that allow linkage to additional firm-level sources, most notably annual financial statements from Upplysningscentralen (UC). These data provide information on firm characteristics such as total sales, employment, capital stock, and other balance sheet variables that are relevant for understanding firms' pricing behavior and their exposure to international input cost shocks.

To measure firms' exposure to foreign input costs, we combine two additional sources of information. First, we use monthly industry-level import price indices from Statistics Sweden, aggregated at the two-digit industry level. These series capture changes in the prices of imported goods faced by Swedish industries over time. Second, we exploit Sweden's input-output (IO) tables, which provide detailed annual information on inter-industry flows of goods and services within the economy. The IO tables allow us to map production linkages across industries and to quantify the extent to which imported inputs propagate through domestic supply chains.

The combination of import price data and input-output linkages is central for addressing the measurement challenges discussed in the previous section. In particular, these data allow us to construct a network-adjusted measure of effective import prices that captures both direct and indirect exposure to foreign cost shocks.

3.1 Network Based Import Price Measure

A key objective of the empirical analysis is to construct a measure of import cost shocks that closely approximates the effective marginal cost pressures faced by domestic firms. As discussed above, conventional aggregate import price indices may provide an imperfect proxy for firms' true exposure to international input prices because they average across heterogeneous sourcing patterns and ignore the propagation of shocks through production networks.

To address this issue, we construct a network-based measure of effective import prices that combines information on import price movements with the structure of domestic input-output linkages. The resulting measure captures both the direct use of imported inputs by each industry and the indirect exposure that arises through upstream suppliers. In doing so, it provides a more accurate representation of the cost shocks that propagate through the production system.

3.1.1 Construction of Network-Based Effective Import Prices

The construction of the network-adjusted import price measure proceeds in three steps. We first quantify the direct exposure of each industry to imported inputs. Let $\mathbf{\Lambda}^{IM}$ denote the matrix of direct import shares, where each element λ_{ij} represents the share of industry j's imported inputs that originates from industry i:

$$\lambda_{ij} = \frac{\text{Imports from industry } i \text{ used by industry } j}{\text{Total imports used by industry } j}. \tag{5}$$

This matrix captures the immediate exposure of each industry to imported inputs from different sectors. However, it does not account for the fact that industries may also be indirectly exposed to imported inputs through their domestic suppliers.

To capture these indirect channels, we exploit the input-output structure of the economy. Let $\mathbf{A}$ denote the domestic Leontief matrix, where each entry a_{ij} represents the share of industry j's total output purchased from industry i:

$$a_{ij} = \frac{\text{Value of inputs from industry } i \text{ purchased by industry } j}{\text{Total sales of industry } j}. \tag{6}$$

The matrix $\mathbf{A}$ summarizes the direct input relationships across industries. To account for the full set of upstream dependencies, we compute the Leontief inverse

$$\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}, \tag{7}$$

which captures the total input requirements, both direct and indirect, needed to produce one unit of output in each industry. By multiplying the Leontief inverse by the direct import share matrix, we obtain a measure of the total exposure of each industry to imported inputs across the production network:

$$\mathbf{L}_e = \mathbf{L} \cdot \mathbf{\Lambda}^{IM}. \tag{8}$$

The matrix $\mathbf{L}_e$ summarizes how imported inputs used anywhere upstream in the production chain ultimately affect each industry's cost structure.

Figure 2 illustrates the structure of the import Leontief exposure matrix for Sweden. Each element of the matrix measures the extent to which a given industry relies on imported inputs originating from another sector, either directly or through intermediate production linkages. The strong diagonal pattern reflects the fact that industries are naturally more exposed to imported inputs from their own sector. However, the substantial off-diagonal mass highlights the importance of cross-industry input linkages and shows that many sectors rely heavily on imported intermediates produced in other industries. The figure therefore illustrates the high degree of heterogeneity in import exposure across sectors and motivates the need for a network-based measure of effective import costs rather than conventional aggregate import price indices.

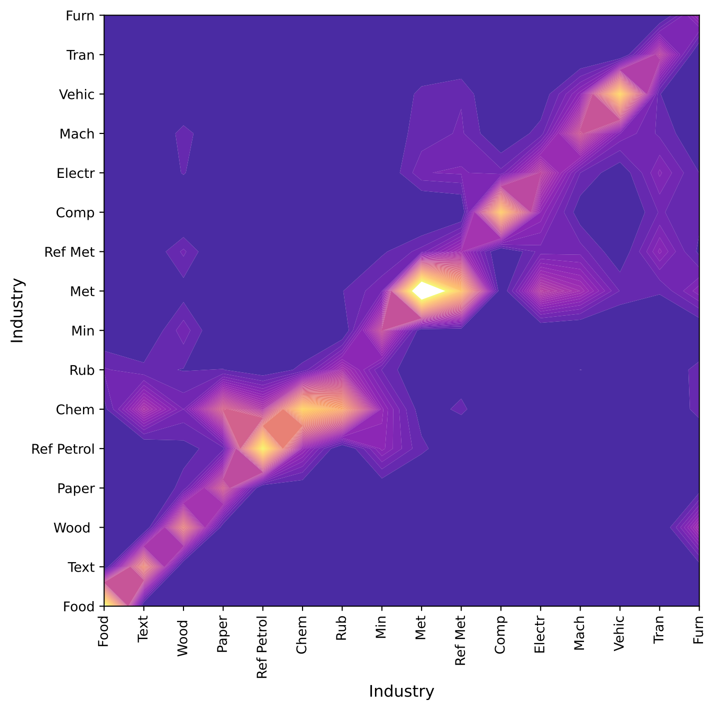
In the final step, we combine the network exposure matrix with observed import price movements. Let $\mathbf{P}_t$ denote the vector of import prices at time t, where $P_{i,t}$ represents the import price index for industry i. The network-adjusted effective import price vector is then given by

$$\mathbf{C}_t = \mathbf{L}_e \cdot \mathbf{P}_t. \tag{9}$$

The matrix $\mathbf{L}_e$ is treated as time invariant throughout the analysis. This choice reflects both conceptual and data considerations. Input-output tables are published only periodically and are therefore not consistently available at an annual frequency over the full sample period. Constructing a fully time-varying network matrix would consequently require interpolating missing years and would introduce substantial measurement noise unrelated to actual changes in production linkages.

To obtain a stable and consistent measure of production network exposure, we therefore

Figure 2: The Effective Leontief Inverse Matrix in Sweden



Notes: The figure reports the effective Leontief inverse matrix $\mathbf{L}_e = \mathbf{L} \cdot \mathbf{\Lambda}^{IM}$ for Sweden. Cells measure the exposure of industry j to imported inputs from industry i, where lighter colors indicate stronger transmission of import cost shocks across industries.

construct $\mathbf{L}_e$ using the average input-output structure across the available years. The resulting matrix captures the persistent component of inter-industry production linkages and abstracts from short-run fluctuations in input shares that are likely to reflect temporary adjustments or measurement error. This approach is standard in the production network literature and is particularly appropriate in our context, where the objective is to measure firms structural exposure to imported inputs rather than high-frequency variation in the input-output network itself.

The resulting vector $\mathbf{C}_t$ captures the effective import cost shocks faced by each industry once both direct and indirect exposure to imported inputs are taken into account.

This measure directly addresses the aggregation bias discussed in the previous section. By incorporating both the composition of imported inputs and the propagation of shocks through domestic supply chains, it provides a closer approximation to the marginal cost shocks that firms face when setting prices. In contrast, conventional aggregate import price indices average across heterogeneous sourcing structures and ignore upstream linkages. The network-based measure therefore captures economically meaningful variation in firms' exposure to foreign input prices and improves the identification of pass-through effects in the empirical analysis.

4 Import Price Pass-Through: Aggregate vs Effective

With the network-adjusted measure of import cost exposure in place, we now turn to the empirical analysis of import price pass-through. The goal of this section is to quantify how changes in import costs translate into domestic price adjustments and to assess how the estimated magnitude of pass-through depends on the measurement of import cost shocks. In particular, we compare results obtained using a conventional aggregate import price index with those based on the network-adjusted effective import price introduced above.

Our empirical framework relies on firm-product level price observations, which allow us to trace how individual firms adjust prices in response to fluctuations in import costs. The dependent variable in the analysis is the monthly change in the price charged by firm i for product j at time t. Specifically, we define domestic price changes as the log difference of observed prices,

$$\Delta P_{ij,t} = \log(P_{ij,t}) - \log(P_{ij,t-1}),$$

where $P_{ij,t}$ denotes the price reported in the PRISMA dataset. This measure captures the percentage change in domestic prices at the firm-product level and allows us to exploit substantial micro-level heterogeneity in pricing behavior across firms and products.

The key explanatory variables correspond to measures of import cost shocks. We consider two alternative proxies for changes in foreign input costs. The first is the conventional aggregate import price index, denoted by ΔP_t, which captures average movements in import prices at the aggregate level. The second measure is the network-adjusted effective import price, which incorporates both the composition of imported inputs and the propagation of cost shocks through production networks.

Formally, the network-adjusted import price change for industry s is defined as

$$\Delta C_{s,t} = \log(C_{s,t}) - \log(C_{s,t-1}), \tag{10}$$

where $C_{s,t}$ corresponds to the s-th element of the effective import price vector $\mathbf{C}_t = \mathbf{L}_e \cdot \mathbf{P}_t$. This measure reflects the total exposure of industry s to foreign input prices once both direct imports and indirect exposure through upstream suppliers are taken into account. By construction, it captures the effective marginal cost pressures faced by firms operating within each industry.

Comparing pass-through estimates obtained using ΔP_t and $\Delta C_{s,t}$ allows us to assess the extent to which conventional aggregate import price indices obscure the true transmission of international cost shocks to domestic prices.

4.1 Descriptive Statistics

Before turning to the pass-through regressions, we present descriptive evidence on the behavior of domestic prices and import cost shocks in the data. The summary statistics highlight key differences in the volatility and distribution of domestic price changes and effective import price changes, which provide useful context for the empirical analysis that follows.

Table 1 reports summary statistics for monthly domestic price changes at the firm-product level, ΔP_{ijt}, together with the corresponding network-adjusted effective import price changes, $\Delta C_{s,t}$. Notice that the number of observations in the case of the effective import price is due to the fact that we restrict the sample to those industries where both import and domestic prices are given. Domestic prices display relatively modest average changes and limited volatility compared with import prices. In particular, the standard deviation of effective import price changes is substantially larger than that of domestic price changes, reflecting the greater variability of international input markets. While domestic prices change only modestly in most months, import prices fluctuate more strongly, generating sizeable cost shocks for firms that rely on foreign inputs.

The difference in dispersion is also reflected in the range of observed price changes. Import price movements exhibit wider tails than domestic prices, indicating that firms are exposed to occasionally large fluctuations in input costs. By contrast, domestic price changes remain more tightly distributed around zero, suggesting that firms adjust prices gradually rather than immediately passing through cost shocks. This pattern is consistent with the presence of price adjustment frictions and staggered price-setting behavior at the firm-product level.

Figure 3 provides a visual representation of the distributions of domestic price changes and effective import price changes. Domestic price changes exhibit a pronounced peak around zero, indicating that most firms adjust prices infrequently and by relatively small amounts in any given month. In contrast, effective import price changes display a wider and more

Table 1: Descriptive Statistics: Domestic vs Import Price Changes

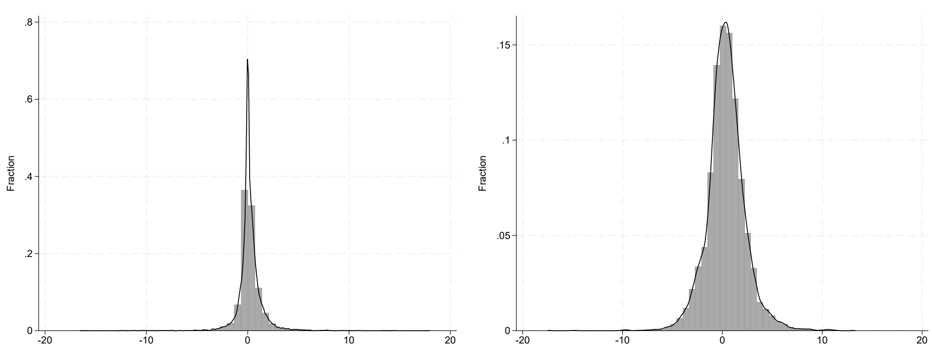
	N	Mean	SD	Skewness	Kurtosis	Min	Median	Max
Domestic Price Change	8870	0.214	1.253	0.383	30.694	-16.544	0.069	17.991
Import Price Change	8915	0.248	1.355	0.463	4.799	-3.530	0.216	7.422
Effective Import Price Change	6224	0.377	1.946	0.136	7.641	-17.514	0.328	13.305

Notes: The table reports summary statistics for monthly domestic price changes at the firm-product level and for network-adjusted effective import price changes constructed using the input-output structure of the Swedish economy. Domestic prices correspond to log changes in product prices reported in the PRISMA dataset. Effective import prices incorporate both direct and indirect exposure to imported inputs through production networks. The statistics show that import price changes are considerably more volatile and dispersed than domestic price changes, reflecting the higher variability of international input markets. The relatively smaller dispersion of domestic prices is consistent with gradual price adjustment and incomplete short-run pass-through of import cost shocks.

symmetric distribution, reflecting the higher volatility of international input prices and the heterogeneous exposure of industries to foreign cost shocks.

The contrast between the two distributions highlights an important feature of the data. Firms face substantial fluctuations in import costs, but domestic prices respond only gradually to these shocks. This difference in volatility is consistent with the gradual pass-through mechanism examined in the next section.

Figure 3: Distribution of Domestic and Effective Import Price Changes



Notes: The figure plots the empirical distributions of monthly domestic price changes at the firm-product level and network-adjusted effective import price changes. Domestic price changes are highly concentrated around zero, reflecting infrequent and relatively small price adjustments at the micro level. By contrast, effective import price changes display substantially wider dispersion, indicating that international input costs fluctuate more strongly than domestic output prices. The difference between the two distributions highlights the presence of price adjustment frictions and suggests that import cost shocks are transmitted to domestic prices only gradually.

4.2 Import Price Pass-Through and Aggregation Bias

We now examine how fluctuations in import prices transmit to domestic prices and how the estimated magnitude of pass-through depends on the measurement of import cost shocks. In particular, we compare pass-through estimates obtained using the network-adjusted effective import price introduced above with those obtained using a conventional aggregate import price index. This comparison allows us to directly assess the role of aggregation bias in standard pass-through regressions.

To trace the dynamic response of domestic prices to import cost shocks, we estimate local projections at the firm-product level. Let $\Delta P_{ijs,t+h}$ denote the log change in the price of product j sold by firm i in industry s between month t and horizon $t+h$. The estimated specification is

$$\Delta P_{ijs,t+h} = \alpha_i + \alpha_j + \alpha_t + \beta_h \Delta C_{s,t} + \gamma_h W_{ijs,t-z} + \varepsilon_{ijs,t+h}, \tag{11}$$

where $\Delta C_{s,t}$ represents the import cost shock. In the baseline specification this variable corresponds to the network-adjusted effective import price, which captures both direct exposure to imported inputs and indirect exposure through upstream suppliers. In alternative specifications we replace this measure with the conventional aggregate import price index. The model includes firm, product, and time fixed effects, denoted by α_i, α_j, and α_t, while $W_{ijs,t-z}$ collects lagged controls such as past price changes. Estimating the coefficient β_h for horizons $h = 0, 1, \ldots, 12$ allows us to recover the dynamic pass-through profile. [3] [4]

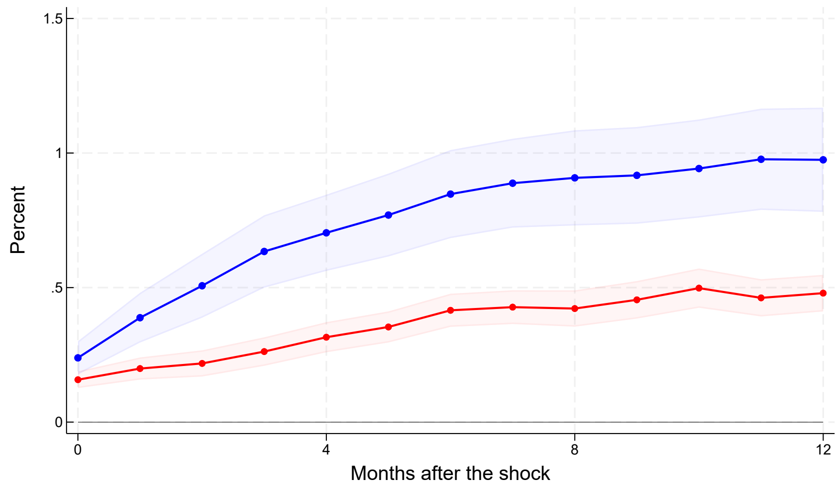
Figure 4 reports the estimated impulse responses of domestic prices to a one percent increase in import prices under the two alternative measures. The blue line shows the response obtained when import prices are measured using the network-adjusted effective import price. Domestic prices respond modestly on impact, increasing by roughly 0.2 percent, and then adjust gradually over time. The cumulative response rises steadily across horizons and approaches close to full pass-through after twelve months.

In contrast, the red line in Figure 4 reports the estimated response when import prices are measured using the aggregate import price index. At every horizon the response is

[3] We then also test the validity of our result by excluding the period after COVID shock in Appendix C.1, by exclusing top 5 and bottom 5 percentile of import price shocks in Appendix C.2 and then we also check if our results are robust when using a placebo as in Appendix C.3

[4] Appendix 4.4 implements an instrumental variable strategy based on global oil supply shocks to address potential endogeneity of import prices. The results confirm the baseline findings and yield even larger pass-through estimates.

Figure 4: Dynamic Import Price Pass-Through: Local Projection Results



Notes: Estimated response of domestic prices to a one percent increase in import prices. The blue line corresponds to the network-adjusted effective import price $\Delta C_{s,t}$, while the red line uses the aggregate import price index. Confidence intervals are based on firm-level clustered standard errors.

substantially smaller than the one obtained using the network-adjusted measure. The gap between the two profiles emerges immediately and persists throughout the adjustment period, indicating that the difference is systematic rather than driven by noise at specific horizons.

Table 2 reports the estimated pass-through coefficients at the three-month and twelve-month horizons using either the aggregate import price index or the network-adjusted effective import price. The coefficients are expressed in elasticity form, where a value of one corresponds to full pass-through of a one percent import price increase into domestic prices.

The results reveal substantial differences between the two measures of import cost shocks. When pass-through is estimated using the aggregate import price index, the short-run coefficient at the three-month horizon is 0.29, indicating that only about thirty percent of the import cost increase is reflected in domestic prices in the short run. The cumulative response rises to 0.64 after twelve months, implying that even after one year domestic prices reflect only about two thirds of the initial import price shock.

In contrast, when import cost shocks are measured using the network-adjusted effective import price, the estimated pass-through is considerably larger. The short-run coefficient at three months is 0.60, more than double the estimate obtained using the aggregate index. This indicates that firms adjust prices much more strongly when the cost shock is measured using a variable that better reflects their effective exposure to imported inputs. At the twelve-month horizon the coefficient reaches 1.03, statistically indistinguishable from full

Table 2: Import Price Pass-Through: Network-Adjusted versus Aggregate Measures

	Short-term Change Aggregate Price (1)	Long-term Change Aggregate Price (2)	Short-term Change Effective Price (3)	Long-term Change Effective Price (4)
Import Price	0.24***	0.48***	0.65***	0.98***
	(0.03)	(0.04)	(0.08)	(0.11)
Constant	-0.07***	-0.15***	0.02***	0.07***
	(0.01)	(0.02)	(0.00)	(0.01)
N	116137	116137	117835	117835
R^2	0.073	0.218	0.093	0.228
adj. R^2	0.060	0.207	0.078	0.214
Firm - Time FE	Yes	Yes	Yes	Yes
Firm - Time Cluster	Yes	Yes	Yes	Yes

Notes: Pass-through coefficients estimated at three-month and twelve-month horizons using either the network-adjusted effective import price $\Delta C_{s,t}$ or the aggregate import price index. All specifications include firm, product, and time fixed effects with firm-level clustered standard errors.

pass-through.

These differences closely mirror the dynamic responses shown in Figure 4. The blue line, which corresponds to the network-adjusted measure, displays a gradual but substantial increase in domestic prices following an import cost shock. Prices rise by roughly 0.2 on impact and continue to adjust over subsequent months, approaching full pass-through after approximately one year. By contrast, the red line associated with the aggregate import price index shows a much more muted response, with the cumulative adjustment stabilizing at roughly sixty percent of the cost shock even at longer horizons.

Taken together, the table and the impulse responses provide consistent evidence that the estimated degree of pass-through depends critically on how import cost shocks are measured. When shocks are proxied using aggregate import price indices, estimated pass-through is substantially attenuated both in the short run and in the long run. By contrast, when the cost shock reflects the effective exposure of industries to imported inputs through production networks, the estimated transmission of import prices to domestic prices is considerably stronger and approaches full adjustment over time.

This pattern is consistent with the conceptual aggregation bias framework discussed earlier. Firms adjust prices in response to the marginal cost shocks they actually face, which depend on both the composition of imported inputs and the propagation of those inputs through upstream suppliers. Aggregate import price indices average across heterogeneous sourcing structures and therefore provide only an imperfect proxy for these firm-level cost pressures. As a result, regressions based on aggregate indices suffer from attenuation bias, mechanically understating the true degree of pass-through. The network-adjusted measure mitigates this problem by incorporating both direct and indirect exposure to imported inputs, allowing the empirical specification to more accurately capture the cost shocks relevant for firms' pricing decisions.

4.3 Asymmetric Import Pass-Through

The baseline analysis assumes that the transmission of import cost shocks is symmetric. We now relax this assumption and examine whether firms respond differently to increases and decreases in import costs. To do so, we decompose import price changes into positive and negative components and estimate their effects jointly within the local projection framework.

Formally, we define

$$\Delta C^{+}_{s,t} = \max\{\Delta C_{s,t}, 0\}, \qquad \Delta C^{-}_{s,t} = \min\{\Delta C_{s,t}, 0\}, \tag{12}$$

so that $\Delta C_{s,t} = \Delta C^{+}_{s,t} + \Delta C^{-}_{s,t}$. The positive component captures increases in import costs, while the negative component captures decreases.

We then estimate the following specification:

$$\Delta P_{ijs,t+h} = \alpha_i + \alpha_j + \alpha_t + \beta^{+}_{h}\Delta C^{+}_{s,t} + \beta^{-}_{h}\Delta C^{-}_{s,t} + \gamma_h W_{ijs,t-z} + \varepsilon_{ijs,t+h}, \tag{13}$$

where all controls and fixed effects are defined as in the baseline specification. Estimating β^{+}_{h} and β^{-}_{h} jointly allows us to directly compare the transmission of positive and negative shocks.

Table 3 reports pass-through coefficients at the three-month and twelve-month horizons using both aggregate and network-adjusted import price measures. A first key result is that the magnitude of pass-through is substantially larger when import costs are measured using the network-adjusted effective price, for both positive and negative shocks.

Focusing first on positive shocks, the difference across measures is particularly striking. Using aggregate import prices, the estimated pass-through is 0.29 at three months and 0.43 at twelve months. In contrast, when using the network-adjusted measure, the response rises to 0.70 in the short run and 1.18 at the twelve-month horizon, indicating more than full pass-through. This shows that aggregation severely understates the transmission of cost increases.

Negative shocks also exhibit stronger pass-through under the granular measure, although

Table 3: Asymmetric Import Price Pass-Through

	Short-term Change Aggregate Price (1)	Long-term Change Aggregate Price (2)	Short-term Change Effective Price (3)	Long-term Change Effective Price (4)
Import Price Negative	-0.17***	-0.56***	-0.56***	-0.66***
	(0.05)	(0.08)	(0.12)	(0.15)
Import Price Positive	0.29***	0.43***	0.70***	1.18***
	(0.04)	(0.06)	(0.07)	(0.14)
Constant	-0.07***	-0.15***	0.02***	0.06***
	(0.01)	(0.02)	(0.00)	(0.01)
N	116137	116137	117835	117835
R^2	0.073	0.218	0.094	0.228
adj. R^2	0.060	0.207	0.078	0.214
Firm - Time FE	Yes	Yes	Yes	Yes
Firm - Time Cluster	Yes	Yes	Yes	Yes

Notes: Pass-through coefficients estimated separately for positive and negative import price changes at three-month and twelve-month horizons. Negative shocks correspond to $\Delta C^{-}_{s,t}$ and positive shocks to $\Delta C^{+}_{s,t}$. All specifications include firm, product, and time fixed effects with firm-level clustered standard errors.

the difference is more moderate. The aggregate specification yields coefficients of -0.17 at three months and -0.56 at twelve months, while the network-adjusted measure produces responses of -0.56 and -0.66, respectively. Thus, aggregation attenuates the response to cost decreases as well, though less dramatically than for cost increases.

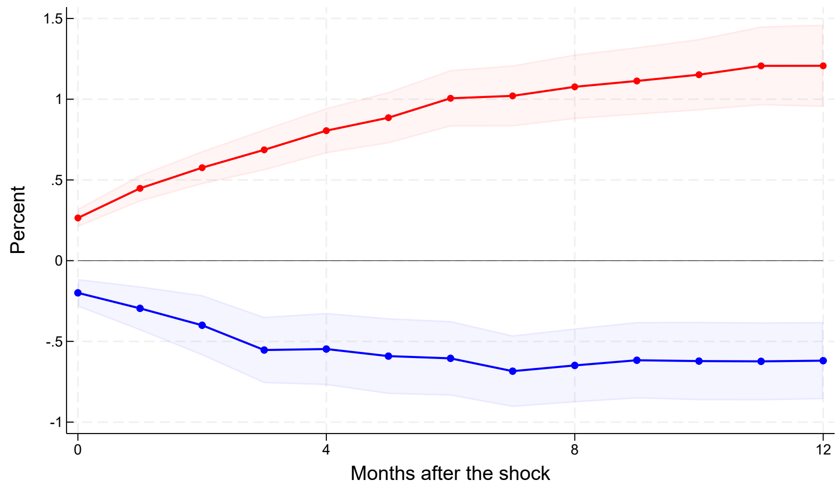
Taken together, these estimates reveal a clear asymmetry in pass-through that becomes much more pronounced when using the network-adjusted measure. In particular, firms respond more strongly to increases in import costs than to decreases, and this asymmetry is largely masked when using aggregate price indices.

Figure 5 complements these results by tracing the full dynamic adjustment. Positive import cost shocks generate a strong and persistent increase in domestic prices, with the cumulative response rising steadily and exceeding one after approximately twelve months. Negative shocks, in contrast, lead to a smaller and more gradual decline in prices, with the response flattening out earlier.

The gap between the two responses emerges immediately and persists across all horizons, indicating that firms transmit cost increases more strongly and more persistently than cost decreases. This pattern is consistent with asymmetric price adjustment, where firms pass through cost increases to protect margins, while cost decreases are only partially transmitted.

Overall, these findings reinforce the central message of the paper. Measurement of import price exposure is crucial not only for the average level of pass-through but also for its

Figure 5: Asymmetric Import Price Pass-Through



Notes: Estimated response of domestic prices to positive and negative import cost shocks. The red line reports the response to positive shocks, while the blue line reports the response to negative shocks. Confidence intervals are based on firm-level clustered standard errors.

asymmetry. Aggregate import price indices compress both positive and negative responses, particularly for cost increases, whereas the network-adjusted measure reveals a much stronger and economically meaningful transmission of international cost shocks to domestic prices.

4.4 Instrumental Variable Strategy

A potential concern in the baseline specification is that observed import price changes may be endogenous to domestic economic conditions. Even in a small open economy such as Sweden, import prices can co-move with domestic demand, exchange rate movements, monetary policy responses, or sector-specific shocks that simultaneously affect firms pricing decisions. In this case, standard OLS estimates may not isolate the causal effect of import cost shocks on domestic prices.

To address this concern, we implement an instrumental variable strategy that isolates exogenous variation in import cost shocks using global oil supply news shocks. The objective of the IV strategy is not only to address potential endogeneity in observed import prices, but also to ensure that the variation used to identify pass-through originates from plausibly exogenous changes in global production costs.

Recall the baseline specification

$$\Delta p_{i,j,t+h} = \alpha_{i,j} + \alpha_t + \beta_h^C \Delta C_{s,t} + \varepsilon_{i,j,t+h}, \tag{14}$$

where $\Delta p_{i,j,t+h}$ denotes the cumulative price change of product j sold by firm i between period t and horizon $t+h$, and $\Delta C_{s,t}$ denotes the effective import cost shock faced by firms in sector s.

Our identification strategy exploits exogenous fluctuations in expected global oil supply, denoted by ε_t^{oil}, and combines them with sector-specific exposure to oil-related inputs. This generates a shift-share instrument in which the common shock is given by the oil supply news shock, while the shares capture the extent to which sectors rely on oil inputs through domestic production networks.

The intuition behind the strategy is straightforward. Oil is a key input into both production and transportation activities and therefore affects the cost structure of a broad range of industries. However, sectors differ substantially in the extent to which they rely on oil-intensive inputs, either directly or indirectly through upstream suppliers. Exogenous changes in expected future oil supply therefore generate heterogeneous cost shocks across sectors depending on their exposure to oil through the production network. By interacting a common exogenous oil supply news shock with predetermined sectoral exposure shares, the IV specification isolates plausibly exogenous variation in effective import costs.

To construct the exposure shares, we focus on the refined petroleum sector, denoted as C19 in the Swedish input-output tables, which captures oil-related inputs used throughout the economy. Let e_{C19} denote a selection vector equal to one for sector C19 and zero otherwise. Using the effective Leontief matrix introduced in Section 3, sectoral exposure to oil is given by

$$\omega_s = \left(L \cdot \Lambda^{IM}\right)' e_{C19}. \tag{15}$$

This measure captures both direct and indirect exposure to oil through production linkages. In particular, sectors may rely on petroleum products not only through their own imported inputs, but also through suppliers that themselves use oil-intensive intermediate goods. The resulting exposure measure therefore reflects the total dependence of each sector on oil once upstream production linkages are taken into account.

The instrument is then constructed as

$$Z_{s,t} = \omega_s \times \varepsilon_t^{oil}. \tag{16}$$

The oil shock series ε_t^{oil} is taken from Kanzig (2021), who constructs an exogenous measure of oil supply news shocks using high-frequency changes in oil futures prices around OPEC announcements. The key advantage of this measure is that it isolates revisions in expectations about future global oil supply that are orthogonal to contemporaneous global demand conditions, financial market developments, and other macroeconomic disturbances. As emphasized by Kanzig (2021), these shocks capture unexpected changes in perceived future oil scarcity and therefore provide plausibly exogenous variation in global energy costs.

This identification strategy is particularly appealing in our context for several reasons. First, Sweden is a small open economy with negligible influence on global oil markets, implying that changes in expected global oil supply are orthogonal to domestic economic conditions. Second, because the shocks are identified using high-frequency asset price responses around narrowly defined OPEC announcement windows, they are less likely to be contaminated by broader macroeconomic news or endogenous business cycle fluctuations. Third, oil supply news shocks primarily operate through firms production and transportation costs, making them a natural instrument for import cost shocks.

To maintain consistency with the baseline analysis, we estimate two IV specifications. For the aggregate specification, the instrument is given by

$$Z_t^{agg} = \varepsilon_t^{oil}, \tag{17}$$

while for the network-adjusted specification we use

$$Z_{s,t}^{net} = \omega_s \times \varepsilon_t^{oil}. \tag{18}$$

The aggregate specification instruments conventional import price indices using the common oil supply news shock. By contrast, the network specification allows oil shocks to propagate heterogeneously across sectors according to their exposure within the production network. This preserves the cross-sectional variation in effective cost exposure that is central to our analysis.

The first-stage regression is given by

$$\Delta C_{s,t} = \pi Z_{s,t} + \alpha_s + \alpha_t + u_{s,t}, \tag{19}$$

while the second-stage specification corresponds to

$$\Delta p_{i,j,t+h} = \alpha_{i,j} + \alpha_t + \beta_h^{IV} \widehat{\Delta C}_{s,t} + \varepsilon_{i,j,t+h}. \tag{20}$$

Table 4: IV Estimation of Import Price Pass-Through

	Short-term Change Aggregate Price (1)	Long-term Change Aggregate Price (2)	Short-term Change Effective Price (3)	Long-term Change Effective Price (4)
Aggregate Import Price (Instrument)	0.28***	0.44**		
	(0.10)	(0.18)		
Effective Import Price (Instrument)			0.99***	1.81***
			(0.35)	(0.60)
N	184379	143321	185394	144026
KP F-Stat	55.41	56.74	64.793	49.52
Firm - Time FE	Yes	Yes	Yes	Yes
Firm - Time Cluster	Yes	Yes	Yes	Yes

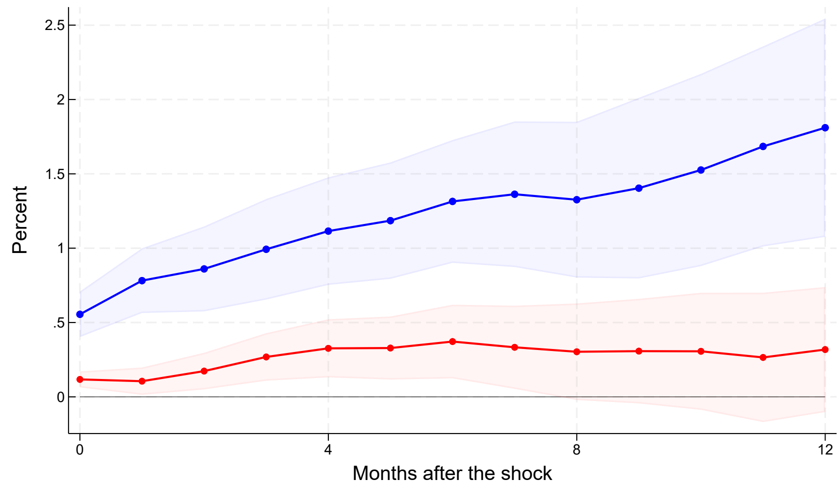
Notes: The table reports IV pass-through coefficients estimated at the three-month and twelve-month horizons using either the aggregate import price index or the network-adjusted effective import price measure. Aggregate specifications are instrumented using the oil supply news shock from Kanzig (2021), while network specifications use the shift-share instrument $\omega_s \times \varepsilon_t^{oil}$, where ω_s captures sectoral exposure to oil through the production network. All specifications include firm, product, and time fixed effects with firm-level clustered standard errors. The reported F-statistics correspond to the first-stage relevance test of the excluded instrument.

Table 4 reports the IV pass-through estimates at the three-month and twelve-month horizons using both the aggregate and network-adjusted import price measures. The table also reports the corresponding first-stage F-statistics associated with the excluded instruments. Across all specifications, the instrument strongly predicts import cost shocks, with first-stage statistics remaining comfortably above conventional weak instrument thresholds. Importantly, the network-adjusted specification displays systematically stronger first-stage relationships, reflecting the fact that the interaction between oil supply news shocks and network exposure shares captures economically meaningful heterogeneity in sectors dependence on imported energy-intensive inputs.

Consistent with the baseline OLS results, the IV estimates based on the network-adjusted measure are substantially larger than those obtained using aggregate import price indices. While pass-through under the aggregate specification remains incomplete even at longer horizons, the network-adjusted specification delivers responses that approach or exceed full transmission within one year. The persistence of this gap under IV identification reinforces the interpretation that aggregation bias in standard import price measures remains a central source of attenuation in pass-through regressions.

Relevance follows from the central role of oil in global production and transportation costs, which ensures that oil supply news shocks generate economically meaningful variation in import costs. The exclusion restriction requires that oil supply news shocks affect domestic prices only through import costs rather than through independent domestic demand

Figure 6: Dynamic Import Price Pass-Through, IV Local Projection Results



Notes: This figure reports the estimated response of domestic prices to an instrumented import cost shock. The blue line corresponds to the network-adjusted effective import price $\Delta C_{s,t}$, instrumented using the shift-share specification $\omega_s \times \varepsilon_t^{oil}$. The red line reports results for the aggregate specification, instrumented directly with the oil supply news shock ε_t^{oil} from Kanzig (2021). Confidence bands are based on firm-level clustered standard errors and correspond to 90 percent intervals.

channels. This assumption is plausible for several reasons. First, Sweden does not influence global oil supply conditions. Second, the identification strategy in Kanzig (2021) isolates exogenous revisions in expected future oil supply from broader macroeconomic conditions. Third, because the shocks primarily reflect changes in anticipated future oil scarcity, they affect firms mainly through imported input and transportation costs rather than through contemporaneous domestic demand fluctuations.

More broadly, this approach is consistent with recent evidence showing that observed international price movements are not structural cost shocks. Di Pace et al. (2025) demonstrate that standard measures such as terms of trade or import prices combine multiple underlying forces, including global demand conditions, financial factors, and supply disturbances, which may have very different macroeconomic implications. In this context, using exogenous oil supply news shocks allows us to isolate a cleaner and more interpretable source of variation in import costs.

Figure 6 reports the dynamic IV local projection estimates. The blue line corresponds to the network-adjusted effective import price instrumented using the shift-share specification $\omega_s \times \varepsilon_t^{oil}$, while the red line reports results for the aggregate specification instrumented directly with the oil supply news shock.

The IV results closely mirror the qualitative patterns obtained under OLS, but with systematically larger magnitudes across horizons. Pass-through based on the aggregate import price index remains below one even at longer horizons, indicating incomplete transmission of import costs even when exogenous variation is isolated. In contrast, the network-adjusted specification delivers substantially larger responses, with pass-through approaching or exceeding unity over a twelve-month horizon.

The larger IV coefficients suggest that observed import prices embed endogenous components, including exchange rate movements, global demand conditions, and monetary policy responses, which attenuate OLS estimates. By isolating exogenous variation in import costs through oil supply news shocks, the IV strategy recovers a stronger and more direct transmission of international cost shocks to domestic prices.

Importantly, the gap between aggregate and network-based estimates persists under IV identification. This result strongly supports the interpretation that measurement error in conventional import price proxies remains a central driver of attenuation bias, independently of endogeneity concerns. The network-adjusted measure provides a substantially closer approximation to firms effective marginal cost shocks and therefore yields larger pass-through estimates even when identification relies exclusively on exogenous variation.

Finally, the fact that pass-through approaches or exceeds unity under the network specification is consistent with amplification through production networks. When cost shocks propagate through upstream linkages, cumulative effects can exceed the initial direct shock, leading to larger and more persistent responses of domestic prices over time.

5 Conclusion

This paper studies how international cost shocks transmit to domestic prices using Swedish firm-level data and a novel network-adjusted measure of effective import prices. The central result of the paper is that the estimated degree of pass-through depends critically on how import cost shocks are measured. When import costs are proxied using conventional aggregate import price indices, pass-through appears incomplete and gradual, in line with the existing literature. In contrast, when import costs are measured using a granular and network-consistent measure that reflects firms effective exposure to imported inputs, pass-through is substantially stronger and approaches full transmission within one year.

We interpret this difference as evidence of aggregation bias in standard pass-through regressions. Aggregate import price indices average across firms and sectors with highly heterogeneous sourcing structures and therefore provide only a noisy proxy for the marginal cost shocks relevant for firms pricing decisions. Moreover, standard aggregate measures ignore the propagation of shocks through production networks, even though imported inputs affect firms both directly through their own purchases and indirectly through upstream suppliers. By smoothing over these dimensions of heterogeneity, aggregate import price indices mechanically attenuate estimated pass-through coefficients.

Our main contribution is therefore to show that correctly measuring import cost exposure is central for identifying pass-through. By combining granular import price information with the input-output structure of the Swedish economy, the network-adjusted measure captures both composition effects and the propagation of shocks through domestic supply chains. Accounting for these channels substantially changes the estimated transmission of international cost shocks to domestic prices and reveals a much stronger degree of pass-through than previously documented.

An important result is that the gap between aggregate and network-adjusted estimates remains large even when identification concerns are addressed through an instrumental variable strategy. Using exogenous oil supply news shocks from Kanzig (2021), we isolate variation in import costs driven by unexpected changes in expected global oil supply conditions. The IV estimates continue to show substantially larger pass-through under the network-adjusted specification relative to the aggregate specification. This finding reinforces the interpretation that standard aggregate import price measures understate the true degree of pass-through because they mismeasure firms effective marginal cost shocks, rather than because pass-through is inherently weak.

Taken together, our findings suggest that the transmission of international cost shocks to domestic prices is substantially stronger and more complete than implied by conventional estimates. More broadly, the paper highlights that accurately measuring firms exposure to imported inputs is essential for understanding inflation dynamics in economies characterized by fragmented global value chains and layered production networks. An important implication is that empirical analyses based on aggregate import price indices may systematically understate the sensitivity of domestic inflation to global cost shocks.

Future work could integrate granular measures of import cost exposure into structural models of firm pricing and production networks. Such an approach would allow for a more comprehensive quantification of how global shocks, commodity price fluctuations, trade policy changes, or supply chain disruptions propagate through the economy and shape inflation dynamics.

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A Data

A.1 Weighted Import Prices

In this set up $\mathbf{X}_t$ is defined as the percentage change of weighted imported prices between time t and $t-1$. To compute this measure, we introduce a transformation that combines import prices with a weighting matrix. This transformation ensures that import price changes are weighted by their relevance to individual firms. Formally, we define:

$$\mathbf{X}_t = \mathbf{\Omega}_t \cdot \mathbf{P}_t^I, \tag{21}$$

where $\mathbf{\Omega}_t$ is the weighting matrix, and $\mathbf{P}_t^I$ is the vector of import prices. The weighting matrix $\mathbf{\Omega}_t$ reflects the importance of different imported products for each firm-product combination. Each row in $\mathbf{\Omega}_t$ corresponds to a product-firm combination, and each column represents a specific product. Formally:

$$\mathbf{\Omega}_t = \begin{bmatrix} \omega_{11,t} & \omega_{12,t} & \cdots & \omega_{1n,t} \\ \omega_{21,t} & \omega_{22,t} & \cdots & \omega_{2n,t} \\ \vdots & \vdots & \ddots & \vdots \\ \omega_{m1,t} & \omega_{m2,t} & \cdots & \omega_{mn,t} \end{bmatrix}, \tag{22}$$

where each element $\omega_{ij,t}$ denotes the proportion of inputs from product j used by product-firm combination i at time t. Using this matrix, the weighted import price for each product-firm combination is calculated as:

$$\mathbf{X}_{i,t}^I = \begin{bmatrix} \sum_{j=1}^n \omega_{1j,t} \log p_{j,t}^I \\ \sum_{j=1}^n \omega_{2j,t} \log p_{j,t}^I \\ \vdots \\ \sum_{j=1}^n \omega_{mj,t} \log p_{j,t}^I \end{bmatrix}. \tag{23}$$

This transformation creates a firm-specific weighted measure of import prices, reflecting the contributions of inputs from all relevant imported products.

A.2 Effective Import Prices

To construct the import share measure, we rely on Sweden's input-output (IO) tables, which provide detailed data on the flow of goods and services across industries within the economy. These tables separate imported goods from domestically produced goods, allowing for a clear understanding of the relationships and dependencies between industries. By using this dataset, we aim to determine the contribution of each industry s to the total imported production used within that industry. Our approach extends beyond identifying only the direct use of imports by incorporating the effects of inter-industry trade. Specifically, we account for both the direct use of imported goods in an industry and the indirect effects that arise from domestic trade between industries. These indirect effects occur when industries with varying levels of import dependency trade with one another, amplifying the impact of imported inputs across the broader economy. By considering both direct and indirect effects, our measure captures how imports influence domestic production processes and the interconnected nature of industries in response to global trade conditions.

A.2.1 Direct Import Shares

We begin by introducing the entries of the import share matrix, $\mathbf{\Lambda}^{IM}$. Each element λ_{ij} represents the share of imports from industry i used in the total imported production of industry j. Specifically, λ_{ij} is computed as:

$$\lambda_{ij} = \frac{\text{Imports from industry } i \text{ used by industry } j}{\text{Total imports used by industry } j}. \tag{24}$$

Using these entries, we define the import share matrix, $\mathbf{\Lambda}^{IM}$, as:

$$\mathbf{\Lambda}^{IM} = \begin{bmatrix} \lambda_{11} & \lambda_{12} & \cdots & \lambda_{1n} \\ \lambda_{21} & \lambda_{22} & \cdots & \lambda_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \lambda_{n1} & \lambda_{n2} & \cdots & \lambda_{nn} \end{bmatrix}. \tag{25}$$

A.2.2 Indirect Import Shares

To account for indirect import effects, we first define the entries of the Leontief matrix, $\mathbf{A}$. Each element a_{ij} represents the proportion of inputs purchased by industry j from industry i relative to the total sales of industry j. Specifically:

$$a_{ij} = \frac{\text{Value of inputs from industry } i \text{ purchased by industry } j}{\text{Total sales of industry } j}. \tag{26}$$

Using these entries, we construct the Leontief matrix, $\mathbf{A}$, which captures inter-industry relationships:

$$\mathbf{A} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix}. \tag{27}$$

From $\mathbf{A}$, we compute the Leontief inverse, $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$. Each element l_{ij} of $\mathbf{L}$ measures the total (direct and indirect) effect of a unit change in demand for industry j on industry i. The Leontief inverse allows us to analyze the cascading effects of inter-industry dependencies.

A.2.3 Including Direct and Indirect Effects

Finally, we combine the components to compute the import share prices. First, we define the vector of import prices, $\mathbf{P}_t$, where $P_{i,t}$ represents the import price for industry i:

$$\mathbf{P}_t = \begin{bmatrix} P_1 \\ P_2 \\ \vdots \\ P_n \end{bmatrix}. \tag{28}$$

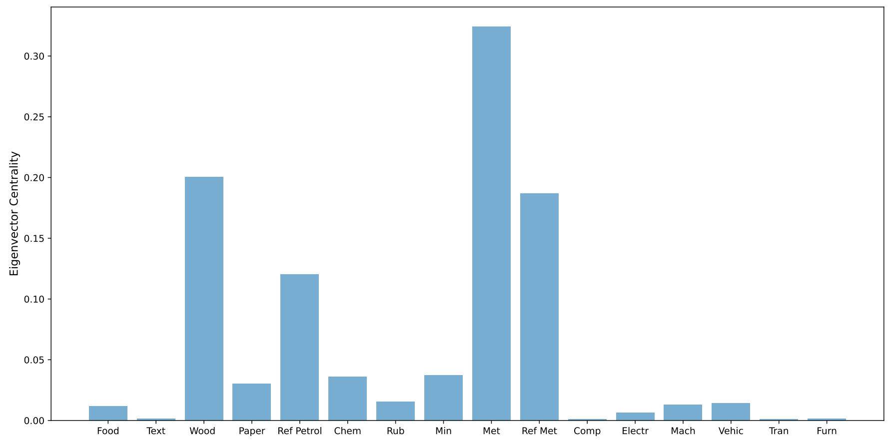
We then combine the Leontief inverse, $\mathbf{L}$, the import share matrix, $\mathbf{\Lambda}^{IM}$, and the vector of import prices, $\mathbf{P}$, to compute the matrix of import share prices, $\mathbf{C}$, as:

$$\mathbf{C}_t = \mathbf{L} \cdot \mathbf{\Lambda}^{IM} \cdot \mathbf{P}_t. \tag{29}$$

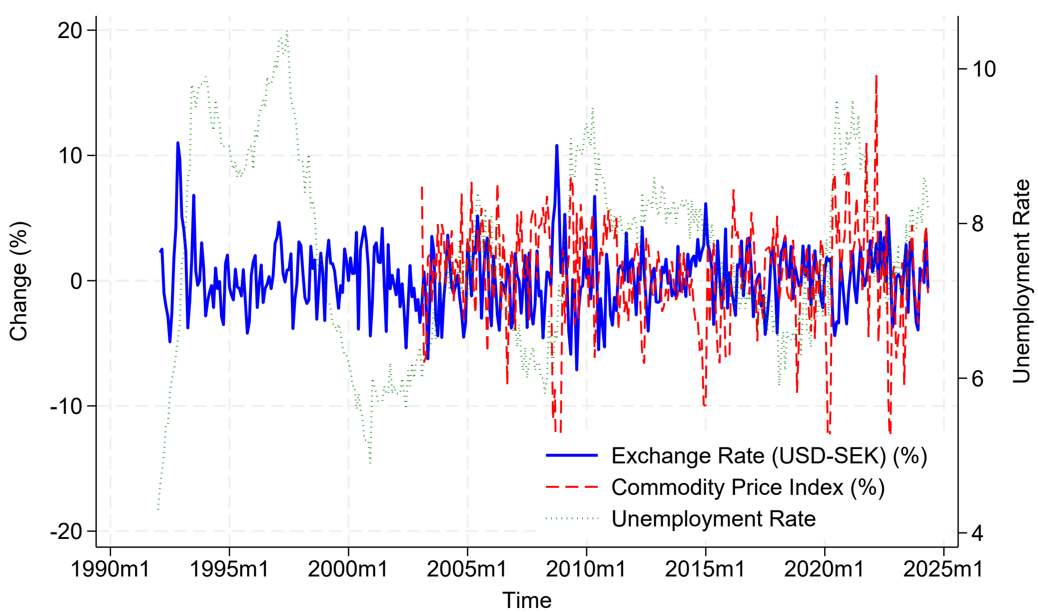
This formulation integrates both direct import shares and indirect effects propagated through domestic trade linkages. The resulting matrix, $\mathbf{C}_t$, reflects how variations in import prices are transmitted across industries, capturing both immediate and broader economic dependencies.

A.3 The Netowrk Structure in Sweden

We now present the network structure in Sweden, when considering the domestic leontief matrix of the economy, $\mathbf{A}_d$.



A.4 Descriptive Statistics



B Derivation of Aggregation Bias

This appendix provides the derivation of the relationship between the estimated pass-through coefficient obtained using an aggregate proxy for import costs and the true structural pass-through parameter.

Let the true model governing price adjustment be

$$\Delta p_{i,j,t+h} = \alpha_{i,j} + \alpha_t + \beta_h^C \Delta C_{s,t} + u_{i,j,t+h}, \tag{30}$$

where $\Delta C_{s,t}$ denotes the effective import cost shock faced by firms in sector s. The coefficient β_h^C captures the structural pass-through of import costs to domestic prices.

Empirically, however, the econometrician does not observe $\Delta C_{s,t}$ and instead uses an aggregate proxy ΔX_t. The estimated regression therefore becomes

$$\Delta p_{i,j,t+h} = \alpha_{i,j} + \alpha_t + \beta_h^X \Delta X_t + \varepsilon_{i,j,t+h}. \tag{31}$$

After residualizing all variables with respect to the fixed effects, denote the residualized variables by

$$\widetilde{\Delta p}_{i,j,t+h}, \quad \widetilde{\Delta C}_{s,t}, \quad \widetilde{\Delta X}_t.$$

The true model can then be written as

$$\widetilde{\Delta p}_{i,j,t+h} = \beta_h^C \widetilde{\Delta C}_{s,t} + \widetilde{u}_{i,j,t+h}. \tag{32}$$

The coefficient estimated using the proxy variable is the linear projection coefficient

$$\beta_h^X = \frac{\mathrm{Cov}(\widetilde{\Delta p}_{i,j,t+h}, \widetilde{\Delta X}_t)}{\mathrm{Var}(\widetilde{\Delta X}_t)}. \tag{33}$$

Substituting the true model into this expression yields

$$\beta_h^X = \frac{\mathrm{Cov}(\beta_h^C \widetilde{\Delta C}_{s,t} + \widetilde{u}_{i,j,t+h}, \widetilde{\Delta X}_t)}{\mathrm{Var}(\widetilde{\Delta X}_t)} \tag{34}$$

$$= \beta_h^C \frac{\mathrm{Cov}(\widetilde{\Delta C}_{s,t}, \widetilde{\Delta X}_t)}{\mathrm{Var}(\widetilde{\Delta X}_t)} + \frac{\mathrm{Cov}(\widetilde{u}_{i,j,t+h}, \widetilde{\Delta X}_t)}{\mathrm{Var}(\widetilde{\Delta X}_t)}. \tag{35}$$

Under the assumption that the proxy is orthogonal to the structural error term, the second term vanishes and we obtain

$$\beta_h^X = \frac{\text{Cov}(\widetilde{\Delta C}_{s,t}, \widetilde{\Delta X}_t)}{\text{Var}(\widetilde{\Delta X}_t)} \beta_h^C. \tag{36}$$

Define

$$\xi_s = \frac{\text{Cov}(\widetilde{\Delta C}_{s,t}, \widetilde{\Delta X}_t)}{\text{Var}(\widetilde{\Delta X}_t)}. \tag{37}$$

The estimated coefficient can therefore be written as

$$\beta_h^X = \xi_s \beta_h^C. \tag{38}$$

An equivalent representation arises if the proxy can be written as

$$\widetilde{\Delta X}_t = \widetilde{\Delta C}_{s,t} + \nu_{s,t}, \tag{39}$$

where $\nu_{s,t}$ represents measurement error. If this measurement error is orthogonal to the true cost shock, then

$$\beta_h^X = \frac{\text{Var}(\widetilde{\Delta C}_{s,t})}{\text{Var}(\widetilde{\Delta C}_{s,t}) + \text{Var}(\nu_{s,t})} \beta_h^C. \tag{40}$$

This expression corresponds to the standard attenuation bias formula.

C Additional Results

C.1 Excluding the COVID-19 and Post-Inflation Period

To assess whether the baseline results are driven by the extraordinary macroeconomic conditions during the COVID-19 pandemic and the subsequent inflation surge, we re-estimate the baseline specification restricting the sample to the pre-2020 period. This is an important robustness check, as the 2020–2022 period was characterized by large supply chain disruptions, sharp commodity price movements, and unusually high inflation, all of which may have altered the transmission of import costs in ways that are not representative of normal times.

Table 5: Import Price Pass-Through: Pre-2020 Sample

	Short-term Change Aggregate Price (1)	Long-term Change Aggregate Price (2)	Short-term Change Effective Price (3)	Long-term Change Effective Price (4)
Import Price	0.22***	0.28***	0.58***	1.03***
	(0.03)	(0.04)	(0.07)	(0.11)
Constant	-0.04***	-0.01	0.01***	0.07***
	(0.01)	(0.02)	(0.00)	(0.01)
N	155056	120719	146985	114844
R^2	0.044	0.158	0.063	0.164
adj. R^2	0.031	0.146	0.049	0.151
Firm - Time FE	Yes	Yes	Yes	Yes
Firm - Time Cluster	Yes	Yes	Yes	Yes

Table 5 reports pass-through coefficients at the three-month and twelve-month horizons. The results are remarkably stable relative to the baseline estimates. When import costs are measured using the aggregate import price index, pass-through remains limited, with coefficients of 0.22 in the short run and 0.28 in the long run. In contrast, the network-adjusted effective import price continues to imply substantially stronger transmission, with coefficients of 0.58 at three months and 1.03 at twelve months, statistically indistinguishable from full pass-through.

The persistence of the gap between the two measures in the pre-2020 sample indicates that the baseline findings are not driven by the recent inflation episode. Instead, they reflect a more general feature of the data, namely that aggregate import price indices systematically attenuate pass-through relative to granular, network-consistent measures of cost exposure.

C.2 Robustness to Extreme Import Price Shocks

A potential concern is that the baseline results may be driven by extreme observations in the distribution of import price changes. As shown in the descriptive statistics, import prices display substantial dispersion and fat tails. This raises the possibility that a small number of large shocks disproportionately influence the estimated pass-through coefficients.

To address this concern, we re-estimate the baseline specification after trimming the top and bottom five percent of the distribution of effective import price changes, thereby excluding the most extreme ten percent of observations.

Table 6: Import Price Pass-Through: Trimmed Sample

	Short-term Change Aggregate Price (1)	Long-term Change Aggregate Price (2)	Short-term Change Effective Price (3)	Long-term Change Effective Price (4)
Import Price	0.19***	0.36***	0.76***	1.23***
	(0.03)	(0.04)	(0.06)	(0.13)
Constant	-0.06***	-0.08***	0.01***	0.08***
	(0.01)	(0.02)	(0.00)	(0.01)
N	178400	139048	166287	130734
R^2	0.052	0.170	0.066	0.174
adj. R^2	0.038	0.157	0.051	0.159
Firm - Time FE	Yes	Yes	Yes	Yes
Firm - Time Cluster	Yes	Yes	Yes	Yes

Table 6 reports the results. The main findings not only remain intact but become even stronger. When using aggregate import price indices, pass-through declines slightly relative to the baseline, with coefficients of 0.19 at three months and 0.36 at twelve months. This suggests that extreme aggregate price movements contribute modestly to the baseline estimates.

In contrast, the network-adjusted measure delivers larger coefficients after trimming, with pass-through rising to 0.76 in the short run and 1.23 in the long run. This indicates that extreme observations in the tails tend to attenuate, rather than inflate, the estimated transmission when using the granular measure.

The widening gap between the aggregate and network-adjusted specifications further strengthens the aggregation bias interpretation. Once outliers are removed, the difference between the two measures becomes even more pronounced, reinforcing the conclusion that conventional aggregate indices understate the true transmission of import cost shocks.

C.3 Placebo Test

This section provides a placebo test to validate the identifying assumption that the network-adjusted effective import price measure captures the relevant cost shocks faced by firms. The key idea is that if the estimated pass-through reflects genuine exposure to industry-specific import costs, then assigning firms cost shocks from unrelated industries should yield no systematic response.

To implement this test, we replace the baseline import cost shock with a placebo shock drawn from a different industry. Specifically, for each firm operating in industry s, we assign the import price shock of an alternative industry $s' \neq s$. The placebo specification is given by

$$\Delta P_{ijs,t+h} = \alpha_i + \alpha_j + \alpha_t + \beta_h^{\text{placebo}} \Delta C_{s',t} + \gamma_h W_{ijs,t-z} + \varepsilon_{ijs,t+h}, \tag{41}$$

where $\Delta C_{s',t}$ denotes the network-adjusted import price shock of an industry different from that of firm i. All other elements of the specification, including fixed effects, lag structure, and controls, are identical to the baseline model.

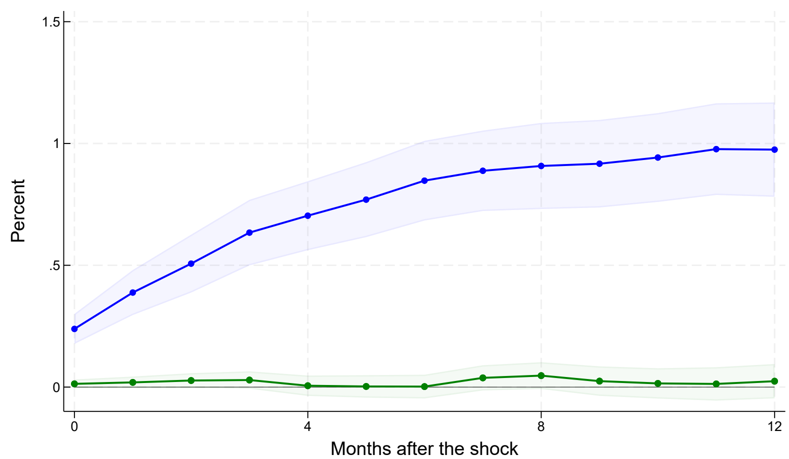


Figure 7: Placebo Test

Notes: The figure reports the estimated cumulative response of domestic prices to a one percent increase in import prices under the baseline and placebo specifications. The blue line corresponds to the baseline network-adjusted effective import price $\Delta C_{s,t}$. The gray line reports the placebo specification in which each firm is assigned the cost shock of a different industry $s' \neq s$. Confidence bands are based on firm-level clustered standard errors and correspond to 90 percent intervals.

Under the null hypothesis that the baseline results are driven by true exposure to industry-specific import costs, the coefficient β_h^{placebo} should be close to zero at all horizons. Any significant response would instead indicate that the baseline results reflect spurious correlations with aggregate or common shocks.

Figure 7 reports the impulse responses from the baseline and placebo specifications. The baseline response, shown in blue, exhibits the gradual adjustment toward full pass-through documented in the main analysis. In contrast, the placebo response remains close to zero across all horizons and is statistically indistinguishable from zero.

These results support the interpretation that the baseline estimates capture the causal transmission of import cost shocks through firms' production networks. The absence of any response in the placebo specification indicates that the estimated pass-through is not driven by common time-series variation or spurious correlations, but instead reflects economically meaningful exposure to industry-specific import prices.

C.4 Industry Heterogeneity

Having established the average relationship between effective import prices and domestic pricing behavior, we now turn to heterogeneity across sectors. In this subsection, we investigate whether the magnitude of pass-through varies systematically across industries. This analysis is motivated by the notion that sectoral differences in production technologies, input compositions, exposure to foreign supply chains, and market structure may all influence how imported cost shocks are transmitted to final goods prices.

To capture this variation, we estimate a modified version of the local projection framework in which we allow the pass-through coefficient to vary by industry. Specifically, we interact the effective import price change $\Delta C_{s,t}$ with a vector of industry dummies, thereby estimating separate coefficients for each sector. Formally, this is implemented by modifying the baseline specification to include interaction terms of the form:

$$\Delta P_{ijs,t+h} = \alpha_i + \alpha_t + \sum_{s \in \mathcal{S}} \beta_{h,s} \left(\Delta C_{s,t} \cdot \mathbf{1}_s \right) + \varepsilon_{ijs,t+h}, \tag{42}$$

where $\mathbf{1}_s$ is an indicator function for industry s, and $\beta_{h,s}$ captures the pass-through coefficient specific to that industry at horizon h. We focus here on $h = 3$, which corresponds to the medium-run response window that aligns with the average price duration in the data.

The results are reported in Figure 8, which displays the estimated pass-through coefficients across a selection of industries. Confidence intervals are constructed using standard errors clustered at the firm level.

The figure highlights substantial heterogeneity in the responsiveness of domestic prices to imported input cost shocks across sectors. At the higher end of the pass-through distribution, we find industries such as paper manufacturing, chemicals, textiles, and computers and electronics. These sectors rely heavily on imported intermediate inputs, often with relatively short supply chains and high exposure to global commodity prices. As a result, changes in international input costs are quickly reflected in domestic price adjustments.

In contrast, other sectors such as wood products and furniture exhibit significantly lower pass-through. This result is economically intuitive in the Swedish context, where domestic production of timber and related raw materials reduces reliance on foreign inputs. In these sectors, cost shocks originating abroad have limited traction on marginal costs, and therefore do not trigger immediate pricing responses.

Several machinery and refined metal sectors fall in the middle range, suggesting a mod-

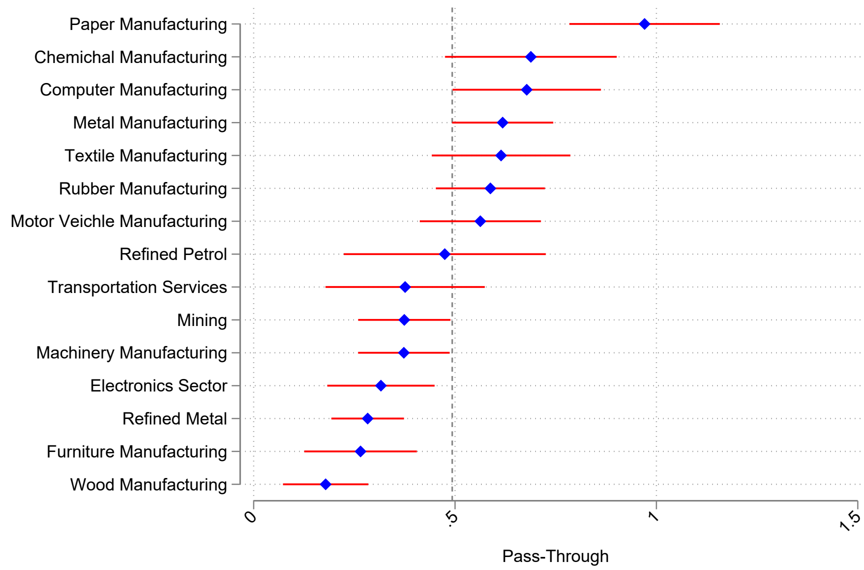


Figure 8: Industry-Specific Import Price Pass-Through

erate degree of exposure to imported inputs. Their pass-through estimates are positive but smaller in magnitude, likely reflecting a mix of domestic and foreign sourcing, coupled with pricing strategies that smooth over short-term fluctuations.

Overall, the results demonstrate that pass-through is not uniform across the economy. Instead, it is closely linked to sector-specific characteristics such as input sourcing patterns, import intensity, and the degree of insulation from global markets. These findings highlight the importance of disaggregated analysis for understanding how external shocks propagate through domestic inflation dynamics. In particular, they underscore the need for sector-aware forecasting and policy design, especially in response to global supply disruptions or commodity price swings that affect industries unevenly.

C.5 Import Price Pass-Through: Heterogeneity

This section studies heterogeneity in import price pass-through by comparing two alternative measures of import cost shocks: the conventional aggregate import price index commonly used in the empirical literature and the network based measure of effective import prices developed in this paper. The central question is whether measuring import cost exposure using a network consistent framework reveals patterns of pass-through heterogeneity that remain muted when using aggregate price indices.

A large empirical literature has documented that the transmission of international cost shocks to domestic prices is far from uniform. Pass-through varies across industries and across firms even within narrowly defined sectors. These differences reflect heterogeneity in production structures, market power, input sourcing, and distribution margins, all of which affect how cost shocks translate into price adjustments.

A key implication of this literature is that pass-through ultimately depends on the effective marginal cost shocks faced by firms. In practice, however, most empirical studies approximate these shocks using aggregate import price indices or exchange rate movements. Because firms differ substantially in their sourcing structures, input composition, and positions within production networks, such aggregate measures may only imperfectly capture the cost shocks that firms actually experience. As a result, aggregation may attenuate or obscure theoretically predicted patterns of pass-through heterogeneity.

The network based measure of effective import prices introduced in this paper provides a way to address this issue. By incorporating information on input composition and the propagation of shocks through production networks, the measure more closely approximates firms effective marginal cost shocks. If aggregation bias is important, then empirical patterns emphasized in the literature should emerge more clearly when pass-through is estimated using the effective import price measure rather than the aggregate index.

We evaluate this prediction along two complementary dimensions. First, we examine heterogeneity within narrowly defined industries, focusing on how pass-through varies across firms with different market shares. Second, we analyze heterogeneity across industries by studying how market concentration and production structure affect the transmission of import price shocks. In both cases we estimate comparable specifications using the aggregate and effective import price measures, allowing us to assess whether the network based measure generates empirical patterns that align more closely with the mechanisms emphasized in the pass-through literature.

C.5.1 Within-Industry Pass-Through Heterogeneity

We begin by examining heterogeneity in pass-through within narrowly defined industries. A central prediction of the framework developed in Auer (2016) is that the relationship between firm size and pass-through need not be monotonic. Instead, differences in market share can generate a nonlinear pricing response to cost shocks, as firms with greater market power may adjust prices more aggressively while very large firms may partially absorb cost shocks through markup adjustment.[5]

Before turning to within-industry variation, it is important to ensure that the results are not driven by cross-sector differences in pass-through across industries.[6] Our objective in this subsection is therefore to evaluate whether the nonlinear relationship predicted by Auer (2016) emerges within industries and whether it is more clearly identified when import cost shocks are measured using the network based effective import price developed in this paper rather than the conventional aggregate import price index.

To do so, we estimate the following specification over a three-month horizon

$$\Delta \mathbf{P}_{i,j,s,t+3,t-1} = \alpha_{i,j,t} + \alpha_s + \Delta \mathbf{C}_{s,t,t-1} \left(\beta + \gamma \mathbf{S}_{i,j} + \delta \mathbf{S}_{i,j}^2 + \xi \mathbb{1}_{i \in J}\right) + \varepsilon_{i,t+3}, \tag{43}$$

where $\mathbf{S}_{i,j}$ denotes the market share of firm i in product j, and $\mathbb{1}_{i \in J}$ captures membership in selected firm groups. The term α_s denotes industry fixed effects, which absorb time-invariant sector characteristics that may influence pricing behavior or exposure to import cost shocks. By controlling for these industry-specific factors, the specification isolates variation in pass-through across firms operating within the same sector. The interaction terms between market share and import price shocks therefore capture nonlinear differences in pass-through associated with firm size within industries.

Table 7 reports the estimation results using two alternative measures of import price shocks. Columns (1) and (2) use the conventional aggregate import price index, while columns (3) and (4) use the network based effective import price measure constructed in this paper.

Figure 9 illustrates this relationship by plotting the implied pass-through elasticity as a function of firm market share using the effective import price specification. The resulting curve displays a clear inverted U shape. Pass-through is relatively low among firms with small market shares, increases steadily as market share rises, and eventually flattens among

[5]The theoretical framework in Auer (2016) predicts a non monotonic relationship between firm size and pass-through. Small firms operate under strong competitive pressure and therefore have limited ability to adjust prices in response to cost shocks. As firms grow larger, increased market power allows them to respond more strongly to cost shocks. However, very large firms may internalize strategic considerations or adjust markups in response to cost shocks, which can reduce the marginal sensitivity of prices to costs. These mechanisms generate an inverted U shaped relationship between market share and pass-through.

[6]Appendix Section C.4 documents the extent of cross-industry heterogeneity in pass-through and shows that our results are robust to controlling for sector-specific responses to import price shocks. In particular, we allow pass-through to vary flexibly across industries and confirm that the nonlinear relationship between firm size and pass-through remains when sector-level heterogeneity is absorbed by industry fixed effects and industry-specific shock interactions. This ensures that the patterns documented in this subsection reflect variation across firms within the same industry rather than differences across sectors.

Table 7: Pass-Through and Market Share

	Short-term Change Aggregate Price (1)	Long-term Change Aggregate Price (2)	Short-term Change Effective Price (3)	Long-term Change Effective Price (4)
Import Price	19.8123***	84.7205***	25.3910***	102.7135***
	(4.7546)	(12.5958)	(6.2453)	(14.1366)
S × Import Price	1.7026*	0.1168	3.5897***	2.2789*
	(0.9564)	(1.3086)	(1.0209)	(1.2745)
S^2 × Import Price	-0.2244***	-0.0112	-0.2245***	-0.0225
	(0.0701)	(0.0160)	(0.0741)	(0.0179)
Constant	1.3282***	7.0269***	1.4228***	7.5004***
	(0.1415)	(0.7332)	(0.1549)	(0.7749)
N	240755	189465	221578	175930
R^2	0.044	0.120	0.076	0.181
adj. R^2	0.032	0.108	0.063	0.168
Firm - Industry - Time FE	Yes	Yes	Yes	Yes
Industry × Import Price	Yes	Yes	Yes	Yes
Firm Cluster	Yes	Yes	Yes	Yes

the largest firms.

This pattern closely mirrors the nonlinear relationship predicted by Auer (2016). Firms with very small market shares face strong competitive pressures and therefore adjust prices less aggressively in response to cost shocks. As firms grow larger, increased market power allows them to pass through a larger fraction of input cost increases. Among the largest firms, however, the marginal effect of market share on pass-through declines, as dominant firms may partially absorb cost shocks in their margins or adjust prices more gradually in order to stabilize market conditions.

The key differences between the two specifications emerge in the interaction terms that capture heterogeneity in pass-through across firms. Under the aggregate import price specification, the interaction between market share and import prices is positive but only weakly significant in the short-term regression (coefficient 1.70, significant at the 10 percent level) and becomes statistically indistinguishable from zero at longer horizons (coefficient 0.12). While the quadratic interaction term is negative and significant in the short-term regression (-0.22), it becomes economically small and statistically insignificant at longer horizons (-0.01). Taken together, the aggregate specification provides only partial and unstable evidence of the nonlinear relationship between firm size and pass-through predicted by Auer (2016).

In contrast, the specification using the network based effective import price measure

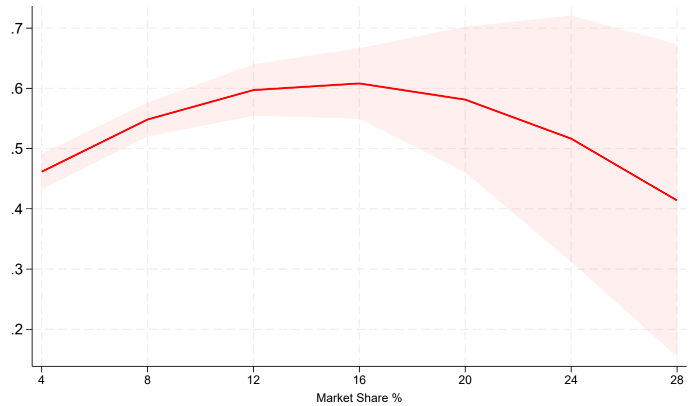


Figure 9: Estimated Pass-Through by Market Share

produces a much clearer and more consistent pattern. In the short-term regression, the interaction between market share and import prices is substantially larger (3.59) and highly statistically significant at the one percent level. At the same time, the quadratic interaction term remains negative and strongly significant (-0.22), indicating that the marginal effect of market share on pass-through declines for very large firms. The same qualitative pattern persists at longer horizons, where the linear interaction remains positive and significant (2.28) while the quadratic term remains negative.

Taken together, these coefficients imply a clear concave relationship between firm size and pass-through when import cost shocks are measured using the effective import price. In contrast, the aggregate price specification produces weaker and less stable estimates of this nonlinear pattern. Consistent with this interpretation, the regressions using the effective import price measure also display substantially higher explanatory power, with the R^2 rising from 0.04 to 0.08 in the short-term specification and from 0.12 to 0.18 in the longer horizon regression. This comparison suggests that aggregation in conventional import price indices obscures firm-level heterogeneity in exposure to import cost shocks, whereas the network based measure more clearly reveals the inverted U-shaped relationship predicted by Auer (2016).

Overall, these results highlight that the network based measure of effective import prices reveals economically meaningful patterns of within-industry heterogeneity that remain largely hidden when using aggregate import price indices. By more accurately capturing firms exposure to foreign input costs, the effective import price measure uncovers a nonlinear relationship between firm size and pass-through that aligns closely with theoretical predictions in the pass-through literature.

C.5.2 Across-Industry Pass-Through Heterogeneity

We next examine heterogeneity in pass-through across industries. While the previous subsection focused on firm-level differences within narrowly defined sectors, industry characteristics can also shape how cost shocks are transmitted to prices. In particular, two dimensions emphasized in the literature are market concentration and production structure. These characteristics influence firms pricing incentives and their exposure to input cost shocks, and therefore may systematically affect the degree of import price pass-through.

A large body of work highlights the importance of these margins for pricing behavior. Market concentration affects firms markup adjustment and pricing power, as documented in studies such as Amiti et al. (2014, 2019). At the same time, the structure of production and distribution margins plays an important role in the transmission of international prices to domestic prices. As discussed in Goldberg (2011), and Nakamura and Zerom (2010), local distribution costs and firms positions in the production chain can dampen or amplify the responsiveness of prices to changes in import costs.

In this subsection we revisit these mechanisms through the lens of the network-based effective import price measure developed in this paper. In particular, we compare whether differences in pass-through across industries are more clearly identified when import cost shocks are measured using the effective import price rather than the conventional aggregate import price index.

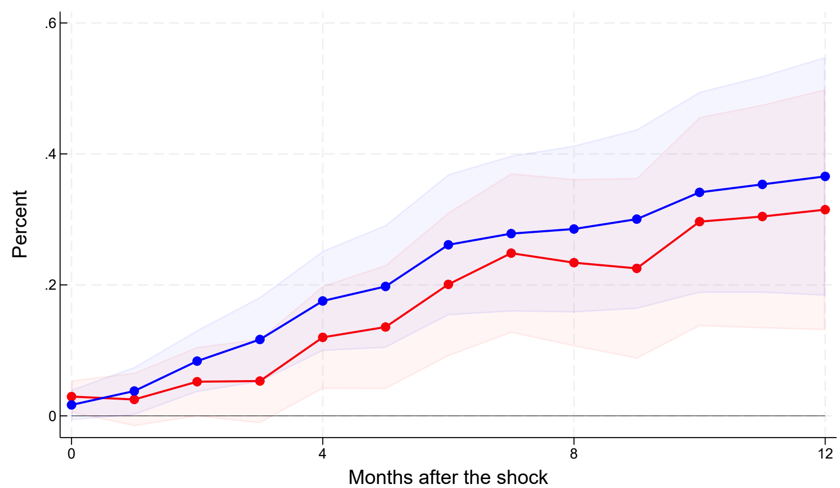
To capture this heterogeneity, we estimate the following local projection specification at monthly horizons $h = 1$ and $h = 12$:

$$\Delta P_{i,k,s,t+h,t-1} = \alpha_{i,t} + \Delta C_{s,t,t-1} \left(\beta_h + \gamma \mathbb{1}_{k=high} + \delta_h \mathbb{1}_{g=int}\right) + \xi_h W_{i,k,s,t-z} + \varepsilon_{i,k,s,t+h}, \quad (44)$$

where i indexes firms and k denotes CN product codes. The variable $\mathbb{1}_{k=high}$ is an indicator equal to one for products whose corresponding CN category exhibits a Herfindahl-Hirschman Index above the median in a given year. This variable captures differences in market concentration across product markets. The variable $\mathbb{1}_{g=int}$ indicates whether product k belongs to the intermediate goods category according to the UN Broad Economic Categories (BEC) classification, where g denotes the corresponding BEC product group.

The coefficient γ therefore captures the differential response of prices to import cost

Figure 10: Import Price Pass-Through: Market Power



Notes: This figure reports local projection estimates of the differential pass-through from import prices to domestic prices by industry characteristics. The red line shows the additional effect in high-concentration industries (above-median HHI). Confidence bands are set at 90 percent.

shocks in highly concentrated product markets, while δ_h captures the differential pass-through associated with products classified as intermediate inputs.

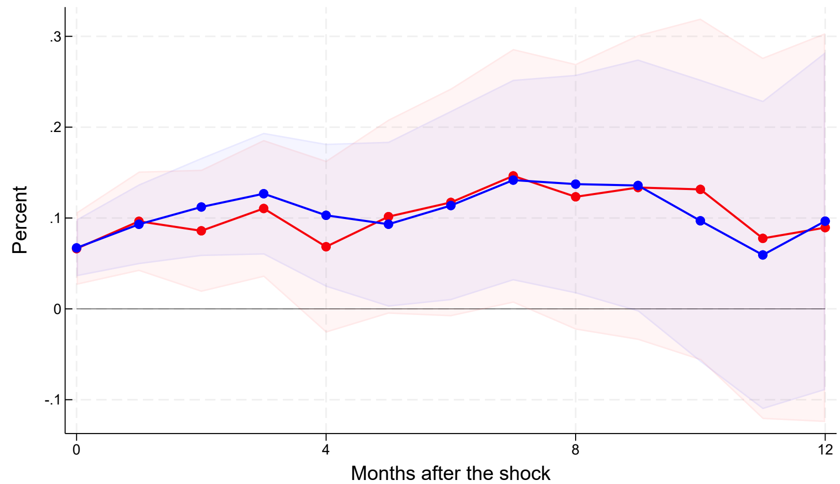
Figures 10 and 11 report the estimated marginal effects across horizons.

Two main patterns emerge. First, industries characterized by higher market concentration exhibit stronger pass-through of import price shocks. Firms operating in concentrated industries appear more able to transmit cost increases to downstream prices rather than absorbing them through reduced margins. The magnitude of this amplification effect is slightly larger when using the effective import price measure, suggesting that accounting for network-based exposure modestly strengthens the estimated role of market power in the transmission of cost shocks.

Second, products classified as intermediate goods display systematically higher pass-through than final consumption goods. Firms producing upstream inputs are more directly exposed to cost fluctuations and play a key role in propagating these shocks through the production network. Because their output prices become inputs for downstream production, price adjustments in these sectors can generate broader price effects along the supply chain.

In contrast to the within-industry analysis, however, the magnitude and statistical significance of these industry-level amplification effects are broadly similar across the aggregate and effective import price specifications. This pattern is consistent with the idea that aggregation bias primarily affects firm-level variation in exposure to import costs rather than

Figure 11: Import Price Pass-Through: Intermediate vs Final Goods



Notes: This figure reports local projection estimates of the differential pass-through from import prices to domestic prices by industry characteristics. The blue line shows the additional pass-through in intermediate goods sectors. Confidence bands are set at 90 percent.

sector-level differences in average exposure. Intuitively, the aggregate import price index can be interpreted as a noisy proxy for the true sector-level cost shock. Formally, we can write

$$X_t^{agg} = C_{s,t} + \nu_{s,t}, \tag{45}$$

where $C_{s,t}$ denotes the true import cost shock affecting sector s, while $\nu_{s,t}$ captures measurement error introduced by aggregation across heterogeneous firms and input structures. When the aggregate proxy is used in place of the true cost shock, standard measurement error results imply that the estimated pass-through coefficient is attenuated relative to the true parameter. In particular, the coefficient estimated using the aggregate price measure can be written as

$$\beta^{agg} = \frac{\text{Var}(C_{s,t})}{\text{Var}(C_{s,t}) + \text{Var}(\nu_{s,t})} \beta^C, \tag{46}$$

where β^C denotes the true pass-through associated with the underlying sector-level cost shock. The degree of attenuation therefore depends on the relative importance of the measurement error component compared to the true variation in sectoral cost shocks. When the variance of the noise term $\nu_{s,t}$ is large relative to $\text{Var}(C_{s,t})$, the aggregate proxy provides a poor approximation of the relevant marginal cost shock and estimated pass-through coefficients become strongly attenuated. Conversely, when most of the variation in the proxy reflects genuine sector-level cost movements, the attenuation bias is limited.

When this ratio is large, the aggregate proxy provides a poor approximation of the underlying marginal cost shocks and estimated pass-through coefficients become attenuated toward zero. Conversely, when the measurement error component is relatively small compared to the true variation in sector-level cost shocks, the aggregate proxy remains a good approximation and attenuation bias is limited.[7]

Taken together, these results suggest that aggregation bias mainly arises from heterogeneity in firms' input sourcing within industries rather than from differences in average exposure across sectors. As a consequence, the network-adjusted import price measure substantially improves the identification of within-industry pass-through heterogeneity, while across-industry amplification patterns remain broadly similar across the two price measures.

Taken together, these findings reinforce the interpretation of the effective import price measure developed in this paper. While the network-adjusted measure substantially improves the identification of within-industry heterogeneity in pass-through, differences across industries appear less sensitive to the choice of import price measure. This internal consistency supports the view that aggregation bias primarily arises from heterogeneity in firms input sourcing within industries rather than from differences in average exposure across sectors.

[7]When heterogeneity arises across firms within the same industry, aggregate import price indices may be only weakly correlated with the true firm-level cost shocks, implying a large measurement error component and therefore substantial attenuation bias. By contrast, when variation occurs across industries, aggregate import price indices already capture most sector-level cost movements, so the measurement error term becomes relatively small and attenuation bias is limited.