Dipartimento
di Economia
Working Papers

n. 293
2026

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ISSN 2279-6916 Working Papers

ROMA TRE
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di Economia
Working Papers

WORKING PAPERS
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Shifting the Boundaries, Pricing Down the Chain: Firm-Level Evidence

Kossi Messanh Agbekponou*†, Ilaria Fusacchia ‡

May 26, 2026

Abstract

Global value chains have made firm boundary decisions central to performance, yet their implications for export prices and shock transmission remain poorly understood. We develop a framework in which vertical integration and productivity jointly shape pricing and pass-through via costs and markups under Nash-in-Nash bargaining. Integration eliminates double marginalization but introduces organizational cost frictions, while productivity affects both costs and organizational choices, generating a counter-intuitive sorting in which low-productivity firms integrate and high-productivity firms outsource. Using French customs data matched to AMADEUS balance-sheet information for agri-food firms (2002–2017), and an instrumental-variable strategy based on exogenous foreign shocks, we find that integration reduces export prices mainly through cumulative markup compression, while productivity lowers prices via costs but increases markups through sorting. Shock transmission is heterogeneous: non-integrated firms adjust through markups, integrated firms through costs, and productivity dampens both channels. Pass-through thus emerges as an equilibrium outcome of firm organization and productivity.

Keywords: Global Value Chains, Vertical Integration, Bargaining Power, Pass-through, Firm Competitiveness

JEL Codes: D21, D22, D43, F12, F14, L11, L22, L23.

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†We are grateful to Carl Gaigné, Rémi Avignon, François-Charles Wolff, Luca Salvatici, Charlotte Emlinger, Alban Thomas, Ariell Reshef, Liza Jabbour, José De Sousa, Catherine Laroche Dupraz, and Kevin Randy Chemo Dzukou for insightful comments and discussions, and to Cécile Le Roy for her invaluable assistance with the data. We also thank participants in the EAAE Congress in Bonn, the AES Conference in Edinburgh, the AFSE Conference in Bordeaux, the IATRC Annual Meeting in Florida, the JMA in Poitiers, and the seminar at CREM, University of Rennes. This work was carried out as part of Kossi Messanh Agpekponou's PhD thesis at INRAE (SMART) and received financial support from the H2020-RIA research project BATModel (grant number 861932) and the INRAE Metaprogramme GloFoods.

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1 Introduction

Global value chains (GVCs) have fundamentally reshaped how firms organize production across borders. By fragmenting production into sequential stages performed by different firms, they have made organizational boundaries—whether firms integrate or outsource upstream and downstream activities—a central determinant of economic performance. Since the seminal contribution of Coase (1937), a large literature has emphasized how firms' internal organization shapes economic outcomes. At the same time, firms participating in GVCs differ widely in productivity, implying that otherwise similar organizational structures may generate very different pricing outcomes across firms. Yet despite the growing importance of GVCs and firm heterogeneity in international trade, a central question remains largely unresolved: *how do organizational choices and productivity jointly shape the formation of prices and the transmission of shocks in international markets?*

This question is challenging because prices in GVCs are not determined by a single production stage applying a constant markup over marginal cost. Instead, they emerge from sequential pricing and bargaining interactions between heterogeneous firms connected through supply chains. When production stages are outsourced, transaction prices are negotiated bilaterally between suppliers and buyers, generating sequential pricing distortions that accumulate along the value chain through bargaining, double marginalization, and incomplete cost pass-through. Vertical integration alters these mechanisms by internalizing transactions, compressing the cumulative markup distortions, and reshaping how upstream costs propagate into export prices. At the same time, integration may increase internal organizational costs. Productivity further interacts with these organizational choices by shaping firms' marginal costs, their exposure to pricing distortions, and the intensity with which shocks are transmitted along the value chain. As a result, prices and pass-through depend jointly on organizational structure and productivity through the interaction of cost and markup channels.

Existing research has largely studied these mechanisms separately. The property-rights literature explains firms' make-or-buy decisions and organizational boundaries (Antràs and Helpman, 2004; Antràs and Chor, 2013; Alfaro et al., 2019), while recent work studies markups and price-setting in supply chains and production networks (De Loecker and Warzynski, 2012; Alviarez et al., 2023; Alvarez-Blaser et al., 2025). Evidence further shows that firms' global sourcing and organizational structures are highly persistent, with limited adjustment even in response to large shocks such as the Covid-19 pandemic (Di Stefano et al., 2022). However, there is still no unified framework linking organizational choices, price formation, and shock transmission along GVCs.

This paper fills this gap by studying how organizational choices and productivity jointly shape export prices, markups, marginal costs, and pass-through along GVCs. Combining a tractable theoretical framework with detailed firm-level data, we examine how organizational structure influences the relative importance of markup and cost channels in price formation and shock transmission, and how productivity interacts with these organizational choices to shape firms' pricing outcomes in international markets.

We start from a simple but often overlooked sequencing at the heart of price formation in GVCs. Firms first differ in productivity and choose their organizational scope along the value chain. Conditional on these choices, suppliers and buyers negotiate transaction prices through bilateral bargaining, and final prices then emerge from downstream pricing and input allocation decisions. Prices are therefore not determined in a single step, but are the outcome of intertwined organizational, bargaining, and production decisions. This sequencing implies that productivity and firm boundaries jointly shape not only marginal costs, but also the way markups and shocks propagate along the value chain.

These insights form the basis of our contributions. First, on the theory side, we develop a tractable framework of pricing in GVCs with endogenous integration decisions and Nash-in-Nash bargaining. We show that organizational choices are shaped by firm productivity—but in a way that departs sharply from standard predictions. In contrast to the canonical view that more productive firms integrate more (Antràs and Helpman, 2004; Antràs and Chor, 2013; Alfaro et al., 2019; Berlingieri et al., 2021; Chor et al., 2021), we uncover a counterintuitive sorting pattern: low-productivity firms optimally choose to integrate, while high-productivity firms rely more on outsourcing. The mechanism becomes transparent once pricing distortions are explicitly accounted for: markup distortions scale with marginal costs and are therefore more costly for low-productivity firms, giving them stronger incentives to internalize transactions and eliminate double marginalization. High-productivity firms, in contrast, operate with lower cost bases and optimally tolerate markup distortions, relying more on external partners.

Abstracting from this endogenous sorting, the model delivers clean predictions about how organizational forms map into price formation. In this regime, vertical integration has ambiguous effects on export prices. On the one hand, downstream integration eliminates sequential pricing distortions by collapsing double marginalization into a single pricing decision, thereby reducing markups. On the other hand, it increases marginal costs through internal organizational frictions required to perform additional activities in-house. Upstream integration further reshapes the cost structure by replacing negotiated input transactions with internal production, thereby modifying the composition of sourcing costs. The net effect on export prices depends on the relative strength of these opposing channels, so that vertical integration operates through a systematic reallocation between markup and cost components of price determination.

In this context, higher productivity reduces marginal cost and therefore lowers export prices for a given organizational structure. However, accounting for endogenous organizational structure, productivity also affects prices through the sorting margin. Because more productive firms are less likely to integrate, they are more frequently exposed to bargaining-induced markups that scale with marginal cost, as well as to downstream cost pass-through into transaction prices. This induces a composition effect whereby higher productivity is associated with organizational forms featuring higher markups, partially offsetting the direct cost-efficiency effect. The net effect of productivity on export prices is therefore ambiguous and depends on the relative strength of these two forces. The sorting mechanism therefore allows interaction between organizational choice and productivity in our framework that generates rich heterogeneity in pricing outcomes across firms, as integration and productivity operate simultaneously but in opposite directions along the markup–cost trade-off.

The sorting result has a second, more subtle implication that is largely absent from the literature: productivity determines not only which channel dominates price formation, but also how strongly upstream shocks are transmitted. Because more productive firms have lower marginal costs, shocks operate on a smaller base, leading to systematically attenuated responses. We therefore distinguish between two dimensions that are typically conflated: exposure to distortions (which depends on organizational structure) and response to shocks (which depends on the cost base). This generates a striking pattern: high-productivity firms are more exposed to markup distortions (because they outsource more), yet less sensitive to shocks (because their cost base is smaller).

Taken together, these mechanisms imply that shock transmission in GVCs is fundamentally heterogeneous and non-monotonic. Low-integration firms exhibit strong markup adjustments and weak cost pass-through, leading to high price sensitivity, whereas highly integrated firms display the opposite pattern: muted markup responses but strong cost transmission, resulting in more direct but smoother price adjustments. Productivity further compresses these responses, dampening both channels across the distribution of integration levels. These predictions overturn the conventional view of pass-through as a stable parameter and instead characterize it as an equilibrium outcome of the interaction between firms' organizational choices and productivity.

Second, our central result can be summarized as follows: *vertical integration reallocates price determination—and the transmission of shocks—from markups to costs, while productivity scales the magnitude of both channels.* Integration therefore governs the channel through which prices and shocks are transmitted, whereas productivity mainly governs the intensity of these effects, jointly generating rich and systematic heterogeneity in pricing outcomes across firms. Importantly, these results do not rely on demand-induced variable markups, but from firms' organizational structure and sequential bargaining along GVCs. Even under CES demand, organizational choices and endogenous sorting generate heterogeneous markups, cost pass-through, and shock transmission across firms. Conceptually, we provide a new lens through which to analyze price formation, pass-through, and competitiveness in GVCs by linking the organizational choices and productivity of firms to the joint determination of costs, markups, and shock transmission. Our framework therefore extends the literature on price formation and transmission by showing that prices, markups, and pass-through are equilibrium outcomes rather than structural constants, shaped jointly by firm organization and productivity.

Third, our empirical contribution combines detailed firm-level data from French customs records with balance-sheet information for agri-food firms from the AMADEUS database over the period 2002–2017. We construct firm-level measures of upstream and downstream integration and merge them with estimates of markups, marginal costs (De Loecker and Warzynski, 2012), and quality-adjusted export prices (Khandelwal et al., 2013; Fan et al., 2015). Since our analysis is conducted at the firm level, observed markups should be interpreted as cumulative outcomes of sequential pricing along GVCs rather than isolated stage-specific markups. Measuring firms' positions along GVCs is challenging in the absence of sufficiently disaggregated input–output tables; to address this, we match customs data to a finely detailed input–output structure derived from the U.S. benchmark using the methodology of Agbekponou et al. (2025), which mitigates aggregation biases (Bems and Kikkawa, 2021) and allows us to compute industry-level upstreamness following Fally (2012), Antràs et al. (2012), and Antràs and Chor (2013). Firms' positions along the value chain are then inferred from the processing level of traded goods, in the spirit of Chor et al. (2021). To address endogeneity, we implement an instrumental-variable strategy based on a shift-share design that exploits exogenous variation in firms' organizational position and productivity. Exogenous shocks to foreign supply and demand serve as instruments. We construct upstream cost shocks within the same framework, allowing us to identify how integration and productivity jointly shape pricing and pass-through along GVCs.

We focus on the agri-food processing industry for several reasons. First, global agri-food value chains have expanded rapidly in recent decades, becoming a central component of international trade with important implications for development, productivity, and value added across countries and firms (e.g. Paul Jr et al., 2024). Second, the agri-food sector lies at the intersection of manufacturing, agriculture, and services, making it particularly well suited to study the role of firm-level organizational choices: processing firms simultaneously manage upstream sourcing of agricultural products and downstream distribution of final goods, retail, and exports, providing a rich environment to analyze firm boundaries. Third, agri-food value chains are highly policy relevant, as governments increasingly face challenges related to food security, supply-chain resilience, and welfare distribution in food systems, where firm-level strategies play a key role. Focusing on this sector therefore allows us to connect micro-level mechanisms of productivity, organization, and pricing to broader policy concerns in trade and food-system resilience.

The empirical results strongly support the model's core mechanisms. First, we show that integration has a large and robust negative effect on export prices, driven primarily by a sharp reduction in markups, consistent with the elimination of double marginalization. Marginal costs, by contrast, respond weakly on average, indicating that the dominant effect of integration operates through the pricing distortion channel rather than technological efficiency. Second, we find that higher productivity also robustly reduces export prices, but through opposing channels: it significantly lowers marginal costs while simultaneously increasing markups. The net effect is negative, implying that the cost channel dominates quantitatively. Third, we uncover substantial heterogeneity: integration compresses markups among low-productivity firms—who are more likely to integrate and thus eliminate double marginalization—but increases markups at the top, where highly productive firms rely more on outsourcing and are therefore more exposed to markup amplification. This pattern is consistent with the model's endogenous sorting mechanism and with misallocation when highly productive firms deviate from their optimal organizational structure. This pattern is mirrored on the cost side: integration tends to raise marginal costs for low-productivity firms due to internal organizational frictions, while having weaker or even cost-reducing effects for more productive firms. Taken together, these results highlight a systematic reallocation between markup and cost components across the productivity distribution.

We then turn to the transmission of upstream shocks and show that integration fundamentally reshapes pass-through, consistent with the model's cost–markup decomposition. Using a shift-share measure of input price shocks, we document that non-integrated firms absorb shocks primarily through markup adjustments—reflecting bargaining frictions—which leads to incomplete cost pass-through but strong price sensitivity. By contrast, integrated firms, having eliminated these distortions, exhibit muted markup responses and transmit shocks directly through marginal costs. As a result, despite stronger cost responses, price adjustments are more gradual and less pronounced, reflecting the absence of markup amplification. Finally, we document a substantial scaling effect of productivity: high-productivity firms display systematically attenuated responses along both channels, reflecting their lower marginal cost base, and indicating that the stronger price responses observed among low-integration firms are primarily driven by low-productivity firms operating under this regime, where shocks are absorbed through markup adjustments induced by bargaining frictions. This confirms that productivity governs not only organizational sorting but also the intensity of shock transmission.

Our findings shed light on several policy questions related to supply chains, inflation, and resilience. First, they suggest that the formation of prices along GVCs and the transmission of global shocks—such as increase in input prices, trade disruptions, or geopolitical tensions—depend critically on firms' organizational structure and productivity. Policies focusing solely on cost conditions may therefore overlook a key margin of adjustment: the endogenous reallocation of pricing distortions between markups and costs along GVCs. Second, the counterintuitive sorting pattern implies that uniform incentives to promote vertical integration may be inefficient. Integration is most valuable for low-productivity firms facing large pricing distortions, whereas for highly productive firms it may generate misallocation and weaker performance. Third, the scaling effect of productivity implies that economies dominated by highly productive firms may display more muted aggregate responses to shocks, even when exposure to global disturbances remains high.

More broadly, our analysis highlights that the resilience and competitiveness of GVCs cannot be understood without accounting for firms' internal organization. Organizational choices shape not only marginal costs, but also the relative importance of markups and costs in price formation, the propagation of shocks, the distribution of rents, and ultimately the dynamics of prices in international markets.

Our paper contributes to several strands of the literature. First, it relates to the literature on negotiated prices and Nash-in-Nash bargaining. Building on Collard-Wexler et al. (2019), we model pricing as the outcome of sequential bilateral bargaining along GVCs. This framework has been widely used to study negotiated prices in supply chains and industrial organization, including hospital-insurer markets (Gowrisankaran et al., 2015) and production networks with bilateral market power (Alvarez-Blaser et al., 2025; Alviarez et al., 2023). Relative to this literature, our contribution is to embed bargaining into a framework with endogenous vertical integration and to decompose price formation into distinct cost and markup channels that are jointly shaped by firms' organizational choices and productivity.

Second, recent work emphasizes the role of demand structure and demand curvature in generating heterogeneous markups and pass-through (Mrázová and Neary, 2017; Annicchiarico and Marvasi, 2019). By contrast, we abstract from demand-side markup variation in order to isolate a different mechanism: organizationally-generated heterogeneity in price formation and shock transmission along GVCs. In our framework, markups and pass-through vary even under CES demand because sequential bargaining and firms' organizational boundaries reshape how costs and markups enter prices.

Third, we contribute to the growing literature on vertical integration and firm performance. Gaigné et al. (2018) show that acquiring an intermediary lowers prices, consistent with a reduction in double marginalization, while improving export performance. We build on this insight but extend it in two key dimensions. First, we jointly analyze upstream and downstream integration, whereas the existing evidence focuses primarily on downstream acquisition. Second, we provide a structural decomposition of price effects into markup and marginal cost components. In contrast to the standard interpretation where price reductions are attributed to the elimination of double marginalization, we show that integration also reshapes marginal costs through internal organization, making the overall price effect ambiguous ex ante. This allows us to distinguish clearly between markup compression and cost adjustments within vertically integrated firms.

Fourth, we contribute to the literature on firm organization in GVCs. The property-rights framework (Antràs and Helpman, 2004; Antràs and Chor, 2013; Alfaro et al., 2019) emphasizes how contractual frictions determine make-or-buy decisions, while other work documents systematic sorting in sourcing patterns (Berlingieri et al., 2021; Chor et al., 2021; Alfaro et al., 2019; Del Prete and Rungi, 2017). We extend this literature by showing that organizational choices are not monotonic in productivity: less productive firms optimally integrate, while more productive firms outsource. This counterintuitive sorting arises because pricing distortions scale with marginal costs, making them disproportionately costly for low-productivity firms. This sorting mechanism is central to our framework, as it governs firms' exposure to both markup distortions and cost pass-through.

Finally, we contribute to the literature on shock transmission in production networks (Carvalho and Tahbaz-Salehi, 2019; Bonadio et al., 2020). We show that firm boundaries fundamentally reshape pass-through mechanisms. Integration reallocates the transmission of upstream shocks from markups toward marginal costs, while non-integration operates through bargaining-induced markup adjustments that amplify price sensitivity but attenuate cost pass-through. Productivity further modulates these effects by scaling marginal costs, thereby dampening the intensity of shock transmission across all organizational forms. This implies that pass-through is not a structural parameter but an equilibrium outcome shaped jointly by organizational structure and productivity.

The remainder of this paper is organized as follows. Section 2 develops the theoretical framework, outlining how firm organizational choices and productivity shape pricing outcomes along GVCs, and presenting the key intuitions behind our main predictions. In Section 3, we introduce the data, detail the construction of key variables, and provide an exploratory analysis. Section 4 tests the theoretical predictions by examining how vertical integration and productivity influence firms' pricing outcomes and their role in transmitting upstream shocks. Finally, Section 5 provides a discussion of the results, drawing conclusions and highlighting the policy implications.

2 Theoretical Framework

This section develops a framework to study how firm organizational choices and productivity jointly shape pricing outcomes and shock transmission along GVCs. Firms operate within a sequence of production stages, where transactions between independent parties are governed by bilateral bargaining. As a result, prices reflect the accumulation of marginalization distortions along the value chain.

We interpret vertical integration as the firm's position within this sequence, determined by the range of activities performed in-house versus through external partners. In this sense, integration reflects the firm's scope of operations rather than a decision taken for a fixed set of products.

The scope of integration is determined by a multi-dimensional trade-off between productivity, surplus-sharing under bargaining, and the organizational costs of internalizing production stages. Productivity is therefore only one of several forces shaping integration choices. Accordingly, in this framework, productivity and integration are treated as distinct but interacting determinants of cost formation and price-setting.

2.1 Consumer Preferences and Demand

Consider a world with J countries. In each country j, consumers have constant elasticity of substitution (CES) preferences over a continuum of differentiated varieties:

$$\Upsilon_j = \left(\int_{\Omega_j} q_j(\upsilon)^{\frac{\varepsilon-1}{\varepsilon}} d\upsilon \right)^{\frac{\varepsilon}{\varepsilon-1}}, \tag{1}$$

where $\upsilon \in \Omega_j$ indexes varieties and $\varepsilon > 1$ is the elasticity of substitution. Utility maximization yields the standard demand function:

$$q_j(\upsilon) = \left(\frac{p_j(\upsilon)}{P_j} \right)^{-\varepsilon} \frac{E_j}{P_j}, \tag{2}$$

where E_j denotes total expenditure and P_j is the CES price index. Defining $A_j \equiv E_j P_j^{\varepsilon-1}$, demand can be written as $q_j(\upsilon) = A_j\, p_j(\upsilon)^{-\varepsilon}$.

2.2 Exporting Firm Technology

On the supply side, firms produce differentiated varieties under monopolistic competition. Each firm f, located in country $h(f)$, imports inputs from country i and produces a variety υ in product k, which it may export to country j. For notational convenience, we suppress the dependence on $h(f)$ throughout this section. Production follows a sequential structure as in Chor et al. (2021), with stages indexed by $u \in [1, \infty)$, where higher u corresponds to more upstream activities and $u = 1$ denotes the final stage.

Firms differ in productivity θ_{fk} and in the span of activities performed in-house, defined by the interval $[U_f^X, U_f^M]$. Activities outside this interval are conducted through external partners, upstream or downstream along the value chain.

Output is produced using a CES aggregator of internal and external (imported) inputs:

$$q_{fk} = \theta_{fk} \left(\int_{U_f^X}^{U_f^M} x_f(u)^{\frac{\sigma-1}{\sigma}} du + q_{if}^{M\,\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}. \tag{3}$$

Internal inputs $x_f(u)$ are produced at unit cost $c_f(u)$, while external inputs q_{if}^M are purchased at price p_{if}^M. The elasticity of substitution is $\sigma > 1$, and productivity θ_{fk} scales the efficiency with which inputs are transformed into output.

2.3 Supplier-Buyer Bilateral Bargaining

Product k may be semi-finished or final. Suppose firm f imports inputs up to stage U_f^M, which are used to produce variety v exported to country j, close to final consumption, so that $1 \leq U_f^X < U_f^M$. Demand in country j follows Equation (2).

Following Gaigné et al. (2018) and Antràs (2020), we assume that, because finding suitable foreign partners is costly, firms f may rely on intermediaries to distribute products in country j. These relationships are governed by arm's-length contracts and may involve repeated interactions when a good matches an importer's needs.

Such patterns of GVC trade can create a form of lock-in between suppliers and buyers, as emphasized by Monarch and Schmidt-Eisenlohr (2017), Martin et al. (2023), and Monarch (2022). Consequently, transaction prices are negotiated bilaterally, rather than set by market-clearing, with the surplus split according to the relative bargaining power of the parties.

We assume a one-to-one matching between firms f and buyers in country j. Prices are set via Nash bargaining, with the following sequence:

1. Each firm f draws productivity θ_{fk} and chooses its scope of activities $[U_f^X, U_f^M]$ along the value chain to maximize profits. The optimal scope maps into the set of products the firm produces and sources.

2. Given productivity and the chosen scope, the manufacturer and importer bargain over the transaction price at quantity q_{fjk} to split the surplus according to relative bargaining power.

3. Conditional on the negotiated price, the importer sets the consumer price to maximize profits, while the manufacturer chooses input quantities to minimize production costs.

2.3.1 Pricing and Production Decisions

Downstream Pricing and Importer Optimization. We solve the game by backward induction. In the final stage, given quantity q_{fjk} supplied by manufacturer f, the importer in j chooses the consumer price p_{jk} to maximize operating profits:

$$\pi_{jk} = (p_{jk} - p_{fjk} - \phi_j(u_j))\, q_{fjk}, \tag{4}$$

where p_{fjk} is the unit price paid to the manufacturer.[1] Additionally, the importer in j incurs a per-unit downstream cost $\phi_j(u_j) > 0$, capturing distribution, processing, or organizational costs associated with handling imported goods.[2] While marginal at the transaction level, it is stage-specific, reflecting differences in complexity and organizational requirements. Its magnitude may also depend on the identity of the party performing the activity, as internalization can alter the cost depending on the proximity of the task to the firm's core competencies.

Maximizing (4) yields the CES-consistent price and demand:

$$p^*_{jk} = \frac{\varepsilon}{\varepsilon - 1} \left(p_{fjk} + \phi_j(u_j)\right), \tag{5}$$

$$q^*_{fjk} = A_{jk} \left(\frac{\varepsilon}{\varepsilon - 1}\right)^{-\varepsilon} \left(p_{fjk} + \phi_j(u_j)\right)^{-\varepsilon}. \tag{6}$$

Downstream costs add additively to the import price. With a constant CES markup, the final price is a constant markup over the total unit cost of sourcing and processing the good, leading to higher consumer prices and lower equilibrium quantities.

Upstream Production and Cost Minimization. Turning to the supply side, given the negotiated price at quantity q_{fjk}, the manufacturer minimizes production costs:

$$\min_{q^M_{if}, x_f(u)} p^M_{if} q^M_{if} + \int_{U^X_f}^{U^M_f} c_f(u) x_f(u) du \tag{7}$$

$$s.t. \qquad q_{fjk} = \theta_{fk} \left(\int_{U^X_f}^{U^M_f} x_f(u)^{\frac{\sigma-1}{\sigma}} du + q^{M \frac{\sigma-1}{\sigma}}_{if} \right)^{\frac{\sigma}{\sigma-1}}$$

The solution defines the manufacturer's marginal cost for producing and exporting quantity q_{fjk}:

$$MC_{fjk} = \frac{1}{\theta_{fk}} \left(p^{M^{1-\sigma}}_{if} + \int_{U^X_f}^{U^M_f} c_f(u)^{1-\sigma} du \right)^{\frac{1}{1-\sigma}}, \tag{8}$$

with corresponding profit

$$\pi_{fjk} = (p_{fjk} - MC_{fjk}) q_{fjk}. \tag{9}$$

2.3.2 Nash Bargaining over Transaction Prices

Given the importer's and manufacturer's profit functions, (4) and (9), we turn to the second stage, where the transaction price p^*_{fjk} is determined via the Nash bargaining problem:

$$\max_{p_{fjk}} \Big[\underbrace{(p_{fjk} - MC_{fjk}) q_{fjk}}_{\pi_{fjk}} \Big]^{\beta} \Big[\underbrace{(p_{jk} - p_{fjk} - \phi_j(u_j)) q_{fjk}}_{\pi_{jk}} \Big]^{1-\beta}, \tag{10}$$

where β is the manufacturer's bargaining power. To solve this problem, we adopt a Nash-in-Nash framework in which each bilateral negotiation takes as given the outcomes of all other

[1] Although international trade is typically subject to iceberg-type trade costs, we do not model them explicitly here, as they would only rescale delivered quantities without altering equilibrium mechanisms.

[2] The cost $\phi_j(u_j)$ can be interpreted as a distribution cost when the importer acts as a retailer, or as a processing cost when it undertakes an additional production stage that combines imported inputs with its internal activities.

relationships. In case of disagreement, both parties can turn to alternative partners, but without generating relationship-specific surplus. Accordingly, outside options are normalized to zero.

Solving the first-order condition (FOC) yields the closed-form expression for the equilibrium transaction price under non-integration, denoted $p^{NI}_{fjk} \equiv p^{*}_{fjk}$ (see Appendix A.1):

$$p^{NI}_{fjk} = \underbrace{\frac{\varepsilon+\beta-1}{\varepsilon-1}}_{\mu(\beta)} \underbrace{\left(p_{if}^{M^{1-\sigma}} + \int_{U_f^X}^{U_f^M} c_f(u)^{1-\sigma} du \right)^{\frac{1}{1-\sigma}} \frac{1}{\theta_{fk}}}_{MC_{fjk}} + \underbrace{\frac{\beta}{\varepsilon-1}\phi_j(u_j)}_{\text{downstream cost pass-through}} . \tag{11}$$

This expression extends standard pricing rules in heterogeneous firm models (Gaigné and Gouel, 2022) along two dimensions. First, the downstream cost $\phi_j(u_j)$, although incurred by the importer, affects the negotiated transaction price through the surplus-sharing rule. In particular, downstream cost pass-through into firm f's price is incomplete and given by:

$$\frac{\partial p^{NI}_{fjk}}{\partial \phi_j(u_j)} = \frac{\beta}{\varepsilon-1}.$$

This mechanism does not require the exporter to directly observe or explicitly internalize downstream costs. Instead, it arises endogenously from the strategic interaction between the two parties, as downstream costs reduce the total surplus available to the trading pair. As a result, downstream organizational costs act as a wedge in the bargaining problem.

Since $\beta/(\varepsilon-1) < 1$, only a fraction of the downstream cost is reflected in the negotiated price. The magnitude of this pass-through depends on the exporter's bargaining power: when β is high, the exporter is able to shift a larger share of the downstream cost onto the importer through a higher transaction price, whereas when β is low, the negotiated price is largely decoupled from downstream costs, reflecting limited transmission of downstream conditions into upstream pricing.

Second, marginal cost MC_{fjk} depends on the firm's internal scope $[U_f^X, U_f^M]$, capturing vertical integration choices within the value chain. Moreover, the markup $\mu(\beta) = (\varepsilon+\beta-1)/(\varepsilon-1)$ emerges endogenously from the bilateral bargaining process and increases with the manufacturer's bargaining power β.[3] Accordingly, the transaction price p^{NI}_{fjk} highlights that downstream costs affect manufacturer f's profit only when the downstream stage is not integrated. In this case, the importer's pricing rule implies (5). Substituting (11) into (5) yields the final consumer price:

$$p^{NI}_{jk} = \underbrace{\frac{\varepsilon}{\varepsilon-1}}_{\mu_j} \underbrace{\frac{\varepsilon+\beta-1}{\varepsilon-1}}_{\mu(\beta)} \left(MC_{fjk} + \phi_j(u_j) \right). \tag{12}$$

where p^{NI}_{jk} denotes the price under non-integration. This expression reflects double marginalization: both the firm and the importer apply markups, raising the final price and reducing equilibrium quantities. The resulting vertical externality lowers total surplus, as each party ignores the impact of its markup on the other's profits (see Tirole, 1988).

[3]Unlike models where markup heterogeneity arises from non-CES demand curvature (see Mrázová and Neary, 2017), our mechanism operates even under CES demand through organizational structure and sequential bargaining along GVCs.

2.3.3 Vertical Integration Decision

Downstream Integration and Firm Sorting We now turn to the first stage of the game, where the integration boundaries $[U_f^X, U_f^M]$ are determined. The firm chooses its scope of activities along the value chain to maximize profits. To do so, we consider a discrete integration choice where the firm integrates the downstream stage by expanding its scope toward u_j. The integrated firm directly sets the final price to maximize joint profits. Its marginal cost becomes:

$$MC_{fjk}^I = MC_{fjk} + \phi_f(u_j), \tag{13}$$

where $\phi_f(u_j)$ is now interpreted as the cost of performing the downstream stage in-house by f.

The optimal price is given by the standard CES markup:

$$p_{fjk}^I = \frac{\varepsilon}{\varepsilon - 1} MC_{fjk}^I. \tag{14}$$

Integration therefore eliminates the downstream bargaining distortion by collapsing the sequential pricing structure into a single decision unit. As a result, markups are reduced, but marginal costs may increase due to organizational frictions $\phi_f(u_j)$ associated with performing additional stages in-house.

Formally, under non-integration, firm's profits are given by:

$$\pi_{fjk}^{NI} = A_{jk}\mu_j^{-\varepsilon} \frac{(\mu(\beta) - 1)MC_{fjk} + \frac{\beta}{\varepsilon - 1}\phi_j(u_j)}{\left[\mu(\beta)\left(MC_{fjk} + \phi_j(u_j)\right)\right]^{\varepsilon}},$$

whereas the bargaining stage disappears under integration and profits simplify to:[4]

$$\pi_{fjk}^I = A_{jk}\mu_I^{-\varepsilon}\left(MC_{fjk} + \phi_f(u_j)\right)^{1-\varepsilon}.$$

A firm integrates the downstream stage if and only if $\pi_{fjk}^I \geq \pi_{fjk}^{NI}$. This condition defines a unique productivity cutoff $\bar{\theta}_{fk}$ such that (see Appendix A.2):

$$\bar{\theta}_{fk} = \frac{(B(\beta, \varepsilon) - 1)\,\tilde{c}_{fk}}{\phi_f(u_j) - B(\beta, \varepsilon)\phi_j(u_j)}, \tag{15}$$

where $\tilde{c}_{fk} \equiv \left(p_{if}^{M^{1-\sigma}} + \int_{U_f^X}^{U_f^M} c_f(u)^{1-\sigma} du\right)^{\frac{1}{1-\sigma}}$, and $B(\beta, \varepsilon) \equiv [\beta\mu(\beta)^{-\varepsilon}]^{\frac{1}{1-\varepsilon}} > 1$.

An interior solution requires $\phi_f(u_j) > B(\beta, \varepsilon)\phi_j(u_j)$, ensuring that the organizational cost of performing the downstream stage in-house is sufficiently large relative to the effective cost of outsourcing. This condition guarantees a non-degenerate trade-off between internalization and market-based organization. Integration then occurs if and only if $\theta_{fk} \leq \bar{\theta}_{fk}$. Strikingly, this counterintuitive result implies that less productive firms are more likely to integrate, in contrast with the standard prediction that integration increases with productivity (Antràs and Helpman, 2004; Antràs and Chor, 2013; Alfaro et al., 2019; Berlingieri et al., 2021; Chor et al., 2021).

Under non-integration, the transaction price p_{fjk}^{NI} embeds both a bargaining-induced markup over marginal cost and a pass-through of downstream costs. Since the markup applies to marginal cost, firms with lower productivity (i.e. $\theta_{fk} \leq \bar{\theta}_{fk}$) face a larger distortion in the

[4] Integration eliminates the bargaining stage by internalizing the transaction within the firm. This does not correspond to a limiting case where bargaining power converges to zero or one. Rather, the bargaining problem becomes irrelevant, as the firm jointly optimizes production and pricing decisions across stages.

negotiated price due to their higher cost base, whereas more productive firms (i.e. $\theta_{fk} > \bar{\theta}_{fk}$) are less affected.

Integration, by contrast, removes these bargaining distortions but entails internal organizational costs $\phi_f(u_j)$ that do not scale with productivity. As a result, integration is relatively more attractive for less productive firms, for which the pricing distortions under non-integration are most severe, leading to a sorting pattern in which low-productivity firms integrate while high-productivity firms rely on market-based transactions.

This result does not rely on efficiency gains from integration *per se*, but on how productivity interacts with pricing distortions along the value chain. In particular, the interaction between bargaining, downstream cost pass-through, and organizational frictions determines how these distortions scale with marginal cost and, in turn, shape the integration cutoff. Parameters that amplify downstream distortions under non-integration—such as higher bargaining power β or higher downstream costs $\phi_j(u_j)$—increase the cutoff $\bar{\theta}_{fk}$, thereby expanding the set of firms that choose to integrate. As a result, non-integration becomes concentrated among the most productive firms.

By contrast, higher organizational costs $\phi_f(u_j)$ reduce the cutoff, making integration less attractive and inducing a reallocation toward market-based sourcing for a larger set of firms. The requirement $\phi_f(u_j) > B(\beta, \varepsilon)\phi_j(u_j)$ ensures that these forces generate a non-degenerate interior sorting, in which neither mode of organization dominates.

These mechanisms translate into a simple characterization of firms' organizational choices, which we summarize in the following proposition.

Proposition 1 (Sorting and Integration under Pricing Distortions): *There exists a unique productivity cutoff $\bar{\theta}_{fk}$ such that firms with $\theta_{fk} \leq \bar{\theta}_{fk}$ choose to integrate the downstream stage (lower U^X_{ft}), while firms with $\theta_{fk} > \bar{\theta}_{fk}$ rely on market-based transactions. This sorting arises because pricing distortions under non-integration, defined as the deviation of the final price p^{NI}_{jk} from a frictionless benchmark $p^*_{jk} = MC_{fjk} + \phi_j(u_j)$, scale with marginal cost, making integration relatively more attractive for less productive firms. The cutoff increases with bargaining power β and downstream costs $\phi_j(u_j)$, but decreases with internal organizational costs $\phi_f(u_j)$, which make integration less attractive and expand the set of non-integrating firms.*

Upstream Sourcing and Integration We now turn to the upstream side of the value chain, where firm f sources intermediate inputs from foreign suppliers in country i. As in the downstream case, transactions are governed by bilateral Nash bargaining under non-integration. The equilibrium input price is given by (see Appendix A.3):

$$p^{NI}_{if} = (1-\varphi)MC^{sup}_{if} + \varphi(\psi_f - \phi_f(u_f)), \tag{16}$$

where φ denotes supplier i's bargaining power, MC^{sup}_{if} is the supplier's marginal cost, $\phi_f(u_f) > 0$ captures upstream organizational costs, and ψ_f is the marginal revenue product of the input within the firm f. This expression reflects a surplus-sharing mechanism in which input prices depend not only on upstream production costs, but also on the downstream value ψ_f generated by the firm.

Under non-integration, the firm sources inputs at the negotiated price p^{NI}_{if} and incurs upstream organizational costs $\phi_f(u_f)$. These costs enter the firm's marginal cost through the CES aggregator:

$$MC^{NI}_{fjk} = \frac{1}{\theta_{fk}} \left[(p^{NI}_{if} + \phi_f(u_f))^{1-\sigma} + \int_{U^X_f}^{U^M_f} c_f(u)^{1-\sigma} du \right]^{\frac{1}{1-\sigma}}. \tag{17}$$

Under upstream integration, the firm internalizes the supplier and directly produces the input in-house. The bargaining stage disappears, and the firm incurs an internal organizational cost $\phi_f(u_i)$ instead. Marginal cost becomes:[5]

$$MC^I_{fjk} = \frac{1}{\theta_{fk}} \left[\phi_f(u_i)^{1-\sigma} + \int_{U_f^X}^{U_f^M} c_f(u)^{1-\sigma} du \right]^{\frac{1}{1-\sigma}}. \tag{18}$$

Unlike downstream integration, upstream integration does not directly affect pricing distortions. Instead, it modifies how input costs are determined and how upstream shocks are transmitted into the firm's marginal cost.

Under non-integration, bargaining acts as a partial buffer: input prices reflect a weighted average of upstream costs and downstream surplus. Under integration, this buffering mechanism disappears, and upstream cost shocks are fully internalized. As a result, upstream integration primarily governs the firm's exposure to cost fluctuations rather than the elimination of markup distortions.

2.3.4 Pricing Effects of Vertical Integration and Productivity

The downstream sorting pattern characterized above, together with upstream integration decisions that shape input costs, has direct implications for export pricing via its impact on markups and marginal costs. To fix ideas, it is useful to consider separately the roles of integration and productivity.

Vertical Integration and Price Formation First, holding productivity constant, downstream integration eliminates the sequential pricing distortion by collapsing the double markups into a single pricing decision. This exerts a direct downward pressure on export prices through a reduction in markups. However, this effect may be partially offset by an increase in marginal cost due to the internal organizational cost $\phi_f(u_j)$ required to perform the downstream stage in-house.

Second, upstream integration affects prices through the cost channel. By internalizing input production, the firm substitutes negotiated sourcing costs p^{NI}_{if} for internal organizational costs $\phi_f(u_i)$ within the marginal-cost aggregator. Unlike downstream integration, this mechanism does not alter markups directly but changes the effective cost of input provision. The resulting impact on export prices depends on whether internal production costs are lower or higher than market-based sourcing costs.

Taken together, vertical integration affects export prices through two distinct mechanisms. Downstream integration reduces pricing distortions, while integration along the value chain reshapes marginal costs. Consequently, the overall effect of vertical integration on export prices depends on whether markup compression dominates the marginal-cost adjustments induced by organizational reallocation across production stages.

These mechanisms imply that the pricing effects of integration depend on how organizational boundaries reshape both markups and marginal costs, which we summarize in the following proposition.

Proposition 2 (Vertical Integration and Export Prices): *Holding productivity fixed, downstream integration (lower U^X_{ft}) reduces export prices through markup compression ($\mu_j\mu(\beta) \to$*

[5] Under integration, MC^{sup}_{if} corresponds to the technological cost of producing the input in-house. This cost is no longer observed as a market price and is instead embedded in the internal cost function $c_f(u)$, which is implicitly captured by the CES aggregator via $\int_{U_f^X}^{U_f^M} c_f(u)^{1-\sigma} du$.

μ_j), while increasing marginal costs through internal organizational frictions $\phi_f(u_j)$. Upstream integration (higher U^M_{ft}) affects export prices through the marginal-cost channel by replacing negotiated sourcing prices p^{NI}_{if} with internal organizational costs $\phi_f(u_i)$.

As a result, the effect of vertical integration ($U^M_{ft} - U^X_{ft}$) on export prices reflects the combination of:

(i) a negative markup effect from downstream integration,

(ii) a positive marginal-cost effect from downstream organizational frictions, and

(iii) an upstream cost effect whose sign depends on the relative magnitude of internal and external sourcing costs.

Export prices therefore decrease when the reduction in downstream markups and any marginal-cost savings associated with upstream internalization dominate the increase in marginal costs generated by downstream organizational frictions.

Productivity and Price Formation Holding the organizational structure fixed, higher productivity reduces marginal cost and therefore lowers export prices. This generates a direct cost-efficiency effect of productivity on prices.

Although higher productivity directly lowers marginal costs, its effect on prices is not unambiguously negative because productivity also shapes organizational choices. Under non-integration, transaction prices embed a bargaining-induced markup that scales with marginal cost, implying that more productive firms are mechanically less affected by this distortion. At the same time, more productive firms are less likely to integrate and therefore more frequently operate under organizational forms characterized by bargaining-induced markups and downstream cost pass-through. This generates a composition effect whereby productivity reduces prices through cost efficiency while simultaneously increasing exposure to pricing distortions associated with market-based transactions.

Overall, productivity affects export prices through two opposing channels, with the net impact depending on the relative strength of these forces. We summarize these results in the following proposition.

Proposition 3 (Productivity and Export Prices): *Holding organizational structure fixed, higher productivity θ_{ft} reduces export prices through lower marginal costs.*

In equilibrium, however, higher productivity is associated with a lower likelihood of integration, increasing exposure to bargaining-induced markups and downstream cost pass-through $\beta\phi_j(u_j)/(\varepsilon - 1)$.

As a result, the effect of productivity on export prices reflects the combination of a negative cost effect and a positive organizational (markup and $\beta\phi_j(u_j)/(\varepsilon - 1)$) effect. Export prices decrease when the cost-efficiency gains dominate the increase in markups and $\beta\phi_j(u_j)/(\varepsilon - 1)$ induced by non-integration.

Combining Propositions 2 and 3 implies that export prices need not vary monotonically with either productivity or organizational structure. Because productivity endogenously shapes firms' integration choices through the sorting mechanism described above, the joint variation in productivity and vertical integration generates heterogeneous pricing outcomes across firms.

Corollary 1 (Heterogeneous Pricing Patterns): *In equilibrium, low-productivity integrated firms may charge lower or higher prices than high-productivity non-integrated firms, depending on the relative strength of organizational costs and bargaining distortions.*

This result generates systematic heterogeneity in export prices across firms, reflecting both differences in productivity and endogenous organizational choices.

2.3.5 Vertical Integration, Productivity and Upstream Shock Pass-through

We now examine how upstream cost shocks are transmitted to export prices as a function of both organizational choices and firm productivity. The key distinction lies in whether inputs are sourced through arm's-length transactions or produced in-house, while productivity shapes both the firm's marginal cost and its endogenous exposure to upstream shocks through the choice of organization.

As shown in Appendix A.4, under non-integration, upstream production costs affect marginal cost through bargaining and CES aggregation. The resulting pass-through is given by:

$$\frac{\partial MC^{NI}_{fjk}}{\partial MC^{sup}_{if}} = (1-\varphi)\, MC^{NI}_{fjk}\, \frac{s^{NI}}{p^{NI}_{if} + \phi^{M}_{i}} > 0, \tag{19}$$

where φ denotes supplier i's bargaining power and s^{NI} is the expenditure share of the imported input under non-integration.

This expression highlights that upstream cost pass-through is incomplete due to bargaining, decreasing in the supplier's bargaining power φ, and further scaled by the CES expenditure share S^{NI}. As a result, non-integrated supply chains partially buffer upstream cost fluctuations, thereby dampening their transmission to marginal cost.

Under integration, the firm internalizes the upstream stage and directly incurs organizational costs $\phi_f(u_i)$, which enter marginal cost without any bargaining-based attenuation. This removes the smoothing role of negotiation but introduces a direct cost component that amplifies the impact of upstream cost shocks on marginal cost:

$$\frac{\partial MC^{I}_{fjk}}{\partial MC^{sup}_{if}} = 0, \qquad \frac{\partial MC^{I}}{\partial \phi_f(u_i)} = MC^{I} \cdot \frac{s^{I}}{\phi_f(u_i)}. \tag{20}$$

In addition, organizational structure also shapes how upstream shock translate into export prices through the markup. Under non-integration, bargaining in downstream production generates markup amplification, whereas integration eliminates these double marginalization distortions. As a result, integration reduces markup sensitivity to upstream shocks but increases marginal cost sensitivity through full internalization of organizational costs.

Overall, upstream shocks affect export prices through two opposing channels: a cost channel, which is stronger under integration, and a markup channel, which is stronger under non-integration. The net effect is therefore theoretically ambiguous.

These mechanisms yield the following result.

Proposition 4 (Upstream Shocks, Marginal Costs and Markups): *Upstream shocks affect export prices, but their transmission depends on organizational structure through two distinct channels. Under non-integration, pass-through to marginal cost is incomplete due to bargaining term $(1-\varphi)$ and CES aggregation S^{NI}, while markups are amplified by downstream bargaining distortions term β. Under integration, upstream shocks are directly transmitted into marginal costs through internal costs $\phi_f(u_f)$, while markup distortions are eliminated.*

As a result, integration increases the sensitivity of marginal costs to upstream shocks but reduces markup-driven amplification. The overall effect on export prices is therefore ambiguous and depends on the relative strength of cost and markup channels.

Productivity mediates these mechanisms through endogenous sorting into organizational modes. More productive firms are more likely to operate under non-integration, where cost pass-through is attenuated but markup amplification may be stronger. Conversely, less productive firms are more likely to integrate and therefore exhibit stronger cost-driven sensitivity but potentially weaker markup amplification.

This heterogeneity in transmission patterns is summarized in the following corollary.

Corollary 2 (Productivity and Shock Transmission): *Productivity affects the transmission of upstream shocks to export prices through endogenous sorting into organizational forms. This generates systematic heterogeneity in how firms adjust to shocks through cost and markup channels.*

3 Data Overview and Exploratory Analysis

3.1 Data Sources

The primary data source for our empirical analysis is French customs, which provides annual data on firms' bilateral imports and exports, including value (in euros) and quantity, at the product and origin/destination country level from 2000 to 2018. This database covers only direct imports and exports carried out by firms themselves, *i.e.* excluding transactions through intermediaries. Products are classified using the 8-digit Combined Nomenclature (CN8) and the 6-digit French Product Classification (CPF6), offering detailed information on the product composition of international purchases and sales. The data is collected at the border by French customs services, covering the international activities of firms regardless of their sector. Firms from all sectors (manufacturing, intermediation, wholesale, retail, catering, *etc.*) may import and/or export agri-food products. Our analysis, however, focuses specifically on agri-food processing firms. Following previous research (Baldwin and Yan, 2014; Antràs, 2020), we assume that firms engaged in both import and export activities are participants in GVCs.

Our second data source, the AMADEUS database, identifies French agri-food firms and records annual data from 2002 to 2017, including employee numbers, turnover, and other firm-level characteristics. We construct additional time-varying firm characteristics, including log labor productivity (measured as turnover per worker), and firm-level markups following the production approach developed by De Loecker and Warzynski (2012). Firms are also categorized by size group: small (1 to 49 employees), medium (50 to 499 employees), and large (500 employees or more). The database classifies firms by their main economic activity using the 4-digit NACE Rev.2 codes, covering 32 agri-food industry codes. Focusing on this sector minimizes unobserved factors affecting firm strategies while maintaining industry diversity. AMADEUS data, sourced from DIANE (Bureau Van Dijk), includes only firms that publish annual accounts and balance sheets with the Commercial Courts.

Each firm is uniquely identified by its SIREN number in both datasets. Merging on SIREN yields a panel of French agri-food firms combining firm characteristics and international activity. We restrict the sample to firms whose primary activity is classified under Chapters 10 and 11 of the 2-digit NACE Rev.2 nomenclature, corresponding to the manufacture of food products and beverages, respectively.

3.2 Measurement of Key Variables

3.2.1 Quality-Adjusted Prices

Export unit values at the CN8 level are used as proxies for prices and adjusted for quality to isolate price variation from quality differences.[6] We follow the demand-based approach of Khandelwal et al. (2013) and Fan et al. (2015), which recovers product quality from residual demand variation using product-destination-year fixed effects and external estimates of substitution elasticities.

Details on the estimation procedure are provided in Appendix B.1. The resulting quality-adjusted prices are used in all specifications and should be interpreted as reflecting the cumulative outcome of sequential pricing interactions along GVCs.

3.2.2 Markups and Marginal Costs

We measure firm-level markups following the production-function approach of De Loecker and Warzynski (2012), which infers markups under minimal structural assumptions from standard production data. In particular, firm-level markups $\widehat{\mu}_{ft}$ are obtained by estimating a Cobb-Douglas production function using standard control function methods to address simultaneity in input choice (see Appendix B.2). Markups are then computed as the ratio of the estimated output elasticity of the flexible input to its observed revenue share. We further construct destination-product-level markups $\widehat{\mu}_{fjkt}$ by scaling firm-level markups using within-firm price variation across destinations and products. Because our empirical analysis is conducted at the level of manufacturing firms, the resulting markup measures should be interpreted as capturing the cumulative outcome of sequential pricing interactions embodied in observed export prices along GVCs, rather than isolated stage-specific bargaining markups. Our objective is therefore not to recover individual markups at each production stage, but to identify how firms' organizational position within fragmented value chains affects the cumulative pricing distortions reflected in firm-level export prices.

Marginal costs $\widehat{MC}_{fjkt}$ are recovered from the standard pricing identity linking prices and markups, yielding destination-product-level measures (see Appendix B.2 for more details). Markups and marginal costs are used as empirical counterparts to the theoretical objects defined in the model, allowing a direct mapping between observed prices and the model's decomposition of costs and pricing distortions.

3.2.3 Industry Upstreamness and Firm's Position in GVCs

We compute the upstreamness index U_r for each industry r using the methodology developed by Fally (2012), Antràs et al. (2012), and Antràs and Chor (2013), based on a national input-output table. Focusing on a single industry (the agri-food sector), we need a highly disaggregated table to identify the level of transformation of each product within French firm-level data. Since French input-output tables are highly aggregated (typically identifying only two agri-food industries, except for the GTAP table, which identifies about 20), we use the more detailed U.S. input-output table for the year 2012, provided by the Bureau of Economic Analysis (BEA) (405 industries, including 42 agri-food).[7] However, reconciling US and

[6] More productive firms tend to supply higher-quality products (see Khandelwal et al., 2013), and may also differ in their position within GVCs (Chor et al., 2021). Failing to control for quality would therefore confound price differences driven by production efficiency and organizational choices with those reflecting quality variation, biasing the estimated effects.

[7] U.S. I–O tables developed by the BEA are publicly available at https://apps.bea.gov/iTable/?reqid=1602&isuri=1&step=8&categories=AR. They are released at five-year intervals (notably 2007, 2012, and

French industry codes presents challenges due to multiple correspondences. These concerns are addressed by assigning equal weights to each correspondence, resulting in a detailed U.S. table with 604 4-digit NACE Rev. 2 industries (including 83 agri-food industries), which directly maps industry codes to sectors in the French firm-level data.[8]

Following Ju and Yu (2015) and Chor et al. (2021), we exploit the level of processing of goods produced and sourced by firms to proxy their position along the value chain.[9] The upstreamness of inputs, U_{ft}^{M}, is defined as the trade-share-weighted average upstreamness of the industries from which firm f imports, where the weights correspond to the share of each product in total imports; a symmetric measure, U_{ft}^{X}, is computed analogously using export shares and industry upstreamness. The difference $U_{ft}^{M} - U_{ft}^{X}$ captures the span of production stages internalized by the firm, and thus serves as a proxy for its effective vertical integration within GVCs.

3.3 Descriptive Analysis

Table 1 reports descriptive statistics for the main variables in our sample of GVC firms over the 2002–2017 period. Our sample comprises $3,334$ firms that engage in both importing and exporting in at least one year within this period. The distribution of productivity, measured as log turnover per worker, shows a moderate dispersion (mean = 5.73, SD = 0.71), indicating some variation in firm efficiency across the sample, though within a relatively contained range. This pattern is consistent with a sample structure dominated by small and medium-sized firms (over 90% of firms have fewer than 500 employees), where heterogeneity in productivity coexists with relatively limited dispersion.

At the transaction level, export prices ($\ln p_{fjkt}$) exhibit a mean of 1.53 with a standard deviation of 1.09, reflecting substantial dispersion across firms and products. This dispersion is underpinned by similarly pronounced variation in both components of pricing. Marginal costs ($\ln \mathrm{MC}_{fjkt}$) are highly dispersed (mean = 1.01, SD = 1.17), while markups ($\ln \mathrm{Markup}_{fjkt}$) display an even broader spread (mean = 0.55, SD = 1.11).

These patterns point to pronounced heterogeneity in both marginal costs and markups at the transaction level. The combination of moderate average markups and substantial dispersion is consistent with a monopolistic competition framework featuring heterogeneous firms and heterogeneous cost structures, as is typical of differentiated-product industries such as the agri-food sector.

2017). More specifically, we rely on the Use Table after redefinition at producer prices for 2012, as it provides a mid-point representation of production structures over our sample period (2002–2017) and limits potential distortions associated with structural changes that may be more pronounced in earlier or later years.

[8] See Agbekponou et al. (2025) for more details.

[9] Re-exports (i.e., firms importing and exporting the same CN8 product within the same year) account for a large share of our data (around 53% of imports and 71% of exports in value terms). Excluding such transactions could better isolate processing activities within GVCs, but may also distort the sample and bias the measurement of upstreamness, particularly the number of production stages performed by firms. Re-exported products typically undergo limited transformation, which mechanically lowers measured upstreamness. Moreover, their identification depends on the level of product disaggregation, as finer classifications (e.g., 10-digit TARIC codes) may distinguish varieties that remain indistinguishable at the CN8 level. Reassuringly, excluding re-exports yields similar results. Moreover, while agri-food firms primarily produce and export within their sector, they may import a broader range of inputs from other industries, implying that both imports and exports span multiple sectors.

Table 1: Summary statistics of main variables: Firms in GVCs

	Frequency	Median	Mean	Standard deviation	Min	Max
# Firms	$3,334$					
ln Productivity$_{ft}$	$10,368$	5.6928	5.7311	0.7128	3.9129	8.0744
Small firms (1 to 49 employees)	$6,893$	-	-	-		
Middle-size firms (50 to 499 employees)	$4,589$	-	-	-		
Large firms (500 employees or more)	888	-	-	-		
Import *upstreamness* (U^M_{ft})	$25,741$	1.6977	1.8480	0.5131	1.000	3.7126
Export *upstreamness* (U^X_{ft})	$25,742$	1.3768	1.5244	0.5000	1.0236	3.7247
$U^M_{ft} - U^X_{ft}$	$25,740$	0.2057	0.3236	0.5419	-2.4400	2.3686
$\ln \text{Markup}_{fjkt}$	$744,031$	0.5775	0.5462	1.1146	-2.0272	3.0388
$\ln \text{MC}_{fjkt}$	$744,920$	0.9169	1.0053	1.1743	-1.3989	3.4954
$\ln p_{fjkt}$	$1,187,157$	1.5292	1.5347	1.0864	-0.8008	3.9426

Notes: Summary statistics are reported for the full 2002-2018 panel. Productivity, size and upstreamness indicators are defined at firm-year level, while price outcomes are defined at both firm-year and firm-destination-product-year level.

3.3.1 Industry-level Upstreamness and its Consistency

As a preliminary step to the analysis of firm-level upstreamness, we assess the consistency of our industry-level measures derived from the U.S. I–O table mapped to the 4-digit NACE Rev.2 classification. We examine both their internal coherence and their adequacy in capturing the structure of French production structure.

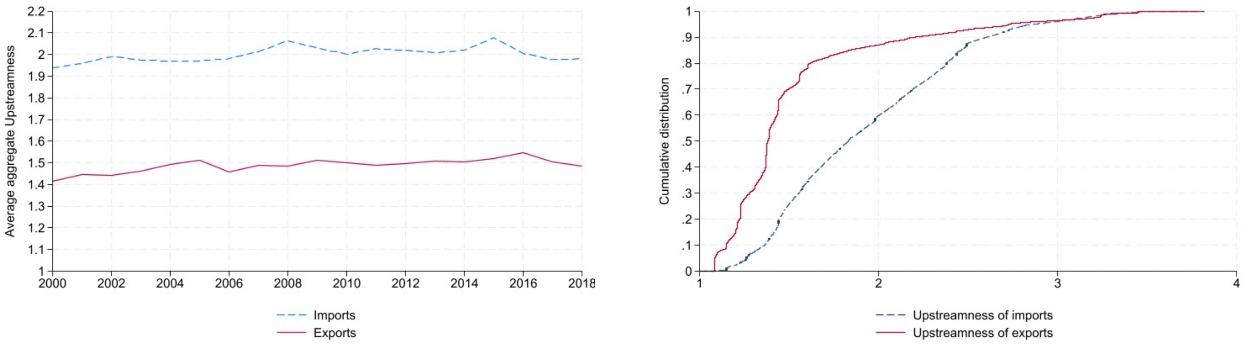
Table C.1 in Appendix C provides illustrative examples, showing that industries closer to final demand include retail and services, whereas upstream industries are more closely tied to agriculture, supplying raw materials to the agri-food sector. Food processing industries lie in between, with intermediate levels of upstreamness. Table C.2 further indicates that agri-food industries (from farming to the manufacture of most processed foodstuff) are more upstream than the rest of the economy, with an average upstreamness of 2.16 compared to 1.89 for the full set of industries.

These patterns confirm the internal coherence of our measure. Additional validation exercises reported in Appendix C show that our upstreamness indicators are highly correlated with those computed from alternative I–O tables for France and U.S., further supporting their robustness and the relevance of using the U.S.-based I–O table in our setting.

3.3.2 Vertical Integration Patterns of French Agri-food Firms in GVCs

We now turn to the extent of integration of the French agri-food firms into GVCs. Using firm-level import and export upstreamness measures, we construct sector-level indicators by computing trade-weighted averages. These aggregates capture the average position of agri-food sector within GVCs, taking into account the relative importance of firms in trade flows.

Figure 1a reports the evolution of agri-food sector averages across time, whereas Figure 1b shows the cumulative distribution of the import and export upstreamness of firms in our sample. A first set of facts emerges. Import upstreamness systematically exceeds export upstreamness, consistent with firms importing relatively more upstream inputs and exporting closer-to-final-demand goods. This pattern is stable over time, as shown in Figure 1a, suggesting persistent specialization patterns rather than short-run adjustments at sector-level. The gap between the two curves reflects the average range of production stages carried out by French agri-food firms in-house (i.e., the extent of vertical integration).



(a) Average import and export upstreamness (b) Cumulative distribution of French firms

Figure 1: Upstreamness of French agri-food firms

While aggregate dynamics are remarkably stable, there is substantial cross-firm heterogeneity in the upstreamness gap, which captures how differently French agri-food firms organize production across stages of the value chain when importing versus exporting. In particular, the distance between the two curves in Figure 1b is largest around the middle of the distribution, meaning that for the bulk of firms, exported products systematically involve more downstream stages relative to imported inputs. At the lower end of the distribution (roughly below the 30th percentile), the gap is narrower.

This pattern does not imply that the same firms jointly rank in the bottom tercile for both import and export upstreamness—import and export baskets may be unrelated. Instead, it reflects that firms with the lowest upstreamness values in imports and exports tend to occupy similar positions along the value chain, even though these observations may involve different firms, product mixes, or trading partners. This pattern becomes even more pronounced at the upper tail (top 10%), where the two curves nearly overlap, indicating a strong alignment between import and export upstreamness among the most upstream firms. Together, these observations highlight that behind similar sector-level averages lie firms that range from relatively downstream processors to firms operating, on average, at more upstream stages of production.

Table 1 complements the graphical evidence by summarizing the underlying levels of upstreamness. Import upstreamness averages 1.85, compared to 1.52 for exports, implying a within-firm gap of 0.32. This magnitude is slightly below the 0.42 documented by Chor et al. (2021) for Chinese manufacturing firms, pointing to differences in GVC integration across contexts.

The distribution of this gap exhibits substantial heterogeneity (SD $= 0.54$; min $= -2.44$; max $= 2.37$), including a negative lower tail, suggesting specialized suppliers or firms serving intermediate segments of the value chain rather than final demand. Overall, these statistics confirm the coexistence of vertically integrated firms and more specialized actors within the sector, consistent with the patterns observed in Figure 1b.

3.4 Descriptive Patterns Linking Integration, Productivity, and Price Components

This section documents a set of empirical regularities linking firms' vertical integration, labor productivity, and price components. These descriptive patterns are presented in light of the theoretical framework developed in Section 2 and guide the empirical analysis that follows.

Integration and Productivity Are Weakly Related at the Sector Level We examine how productivity relates to vertical integration across sectors at the 4-digit NACE Rev.2 codes level. Table C.4 in Appendix C reports sector-level averages of productivity and upstreamness measures, with sectors ranked by the mean integration span $(U^M_{ft} - U^X_{ft})$. While substantial variation exists across sectors in vertical positioning within GVCs, the data do not reveal a systematic monotonic relationship between productivity and integration intensity. Some highly integrated sectors display relatively high productivity (e.g. beverages) while others, such as malt or starches, combine high productivity with limited integration spans. These descriptive patterns are consistent with heterogeneous integration choices across activities, driven by endogenous firm-level sorting along the value chain, as rationalized in our model.

Vertical Integration, Productivity and Heterogeneous Export Pricing Patterns Figure 2 reports cumulative distributions of quality-adjusted export prices across quintiles of firms' vertical integration span, measured by $U^M_{ft} - U^X_{ft}$ (left panel). Firms with greater integration intensity tend to exhibit lower export prices, as reflected by a leftward shift of the distribution for higher integration quintiles. However, this relationship is not monotonic across the entire distribution, as intermediate groups display overlapping curves and multiple crossings. Similar patterns emerge when firms are ranked by productivity (right panel). These observations are consistent with the model's prediction that both integration and productivity shape prices through multiple, potentially offsetting channels, via their effects on markup distortions and underlying cost structures.

We further assess these heterogeneities by examining how the relationship between vertical integration and export prices varies across firms with different productivity levels, splitting the sample into the bottom and top thirds of the productivity distribution (Figure 3). Consistent with our framework, price distributions among low-productivity firms are relatively ordered across integration quintiles, with more integrated firms tending to exhibit lower export prices despite higher organizational costs. Among high-productivity firms, however, this pattern reverses, with highly integrated firms exhibiting higher prices, consistent with larger distortions when productive firms deviate from their optimal organizational structure (outsourcing).

Vertical Integration: Markup Compression and Heterogeneous Cost Effects Figure 4 compares the cumulative distributions of firm-level markups and marginal costs across quintiles of $U^M_{ft} - U^X_{ft}$. For markups, the distributions largely overlap at low and high values but progressively shift to the left at intermediate values for higher integration quintiles (4–5), consistent with integration reducing pricing distortions by eliminating double marginalization. By contrast, marginal costs exhibit a more heterogeneous pattern: the distributions of the lowest and highest integration quintiles overlap over part of the support but diverge at both low and high values, with no systematic ordering across integration levels. This is consistent with the coexistence of opposing mechanisms, whereby downstream integration increases marginal costs through internal organizational frictions, while upstream integration modifies the composition of sourcing costs by substituting negotiated input prices for internal organizational costs within the marginal-cost structure.

Productivity: Markup Amplification and Cost Compression Figure 5 shows that both markups and marginal costs are strongly ordered across productivity quintiles. For markups, higher-productivity quintiles are associated with systematically higher distributions (rightward shift), reflecting greater prevalence of non-integration and thus stronger exposure to bargaining-induced markups under the organizational equilibrium. By contrast, marginal

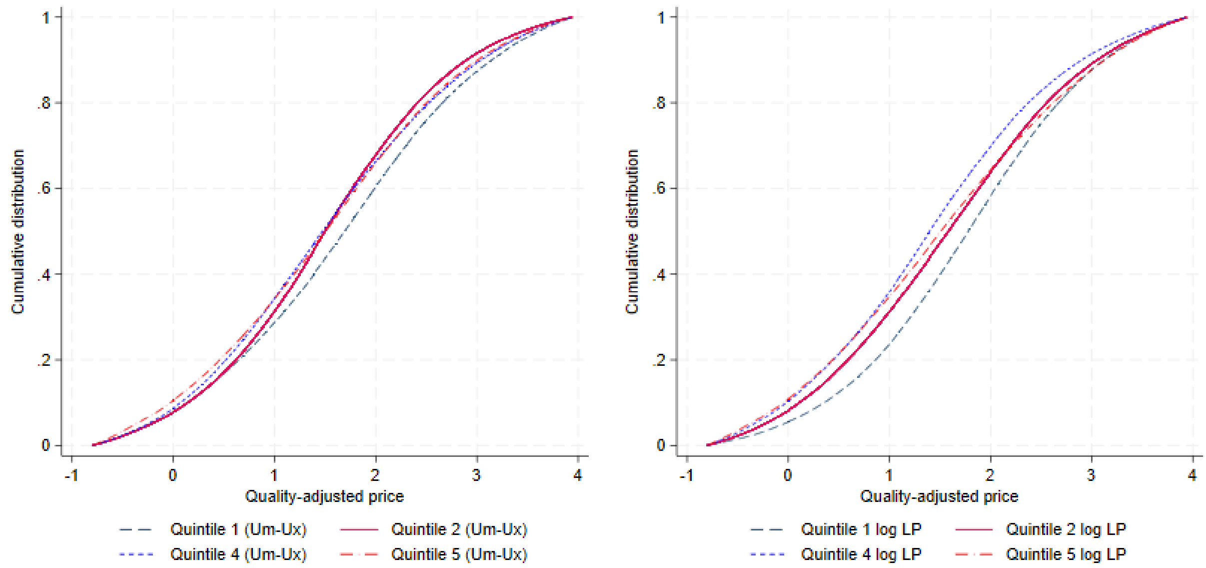


Figure 2: Cumulative distributions of export prices by integration span and productivity
Note: Left panel: quintiles of integration span ($U^M_{ft} - U^X_{ft}$); Right panel: quintiles of labor productivity. Prices are quality-adjusted, expressed in logarithms, and measured at the firm-destination-product-year level.

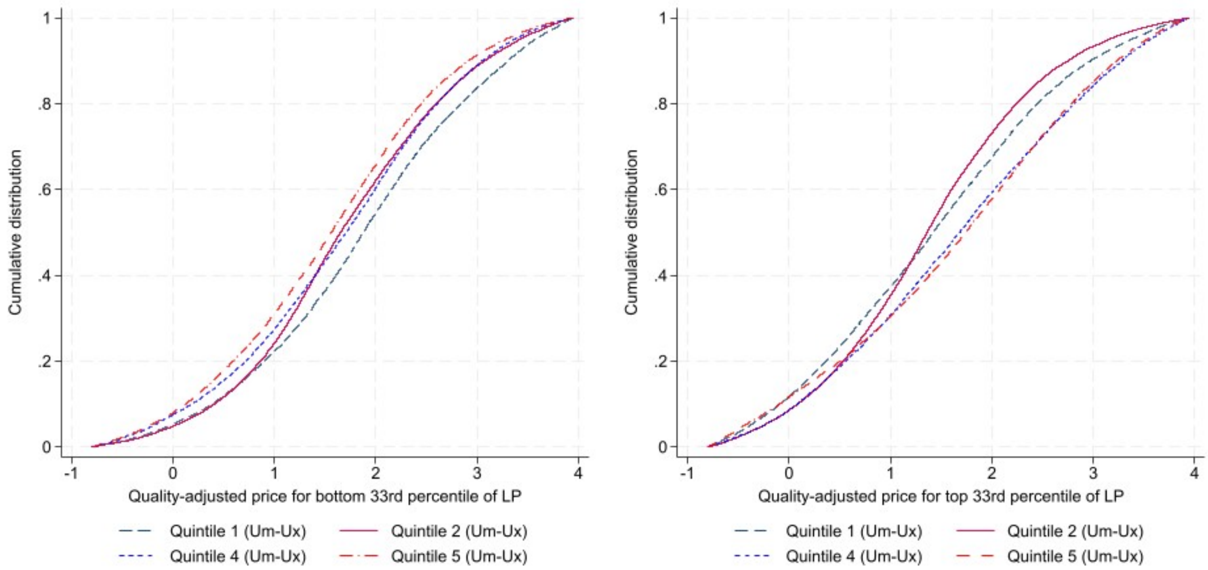


Figure 3: Cumulative distributions of export prices by integration span ($U^M_{ft} - U^X_{ft}$) and productivity
Note: Left panel: bottom 33rd percentile of log productivity; Right panel: top 33rd percentile of log productivity. Prices are quality-adjusted, expressed in logarithms, and measured at the firm-destination-product-year level.

costs display the opposite ordering, with higher productivity firms systematically associated with lower costs across the distribution, consistent with standard cost-efficiency effects. As a result, productivity simultaneously reduces marginal costs but increases exposure to markup distortions through endogenous organizational choices, in line with our theoretical framework.

Overall, the descriptive evidence highlights substantial heterogeneity in vertical integration, productivity, and price components across firms, with non-trivial and sometimes non-

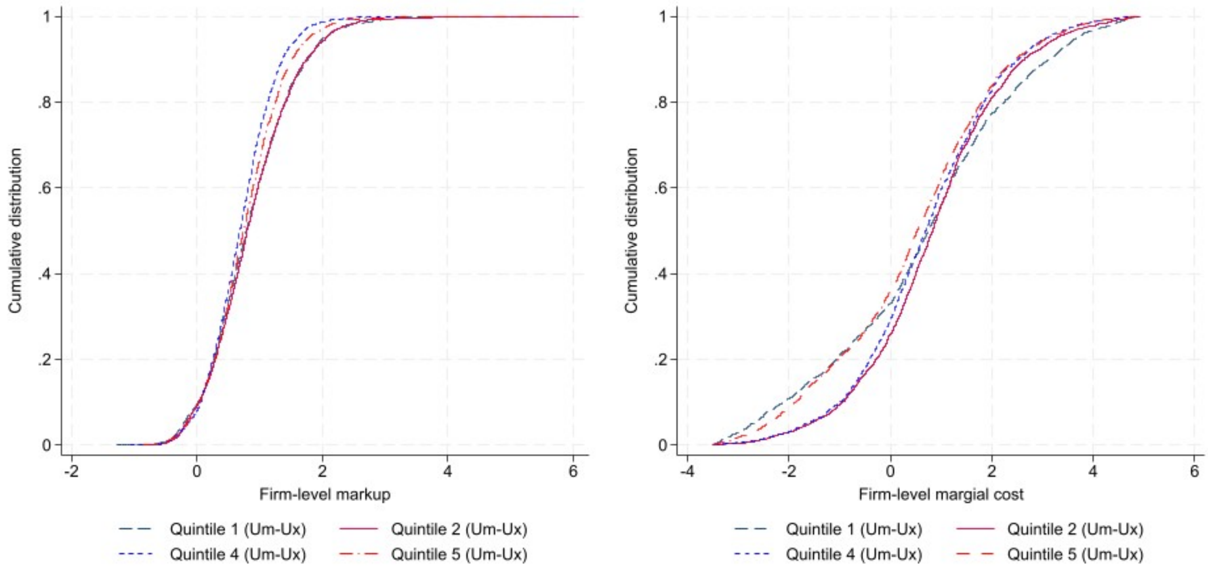


Figure 4: Firm-level markups and marginal costs by quintiles of $U_{ft}^{M} - U_{ft}^{X}$

Note: Cumulative distributions of firm-level markups (left panel) and marginal costs (right panel) by quintiles of $U_{ft}^{M} - U_{ft}^{X}$. Markups, and the resulting marginal costs, are computed following De Loecker and Warzynski (2012).

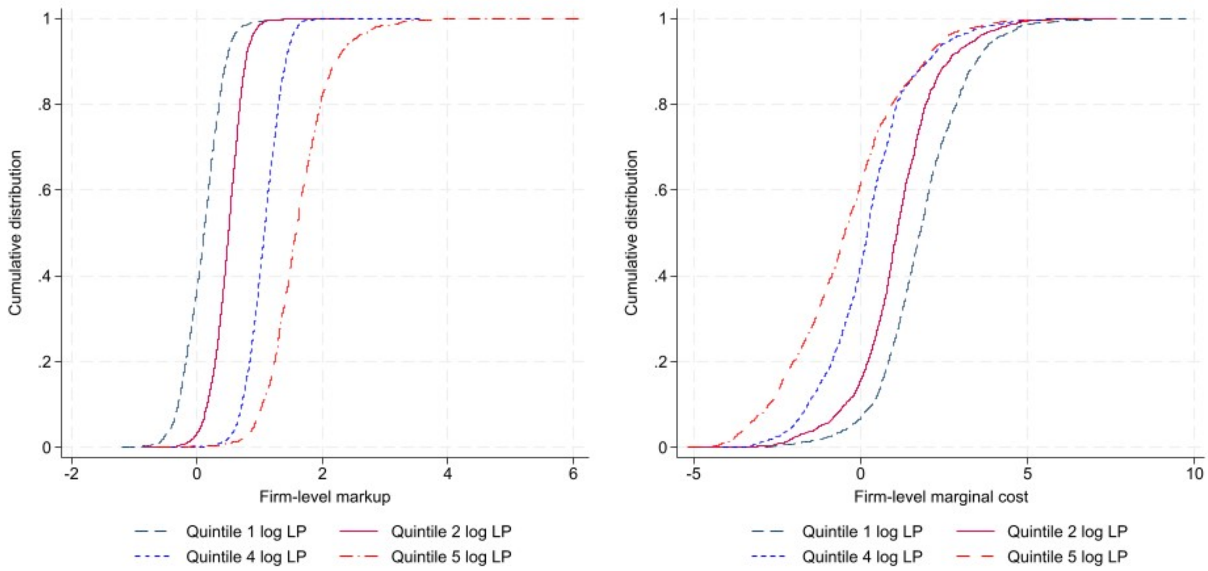


Figure 5: Firm-level markups and marginal costs by productivity quintiles.

Note: Cumulative distributions of firm-level markups (left panel) and marginal costs (right panel) by quintiles of labor productivity. Markups and marginal costs are computed following De Loecker and Warzynski (2012).

monotonic relationships between them. These patterns are consistent with the coexistence of multiple mechanisms operating through both cost and markup channels, as emphasized by the model. This motivates the econometric analysis that follows, which aims to formally identify how firms' organizational choices and productivity shape prices along the value chain.

4 Test of Model Predictions

This section tests the theoretical predictions derived in Section 2. We examine how vertical integration and productivity affect firms' pricing outcomes—export prices, markups, and marginal costs—and how they shape the transmission of upstream shocks, in line with Propositions 2 to 4 and Corollaries 1 and 2. We do not test the sorting mechanism in Proposition 1, as it relies on unobserved structural parameters, including bargaining power β and organizational costs $\phi_f(\cdot)$. Instead, we focus on the model's reduced-form implications for observable outcomes.

4.1 Test of Propositions 2 and 3: Pricing Implications of Integration and Productivity

We begin by estimating linear regressions linking pricing outcomes to firm organizational positioning within GVCs and productivity. Specifically, we estimate specifications of the form:

$$\ln Y_{fjkt} = \alpha_0 + \alpha_u GVC_{ft} + \alpha_\theta \ln \theta_{ft} + \Lambda X_{ft} + \Theta \Xi_{jt} + \text{FE} + \varepsilon_{fjkt}, \tag{21}$$

where the dependent variable, $\ln Y_{fjkt}$, corresponds to either the log of quality-adjusted export unit values $\ln p_{fjkt}$; the markup $\ln \text{Markup}_{fjkt}$; or marginal cost $\ln MC_{fjkt}$, measured at the firm-destination-product level. The key independent variables include a measure of vertical integration, GVC_{ft}, proxied by the firm's relative upstreamness in imports and exports—U^M_{ft}, U^X_{ft}—and the span $U^M_{ft} - U^X_{ft}$—as well as firm productivity, $\ln \theta_{ft}$, measured as log turnover per worker.

X_{ft} includes firm size categories (small: 1–49 employees, medium: 50–499 employees, large: 500 or more employees) as a control in the form of dummy variables. Ξ_{jt} captures a set of time-varying destination-level characteristics—including the log of GDP per capita, the share of industrial value added, and the share of agricultural value added in GDP. All destination-level variables are sourced from the World Development Indicators (WDI). The term FE denotes the full set of fixed effects, and ε_{fjkt} is the corresponding error term.

The baseline regression is estimated without fixed effects, serving as a benchmark. To mitigate potential biases from omitted variables, we then introduce a set of three-way fixed effects (destination-product-year), to control for demand-side variation common to all firms selling a given product in a specific destination and year. This setup enables cross-firm price comparisons within narrowly defined destination-product-year cells. Since prices are quality-adjusted, remaining variation is less likely to be driven by market-specific factors such as financial conditions, trade costs, competitive conditions, or common sectoral shocks and variations. In the most saturated specification, we further include firm fixed effects to absorb time-invariant heterogeneity—such as average productivity, size, capital intensity, or managerial quality. This sequential approach ensures that the estimated effects of vertical integration and productivity on pricing outcomes are not confounded by unobserved firm- or market-level dynamics.

Primary inference relies on heteroskedasticity-robust standard errors clustered at the product × destination level to account for potential correlation in residual shocks across firms exporting the same product to the same market. Our identification, however, relies on variation in the explanatory variables at the firm × year level. Clustering at the product × destination level thus preserves the intra-firm × year variation that identifies our coefficients, while appropriately adjusting for correlated shocks across firms within the same product-market pair. This approach ensures valid inference without discarding the effective variation underlying our estimates. As a robustness check, we report bootstrap standard errors in specifications using generated regressors, such as markups and marginal costs, to account for potential dependence across observations within firms.

4.1.1 OLS Correlation

We begin by documenting the relationship between firms' vertical integration, productivity, and export prices in Table 2. Time-varying destination characteristics are omitted in Columns (3)–(6) due to collinearity with product-destination-year fixed effects.

Several robust patterns emerge and provide support for Propositions 2 and 3. First, upstream integration U_{ft}^{M} is consistently negative and statistically significant. In the most saturated specification, a one-unit increase in upstream positioning is associated with an approximately 2.5% decrease in export prices (Column 5). The overall integration span $U_{ft}^{M} - U_{ft}^{X}$ yields similar magnitudes, with each additional integrated stage reducing prices by about 2% (Column 6). These results suggest that, empirically, the internal organizational costs associated with upstream integration are lower than the negotiated sourcing costs prevailing under non-integration, so that the reallocation of sourcing toward internal production reduces export prices overall. By contrast, downstream integration U_{ft}^{X} is small and becomes statistically insignificant once fixed effects are included. This is in line with the theoretical ambiguity emphasized in Section 2: downstream integration combines a markup-compression effect with an increase in organizational costs, leading to offsetting forces on prices.

Productivity is robustly and negatively correlated with export prices across all specifications, with an elasticity of about -0.04% in the most saturated regressions. This pattern is consistent with a dominant cost-efficiency channel, which outweighs the countervailing markup-related mechanism operating through endogenous sorting into non-integration. Moreover, firm size consistently exhibit a negative correlation with export prices, reflecting systematic scale-related cost advantages across size classes.

The inclusion of firm fixed effects further reduces the magnitude of the coefficients for both integration and productivity, indicating that part of the variation in prices, productivity, and integration reflects persistent firm heterogeneity. This pattern is consistent with the endogenous sorting mechanism highlighted in Section 2, whereby productivity affects outcomes both directly and indirectly through firms' organizational choices. As a result, the estimated coefficients may reflect a combination of these two channels rather than a purely direct effect. This interpretation motivates the instrumental variable (IV) strategy developed below, which isolates exogenous variation in organizational structure and productivity in order to separately identify their effects on export prices.

4.1.2 IV Causality

The OLS estimates reveal systematic correlations between firms' vertical integration, productivity, and export prices. However, identifying the causal effects of both variables on pricing outcomes requires addressing endogeneity. Both firm productivity θ_{ft} and organizational choices GVC_{ft} are likely to be endogenously determined.

On the one hand, productivity may respond to unobserved demand or cost shocks, or reflect managerial capabilities that simultaneously affect markups, marginal costs, and prices. On the other hand, firms' organizational choices may also be shaped by these same unobserved factors.

Importantly, the theoretical framework implies that productivity can causally affect firm boundaries through endogenous sorting. Conversely, organizational structure may also affect productivity through mechanisms such as improved input control, lower transaction costs, or better quality monitoring. Relatedly, prices themselves may feed back into organizational

Table 2: Firm's position in GVCs and Firm prices: OLS estimates

	OLS					
Dependent variable:	Quality-adjusted price ($\ln \text{Price}_{fjkt}$)					
	(1)	(2)	(3)	(4)	(5)	(6)
U^M_{ft}	-0.2142^{***}		-0.1035^{***}		-0.0255^{**}	
	(0.0086)		(0.0088)		(0.0105)	
U^X_{ft}	-0.0334^{***}		0.0784^{***}		-0.0049	
	(0.0120)		(0.0161)		(0.0315)	
$(U^M_{ft} - U^X_{ft})$		-0.1066^{***}		-0.0981^{***}		-0.0219^{**}
		(0.0093)		(0.0086)		(0.0101)
$\ln \text{Productivity}_{ft}(\theta_{ft})$	-0.0990^{***}	-0.1130^{***}	-0.1343^{***}	-0.1349^{***}	-0.0401^{***}	-0.0402^{***}
	(0.0043)	(0.0043)	(0.0045)	(0.0045)	(0.0088)	(0.0088)
Firm size:						
Small_{ft}	reference	reference	reference	reference	reference	reference
Medium_{ft}	-0.1758^{***}	-0.1506^{***}	-0.2305^{***}	-0.2292^{***}	-0.0233	-0.0230
	(0.0074)	(0.0074)	(0.0079)	(0.0079)	(0.0144)	(0.0144)
Large_{ft}	-0.3024^{***}	-0.2632^{***}	-0.5478^{***}	-0.5458^{***}	-0.1250^{***}	-0.1252^{***}
	(0.0096)	(0.0096)	(0.0098)	(0.0097)	(0.0248)	(0.0248)
ln GDP per capita	0.0218^{***}	0.0323^{***}				
	(0.0070)	(0.0071)				
Share of industrial value added in GDP	0.0005	0.0002				
	(0.0005)	(0.0005)				
Share of agricultural value added in GDP	-0.0058^{***}	-0.0050^{***}				
	(0.0013)	(0.0013)				
Product-destination-year FE	NO	NO	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	YES	YES
Observations	470,074	470,074	300,153	300,153	299,917	299,917
R^2	0.027	0.020	0.561	0.561	0.616	0.616

Notes: The constant term is included but not reported for brevity. All specifications include controls for firm size categories (Small = 1–49 employees; Medium = 50–499; Large = 500+), GDP per capita, and the sectoral composition of GDP (industry and agriculture shares), where indicated. These controls are omitted in specifications where they are collinear with fixed effects. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Robust standard errors clustered at the product-destination level are reported in parentheses. Significance levels are denoted as follows: $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

choices: changes in output prices or trade policy can alter firms' integration patterns, as shown by Alfaro et al. (2016) and Conconi et al. (2012). As a result, productivity, integration, and pricing decisions are jointly determined, giving rise to simultaneity and reverse causality concerns.

To disentangle these effects and recover causal relationships, we implement a two-stage IV strategy that exploits firms' differential exposure to exogenous shocks to foreign supply and demand, drawn from the CEPII BACI database, following the approach developed by Chor et al. (2021). This approach provides separate instruments for upstream integration U^M_{ft}, downstream integration U^X_{ft}, and productivity θ_{ft}.

We proceed in three steps: first, we describe the instruments; second, we outline our identification strategy; and third, we present the results

Instruments for integration To instrument upstream integration U^M_{ft}, we construct a shift-share measure capturing firm-level exposure to global supply shocks in upstream sectors:

$$\text{Inst}^{U^M}_{ft} = \sum_{j \neq France, r} \frac{M_{fjr,0}}{M_{f,0}} \cdot U_r \cdot \Delta \ln \mathrm{M}^{\mathrm{RoW}}_{jr,t}, \tag{22}$$

where U_r denotes sectoral upstreamness measured at the 4-digit NACE Rev.2 level. Consistently, trade flows are aggregated at the same level, so that r indexes industries in $\Delta \ln \mathrm{M}^{\mathrm{RoW}}_{jr,t}$, which captures world import growth excluding France. The term $M_{fjr,0}/M_{f,0}$ captures firm f's initial import share from sector r (origin j) in total imports, computed in the first year in which the firm is observed in the customs data. This ensures that the weights are predetermined and not affected by contemporaneous shocks. Firms more exposed to upstream sectors are thus differentially affected by global supply shocks, which alter input availability and induce adjustments in upstream integration.

Similarly, downstream integration U^X_{ft} is instrumented using a shift-share measure based on firms' exposure to global demand shocks:

$$\text{Inst}^{U^X}_{ft} = \sum_{j \neq France, r} \frac{X_{fjr,0}}{X_{f,0}} \cdot U_r \cdot \Delta \ln \mathrm{X}^{\mathrm{RoW}}_{jr,t}, \tag{23}$$

where $\Delta \ln X^{\mathrm{RoW}}_{r,t}$ captures growth in foreign demand for product r in world markets excluding France, and $X_{fjr,0}/X_{f,0}$ measures firm f's initial exposure to destination-product markets jr through its export structure. By construction, this mirrors the upstream integration instrument, replacing imports with exports. Firms more exposed to downstream sectors are thus differentially affected by global demand shocks, which induce adjustments in downstream integration.

Instrument for productivity To instrument productivity θ_{ft}, we exploit firms' exposure to foreign supply and demand shocks through their initial trade structure, as defined above. We implement the following shift-share measures:

$$\text{Inst}^{\theta,M}_{ft} = \ln\left(M_{f,t-1} \left[1 + \sum_{j \neq \text{France}, k} \frac{M_{fjk,0}}{M_{f,0}} \cdot \frac{\Delta \mathrm{M}^{\mathrm{RoW}}_{jk,t}}{\mathrm{M}^{\mathrm{RoW}}_{jk,t-1}} \right] \right), \tag{24}$$

$$\text{Inst}^{\theta,X}_{ft} = \ln\left(X_{f,t-1} \left[1 + \sum_{j \neq \text{France}, k} \frac{X_{fjk,0}}{X_{f,0}} \cdot \frac{\Delta \mathrm{X}^{\mathrm{RoW}}_{jk,t}}{X^{\mathrm{RoW}}_{jk,t-1}} \right] \right), \tag{25}$$

where both instruments exclude France on the origin and destination sides, and k is defined at the HS6 product level. Formally, $\text{Inst}^{\theta,M}_{ft}$ captures the projected change in foreign supply conditions affecting firm f's input bundle, while $\text{Inst}^{\theta,X}_{ft}$ captures the projected change in foreign demand for its export basket, both between $t-1$ and t. Such shocks can boost productivity through mechanisms such as learning, improvements in foreign productivity or product quality, and scale-driven efficiency gains.

Identification Strategy Our identification strategy exploits exogenous variation in firms' exposure to global supply and demand shocks through a standard shift-share design.

Each instrument takes the form:

$$\text{Inst}_{ft} = \sum_{j \neq \text{France}, k} s_{fjk,0} \cdot \Delta Shock_{jk,t},$$

where $s_{fjk,0}$ denotes firm f's predetermined exposure to sector-country pairs jk, and $\Delta Shock_{jk,t}$ captures aggregate changes in global supply or demand excluding France. Identification arises from the interaction between common shocks and heterogeneous, pre-determined exposure across firms.

We include product-destination-year fixed effects and firm fixed effects. The former absorb all time-varying market-level conditions, including demand shifts, cost shocks, and price movements common to all firms within a market. The latter capture time-invariant heterogeneity in productivity, average markups, and persistent differences in integration structure. As a result, identification is based on within-firm variation over time in exposure to global shocks, net of both market-level and firm-level components.

Exclusion restriction The identifying assumption is that predetermined exposure shares are orthogonal to contemporaneous firm-level shocks. This ensures that exposure-weighted shocks do not proxy for endogenous adjustments in pricing or production decisions.

A key concern is that global shocks to supply and demand may directly affect prices through input costs or competitive conditions shaping markups. However, product-destination-year fixed effects absorb all common market-level price and cost movements, while firm fixed effects remove persistent pricing differences across firms. Consequently, remaining variation is driven by differential exposure to global shocks rather than common market-level price effects.

Under the assumption that initial exposure shares are predetermined, the instrument isolates exogenous variation that operates through firms' adjustments in integration choices and productivity, rather than through direct market-wide effects on marginal costs or markups. Supply shocks shift firms' input conditions and upstream integration decisions, affecting marginal costs. Demand shocks alter firms' export opportunities, influencing downstream organization. Both shocks affect productivity. This structure allows us to separately trace cost and markup channels in lne with the theoretical framework.

Remaining threats may arise if global shocks differentially affect firms within the same product–destination–year cell due to time-varying, firm-specific sensitivities to these shocks. For instance, firms may vary in their exposure to supplier-specific disruptions, input-quality upgrading, contractual renegotiation, or firm-specific sourcing networks that alter procurement costs independently of organizational adjustment. Likewise, heterogeneous pass-through of exchange-rate fluctuations, financing constraints, or logistics frictions could generate firm-level responses to global shocks beyond integration and productivity choices.

Our empirical design mitigates these concerns in several ways. The use of quality-adjusted prices addresses potential biases from endogenous quality upgrading. Moreover, firm fixed effects absorb time-invariant differences in sourcing networks, contractual structures, pricing strategies, financial constraints, and persistent supplier relationships. Any remaining differential responses are thus expected to operate primarily through adjustments in organizational choices and productivity, consistent with the mechanisms of the model. To the extent that residual direct effects persist, they would attenuate the estimates toward zero.

Results Table 3 reports the IV estimates of specification (21). Each endogenous variable is instrumented separately to avoid over-identification concerns. We instrument U^M_{ft}, U^X_{ft}, and θ_{ft} using, respectively, $\text{Inst}^{U^M}_{ft}$, $\text{Inst}^{U^X}_{ft}$, and $\text{Inst}^{\theta,M}_{ft}$. For the specification in which $U^M_{ft} - U^X_{ft}$ enters, we use $\text{Inst}^{U^M}_{ft}$ as the corresponding instrument.[10]

[10] A potential concern is that all instruments exploit variation in global trade flows, which may induce mechanical correlation across shift-share constructions. While they differ in their economic content and weight-

The IV estimates replicate the qualitative patterns documented in Table 2 and point to a causal effect of firms' organizational choices and productivity on export prices. First-stage results indicate strong predictive power of the instruments in the baseline specifications (Columns 1–3 and 5–6), with F-statistics well above conventional thresholds. While instrument strength declines when firm fixed effects are included (Columns 8–10), it remains above conventional weak-instrument thresholds for the preferred specifications involving the integration span (Columns 12–13).

Table 3: Firm's position in GVCs and Firm prices: IV estimates

	IV													
	1^{st} stage			2^{nd} stage	1^{st} stage		2^{nd} stage	1^{st} stage			2^{nd} stage	1^{st} stage		2^{nd} stage
	U_{ft}^M	U_{ft}^X	θ_{ft}	$\ln \text{Price}_{fjkt}$	$U_{ft}^M - U_{ft}^X$	θ_{ft}	$\ln \text{Price}_{fjkt}$	U_{ft}^M	U_{ft}^X	θ_{ft}	$\ln \text{Price}_{fjkt}$	$U_{ft}^M - U_{ft}^X$	θ_{ft}	$\ln \text{Price}_{fjkt}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
$\text{Inst}_{ft}^{U^M}$	-0.0532^{***}	0.0350^{***}	-0.0274^{***}		-0.0837^{***}	-0.0303^{***}		-0.0243^{***}	-0.0018	-0.0019		-0.0196^{***}	-0.0015	
	(0.0068)	(0.0045)	(0.0079)		(0.0069)	(0.0077)		(0.0022)	(0.0015)	(0.0033)		(0.0027)	(0.0032)	
$\text{Inst}_{ft}^{\theta,M}$	-0.0078^{***}	0.0212^{***}	0.1798^{***}		-0.0283^{***}	0.1794^{***}		0.0041^{***}	0.0031^{***}	0.0244^{***}		0.0035^{***}	0.0247^{***}	
	(0.0009)	(0.0006)	(0.0024)		(0.0009)	(0.0023)		(0.0012)	(0.0003)	(0.0014)		(0.0013)	(0.0014)	
$\text{Inst}_{ft}^{U^X}$	0.0141^{***}	0.0077^{***}	-0.0565^{***}					0.0100^{***}	0.0040^{***}	0.0011				
	(0.0019)	(0.0016)	(0.0040)					(0.0009)	(0.0005)	(0.0010)				
U_{ft}^M				-2.0038^{***}							-1.6150^{***}			
				(0.3001)							(0.5950)			
U_{ft}^X				-0.7882^{**}							2.2257			
				(0.3582)							(2.0518)			
$(U_{ft}^M - U_{ft}^X)$							-0.8794^{***}							-1.8665^{***}
							(0.1534)							(0.6172)
$\ln \text{Productivity}_{ft}(\theta_{ft})$				-0.3059^{***}			-0.4558^{***}				-0.6542^{**}			-0.3805^{**}
				(0.0438)			(0.0268)				(0.2540)			(0.1811)
Firm size:														
Small_{ft}	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference
Medium_{ft}	-0.0044	-0.1066^{***}	-0.3446^{***}	-0.3305^{***}	0.1045^{***}	-0.3443^{***}	-0.1890^{***}	0.0129^{***}	-0.0130^{***}	-0.5355^{***}	-0.2979^{**}	0.0233^{***}	-0.5273^{***}	-0.1545
	(0.0045)	(0.0038)	(0.0066)	(0.0275)	(0.0040)	(0.0065)	(0.0117)	(0.0036)	(0.0016)	(0.0124)	(0.1172)	(0.0041)	(0.0122)	(0.1044)
Large_{ft}	-0.0225^{***}	-0.1695^{***}	-0.7463^{***}	-0.7309^{***}	0.1484^{***}	-0.7389^{***}	-0.5234^{***}	0.0533^{***}	-0.0074^{***}	-0.8437^{***}	-0.5344^{***}	0.0582^{***}	-0.8356^{***}	-0.2925^{*}
	(0.0062)	(0.0046)	(0.0120)	(0.0378)	(0.0056)	(0.0119)	(0.0122)	(0.0058)	(0.0023)	(0.0192)	(0.1939)	(0.0063)	(0.0190)	(0.1711)
Observations	264,266	264,266	264,266	264,266	268,878	268,878	268,878	264,121	264,121	264,121	264,121	268,712	268,712	268,712
R^2	0.495	0.683	0.560	0.555	0.440	0.558	0.558	0.924	0.980	0.952	0.611	0.894	0.952	0.614
F-stat	26.1889	26.1889	26.1889		80.3250	80.3250		4.4634	4.4634	4.4634		23.8433	23.8433	
Endogeneity test (p-value)				0.0000			0.0000				0.0000			0.0000
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Robust standard errors clustered at the product-destination level are reported in parentheses. Significance levels are denoted as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In the second stage, the estimated effects are substantially larger in magnitude than in OLS. In the most saturated specifications with firm fixed effects, upstream integration remains strongly negative (-1.615, Column 11), corresponding to a reduction of approximately 80% in the price for a one-unit increase in upstream positioning. The overall integration span exhibits an even larger effect (-1.866, Column 14), implying a reduction of around 85% in the price for a one-unit increase in overall integration. These estimates imply economically large price responses to exogenous changes in vertical integration. By contrast, downstream integration becomes imprecisely estimated once firm fixed effects are included (Column 11), consistent with offsetting markup and organizational cost effects.

Productivity retains a negative and significant effect on prices, with elasticities ranging from -0.38 to -0.65 in the preferred specifications, implying that a 10% increase in productivity reduces export prices by approximately 3.8% to 6.5%. The amplification of IV estimates relative to OLS—observed for both vertical integration and productivity—is consistent with attenuation bias arising from measurement error, as well as stronger firm responses to exogenous shocks than to endogenous adjustments.

In Appendix Table D.2, we re-estimate the effect of overall integration $U_{ft}^M - U_{ft}^X$ using alternative instrument pairs. The results remain broadly consistent with the baseline, although magnitudes are less precisely estimated in some cases. In particular, when integration

ing schemes, this may generate some collinearity across instruments. However, the observed correlations, presented in Appendix Table D.1, are generally low: $\text{Inst}_{ft}^{U^M}$ and $\text{Inst}_{ft}^{U^X}$ are weakly correlated (0.1293), $\text{Inst}_{ft}^{\theta,M}$ and the two GVC-related instruments are close to zero (0.0209 and -0.0147), and only the two productivity-related instruments show a moderate correlation (0.4345), but they are never included jointly in any specification. Overall, these magnitudes suggest that multicollinearity concerns are limited and do not threaten the separate identification of the different channels.

is instrumented using $\text{Inst}_{ft}^{U^X}$ (Columns 6 and 9), the effect becomes smaller and statistically less significant or insignificant, consistent with demand-driven variation capturing offsetting markup and organizational cost effects. By contrast, specifications relying on $\text{Inst}_{ft}^{U^M}$ (Column 3) continue to yield larger, negative, and highly significant effects, supporting the interpretation that the baseline results are primarily driven by the upstream cost channel. This pattern indicates that different instruments isolate distinct sources of exogenous variation, delivering effects that align closely with the mechanisms emphasized in our model. As such, the results provide strong support for the validity of the identification strategy and its ability to separately identify the underlying economic channels.

4.1.3 Residual-based Approach

To further strengthen our analysis, we implement a residual-based approach that disentangles the variation in vertical integration from the productivity-driven components. This method allows us to directly assess whether our baseline identification strategy effectively isolates the influence of organizational choices, independent of firm-level productivity, providing additional confidence in the robustness of our findings.

Following a two-stage IV procedure à la Chor et al. (2021), we estimate productivity using instrumental variables:

$$\ln \theta_{ft} = \delta_0 + \delta_1 \text{Inst}_{ft}^{\theta,M/X} + \Pi X_{ft} + \text{FE} + \nu_{ft}, \tag{26}$$

and retrieve the implied fitted values. In a second stage, we regress our measure of vertical integration on predicted productivity:

$$GVC_{ft} = \rho_0 + \rho_1 \widehat{\ln \theta_{ft}} + \Pi X_{ft} + \text{FE} + \hat{\varepsilon}^{GVC_{ft}}. \tag{27}$$

The residual component $\hat{\varepsilon}_{ft}^{GVC}$ is then interpreted as the portion of firms' position in GVCs orthogonal to productivity, and is reintroduced in our baseline equation (21) as follow:

$$\ln Y_{fjkt} = \alpha_0 + \alpha_{\hat{u}}\, \hat{\varepsilon}^{GVC_{ft}} + \alpha_\theta \ln \theta_{ft} + \Lambda X_{ft} + \text{FE} + \varepsilon_{fjkt}. \tag{28}$$

We estimate this specification using both OLS and IV, mirroring our baseline strategy. As shown in Table 4, the residual-based estimates closely mirror those of the baseline specification. This result is particularly striking in the IV framework using the same instruments as in the baseline (Columns 7–12), where coefficients and standard errors are virtually unchanged (Column 12), indicating that our baseline results are not driven by residual productivity confounding.

Because the residual-based regressor is generated, we further re-estimate all specifications using bootstrap standard errors. As reported in Appendix Table D.3, inference remains unchanged, with coefficient magnitudes and significance levels fully preserved. These results further confirm the robustness of our baseline findings and support the validity of our identification strategy in separately capturing the effects of productivity and firms' organizational positioning along GVCs.

4.1.4 Robustness and Economic Consistency Checks

We conduct a series of tests to further assess the stability and interpretation of our baseline results. First, we re-estimate Equation (21) using total factor productivity estimated following the semi-parametric Olley and Pakes (1996) procedure (OP-TFP). This measure, being based on a structural correction for simultaneity and selection, provides a more comprehensive proxy of firm efficiency than labor productivity alone, which may be more partial and potentially

Table 4: Firm's position in GVCs and Firm prices: residual-based approach

	GVC decomposition		Residual-based specification				GVC decomposition		Residual-based specification			
	IV		OLS	IV			IV		OLS	IV		
	1^{st} stage	2^{nd} stage		1^{st} stage		2^{nd} stage	1^{st} stage	2^{nd} stage		1^{st} stage		2^{nd} stage
	θ_{ft}	$U^M_{ft} - U^X_{ft}$	$\ln \text{Price}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Price}_{fjkt}$	θ_{ft}	$U^M_{ft} - U^X_{ft}$	$\ln \text{Price}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Price}_{fjkt}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\text{Inst}^{\theta,X}_{ft}$	0.0582***											
	(0.0017)											
$\text{Inst}^{\theta,M}_{ft}$				0.0031**	0.0280***		0.0225***			0.0021*	0.0247***	
				(0.0014)	(0.0016)		(0.0011)			(0.0013)	(0.0014)	
$\text{Inst}^{U^M}_{ft}$				−0.0241***	−0.0008					−0.0195***	−0.0015	
				(0.0026)	(0.0033)					(0.0027)	(0.0032)	
$\hat{\varepsilon}^{U^M_{ft} - U^X_{ft}}$			−0.0207**			−1.5331***			−0.0163			−1.8665***
			(0.0105)			(0.4834)			(0.0109)			(0.6172)
$\ln \text{Productivity}_{ft}(\theta_{ft})$		−0.0221	−0.0403***			−0.3195**		0.0546	−0.0397***			−0.4824***
		(0.0206)	(0.0089)			(0.1521)		(0.0483)	(0.0091)			(0.1686)
Firm size:												
Small_{ft}	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference
Medium_{ft}	−0.5586***	0.0063	−0.0195	0.0059	−0.5422***	−0.1583*	−0.5612***	0.0497*	−0.0233	0.0023	−0.5273***	−0.2474***
	(0.0123)	(0.0123)	(0.0146)	(0.0042)	(0.0125)	(0.0856)	(0.0125)	(0.0278)	(0.0149)	(0.0042)	(0.0122)	(0.0915)
Large_{ft}	−0.8671***	0.0308*	−0.1274***	0.0053	−0.8564***	−0.3515***	−0.8577***	0.1036**	−0.1277***	0.0002	−0.8356***	−0.4858***
	(0.0190)	(0.0187)	(0.0250)	(0.0063)	(0.0194)	(0.1326)	(0.0190)	(0.0419)	(0.0254)	(0.0065)	(0.0190)	(0.1426)
Observations	290,444	290,444	290,444	261,359	261,359	261,359	288,417	288,417	288,417	268,712	268,712	268,712
R^2	0.948	0.874	0.613	0.125	0.953	0.611	0.947	0.882	0.615	0.101	0.952	0.614
F-stat	1,132.2645			40.6388	40.6388		408.4895			23.8433	23.8433	
Endogeneity test (p-value)		0.7814				0.0000		0.1095				0.0000
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Robust standard errors clustered at the product-destination level are reported in parentheses. Significance levels are denoted as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

miss indirect effects operating through organizational adjustments. However, as shown in Appendix Table D.4, the results closely mirror our baseline estimates: while productivity coefficients are somewhat larger in magnitude, the effects of vertical integration on prices remain remarkably stable in both sign and economic magnitude. Reassuringly, inference is unchanged when we further account for sampling uncertainty by bootstrapping the OP-TFP estimates (Appendix Table D.5), confirming that measurement error in productivity is not driving our findings.

Second, we address potential concerns regarding the construction of our vertical integration measure by replacing the U.S. input-output benchmark with the French IO structure from the GTAP database. Our baseline relies on U.S. IO tables to proxy French production linkages under the assumption of technological similarity across advanced economies. However, using foreign IO data may introduce measurement error if sectoral linkages or comparative advantages differ across countries—for instance, the U.S. is relatively more upstream-oriented (Alfaro and Chor, 2023), while France relies more intensively on imported intermediates, particularly in sectors such as agri-food. Despite a high but imperfect correlation between the upstreamness measures constructed from different IO sources (0.70), the estimated effects are virtually unchanged (Appendix Table D.6), indicating that our results are not sensitive to the choice of technological benchmark and are not driven by country-specific production structures.

Third, we exploit the structure of the demand system to validate the economic consistency of our estimates. If vertical integration and productivity reduce prices as shown in our baseline results, they should mechanically translate into higher equilibrium quantities. The appendix Table D.7 confirms this prediction: both integration and productivity are associated with significantly higher export quantities, in line with the predicted effects of the model on export prices.

Taken together, these three exercises reinforce the robustness of our findings. More importantly, they support the credibility of our identification strategy by showing that it delivers stable, structurally consistent, and economically interpretable effects across alternative measurement choices and theoretical implications.

4.1.5 Mechanism Tests: Markup and Cost Channels

To discipline the mechanisms underlying the price effects of organizational choices and productivity, we re-estimate Equation (21) using markups and marginal costs as dependent variables, measured at the firm–product–destination level. This allows us to directly map the empirical results to the theoretical channels highlighted in Propositions 2 and 3.

Table 5 reports the results. A clear pattern emerges. First, vertical integration exerts a negative effect on markups in the OLS and IV specifications (Column 1 & 4), while it has no statistically significant effect on marginal costs (Column 8). The magnitude is economically sizable in the IV specification: a one-unit increase in overall integration reduces markups by about 92%. This provides direct evidence that once prices are decomposed into markups and costs, integration lowers prices mainly through markup compression. The opposing organizational cost effects of upstream and downstream integration largely cancel out, highlighting the markup channel as the key driver.

This result is consistent with the theoretical ambiguity of the cost channel. Although downstream integration increases marginal costs through internal organizational friction, upstream integration decreases marginal costs, as previously observed. These countervailing cost adjustments therefore offset each other, yielding no systematic effect on marginal costs. By contrast, the markup channel operates unambiguously through the elimination of sequential bargaining distortions, which is directly reflected in the data.

Second, productivity exhibits the opposite pattern. It strongly increases markups (Column 4) while simultaneously reducing marginal costs, with large and precisely estimated coefficients (Column 8). This is exactly in line with the model: higher productivity is associated with organizational choices that expose firms to higher bargaining-induced markups, even as it lowers marginal costs.

These results provide direct empirical support for the theoretical mechanisms. Vertical integration affects prices primarily through the markup channel, while productivity operates through a dominant cost-efficiency channel combined with an offsetting markup effect. The joint evidence confirms that the reduced-form price effects documented above reflect the distinct structural channels emphasized in the model.

These findings are robust to alternative inference procedures, measurement choices, and instrumentation strategies. Using bootstrap standard errors leaves statistical inference unchanged (Appendix Table D.8). Replacing U.S. input-output tables with French GTAP data yields very similar results, with the effect of integration on markups remaining strongly negative, while its effect on marginal costs remains statistically insignificant (Appendix Tables D.9 and D.10).

Using alternative instruments further strengthens these patterns. The negative effect of integration on markups not only remains but increases substantially in magnitude when variation is driven by downstream instrument such as Inst_{ft}^{UX} (Appendix Table D.11). At the same time, the effect on marginal costs becomes positive and statistically significant under these specifications (Appendix Table D.12). This is consistent with this instrument capturing downstream organizational adjustments, thereby more sharply identifying the associated markup and organizational cost component. Reinforcing the earlier findings, these results confirm that the price-reducing effect of integration is robustly driven by markup compression, while its impact on marginal costs depends on the margin of adjustment and becomes positive when downstream organizational frictions are more salient.

Table 5: Vertical integration, markup and marginal cost

	OLS	IV			OLS	IV		
		1^{st} stage		2^{nd} stage		1^{st} stage		2^{nd} stage
	ln Markup_{fjkt}	$U^M_{ft} - U^X_{ft}$	θ_{ft}	ln Markup_{fjkt}	ln MC_{fjkt}	$U^M_{ft} - U^X_{ft}$	θ_{ft}	ln MC_{fjkt}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\text{Inst}^{U^M}_{ft}$		-0.0151^{***}	-0.0019			-0.0151^{***}	-0.0019	
		(0.0026)	(0.0032)			(0.0026)	(0.0033)	
$\text{Inst}^{\theta,M}_{ft}$		0.0039^{***}	0.0249^{***}			0.0039^{***}	0.0249^{***}	
		(0.0013)	(0.0014)			(0.0012)	(0.0013)	
$(U^M_{ft} - U^X_{ft})$	-0.0225^{*}			-2.5701^{***}	0.0013			0.2026
	(0.0123)			(0.9783)	(0.0073)			(0.4898)
ln $\text{Productivity}_{ft}(\theta_{ft})$	0.2503^{***}			1.2348^{***}	-0.2911^{***}			-1.4934^{***}
	(0.0114)			(0.2451)	(0.0073)			(0.1171)
Firm size:								
Small_{ft}	reference	reference	reference	reference	reference	reference	reference	
Medium_{ft}	-0.1567^{***}	0.0233^{***}	-0.5275^{***}	0.4236^{***}	0.1332^{***}	0.0233^{***}	-0.5275^{***}	-0.5024^{***}
	(0.0184)	(0.0041)	(0.0122)	(0.1458)	(0.0120)	(0.0040)	(0.0117)	(0.0726)
Large_{ft}	-0.2690^{***}	0.0572^{***}	-0.8359^{***}	0.6916^{***}	0.1413^{***}	0.0572^{***}	-0.8359^{***}	-0.8578^{***}
	(0.0296)	(0.0063)	(0.0190)	(0.2433)	(0.0174)	(0.0063)	(0.0179)	(0.1212)
Observations	298,452	267,279	267,279	267,279	298,452	267,279	267,279	267,279
R^2	0.739	0.895	0.952	0.744	0.939	0.895	0.952	0.940
F-stat		14.1515	14.1515		14.6057	14.6057		
Endogeneity test (p-value)				0.0000				0.0000
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES	
Firm FE	YES	YES	YES	YES	YES	YES	YES	

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Robust standard errors clustered at the product-destination level are reported in parentheses. Significance levels are denoted as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.2 Test of Corollary 1: Heterogeneous Pricing Effects of Integration Across Productivity Levels

To evaluate the empirical content of Corollary 1, we study whether non-monotonic pricing patterns emerge when firms differ simultaneously in productivity and organizational structure. A key challenge is that vertical integration is inherently correlated with productivity, which may mechanically generate spurious heterogeneity across productivity groups. To address this concern, we rely on the residualized integration component $\hat{\varepsilon}^{GVC}_{ft}$ introduced in Section 4.1.3. By construction, this residual isolates variation in organizational choices that is orthogonal to productivity, ensuring that the interaction captures genuine economic heterogeneity rather than mechanical co-movement between the two dimensions.

We estimate the following specification:

$$\ln Y_{fjkt} = \alpha_0 + \sum_{d=1}^{10} \alpha_{d\hat{u}} \left(D^d_{ft} \times \hat{\varepsilon}^{GVC}_{ft} \right) + \sum_{d=2}^{10} \alpha_d D^d_{ft} + \Lambda X_{ft} + \text{FE} + \varepsilon_{fjkt}, \tag{29}$$

where D^d_{ft} denotes membership in productivity decile d, and Y_{fjkt} successively corresponds to export prices, markups, and marginal costs. The coefficients $\alpha_{d\hat{u}}$ capture the productivity-specific effect of vertical integration.

The specification is estimated by IV, instrumenting each interaction term with the corresponding interaction between productivity deciles and $\text{Inst}^{U^M}_{ft}$. The specification includes the full set of controls, as well as firm and product-destination-year fixed effects. This strategy preserves a clear interpretation of the coefficients while maintaining identification from exogenous variation in firms' position along GVCs.

This empirical design maps directly into the model's structure. Integration compresses markups but raises marginal costs while productivity exerts opposite forces. Their interaction therefore generates ambiguous—and potentially non-monotonic—effects on prices.

The estimates, reported graphically in Figure 6, strongly support this prediction. For export prices, the interaction coefficients fluctuate around zero and display no monotonic pattern across productivity deciles. Integration tends to increase prices among lower-productivity firms, but this effect weakens—and occasionally reverses—higher up in the productivity distribution. The absence of a clear gradient is precisely what the corollary predicts: price effects emerge as the net outcome of two opposing forces whose relative strength varies across firms.

The markup results reveal a striking pattern. The effect of integration becomes progressively larger—and often positive—at higher productivity levels. This indicates that markup compression is not uniform: it is strongest among low-productivity firms and attenuates substantially as productivity rises. At the top of the distribution, integration is even associated with higher observed markups.

This pattern is tightly aligned with the model's sorting mechanism. Highly productive firms optimally tend to remain non-integrated; when they do integrate, this reflects a deviation from the equilibrium allocation. In that region, integration no longer relaxes distortions but instead amplifies them, overturning the standard pro-competitive effect.

The marginal cost estimates exhibit the clearest structure. Integration raises costs for low-productivity firms but reduces them sharply for highly productive ones, generating a pronounced downward gradient across the distribution. This suggests that organizational cost frictions dominate at low productivity, while efficiency gains dominate at high productivity, where firms are better able to absorb or mitigate the internal costs of integration.

The results reveal a clear non-monotonic pattern: the effect of integration varies sharply along the productivity distribution, reflecting a shifting balance between markup compression and organizational costs. This directly supports Corollary 1. Rather than overturning the baseline results, the interaction refines them by showing that these average effects mask substantial heterogeneity across firms. In particular, the impact of integration depends critically on firms' productivity, with the same organizational choice generating markedly different pricing outcomes across the distribution.

4.3 Test of Proposition 4: Upstream Shocks, Integration, and Price Transmission

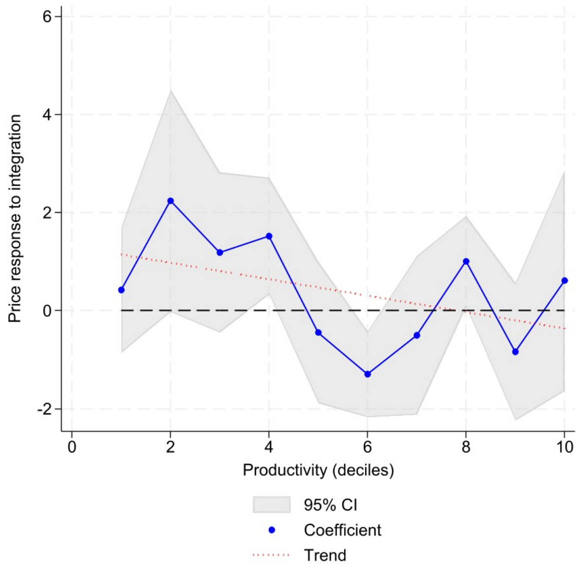
We test Proposition 4 by examining the pass-through of upstream cost shocks to export prices and how it varies with firms' organizational structure across distinct channels. We construct a firm-specific upstream shock using a shift-share design based on international input price fluctuations:

$$\text{Shock}_{ft} = \sum_{j \neq France,k} \frac{M_{fjk,t-1}}{M_{f,t-1}} \cdot \Delta \ln \mathrm{P}^{\text{RoW}}_{jk,t}, \tag{30}$$

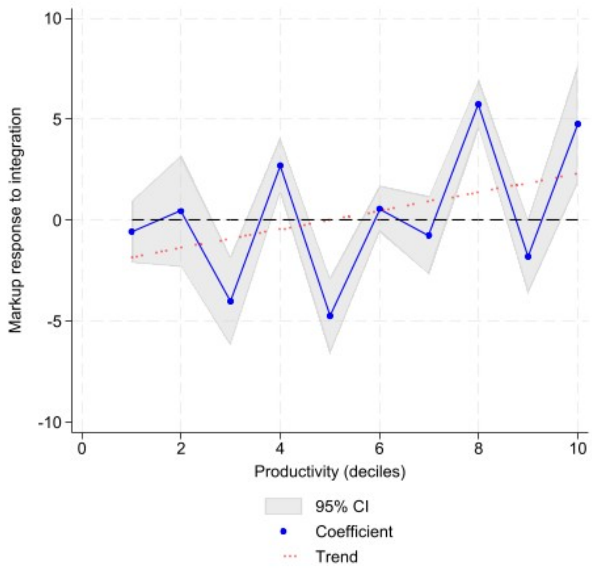
where $M_{fjk,t-1}/M_{f,t-1}$ denotes lagged import shares of firm f for product k sourced from country j, and $\Delta \ln \mathrm{P}^{\text{RoW}}_{jk,t}$ is the change in world prices, computed from BACI bilateral trade data as unit values aggregated at the origin–HS6–year level. By relying on pre-determined import shares and excluding domestic (French) flows, this measure captures plausibly exogenous variation in input costs while preserving firm-level heterogeneity in sourcing exposure.

Before exploring heterogeneity, we check that the shock propagates to firms' outcomes. Table 6 shows that upstream shocks significantly increase marginal costs, reduce markups, and raise export prices. The marginal-cost response is economically large relative to the price response, consistent with incomplete pass-through. This pattern accords with the model: upstream shocks affect prices through both cost adjustments and markup responses.

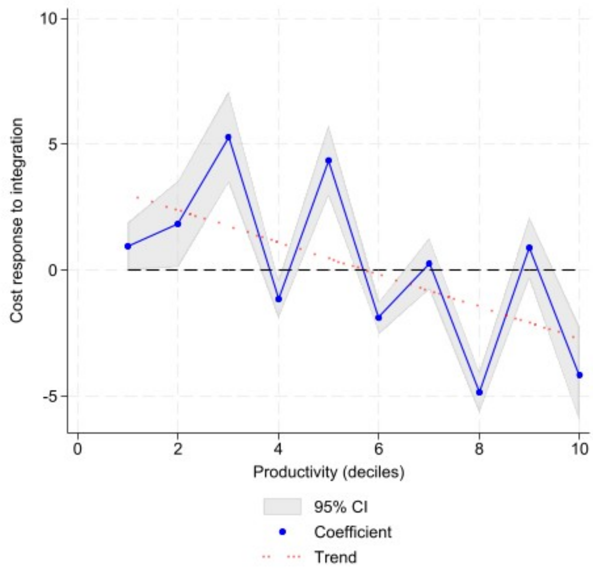
We then examine how organizational structure shapes this transmission. We estimate a specification analogous to Equation (29), interacting Shock_{ft} with deciles of residualized in-



(a) Export price effects



(b) Markup effects



(c) Marginal cost effects

Figure 6: Integration effects across productivity levels: Prices, markups, and marginal costs.
Note: IV estimates of the effect of residualized integration on outcomes across productivity deciles. Each point corresponds to the coefficient $\hat{\alpha}_{du}$ from Equation (29). Productivity deciles are defined based on θ_{ft}. All specifications include the full set of controls and firm and destination-product-year fixed effects.

tegration $\hat{\varepsilon}^{GVC}_{ft}$. The interaction terms are instrumented using the corresponding interactions with $\text{Inst}^{U^M}_{ft}$, isolating exogenous variation in firms' organizational position.

Figure 7 reports the estimated coefficients across integration deciles for export prices, markups, and marginal costs. Price pass-through is positive across most of the distribution but clearly non-monotonic: it is strongest among less integrated firms, declines sharply, and then stabilizes in intermediate deciles, and rises again for highly integrated firms.

The underlying mechanisms are transparent in the markup and cost responses. Upstream

Table 6: Upstream shock validity and transmission channels

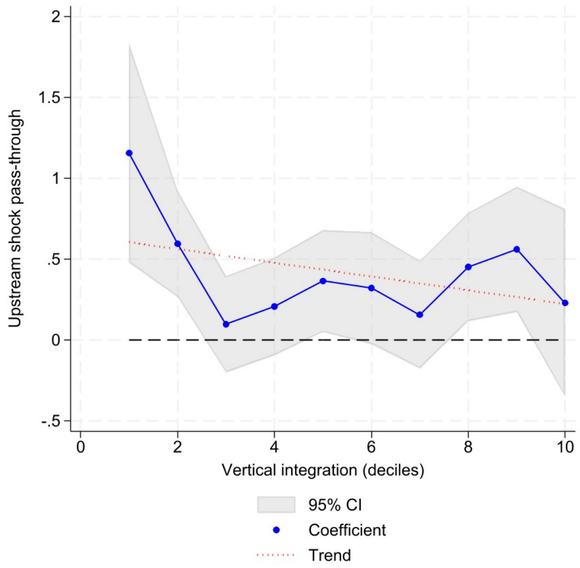
	OLS		
	$\ln \text{Price}_{fjkt}$	$\ln \text{Markup}_{fjkt}$	$\ln \text{MC}_{fjkt}$
	(1)	(2)	(3)
Upstream Shock$_{ft}$	0.0297**	−0.0683***	0.0994***
	(0.0147)	(0.0176)	(0.0094)
$(U_{ft}^M - U_{ft}^X)$	−0.0206*	−0.0060	−0.0135*
	(0.0107)	(0.0131)	(0.0077)
ln Productivity$_{ft}(\theta_{ft})$	−0.0421***	0.2504***	−0.2932***
	(0.0090)	(0.0116)	(0.0074)
Firm size:			
Small$_{ft}$	reference	reference	reference
Medium$_{ft}$	−0.0222	−0.1501***	0.1274***
	(0.0146)	(0.0187)	(0.0123)
Large$_{ft}$	−0.1259***	−0.2621***	0.1336***
	(0.0250)	(0.0298)	(0.0176)
Observations	294,648	293,209	293,209
R^2	0.616	0.740	0.939
Product-destination-year FE	YES	YES	YES
Firm FE	YES	YES	YES

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Robust standard errors clustered at the product-destination level are reported in parentheses. Significance levels are denoted as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

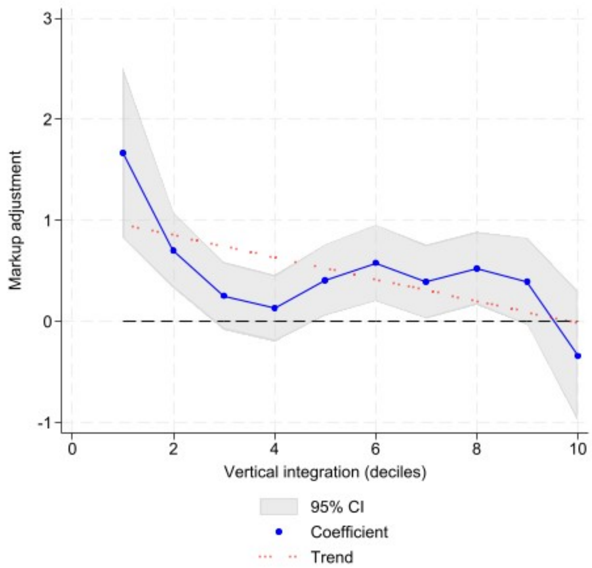
shocks significantly increase markups among low-integration firms, but this effect weakens and vanishes with integration—consistent with the attenuation of double marginalization. By contrast, marginal costs display the opposite pattern: responses are muted or even negative at low integration levels, consistent with bargaining-based smoothing, but become larger and positive as integration increases, reflecting direct internalization of input costs.

These results closely match the mechanism in Proposition 4. Non-integration dampens cost pass-through through bargaining while amplifying shocks through markups, generating a strong price response among less integrated firms. As integration rises, markup amplification is progressively shut down and cost pass-through becomes more direct, leading to a decline and subsequent stabilization in price sensitivity, with a more gradual and less pronounced increase in sensitivity for the top deciles.

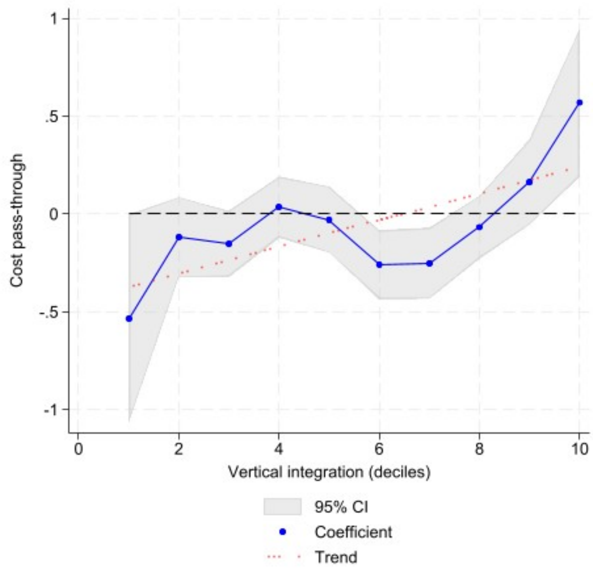
Overall, integration does not simply dampen or amplify upstream shocks—it fundamentally alters the channels through which they propagate. The same cost shock is transmitted through distinct mechanisms depending on firms' organizational structure.



(a) Export price effects



(b) Markup effects



(c) Marginal cost effects

Figure 7: Organizational structure and upstream shock pass-through.
Note: IV estimates of upstream cost shock pass-through across deciles of residualized vertical integration ($\hat{\varepsilon}_{ft}^{GVC}$). Interaction terms are instrumented using decile-specific interactions between integration deciles and the upstream integration instrument $\text{Inst}_{ft}^{U^M}$. All specifications include the full set of controls and firm and destination-product-year fixed effects.

4.4 Test of Corollary 2: Integration, Productivity, and Heterogeneous Shock Pass-Through

We now test Corollary 2 by examining how productivity shapes the transmission of upstream shocks through firms' organizational choices. Building on the previous section, which isolates the role of integration, we introduce an additional layer of heterogeneity by splitting firms according to the median of the productivity distribution.

Specifically, we interact Shock_{ft} with deciles of residualized integration $\hat{\varepsilon}_{ft}^{GVC}$ and with indicators for high- and low-productivity firms. This allows the pass-through of upstream shocks to vary jointly with firms' organizational structures in the value chain and their productivity level.

To preserve identification, all interaction terms are instrumented using the corresponding interactions between Inst_{ft}^{UM}, productivity groups, and integration deciles. The specification still includes the full set of controls, as well as firm and product-destination-year fixed effects. The productivity group indicators are also included as controls.

Figure 8 reports the estimated coefficients across integration deciles separately for high- and low-productivity firms, and reveals several patterns. First, the response of export prices to upstream shocks remains positive across most integration deciles for both productivity groups, but the magnitude and stability of pass-through differ markedly. High-productivity firms display relatively stable price responses across integration levels, whereas low-productivity firms exhibit stronger dispersion and greater sensitivity to organizational position. This suggests that productivity contributes to smoothing transmission mechanisms.

Second, markup responses differ sharply across productivity groups. Among low-productivity firms, markup adjustment declines monotonically with integration intensity. The strongest markup amplification occurs among weakly integrated firms, while highly integrated firms exhibit near-zero or even negative markup responses. This pattern is closely aligned with the theoretical prediction that bargaining-based pricing distortions dominate in arm's-length relationships and progressively disappear under integration.

For high-productivity firms, by contrast, markup responses are substantially flatter and less sensitive to integration. This indicates that highly productive firms rely less on markup adjustment as a shock-absorption margin.

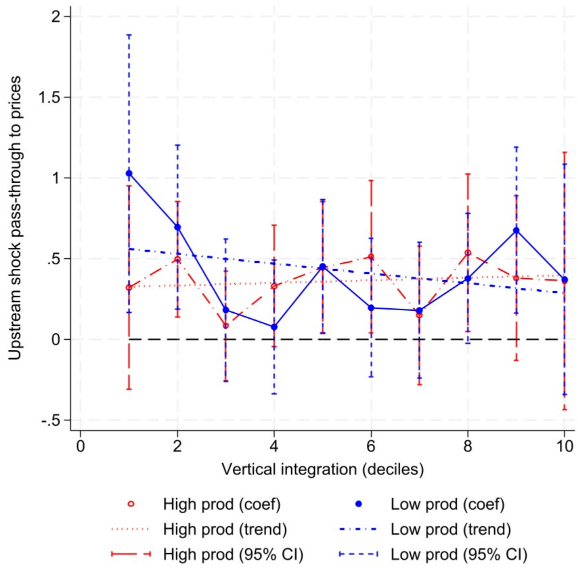
Third, marginal-cost pass-through exhibits the opposite pattern. For low-productivity firms, cost pass-through increases steeply with integration intensity, becoming strongly positive in the upper integration deciles. This result provides direct empirical support for the model's prediction that integration reallocates shock transmission toward internal cost absorption.

Among high-productivity firms, cost responses remain comparatively muted and close to zero across most integration deciles. This suggests that productivity dampens the direct cost sensitivity associated with internalized sourcing structures.

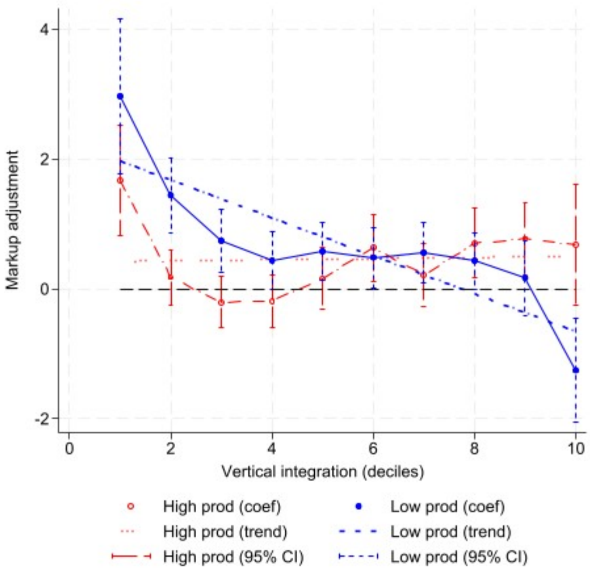
Taken together, these patterns provide strong support for Corollary 2. Productivity shapes shock transmission through endogenous organizational sorting, which reallocates the relative importance of markup and cost channels. Low-productivity firms, which are more likely to integrate, exhibit stronger cost-based transmission but weaker markup amplification. Conversely, high-productivity firms, which rely more on non-integration, are structurally more exposed to markup distortions, yet display more muted responses to upstream shocks across integration deciles. This attenuation reflects the model's scaling mechanism: because highly productive firms operate with lower marginal costs, both the bargaining component under non-integration and the internal cost channel under integration apply to a smaller cost base. As a result, upstream shocks induce smaller adjustments in both markups and marginal costs, even though the underlying organizational exposure differs across firms.

These findings further highlight that productivity shapes not only the composition but also the intensity of shock transmission. While integration reallocates pass-through from markups toward costs, this reallocation is quantitatively weaker among highly productive firms due to the smaller cost base over which both channels operate.

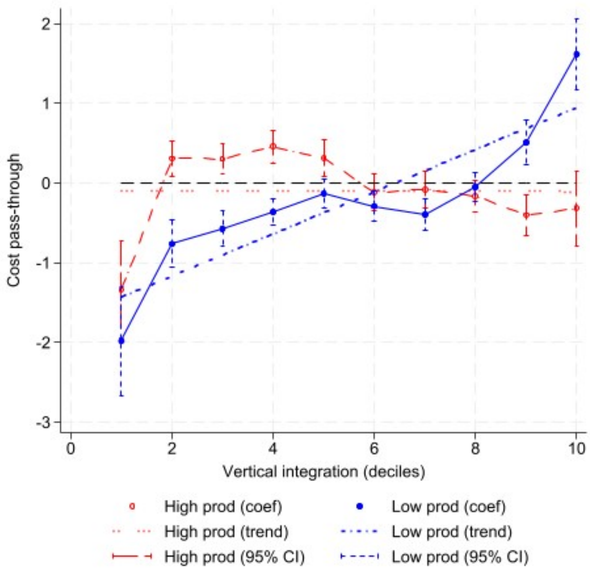
Relative to the previous section—where only integration heterogeneity was considered—the introduction of productivity uncovers an additional layer of sorting. Integration governs how



(a) Export price effects



(b) Markup effects



(c) Marginal cost effects

Figure 8: Productivity, organization, and shock transmission.
Note: IV estimates of upstream shock pass-through across deciles of residualized vertical integration ($\hat{\varepsilon}_{ft}^{GVC}$), separately for firms below and above the median of labor productivity. Interaction terms are instrumented using productivity-specific interactions between integration deciles and the upstream integration instrument Inst_{ft}^{UM}. All specifications include the full set of controls and firm and destination-product-year fixed effects.

pass-through is allocated across pricing margins, while productivity determines the magnitude with which these organizational mechanisms operate.

5 Discussion and concluding remarks

This paper provides a unified framework to understand how prices are formed and how shocks propagate in GVCs. Moving beyond the standard view of prices as constant markups over marginal costs, we show that export prices reflect the joint outcome of sequential production, bilateral bargaining, and firms' organizational choices. Accordingly, price determination is an equilibrium result shaped by organizational structure and productivity, which jointly govern costs, markups, and shock transmission along GVCs.

Our results point to a simple but powerful mechanism: vertical integration does not simply reduce frictions—it reshapes the composition of price formation. By internalizing transactions, firms do not fully eliminate distortions; they replace markup-based pricing with cost-based pricing. Non-integrated firms, in contrast, rely on bargaining arrangements that generate double marginalization and induce price adjustments primarily through markups, in line with classic insights on vertical externalities and double marginalization (e.g. Grossman and Helpman, 2002). Integration therefore reallocates the locus of price determination from markups toward marginal costs, while preserving the underlying trade-offs in price formation.

A central implication is that productivity enters price determination through organizational sorting. Contrary to the canonical prediction that more productive firms integrate more (Antràs and Helpman, 2004; Antràs and Chor, 2013; Alfaro et al., 2019; Chor et al., 2021), we find that low-productivity firms integrate, while high-productivity firms outsource. This pattern is consistent with the idea that pricing distortions scale with marginal costs, making them disproportionately costly for less efficient firms.

This sorting mechanism also reshapes how productivity maps into observed prices. Because more productive firms operate with lower marginal costs, they are less sensitive to cost-based variation in pricing, consistent with standard pass-through logic. At the same time, their greater reliance on outsourcing exposes them more frequently to bargaining-based markups, as emphasized in models of negotiated prices in supply chains (Collard-Wexler et al., 2019; Alviarez et al., 2023). Productivity therefore simultaneously reduces cost-driven variation in prices while increasing exposure to markup distortions.

The empirical evidence strongly supports these mechanisms. Integration is associated with large reductions in markups, consistent with the elimination of double marginalization, echoing evidence in vertically related industries (Gaigné et al., 2018). Its effect on marginal costs is more limited on average, indicating that the main adjustment occurs via pricing distortions rather than technological efficiency gains, as the net effect of upstream and downstream organizational costs is nearly zero. At the same time, the effects of integration are strongly heterogeneous: among low-productivity firms, integration compresses markups and aligns prices more closely with costs, whereas among high-productivity firms it is associated with higher markups, consistent with deviations from their optimal organizational structure. Moreover, for high-productivity firms, integration is also associated with lower costs, and as a result, the price impact is less pronounced.

We further document that firms adjust along different margins depending on their organizational position. Non-integrated firms absorb adjustments primarily through markups, consistent with bargaining frictions and incomplete pass-through in supply chains (Alvarez-Blaser et al., 2025). Integrated firms adjust instead through marginal costs, reflecting direct exposure to internal production costs once double marginalization is removed. This reallocation of adjustment margins generates systematic heterogeneity in pricing responses across firms: more fragmented firms exhibit stronger price sensitivity through markup adjustments, whereas integrated firms display adjustments that are more directly tied to cost movements but less amplified through pricing distortions.

Productivity further scales these effects. Low-productivity firms exhibit large adjustments in both markups and marginal costs, while high-productivity firms display muted responses across both channels, consistent with a smaller cost base and lower sensitivity of pricing margins. This reinforces the idea that heterogeneity in pricing outcomes is jointly determined by organizational structure and productivity, rather than either dimension in isolation.

More broadly, these results extend a growing literature on firm organization in GVCs (Antràs and Helpman, 2004; Berlingieri et al., 2021), by showing that organizational boundaries determine not only sourcing patterns but also the decomposition of prices into cost and markup components. They also connect to recent work on price formation in production networks and negotiated trade (Gowrisankaran et al., 2015; Alviarez et al., 2023), by highlighting that bargaining frictions and internalization jointly shape price-setting.

Our analysis shows that understanding GVC dynamics requires looking beyond costs: organizational choices and productivity jointly shape how prices, markups, and shocks propagate. Policies that ignore these structural dimensions risk misjudging the channels through which firms adjust and may yield unintended outcomes. In particular, blanket promotion of vertical integration is unlikely to be optimal, while the concentration of highly productive firms can dampen aggregate responses to global shocks

Several avenues for future research emerge from this work. Extending the analysis to other sectors and countries would help assess the generality of the mechanisms we identify. Incorporating richer forms of contracting, multi-partner bargaining, or endogenous matching could further refine the analysis of supply chain interactions. Finally, exploring the interaction between organizational choices and large-scale disruptions—such as pandemics, trade wars, or technological shifts—would provide valuable insights into the evolution of global production networks.

In sum, this paper shows that integration and productivity shape price formation and shock transmission in GVCs: integration reallocates adjustment from markups to costs, while productivity scales its intensity. By uncovering these mechanisms, we provide a new perspective on firm heterogeneity, organizational choices, and pricing behavior in an increasingly fragmented world economy.

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Appendices

A Theory Appendix

A.1 Nash Bargaining with Downstream Costs

Using the demand system:

$$q_{fjk} = A_{jk}\left(\frac{\varepsilon}{\varepsilon-1}\right)^{-\varepsilon}(p_{fjk}+\phi_j(u_j))^{-\varepsilon},$$

profits are:

$$\pi_{fjk} = (p_{fjk} - MC_{fjk})q_{fjk} \tag{A.1}$$

$$\pi_{jk} = \left(\frac{1}{\varepsilon-1}(p_{fjk}+\phi_j(u_j))\right)q_{fjk} \tag{A.2}$$

The Nash product is:

$$\mathcal{N} = \pi_{fjk}^{\beta}\pi_{jk}^{1-\beta}$$

Taking logs:

$$\ln\mathcal{N} = \beta\ln(p_{fjk} - MC_{fjk}) + (1-\beta)\ln(p_{fjk}+\phi_j(u_j)) + \ln q_{fjk} + \text{const}$$

Using:

$$\ln q_{fjk} = -\varepsilon\ln(p_{fjk}+\phi_j(u_j)) + \text{const}$$

we obtain:

$$\ln\mathcal{N} = \beta\ln(p_{fjk} - MC_{fjk}) + (1-\beta-\varepsilon)\ln(p_{fjk}+\phi_j(u_j)) + \text{const}$$

FOC:

$$\frac{\beta}{p_{fjk}-MC_{fjk}} + \frac{1-\beta-\varepsilon}{p_{fjk}+\phi_j(u_j)} = 0 \tag{A.3}$$

Rearranging:

$$\beta(p_{fjk}+\phi_j(u_j)) = (\varepsilon+\beta-1)(p_{fjk}-MC_{fjk})$$

Solving:

$$p^*_{fjk} = \frac{\varepsilon+\beta-1}{\varepsilon-1}MC_{fjk} + \frac{\beta}{\varepsilon-1}\phi_j(u_j) \tag{A.4}$$

$$= \mu(\beta)MC_{fjk} + (\mu(\beta)-1)\phi_j(u_j) \tag{A.5}$$

A.2 Downstream Integration Condition and Productivity Cutoff

Non-integration profits

Under non-integration, the transaction price is determined by Nash bargaining:

$$p^{NI}_{fjk} = \mu(\beta)MC_{fjk} + (\mu(\beta)-1)\phi_j(u_j), \tag{A.6}$$

where $\mu(\beta) = \frac{\varepsilon+\beta-1}{\varepsilon-1}$.

Using the manufacturer's profit function:

$$\pi^{NI}_{fjk} = (p^{NI}_{fjk} - MC_{fjk})q_{fjk}. \tag{A.7}$$

Substituting the price:

$$\pi^{NI}_{fjk} = [(\mu(\beta) - 1)MC_{fjk} + (\mu(\beta) - 1)\phi_j(u_j)]\, q_{fjk}. \tag{A.8}$$

Using CES demand:

$$q_{fjk} = A_{jk}\left[\mu_j \mu(\beta)(MC_{fjk} + \phi_j(u_j))\right]^{-\varepsilon}, \tag{A.9}$$

we obtain:

$$\pi^{NI}_{fjk} = A_{jk}\mu_j^{-\varepsilon}\mu(\beta)^{-\varepsilon}(\mu(\beta) - 1)(MC_{fjk} + \phi_j(u_j))\left(MC_{fjk} + \phi_j(u_j)\right)^{-\varepsilon}. \tag{A.10}$$

Simplifying:

$$\pi^{NI}_{fjk} = A_{jk}\mu_j^{-\varepsilon}\mu(\beta)^{-\varepsilon}(\mu(\beta) - 1)\left(MC_{fjk} + \phi_j(u_j)\right)^{1-\varepsilon}. \tag{A.11}$$

Integration profits

Under integration, the firm internalizes the downstream stage, and marginal cost becomes:

$$MC^{I}_{fjk} = MC_{fjk} + \phi_f(u_j). \tag{A.12}$$

The firm sets the CES price:

$$p^{I}_{fjk} = \mu_j\left(MC_{fjk} + \phi_f(u_j)\right). \tag{A.13}$$

Profits are:

$$\pi^{I}_{fjk} = (p^{I}_{fjk} - MC^{I}_{fjk})q_{fjk}. \tag{A.14}$$

Using CES demand:

$$q_{fjk} = A_{jk}\left[\mu_j(MC_{fjk} + \phi_f(u_j))\right]^{-\varepsilon}, \tag{A.15}$$

we obtain:

$$\pi^{I}_{fjk} = A_{jk}\mu_j^{-\varepsilon}(\mu_j - 1)\left(MC_{fjk} + \phi_f(u_j)\right)^{1-\varepsilon}. \tag{A.16}$$

Integration condition

Integration occurs whenever:

$$\pi^{I}_{fjk} \geq \pi^{NI}_{fjk}.$$

Substituting the expressions for profits yields:

$$(\mu_j - 1)\left(MC_{fjk} + \phi_f(u_j)\right)^{1-\varepsilon} \geq \mu(\beta)^{-\varepsilon}(\mu(\beta) - 1)\left(MC_{fjk} + \phi_j(u_j)\right)^{1-\varepsilon}.$$

Using $MC_{fjk} = \frac{\tilde{c}_{fk}}{\theta_{fk}}$, where $\tilde{c_{fk}} = \left(p_{if}^{M^{1-\sigma}} + \int_{U_f^X}^{U_f^M} c_f(u)^{1-\sigma}du\right)^{\frac{1}{1-\sigma}}$, we obtain:

$$(\mu_j - 1)\left(\frac{\tilde{c}_{fk}}{\theta_{fk}} + \phi_f(u_j)\right)^{1-\varepsilon} \geq \mu(\beta)^{-\varepsilon}(\mu(\beta) - 1)\left(\frac{\tilde{c}_{fk}}{\theta_{fk}} + \phi_j(u_j)\right)^{1-\varepsilon}.$$

Since $1-\varepsilon<0$, the inequality reverses:

$$\frac{\tilde{c}_{fk}}{\theta_{fk}}+\phi_f(u_j)\leq B(\beta,\varepsilon)\left(\frac{\tilde{c}_{fk}}{\theta_{fk}}+\phi_j(u_j)\right),$$

where

$$G(\beta,\varepsilon)\equiv\left[\frac{\mu(\beta)^{-\varepsilon}(\mu(\beta)-1)}{\mu_j-1}\right]^{\frac{1}{1-\varepsilon}}.$$

Using $\mu(\beta)=\frac{\varepsilon+\beta-1}{\varepsilon-1}$ and $\mu_j=\frac{\varepsilon}{\varepsilon-1}$, we obtain:

$$\frac{\mu(\beta)-1}{\mu_j-1}=\beta,\quad\Rightarrow\quad B(\beta,\varepsilon)=\left[\beta\,\mu(\beta)^{-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}.$$

Since $\beta\in(0,1]$ and $\mu(\beta)>1$, it follows that $B(\beta,\varepsilon)>1$.

Rearranging the inequality:

$$\frac{\tilde{c}_{fk}}{\theta_{fk}}(1-B)\leq B\phi_j(u_j)-\phi_f(u_j).$$

As $1-B<0$, dividing both sides reverses the inequality:

$$\frac{\tilde{c}_{fk}}{\theta_{fk}}\geq\frac{B\phi_j(u_j)-\phi_f(u_j)}{1-B}.$$

Multiplying by θ_{fk} and rearranging yields:

$$\theta_{fk}\leq\frac{\tilde{c}_{fk}(B-1)}{\phi_f(u_j)-B\phi_j(u_j)}.$$

Defining the productivity cutoff:

$$\bar{\theta}_{fk}=\frac{\tilde{c}_{fk}(B(\beta,\varepsilon)-1)}{\phi_f(u_j)-B(\beta,\varepsilon)\phi_j(u_j)},\tag{A.17}$$

we obtain the integration condition:

$$\theta_{fk}\leq\bar{\theta}_{fk}$$

provided that $\phi_f(u_j)>B(\beta,\varepsilon)\phi_j(u_j)$, which ensures that $\bar{\theta}_{fk}>0$.

Otherwise, if $\phi_f(u_j)\leq B(\beta,\varepsilon)\phi_j(u_j)$, the inequality is always satisfied and integration occurs for all firms.

A.3 Upstream Sourcing and Bargaining

We consider the upstream sourcing problem between firm f and a foreign supplier i. The firm sources an intermediate input at price p_{if}^{NI}, with associated per-unit upstream organizational costs $\phi_f(u_f)>0$, capturing contracting, coordination, and logistics frictions.

The input is demanded according to a CES structure. Let the derived demand for the input be:

$$q_{if}^{M}=\mathcal{B}_f(p_{if}^{NI}+\phi_f(u_f))^{-\eta},$$

where $\eta>1$ is the elasticity of substitution and

$$\mathcal{B}_f\equiv\frac{E_f}{P_f^{1-\eta}}>0$$

is a demand shifter summarizing total expenditure and the CES price index.

The supplier's profit is given by:

$$\pi_{if}^{sup} = (p_{if}^{NI} - MC_{if}^{sup})q_{if}^{M}, \tag{A.18}$$

where MC_{if}^{sup} denotes the supplier's marginal cost of production.

The firm's surplus from the input is the contribution of the input to production net of its sourcing cost:

$$\pi_{if}^{f} = \psi_f q_{if}^{M} - (p_{if}^{NI} + \phi_f(u_f))q_{if}^{M}, \tag{A.19}$$

where ψ_f denotes the marginal revenue product of the input within the firm's production technology.

The input price is determined via Nash bargaining:

$$\max_{p_{if}^{NI}} \left[(p_{if}^{NI} - MC_{if}^{sup})q_{if}^{M}\right]^{\varphi} \left[(\psi_f - p_{if}^{NI} - \phi_f(u_f))q_{if}^{M}\right]^{1-\varphi}, \tag{A.20}$$

where $\varphi \in (0,1)$ is the supplier's bargaining power.

Since q_{if}^{M} enters multiplicatively in both surplus terms, it cancels out in the maximization problem. The program reduces to:

$$\max_{p_{if}^{NI}} (p_{if}^{NI} - MC_{if}^{sup})^{\varphi}(\psi_f - p_{if}^{NI} - \phi_f(u_f))^{1-\varphi}. \tag{A.21}$$

Taking logs and differentiating yields the first-order condition:

$$\frac{\varphi}{p_{if}^{NI} - MC_{if}^{sup}} = \frac{1-\varphi}{\psi_f - p_{if}^{NI} - \phi_f(u_f)}. \tag{A.22}$$

Solving for the optimal price gives:

$$p_{if}^{NI} = (1-\varphi)MC_{if}^{sup} + \varphi(\psi_f - \phi_f(u_f)). \tag{A.23}$$

A.4 Upstream Shock Transmission and Pass-Through

This appendix derives the transmission of upstream cost shocks under non-integration and integration. We characterize how bargaining and organizational structure affect the pass-through of upstream cost shocks into the firm's marginal cost.

Step 1: CES marginal cost structure Under non-integration, the firm's marginal cost is given by:

$$MC_{fjk}^{NI} = \frac{1}{\theta_{fk}} \left[(p_{if}^{NI} + \phi_f(u_f))^{1-\sigma} + \int_{U_f^X}^{U_f^M} c_f(u)^{1-\sigma} du\right]^{\frac{1}{1-\sigma}}. \tag{A.24}$$

Define the CES cost index:

$$Z^{NI} \equiv (p_{if}^{NI} + \phi_f(u_f))^{1-\sigma} + \int_{U_f^X}^{U_f^M} c_f(u)^{1-\sigma} du, \tag{A.25}$$

so that:

$$MC_{fjk}^{NI} = \frac{1}{\theta_{fk}}(Z^{NI})^{\frac{1}{1-\sigma}}. \tag{A.26}$$

Define the input cost share:

$$s^{NI} \equiv \frac{(p_{if}^{NI} + \phi_f(u_f))^{1-\sigma}}{Z^{NI}} \in (0,1). \tag{A.27}$$

Step 2: Input price under bargaining The equilibrium input price is:

$$p_{if}^{NI} = (1-\varphi)MC_{if}^{sup} + \varphi(\psi_f - \phi_f(u_f)), \tag{A.28}$$

implying:

$$\frac{\partial p_{if}^{NI}}{\partial MC_{if}^{sup}} = (1-\varphi), \qquad \frac{\partial p_{if}^{NI}}{\partial \phi_f(u_f)} = -\varphi. \tag{A.29}$$

Step 3: Pass-through into marginal cost (non-integration) Using the CES structure:

$$MC_{fjk}^{NI} = \frac{1}{\theta_{fk}}(Z^{NI})^{\frac{1}{1-\sigma}}, \tag{A.30}$$

we compute:

$$\frac{\partial MC^{NI}}{\partial p^{NI}} = MC^{NI} \cdot \frac{(p^{NI} + \phi_f(u_f))^{-\sigma}}{Z^{NI}}. \tag{A.31}$$

Using the definition of s^{NI}:

$$\frac{\partial MC^{NI}}{\partial p^{NI}} = MC^{NI} \cdot \frac{s^{NI}}{p^{NI} + \phi_f(u_f)}. \tag{A.32}$$

Therefore, the pass-through of upstream production costs is:

$$\frac{\partial MC^{NI}}{\partial MC_{if}^{sup}} = (1-\varphi)\, MC^{NI}\, \frac{s^{NI}}{p_{if}^{NI} + \phi_f(u_f)}. \tag{A.33}$$

Step 4: Integration case Under integration, the firm internalizes upstream production. The marginal cost becomes:

$$MC_{fjk}^{I} = \frac{1}{\theta_{fk}}\left[\phi_f(u_i)^{1-\sigma} + \int_{U_f^X}^{U_f^M} c_f(u)^{1-\sigma} du\right]^{\frac{1}{1-\sigma}}. \tag{A.34}$$

Define:

$$Z^I = \phi_f(u_i)^{1-\sigma} + \int_{U_f^X}^{U_f^M} c_f(u)^{1-\sigma} du, \qquad s^I = \frac{\phi_f(u_i)^{1-\sigma}}{Z^I}. \tag{A.35}$$

Then:

$$MC_{fjk}^{I} = \frac{1}{\theta_{fk}}(Z^I)^{\frac{1}{1-\sigma}}. \tag{A.36}$$

Pass-through under integration Since upstream input prices disappear under integration:

$$\frac{\partial MC^I}{\partial MC_{if}^{sup}} = 0, \tag{A.37}$$

and:

$$\frac{\partial MC^I}{\partial \phi_f(u_i)} = MC^I \cdot \frac{s^I}{\phi_f(u_i)}. \tag{A.38}$$

Non-integration acts as a partial shock absorber due to bargaining, which dampens the transmission of upstream cost shocks. Integration removes this buffering mechanism and embeds upstream costs directly into the production technology. As a result, upstream integration governs exposure to cost fluctuations rather than introducing additional amplification of shocks.

B Variable Construction

B.1 Construction of Quality-Adjusted Prices

We construct quality-adjusted export prices following Khandelwal et al. (2013) and Fan et al. (2015). For each firm-destination-product-year observation, quality is recovered from the residual demand equation:

$$\ln \tilde{q}_{fjkt} + \varepsilon_k \ln \tilde{p}_{fjkt} = FE_{jkt} + e_{fjkt}, \tag{B.1}$$

where FE_{jkt} are destination-product-year fixed effects and ε_k denotes the elasticity of substitution from Ossa (2015).

Quality is then defined as:

$$\ln \widehat{\lambda}_{fjkt} = \frac{\widehat{e}_{fjkt}}{\varepsilon_k - 1},$$

and quality-adjusted prices are given by:

$$\ln p_{fjkt} = \ln \tilde{p}_{fjkt} - \ln \widehat{\lambda}_{fjkt}.$$

B.2 Estimation of Markups and Marginal Costs

Following De Loecker and Warzynski (2012), we estimate first a Cobb-Douglas production function:

$$\ln Q_{ft} = \gamma_K \ln K_{ft} + \gamma_L \ln L_{ft} + \gamma_I \ln I_{ft} + \omega_{ft} + \varepsilon_{ft}, \tag{B.2}$$

where $\ln Q_{ft}$ K_{ft} is the logarithm of output—proxied by total sales, L_{ft}, and I_{ft} represent capital, labor, and intermediate inputs, respectively. All input variables are expressed in monetary terms to ensure consistency across firms: capital is proxied by total assets, labor by the wage bill, and materials by expenditures on intermediate goods (primarily raw materials). While physical quantities of labor are available, similar data are not available for capital, output, and materials. Hence, we adopt a value-based approach uniformly across all inputs to maintain coherence in the estimation of elasticities. Moreover, we proxy output using nominal sales, rather than deflated values, to maintain conceptual consistency with our main outcome variable—quality-adjusted prices—which are inherently nominal. This choice is motivated by methodological rather than data availability considerations. Deflating inputs and output would generate a misalignment between the nominal price variable and its structural decomposition into markup and marginal cost. Working in nominal terms ensures that the estimated cost-price structure can be directly interpreted in the same nominal framework as the pricing outcomes we aim to explain.

The term ω_{ft} captures firm-specific productivity shocks observed by the firm but not by the econometrician, while ε_{ft} represents the idiosyncratic error term. We estimate the output elasticities with respect to inputs, including that of the flexible input—labor in our baseline specification—using a control function approach à la Olley and Pakes (1996), which addresses simultaneity bias arising from the endogenous choice of inputs.

In the second step, we compute the markup μ_{ft} as the ratio of the output elasticity with respect to the flexible input, $\widehat{\gamma}_L$, to its observed revenue share:

$$\widehat{\mu}_{ft} = \frac{\widehat{\gamma}_L}{s_{L,ft}},$$

where $s_{L,ft} = L_{ft}/Q_{ft}$ denotes the share of expenditures on labor inputs in total sales. This expression yields a consistent estimate of the markup under the standard assumptions of cost minimization and profit maximization in perfectly competitive input markets. The choice of flexible input—so long as it satisfies the required identifying assumptions—does not affect the resulting markup estimates (De Loecker and Warzynski, 2012). That is, regardless of which input is used, the implied markup $\widehat{\mu}_{ft}$ remains the same, provided the input meets the theoretical conditions.

Once the firm level markup μ_{ft} has been estimated, we allocate it to the firm-destination-product level. To do so, we compute the firm-level average export price P_{ft} as a weighted average of product-level prices, where the weights reflect the share of each product in the firm's total export revenue for year t:

$$P_{ft} = \sum_{(j,k)} s_{fjkt} \cdot p_{fjkt}, \quad \text{where} \quad s_{fjkt} = \frac{X_{fjkt}}{\sum_{(j,k)} X_{fjkt}}.$$

where (j, k) refers to a destination-product pair served by firm f in year t. p_{fjkt} is the quality-adjusted price of product k exported by firm f to destination j in year t, and X_{fjkt} is the corresponding export revenue. The weights s_{fjkt} therefore capture each destination-product pair's contribution to the firm's total annual export sales.

Then, we compute the firm-destination-product level markup μ_{fjkt} by scaling the firm-year markup μ_{ft} using the relative price of the destination-product observation with respect to the firm-level average price:

$$\widehat{\mu}_{fjkt} = \widehat{\mu}_{ft} \cdot \frac{p_{fjkt}}{P_{ft}},$$

This transformation preserves the relative pricing structure across destinations and products within each firm while maintaining the aggregate markup level estimated at the firm level.

Given the estimated markups $\widehat{\mu}_{fjkt}$ and their corresponding export price p_{fjkt}, marginal costs are recovered using the standard pricing identity:

$$\widehat{MC}_{fjkt} = \frac{p_{fjkt}}{\widehat{\mu}_{fjkt}}.$$

These measures provide consistent estimates of variable production costs at destination-product level.

C Industry *upstreamness*

Table C.1 reports upstreamness levels for selected industries, based on the 4-digit NACE Rev.2 I–O table developed in Agbekponou et al. (2025). To test the relevance of our approach, we compare the upstreamness measures based on the 4-digit NACE Rev.2 U.S. I–O table with those computed using alternative I–O tables. More specifically, we use the French I–O tables obtained from OECD STAN, INSEE, and GTAP databases, and the U.S. I–O table from GTAP. These alternative tables operate with much broader industries, and accordingly provide a much lower level of detail. The OECD STAN table resumes all economic activities into 34 industries, the INSEE I–O table in only 15 industries, while the GTAP tables include 65 industries. To compare industry upstreamness computed with different I–O tables, we aggregate the 4-digit NACE Rev.2 U.S. I–O table to match the industry classification in each alternative data source on I–O linkages (OECD STAN, INSEE, GTAP), and recompute the industry upstreamness.

Table C.1: Industry upstreamness (selection)

NACE industry	Upstreamness
Retail sale of fruit and vegetables in specialised stores	1.01
Retail sale of meat and meat products in specialised stores	1.01
Retail sale of fish, crustaceans and molluscs in specialised stores	1.01
Retail sale of bread, cakes, flour confectionery and sugar confectionery	1.01
Retail sale of beverages in specialised stores	1.01
Manufacture of rusks and biscuits; of preserved pastry goods and cakes	1.08
Manufacture of soft drinks; of mineral waters and other bottled waters	1.09
Manufacture of bread; manufacture of fresh pastry goods and cakes	1.10
Manufacture of macaroni, noodles, couscous and similar farinaceous products	1.15
Manufacture of prepared meals and dishes	1.20
Manufacture of grain mill products	1.21
Manufacture of wine from grape	1.23
Growing of vegetables and melons, roots and tubers	1.28
Processing and preserving of poultry meat	1.31
Manufacture of condiments and seasonings	1.35
Production of meat and poultry meat products	1.37
Operation of dairies and cheese making	1.38
Manufacture of cocoa, chocolate and sugar confectionery	1.39
Manufacture of sugar	1.42
Processing and preserving of meat	1.44
Growing of perennial crops	1.46
Processing of tea and coffee	1.47
Manufacture of fruit and vegetable juice	1.47
Processing and preserving of fish, crustaceans and molluscs	1.60
Marine fishing	1.66
Freshwater fishing	1.69
Freshwater aquaculture	1.86
Sewerage	1.89
Growing of sugar cane	2.07
Marine aquaculture	2.10
Raising of swine/pigs	2.10
Raising of other animals	2.15
Raising of poultry	2.16
Manufacture of starches and starch products	2.16
Manufacture of oils and fats	2.72
Raising of dairy cattle	2.98
Manufacture of prepared feeds for farm animals	3.24
Raising of other cattle and buffaloes	3.30
Growing of rice	3.38
Growing of cereals (except rice), leguminous crops and oil seeds	3.45
Post-harvest crop activities	3.61
Seed processing for propagation	3.61

Source: Agbekponou et al. (2025)

Results reveal a strong correlation between the industry upstreamness obtained with different I–O tables (see Table C.3). We find large values for Spearman rank and Pearson correlation tests that range from 0.65 to 0.73. Both tests are always of similar magnitude,

Table C.2: Summary statistics for industry upstreamness

	Frequency	Min	Max	Mean	Std. dev.
Upstreamness of all industries	604	1.00	4.51	1.89	0.75
Upstreamness of agri-food industries	83	1.08	4.51	2.16	0.96

Table C.3: Correlation of industry upstreamness computed with different data

	The I–O table at the 4-digit NACE Rev.2 level aggregated into			
	34 industries	15 industries	65 industries	GTAP France (65 industries)
OECD (34 industries)	0.65 [0.66]			
INSEE (15 industries)		0.68 [0.67]		
GTAP France (65 industries)			0.70 [0.68]	
GTAP U.S. (65 industries)			0.73 [0.73]	0.89 [0.90]

Notes: Results report the Spearman rank correlation. Pearson correlation in brackets. The U.S. I–O table converted to the level of 4-digit NACE Rev.2 level was aggregated to match the classification of industries in the OECD STAN, INSEE, and GTAP I–O tables.

and are significantly different from zero at a p-value of 0.01. These findings confirm the consistency of our results, and that we can confidently use the constructed I–O table to identify the position of French industries in value chains. The cross-industry variation in the upstreamness computed based on the original French I–O tables (from OECD STAN and INSEE) and our constructed NACE-level I–O table from the U.S. table is broadly consistent with the range of values reported by Antràs et al. (2012) for a subset of EU countries (Czech Republic, Luxembourg, Germany, Spain, *etc.*). Furthermore, the strong correlation of industry upstreamness computed with the GTAP I–O tables for France and the U.S. (0.89 and 0.90) confirms our hypothesis that the two countries share the same patterns of input use for the production of identical outputs. In sum, this evidence gives us great confidence that industry-level upstreamness measures are stable between the U.S. and France, at least at a high level of aggregation, and confirms the relevance of using the U.S. table with French data.

Table C.4: Descriptive statistics by sector (sorted by mean of $U^M - U^X$)

Code	U^M		U^X		$U^M - U^X$		Log LP	
	mean	sd	mean	sd	mean	sd	mean	sd
Margarine and similar edible fats (1042)	2.960	0.505	1.761	0.704	1.199	1.207	.	
Soft drinks; mineral waters and other bottled waters (1107)	2.216	0.418	1.299	0.342	0.918	0.549	6.025	0.647
Beer (1105)	2.014	0.364	1.256	0.180	0.757	0.430	5.977	0.632
Cider and other fruit wines (1103)	2.047	0.355	1.295	0.109	0.752	0.363	5.680	0.522
Grain mill products (1061)	2.197	0.725	1.547	0.631	0.648	0.878	6.033	0.597
Wine from grape (1102)	1.894	0.417	1.265	0.178	0.629	0.444	6.249	0.705
Rusks and biscuits; preserved pastry goods and cakes (1072)	1.692	0.420	1.151	0.213	0.542	0.481	5.201	0.568
Bread; fresh pastry goods and cakes (1071)	1.643	0.404	1.171	0.206	0.472	0.430	5.172	0.596
Homogenised food preparations and dietetic food (1086)	1.869	0.532	1.397	0.355	0.471	0.582	5.606	0.766
Condiments and seasonings (1084)	1.880	0.481	1.431	0.281	0.449	0.530	5.547	0.503
Sugar (1081)	1.920	0.355	1.485	0.206	0.434	0.395	6.038	0.961
Processed and preserved poultry meat (1012)	1.700	0.396	1.345	0.096	0.356	0.402	5.496	0.745
Distilled alcoholic beverages (1101)	1.957	0.407	1.602	0.275	0.356	0.430	6.003	0.745
Processed and preserved potatoes (1031)	1.739	0.394	1.411	0.452	0.328	0.577	5.312	0.378
Prepared meals and dishes (1085)	1.655	0.296	1.347	0.220	0.308	0.339	5.344	0.547
Other non-distilled fermented beverages (1104)	1.648	0.153	1.356	0.367	0.292	0.413	5.927	0.494
Starches and starch products (1062)	2.475	0.391	2.204	0.119	0.270	0.370	6.222	0.398
Malt (1106)	2.322	0.681	2.050	0.551	0.272	0.810	7.041	0.396
Processed tea and coffee (1083)	1.743	0.332	1.491	0.219	0.253	0.376	5.513	0.649
Cocoa, chocolate and sugar confectionery (1082)	1.674	0.397	1.437	0.217	0.237	0.414	5.063	0.730
Other food products n.e.c. (1089)	1.936	0.563	1.700	0.585	0.235	0.547	5.688	0.815
Meat and poultry meat products (1013)	1.596	0.328	1.380	0.113	0.217	0.337	5.400	0.545
Other processed and preserved fruit and vegetables (1039)	1.551	0.421	1.344	0.359	0.206	0.457	5.599	0.698
Processed and preserved meat (1011)	1.655	0.412	1.460	0.185	0.194	0.397	6.094	0.664
Fruit and vegetable juices (1032)	1.608	0.241	1.452	0.247	0.156	0.343	5.992	0.414
Large$_{ft}$	1.880	0.481	1.431	0.281	0.449	0.530	5.547	0.503
Processed and preserved fish, crustaceans and molluscs (1020)	1.752	0.205	1.642	0.196	0.110	0.283	5.609	0.721
Oils and fats (1041)	2.400	0.534	2.310	0.533	0.083	0.536	6.315	1.198
Prepared pet foods (1092)	2.091	0.473	2.066	0.487	0.025	0.439	6.022	0.564
Ice cream (1052)	1.692	0.222	1.660	0.345	0.029	0.354	5.405	0.575
Prepared feeds for farm animals (1091)	2.568	0.567	2.773	0.698	−0.206	0.733	6.169	0.709
Total	**1.845**	**0.514**	**1.529**	**0.503**	**0.316**	**0.540**	**5.744**	**0.785**

D Additional Results

Table D.1: Correlation matrix of instrumental variables

	$\text{Inst}_{ft}^{U^M}$	$\text{Inst}_{ft}^{U^X}$	$\text{Inst}_{ft}^{\theta,M}$	$\text{Inst}_{ft}^{\theta,X}$
$\text{Inst}_{ft}^{U^M}$	1.0000			
$\text{Inst}_{ft}^{U^X}$	0.1293	1.0000		
$\text{Inst}_{ft}^{\theta,M}$	0.0209	−0.0124	1.0000	
$\text{Inst}_{ft}^{\theta,X}$	−0.0147	0.0276	0.4345	1.0000

Table D.2: Firm's position in GVCs and Firm prices: alternative instrumentation strategies

	IV								
	1^{st} stage		2^{nd} stage	1^{st} stage		2^{nd} stage	1^{st} stage		2^{nd} stage
	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Price}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Price}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Price}_{fjkt}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Panel A: $GVC_{ft}(\text{Inst}^{U^M}_{ft})$ $\theta_{ft}(\text{Inst}^{\theta,X}_{ft})$			**Panel B**: $GVC_{ft}(\text{Inst}^{U^X}_{ft})$ $\theta_{ft}(\text{Inst}^{\theta,X}_{ft})$			**Panel C**: $GVC_{ft}(\text{Inst}^{U^X}_{ft})$ $\theta_{ft}(\text{Inst}^{\theta,M}_{ft})$		
$\text{Inst}^{U^M}_{ft}$	-0.0229^{***}	0.0003							
	(0.0026)	(0.0032)							
$\text{Inst}^{\theta,X}_{ft}$	-0.0036^{***}	0.0549^{***}		-0.0015	0.0581^{***}				
	(0.0012)	(0.0017)		(0.0012)	(0.0017)				
$\text{Inst}^{U^X}_{ft}$				0.0083^{***}	0.0009		0.0071^{***}	0.0049^{***}	
				(0.0008)	(0.0009)		(0.0009)	(0.0010)	
$\text{Inst}^{\theta,M}_{ft}$							-0.0009	0.0223^{***}	
							(0.0011)	(0.0011)	
$(U^M_{ft} - U^X_{ft})$			-1.4988^{***}			-0.7239			-1.0095^{*}
			(0.5039)			(0.5294)			(0.6126)
ln Productivity$_{ft}(\theta_{ft})$			-0.8422^{***}			-0.7179^{***}			-0.5431^{***}
			(0.0967)			(0.0762)			(0.1306)
Firm size:									
Small$_{ft}$	reference	reference	reference	reference	reference	reference	reference	reference	reference
Medium$_{ft}$	0.0208^{***}	-0.5334^{***}	-0.4046^{***}	0.0188^{***}	-0.5585^{***}	-0.3760^{***}	0.0253^{***}	-0.5713^{***}	-0.2834^{***}
	(0.0042)	(0.0123)	(0.0527)	(0.0039)	(0.0123)	(0.0452)	(0.0040)	(0.0127)	(0.0774)
Large$_{ft}$	0.0543^{***}	-0.8511^{***}	-0.7038^{***}	0.0505^{***}	-0.8670^{***}	-0.6552^{***}	0.0627^{***}	-0.8674^{***}	-0.4951^{***}
	(0.0063)	(0.0193)	(0.0814)	(0.0063)	(0.0190)	(0.0715)	(0.0063)	(0.0192)	(0.1198)
Observations	267,461	267,461	267,461	290,444	290,444	290,444	283,635	283,635	283,635
R^2	0.891	0.953	0.611	0.874	0.948	0.614	0.882	0.947	0.613
F-stat	40.9448	40.9448		47.8573	47.8573		32.6240	32.6240	
Endogeneity test (p-value)			0.0000			0.0000			0.0001
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Robust standard errors clustered at the product-destination level are reported in parentheses. Significance levels are denoted as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table D.3: Firm's position in GVCs and Firm prices: residual-based approach with bootstrap standard errors

	GVC decomposition		Residual-based specification				GVC decomposition		Residual-based specification			
	IV		OLS	IV			IV		OLS	IV		
	1^{st} stage	2^{nd} stage		1^{st} stage		2^{nd} stage	1^{st} stage	2^{nd} stage		1^{st} stage		2^{nd} stage
	θ_{ft}	$U^M_{ft} - U^X_{ft}$	$\ln \text{Price}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Price}_{fjkt}$	θ_{ft}	$U^M_{ft} - U^X_{ft}$	$\ln \text{Price}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Price}_{fjkt}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\text{Inst}^{\theta,X}_{ft}$	0.0582^{***}											
	(0.0017)											
$\text{Inst}^{\theta,M}_{ft}$				0.0031^{**}	0.0280^{***}		0.0225^{***}			0.0021^{*}	0.0247^{***}	
				(0.0014)	(0.0016)		(0.0011)			(0.0013)	(0.0014)	
$\text{Inst}^{U^M}_{ft}$				-0.0241^{***}	-0.0008					-0.0195^{***}	-0.0015	
				(0.0026)	(0.0033)					(0.0027)	(0.0032)	
$\hat{\varepsilon}^{U^M_{ft} - U^X_{ft}}$			-0.0207^{*}			-1.5331^{**}			-0.0163			-1.8665^{**}
			(0.0118)			(0.6143)			(0.0124)			(0.8059)
ln Productivity$_{ft}(\theta_{ft})$		-0.0221	-0.0403^{***}			-0.3195^{*}		0.0546	-0.0397^{***}			-0.4824^{**}
		(0.0206)	(0.0102)			(0.1920)		(0.0483)	(0.0105)			(0.2181)
Firm size:												
Small$_{ft}$	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference
Medium$_{ft}$	-0.5586^{***}	0.0063	-0.0195	0.0059	-0.5422^{***}	-0.1583	-0.5612^{***}	0.0497^{*}	-0.0233	0.0023	-0.5273^{***}	-0.2474^{**}
	(0.0123)	(0.0123)	(0.0167)	(0.0042)	(0.0125)	(0.1060)	(0.0125)	(0.0278)	(0.0172)	(0.0042)	(0.0122)	(0.1182)
Large$_{ft}$	-0.8671^{***}	0.0308^{*}	-0.1274^{***}	0.0053	-0.8564^{***}	-0.3515^{**}	-0.8577^{***}	0.1036^{**}	-0.1277^{***}	0.0002	-0.8356^{***}	-0.4858^{***}
	(0.0190)	(0.0187)	(0.0279)	(0.0063)	(0.0194)	(0.1636)	(0.0190)	(0.0419)	(0.0279)	(0.0065)	(0.0190)	(0.1846)
Observations	290,444	290,444	290,444	261,359	261,359	261,359	288,417	288,417	288,417	268,712	268,712	268,712
R^2	0.948	0.874	0.613	0.125	0.953	0.611	0.947	0.882	0.615	0.101	0.952	0.614
F-stat	1132.2645			40.6388	40.6388		408.4895			23.8433	23.8433	
Endogeneity test (p-value)		0.7814				0.0000		0.1095				0.0000
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Bootstrap standard errors are reported in parentheses. Significance levels are denoted as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table D.4: Firm's position in GVCs and Firm prices: estimates with Olley-Pakes TFP

	OLS		IV						
			1^{st} stage			2^{nd} stage	1^{st} stage		2^{nd} stage
	$\ln \text{Price}_{fjkt}$	$\ln \text{Price}_{fjkt}$	U^M_{ft}	U^X_{ft}	θ_{ft}	$\ln \text{Price}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Price}_{fjkt}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\text{Inst}^{U^M}_{ft}$			-0.0203^{***}	-0.0007	-0.0075^{***}		-0.0192^{***}	-0.0073^{***}	
			(0.0022)	(0.0014)	(0.0023)		(0.0026)	(0.0023)	
$\text{Inst}^{\theta,X}_{ft}$			-0.0047^{***}	-0.0026^{***}	0.0679^{***}		-0.0019	0.0680^{***}	
			(0.0009)	(0.0008)	(0.0016)		(0.0012)	(0.0016)	
$\text{Inst}^{U^X}_{ft}$			0.0105^{***}	0.0042^{***}	0.0038^{***}				
			(0.0009)	(0.0005)	(0.0009)				
U^M_{ft}	-0.0249^{**}					-1.6127^{**}			
	(0.0106)					(0.6805)			
U^X_{ft}	0.0023					3.3041			
	(0.0317)					(2.1354)			
$(U^M_{ft} - U^X_{ft})$		-0.0222^{**}							-1.5439^{**}
		(0.0102)							(0.6012)
$\ln \text{Productivity}_{ft}(\theta_{ft})$	-0.1047^{***}	-0.1052^{***}				-0.6026^{***}			-0.6630^{***}
	(0.0143)	(0.0143)				(0.0935)			(0.0751)
Firm size:									
Small_{ft}	reference	reference	reference	reference	reference	reference	reference	reference	reference
Medium_{ft}	0.0017	0.0020	0.0144^{***}	-0.0111^{***}	0.0068^{**}	0.0758^{**}	0.0254^{***}	0.0067^{*}	0.0555^{**}
	(0.0136)	(0.0136)	(0.0037)	(0.0016)	(0.0035)	(0.0363)	(0.0042)	(0.0035)	(0.0222)
Large_{ft}	-0.0759^{***}	-0.0759^{***}	0.0553^{***}	-0.0026	0.1105^{***}	0.0903^{*}	0.0576^{***}	0.1103^{***}	0.0882^{**}
	(0.0240)	(0.0240)	(0.0059)	(0.0023)	(0.0067)	(0.0476)	(0.0064)	(0.0067)	(0.0447)
Observations	298,359	298,359	259,978	259,978	259,978	259,978	259,978	259,978	259,978
R^2	0.616	0.616	0.925	0.979	0.983	0.612	0.896	0.983	0.612
F-stat			4.0372	4.0372	4.0372		28.7059	28.7059	
Endogeneity test (p-value)						0.0000			0.0000
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Robust standard errors clustered at the product-destination level are reported in parentheses. Significance levels are denoted as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table D.5: Firm's position in GVCs and Firm prices: estimates with Olley-Pakes TFP and Bootstrap standard errors

	OLS		IV						
			1^{st} stage			2^{nd} stage	1^{st} stage		2^{nd} stage
	$\ln \text{Price}_{fjkt}$	$\ln \text{Price}_{fjkt}$	U^M_{ft}	U^X_{ft}	θ_{ft}	$\ln \text{Price}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Price}_{fjkt}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\text{Inst}^{U^M}_{ft}$			-0.0203^{***}	-0.0007	-0.0075^{***}		-0.0192^{***}	-0.0073^{***}	
			(0.0022)	(0.0014)	(0.0023)		(0.0026)	(0.0023)	
$\text{Inst}^{\theta,X}_{ft}$			-0.0047^{***}	-0.0026^{***}	0.0679^{***}		-0.0019	0.0680^{***}	
			(0.0009)	(0.0008)	(0.0016)		(0.0012)	(0.0016)	
$\text{Inst}^{U^X}_{ft}$			0.0105^{***}	0.0042^{***}	0.0038^{***}				
			(0.0009)	(0.0005)	(0.0009)				
U^M_{ft}	-0.0249^{**}					-1.6127^{*}			
	(0.0120)					(0.8847)			
U^X_{ft}	0.0023					3.3041			
	(0.0329)					(2.9117)			
$(U^M_{ft} - U^X_{ft})$		-0.0222^{**}							-1.5439^{**}
		(0.0113)							(0.7697)
$\ln \text{Productivity}_{ft}(\theta_{ft})$	-0.1047^{***}	-0.1052^{***}				-0.6026^{***}			-0.6630^{***}
	(0.0159)	(0.0159)				(0.1098)			(0.0792)
Firm size:									
Small_{ft}	reference	reference	reference	reference	reference	reference	reference	reference	reference
Medium_{ft}	0.0017	0.0020	0.0144^{***}	-0.0111^{***}	0.0068^{**}	0.0758	0.0254^{***}	0.0067^{*}	0.0555^{**}
	(0.0155)	(0.0156)	(0.0037)	(0.0016)	(0.0035)	(0.0463)	(0.0042)	(0.0035)	(0.0275)
Large_{ft}	-0.0759^{***}	-0.0759^{***}	0.0553^{***}	-0.0026	0.1105^{***}	0.0903	0.0576^{***}	0.1103^{***}	0.0882
	(0.0274)	(0.0274)	(0.0059)	(0.0023)	(0.0067)	(0.0597)	(0.0064)	(0.0067)	(0.0554)
Observations	298,359	298,359	259,978	259,978	259,978	259,978	259,978	259,978	259,978
R^2	0.616	0.616	0.925	0.979	0.983	0.612	0.896	0.983	0.612
F-stat			4.0372	4.0372	4.0372		28.7059	28.7059	
Endogeneity test (p-value)						0.0000			0.0000
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Bootstrap standard errors are reported in parentheses. Significance levels are denoted as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table D.6: Firm's position in GVCs and Firm prices: upstreamness from GTAP database

	OLS	IV					
		1^{st} stage		2^{nd} stage	1^{st} stage		2^{nd} stage
	$\ln \text{Price}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Price}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Price}_{fjkt}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\text{Inst}^{\theta,M}_{ft}$		0.0099^{***}	0.0247^{***}				
		(0.0012)	(0.0014)				
$\text{Inst}^{U^M}_{ft}$		-0.0187^{***}	-0.0015		-0.0187^{***}	0.0003	
		(0.0022)	(0.0032)		(0.0021)	(0.0032)	
$\text{Inst}^{\theta,X}_{ft}$					0.0035^{***}	0.0549^{***}	
					(0.0009)	(0.0017)	
$(U^M_{ft} - U^X_{ft})$	-0.0327^{***}			-2.0039^{***}			-1.8306^{***}
	(0.0098)			(0.6457)			(0.6054)
$\ln \text{Productivity}_{ft}(\theta_{ft})$	-0.0405^{***}			0.1633			-0.6274^{***}
	(0.0088)			(0.3051)			(0.0976)
Firm size:							
Small_{ft}	reference	reference	reference	reference	reference	reference	reference
Medium_{ft}	-0.0231	0.0085^{***}	-0.5273^{***}	0.1058	0.0035	-0.5334^{***}	-0.3147^{***}
	(0.0144)	(0.0031)	(0.0122)	(0.1654)	(0.0032)	(0.0123)	(0.0551)
Large_{ft}	-0.1248^{***}	0.0393^{***}	-0.8356^{***}	0.1321	0.0372^{***}	-0.8511^{***}	-0.5342^{***}
	(0.0248)	(0.0056)	(0.0190)	(0.2750)	(0.0056)	(0.0193)	(0.0956)
Observations	299,917	268,712	268,712	268,712	267,461	267,461	267,461
R^2	0.616	0.890	0.952	0.614	0.885	0.953	0.611
F-stat		20.4586	20.4586		36.6143	36.6143	
Endogeneity test (p-value)				0.0000			0.0000
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Robust standard errors clustered at the product-destination level are reported in parentheses. Significance levels are denoted as follows: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table D.7: Vertical integration and export quantities

	OLS	IV											
		1^{st} stage		2^{nd} stage	1^{st} stage		2^{nd} stage	1^{st} stage		2^{nd} stage	1^{st} stage		2^{nd} stage
	$\ln \text{Q}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Q}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Q}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Q}_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	$\ln \text{Q}_{fjkt}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
		Panel A:	$GVC_{ft}(\text{Inst}^{U^M}_{ft})$ $\theta_{ft}(\text{Inst}^{\theta,M}_{ft})$		**Panel B**:	$GVC_{ft}(\text{Inst}^{U^X}_{ft})$ $\theta_{ft}(\text{Inst}^{\theta,M}_{ft})$		**Panel C**:	$GVC_{ft}(\text{Inst}^{U^M}_{ft})$ $\theta_{ft}(\text{Inst}^{\theta,X}_{ft})$		**Panel D**:	$GVC_{ft}(\text{Inst}^{U^X}_{ft})$ $\theta_{ft}(\text{Inst}^{\theta,X}_{ft})$	
$\text{Inst}^{U^M}_{ft}$		-0.0196^{***}	-0.0015					-0.0229^{***}	0.0003				
		(0.0027)	(0.0032)					(0.0026)	(0.0032)				
$\text{Inst}^{\theta,M}_{ft}$		0.0035^{***}	0.0247^{***}		-0.0009	0.0223^{***}							
		(0.0013)	(0.0014)		(0.0011)	(0.0011)							
$\text{Inst}^{U^X}_{ft}$					0.0071^{***}	0.0049^{***}					0.0083^{***}	0.0009	
					(0.0009)	(0.0010)					(0.0008)	(0.0009)	
$\text{Inst}^{\theta,X}_{ft}$								-0.0036^{***}	0.0549^{***}		-0.0015	0.0581^{***}	
								(0.0012)	(0.0017)		(0.0012)	(0.0017)	
$(U^M_{ft} - U^X_{ft})$	0.0409			3.8935^{***}			3.6035^{**}			3.2942^{***}			2.4441^{*}
	(0.0249)			(1.5039)			(1.6827)			(1.2547)			(1.4455)
$\ln \text{Productivity}_{ft}(\theta_{ft})$	0.0706^{***}			0.6838			1.0060^{***}			2.0946^{***}			1.8587^{***}
	(0.0217)			(0.4292)			(0.3465)			(0.2349)			(0.1919)
Firm size:													
Small_{ft}	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference
Medium_{ft}	0.0221	0.0233^{***}	-0.5273^{***}	0.2490	0.0253^{***}	-0.5713^{***}	0.4671^{**}	0.0208^{***}	-0.5334^{***}	0.9940^{***}	0.0188^{***}	-0.5585^{***}	0.9475^{***}
	(0.0353)	(0.0041)	(0.0122)	(0.2484)	(0.0040)	(0.0127)	(0.2040)	(0.0042)	(0.0123)	(0.1289)	(0.0039)	(0.0123)	(0.1140)
Large_{ft}	0.2592^{***}	0.0582^{***}	-0.8356^{***}	0.5300	0.0627^{***}	-0.8674^{***}	0.8464^{***}	0.0543^{***}	-0.8511^{***}	1.7391^{***}	0.0505^{***}	-0.8670^{***}	1.6349^{***}
	(0.0626)	(0.0063)	(0.0190)	(0.4095)	(0.0063)	(0.0192)	(0.3159)	(0.0063)	(0.0193)	(0.2020)	(0.0063)	(0.0190)	(0.1824)
Observations	299,917	268,712	268,712	268,712	283,635	283,635	283,635	267,461	267,461	267,461	290,444	290,444	290,444
R^2	0.679	0.894	0.952	0.682	0.882	0.947	0.678	0.891	0.953	0.680	0.874	0.948	0.677
F-stat		23.8433	23.8433		32.6240	32.6240		40.9448	40.9448		47.8573	47.8573	
Endogeneity test (p-value)				0.0000			0.0016			0.0000			0.0000
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Robust standard errors clustered at the product-destination level are reported in parentheses. Significance levels are denoted as follows: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table D.8: Vertical integration, markup and marginal cost: bootstrap standard errors

	OLS	IV			OLS	IV		
		1^{st} stage		2^{nd} stage		1^{st} stage		2^{nd} stage
	ln Markup$_{fjkt}$	$U_{ft}^{M} - U_{ft}^{X}$	θ_{ft}	ln Markup$_{fjkt}$	ln MC$_{fjkt}$	$U_{ft}^{M} - U_{ft}^{X}$	θ_{ft}	ln MC$_{fjkt}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Inst$_{ft}^{U^M}$		-0.0151^{***}	-0.0019			-0.0151^{***}	-0.0019	
		(0.0026)	(0.0032)			(0.0026)	(0.0033)	
Inst$_{ft}^{\theta,M}$		0.0039^{***}	0.0249^{***}			0.0039^{***}	0.0249^{***}	
		(0.0013)	(0.0014)			(0.0012)	(0.0013)	
$(U_{ft}^{M} - U_{ft}^{X})$	-0.0225			-2.5701^{**}	0.0013			0.2026
	(0.0142)			(1.2545)	(0.0080)			(0.5779)
ln Productivity$_{ft}(\theta_{ft})$	0.2503^{***}			1.2348^{***}	-0.2911^{***}			-1.4934^{***}
	(0.0119)			(0.3283)	(0.0070)			(0.1537)
Firm size:								
Small$_{ft}$	reference	reference	reference	reference	reference	reference	reference	
Medium$_{ft}$	-0.1567^{***}	0.0233^{***}	-0.5275^{***}	0.4236^{**}	0.1332^{***}	0.0233^{***}	-0.5275^{***}	-0.5024^{***}
	(0.0212)	(0.0041)	(0.0122)	(0.1990)	(0.0132)	(0.0040)	(0.0117)	(0.0927)
Large$_{ft}$	-0.2690^{***}	0.0572^{***}	-0.8359^{***}	0.6916^{**}	0.1413^{***}	0.0572^{***}	-0.8359^{***}	-0.8578^{***}
	(0.0326)	(0.0063)	(0.0190)	(0.3340)	(0.0180)	(0.0063)	(0.0179)	(0.1555)
Observations	298,452	267,279	267,279	267,279	298,452	267,279	267,279	267,279
R^2	0.739	0.895	0.952	0.744	0.939	0.895	0.952	0.940
F-stat		14.1515	14.1515		14.6057	14.6057		
Endogeneity test (p-value)				0.0000				0.0000
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES	
Firm FE	YES	YES	YES	YES	YES	YES	YES	

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Bootstrap standard errors are reported in parentheses. Significance levels are denoted as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table D.9: Vertical integration, markup and marginal cost: upstreamness from GTAP database

	OLS	IV			OLS	IV		
		1^{st} stage		2^{nd} stage		1^{st} stage		2^{nd} stage
	ln Markup$_{fjkt}$	$U_{ft}^{M} - U_{ft}^{X}$	θ_{ft}	ln Markup$_{fjkt}$	ln MC$_{fjkt}$	$U_{ft}^{M} - U_{ft}^{X}$	θ_{ft}	ln MC$_{fjkt}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Inst$_{ft}^{U^M}$		-0.0188^{***}	-0.0019			-0.0188^{***}	-0.0019	
		(0.0022)	(0.0032)			(0.0022)	(0.0033)	
Inst$_{ft}^{\theta,M}$		0.0100^{***}	0.0249^{***}			0.0100^{***}	0.0249^{***}	
		(0.0012)	(0.0014)			(0.0011)	(0.0013)	
$(U_{ft}^{M} - U_{ft}^{X})$	-0.0740^{***}			-2.1026^{***}	0.0407^{***}			0.1658
	(0.0115)			(0.7700)	(0.0061)			(0.4032)
ln Productivity$_{ft}(\theta_{ft})$	0.2489^{***}			1.6759^{***}	-0.2901^{***}			-1.5282^{***}
	(0.0114)			(0.3618)	(0.0073)			(0.1839)
Firm size:								
Small$_{ft}$	reference	reference	reference	reference	reference	reference	reference	
Medium$_{ft}$	-0.1569^{***}	0.0084^{***}	-0.5275^{***}	0.6141^{***}	0.1333^{***}	0.0084^{***}	-0.5275^{***}	-0.5174^{***}
	(0.0185)	(0.0031)	(0.0122)	(0.1969)	(0.0121)	(0.0031)	(0.0117)	(0.1022)
Large$_{ft}$	-0.2673^{***}	0.0390^{***}	-0.8359^{***}	0.9953^{***}	0.1401^{***}	0.0390^{***}	-0.8359^{***}	-0.8818^{***}
	(0.0296)	(0.0056)	(0.0190)	(0.3279)	(0.0174)	(0.0058)	(0.0179)	(0.1704)
Observations	298,452	267,279	267,279	267,279	298,452	267,279	267,279	267,279
R^2	0.739	0.890	0.952	0.744	0.939	0.890	0.952	0.940
F-stat		20.1317	20.1317		21.3744	21.3744		
Endogeneity test (p-value)				0.0000				0.0000
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES	
Firm FE	YES	YES	YES	YES	YES	YES	YES	

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Robust standard errors clustered at the product-destination level are reported in parentheses. Significance levels are denoted as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table D.10: Vertical integration, markup and marginal cost: upstreamness from GTAP database with bootstrap standard errors

	OLS	IV			OLS	IV		
		1^{st} stage		2^{nd} stage		1^{st} stage		2^{nd} stage
	ln Markup$_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	ln Markup$_{fjkt}$	ln MC$_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	ln MC$_{fjkt}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Inst$^{U^M}_{ft}$		-0.0188^{***}	-0.0019			-0.0188^{***}	-0.0019	
		(0.0022)	(0.0032)			(0.0022)	(0.0033)	
Inst$^{\theta,M}_{ft}$		0.0100^{***}	0.0249^{***}			0.0100^{***}	0.0249^{***}	
		(0.0012)	(0.0014)			(0.0011)	(0.0013)	
$(U^M_{ft} - U^X_{ft})$	-0.0740^{***}			-2.1026^{**}	0.0407^{***}			0.1658
	(0.0130)			(0.9192)	(0.0067)			(0.4585)
ln Productivity$_{ft}(\theta_{ft})$	0.2489^{***}			1.6759^{***}	-0.2901^{***}			-1.5282^{***}
	(0.0116)			(0.4476)	(0.0071)			(0.2230)
Firm size:								
Small$_{ft}$	reference	reference	reference	reference	reference	reference	reference	
Medium$_{ft}$	-0.1569^{***}	0.0084^{***}	-0.5275^{***}	0.6141^{**}	0.1333^{***}	0.0084^{***}	-0.5275^{***}	-0.5174^{***}
	(0.0208)	(0.0031)	(0.0122)	(0.2400)	(0.0132)	(0.0031)	(0.0117)	(0.1216)
Large$_{ft}$	-0.2673^{***}	0.0390^{***}	-0.8359^{***}	0.9953^{**}	0.1401^{***}	0.0390^{***}	-0.8359^{***}	-0.8818^{***}
	(0.0325)	(0.0056)	(0.0190)	(0.3989)	(0.0186)	(0.0058)	(0.0179)	(0.2017)
Observations	298,452	267,279	267,279	267,279	298,452	267,279	267,279	267,279
R^2	0.739	0.890	0.952	0.744	0.939	0.890	0.952	0.940
F-stat		20.1317	20.1317		21.3744	21.3744		
Endogeneity test (p-value)				0.0000				0.0000
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES	
Firm FE	YES	YES	YES	YES	YES	YES	YES	

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Bootstrap standard errors are reported in parentheses. Significance levels are denoted as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table D.11: Vertical integration and markup: alternative instrumentation strategies

	IV								
	1^{st} stage		2^{nd} stage	1^{st} stage		2^{nd} stage	1^{st} stage		2^{nd} stage
	$U^M_{ft} - U^X_{ft}$	θ_{ft}	ln Markup$_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	ln Markup$_{fjkt}$	$U^M_{ft} - U^X_{ft}$	θ_{ft}	ln Markup$_{fjkt}$
	(1)	(2)	(3)	(7)	(8)	(9)	(4)	(5)	(6)
	Panel A: GVC_{ft}(Inst$^{U^M}_{ft}$) θ_{ft}(Inst$^{\theta,X}_{ft}$)			**Panel B**: GVC_{ft}(Inst$^{U^X}_{ft}$) θ_{ft}(Inst$^{\theta,M}_{ft}$)			**Panel C**: GVC_{ft}(Inst$^{U^X}_{ft}$) θ_{ft}(Inst$^{\theta,X}_{ft}$)		
Inst$^{U^M}_{ft}$	-0.0185^{***}	-0.0000							
	(0.0025)	(0.0032)							
Inst$^{\theta,X}_{ft}$	-0.0031^{***}	0.0554^{***}					-0.0010	0.0586^{***}	
	(0.0012)	(0.0018)					(0.0012)	(0.0017)	
Inst$^{U^X}_{ft}$				0.0072^{***}	0.0050^{***}		0.0083^{***}	0.0009	
				(0.0009)	(0.0010)		(0.0008)	(0.0009)	
Inst$^{\theta,M}_{ft}$				-0.0007	0.0224^{***}				
				(0.0011)	(0.0011)				
$(U^M_{ft} - U^X_{ft})$			-2.2482^{***}			-4.6614^{***}			-4.0121^{***}
			(0.7246)			(0.8589)			(0.6873)
ln Productivity$_{ft}(\theta_{ft})$			0.3022^{***}			0.4316^{*}			0.4647^{***}
			(0.1149)			(0.2479)			(0.1221)
Firm size:									
Small$_{ft}$	reference	reference	reference	reference	reference	reference	reference	reference	reference
Medium$_{ft}$	0.0209^{***}	-0.5337^{***}	-0.0816	0.0255^{***}	-0.5716^{***}	0.0505	0.0190^{***}	-0.5589^{***}	0.0268
	(0.0042)	(0.0123)	(0.0623)	(0.0040)	(0.0127)	(0.1512)	(0.0039)	(0.0123)	(0.0734)
Large$_{ft}$	0.0534^{***}	-0.8516^{***}	-0.1114	0.0621^{***}	-0.8677^{***}	0.1596	0.0500^{***}	-0.8675^{***}	0.0999
	(0.0064)	(0.0193)	(0.0958)	(0.0063)	(0.0192)	(0.2311)	(0.0063)	(0.0190)	(0.1146)
Observations	266,082	266,082	266,082	282,225	282,225	282,225	289,036	289,036	289,036
R^2	0.892	0.953	0.744	0.883	0.947	0.740	0.875	0.948	0.739
F-stat	27.4618	27.4618		33.0137	33.0137		48.3507	48.3507	
Endogeneity test (p-value)			0.0004			0.0000			0.0000
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Robust standard errors clustered at the product-destination level are reported in parentheses. Significance levels are denoted as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table D.12: Vertical integration and marginal cost: alternative instrumentation strategies

	IV								
	1^{st} stage		2^{nd} stage	1^{st} stage		2^{nd} stage	1^{st} stage		2^{nd} stage
	$U^M_{ft} - U^X_{ft}$	θ_{ft}	ln MC_{fjkt}	$U^M_{ft} - U^X_{ft}$	θ_{ft}	ln MC_{fjkt}	$U^M_{ft} - U^X_{ft}$	θ_{ft}	ln MC_{fjkt}
	(1)	(2)	(3)	(7)	(8)	(9)	(4)	(5)	(6)
	Panel A: $GVC_{ft}(\text{Inst}^{U^M}_{ft})$ $\theta_{ft}(\text{Inst}^{\theta,X}_{ft})$			**Panel B**: $GVC_{ft}(\text{Inst}^{U^X}_{ft})$ $\theta_{ft}(\text{Inst}^{\theta,M}_{ft})$			**Panel C**: $GVC_{ft}(\text{Inst}^{U^X}_{ft})$ $\theta_{ft}(\text{Inst}^{\theta,X}_{ft})$		
$\text{Inst}^{U^M}_{ft}$	-0.0185^{***}	-0.0000							
	(0.0025)	(0.0032)							
$\text{Inst}^{\theta,X}_{ft}$	-0.0031^{***}	0.0554^{***}					-0.0010	0.0586^{***}	
	(0.0012)	(0.0018)					(0.0012)	(0.0017)	
$\text{Inst}^{U^X}_{ft}$				0.0072^{***}	0.0050^{***}		0.0083^{***}	0.0009	
				(0.0009)	(0.0010)		(0.0008)	(0.0009)	
$\text{Inst}^{\theta,M}_{ft}$				-0.0007	0.0224^{***}				
				(0.0011)	(0.0011)				
$(U^M_{ft} - U^X_{ft})$			0.4588			3.6665^{***}			3.3062^{***}
			(0.3511)			(0.5584)			(0.4287)
ln $\text{Productivity}_{ft}(\theta_{ft})$			-1.1340^{***}			-0.9514^{***}			-1.1691^{***}
			(0.0629)			(0.1763)			(0.0882)
Firm size:									
Small_{ft}	reference	reference	reference	reference	reference	reference	reference	reference	reference
Medium_{ft}	0.0209^{***}	-0.5337^{***}	-0.3117^{***}	0.0255^{***}	-0.5716^{***}	-0.3210^{***}	0.0190^{***}	-0.5589^{***}	-0.3958^{***}
	(0.0042)	(0.0123)	(0.0365)	(0.0040)	(0.0127)	(0.1093)	(0.0039)	(0.0123)	(0.0549)
Large_{ft}	0.0534^{***}	-0.8516^{***}	-0.5718^{***}	0.0621^{***}	-0.8677^{***}	-0.6380^{***}	0.0500^{***}	-0.8675^{***}	-0.7468^{***}
	(0.0064)	(0.0193)	(0.0551)	(0.0063)	(0.0192)	(0.1670)	(0.0063)	(0.0190)	(0.0852)
Observations	266,082	266,082	266,082	282,225	282,225	282,225	289,036	289,036	289,036
R^2	0.892	0.953	0.940	0.883	0.947	0.937	0.875	0.948	0.937
F-stat	27.4618	27.4618		33.0137	33.0137		48.3507	48.3507	
Endogeneity test (p-value)			0.0000			0.0000			0.0000
Product-destination-year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: The constant term is included but not reported for brevity. The sample is based on matched French Customs-AMADEUS data for the period 2002–2017. Observations in the top and bottom 5 percentiles of the quality-adjusted price distribution are excluded. Kleibergen-Paap Wald rk F-stat are reported. Robust standard errors clustered at the product-destination level are reported in parentheses. Significance levels are denoted as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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