Internalizing Global Value Chains: A Firm-Level Analysis

Laura Alfaro
HBS

Pol Antràs
Harvard

Davin Chor
NUS

Paola Conconi
ECARES

Preamble

- Most production processes are sequential: raw materials are converted into basic components, which are then combined with other components to produce more complex inputs, before being assembled into final goods.
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- Growing interest in how the sequential nature of production affects location and organizational decisions of firms.

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- Firm-level tests of the implications of these theories are still sparse.

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  - Combine with U.S. Input-Output Tables to identify firms' integrated vs non-integrated inputs.
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- Sequentiality: Compute a measure of upstreamness of each input i in the production of final good j (from U.S. Input-Output Tables)
- Find strong and robust evidence that firms' propensity to integrate upstream vs downstream inputs depends on the
  - elasticity of demand for the final good
  - profile of contractibility along the value chain

Related Literature

- Theoretical studies on integration vs outsourcing decisions of firms

  Grossman and Hart 1986; Grossman and Helpman 2002, 2005; Antràs 2003; Antràs and Helpman 2004, 2008; Acemoglu, Antràs and Helpman 2007

- Empirical studies testing property-rights theory of firm boundaries

  Yeaple 2006; Nunn and Trefler 2008, 2013; Corcos *et al.* 2013; Defever and Toubal 2013, Díez 2014; Antràs 2015

- Theoretical studies on how the sequential nature of production affects location and organizational decisions of firms

  Harms, Lorz and Urban 2012; Baldwin and Venables 2013; Costinot, Vogel and Wang 2013; Antràs and Chor 2013; Fally and Hillberry 2014

- Empirical studies on firm boundaries based on D&B (and similar datasets)

  Fan and Lang 2000; Acemoglu, Johnson and Mitton 2009; Alfaro and Charlton 2009; Alfaro and Chen 2012; Alfaro, Conconi, Fadinger and Newman 2016; Fajgelbaum, Grossman and Helpman 2014; Del Prete and Rungi 2015

Plan of Talk

1. Introduction and Motivation
2. **Theory**
   - Baseline model
   - The role of contractibility
3. Empirical Setting
   - Data and measures
   - Regression specifications
4. Findings
   - From cross-firm variation
   - From within-firm, cross-input variation
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Model Environment

- Develop a property rights model of firm boundaries in the tradition of Grossman-Hart-Moore.
- Production entails a continuum of uniquely sequenced inputs, $i \in [0, 1]$.
- Each i is sourced from a distinct supplier (facing a marginal cost $c(i)$).

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- Production entails a continuum of uniquely sequenced inputs, $i \in [0, 1]$.
- Each i is sourced from a distinct supplier (facing a marginal cost $c(i)$).
- Suppliers undertake relationship-specific investments to make their components compatible with those of other suppliers in the value chain.
- Division of surplus not (fully) disciplined by ex-ante contracts.
- Suppliers' investments affected by ex-post bargaining power, which is in turn shaped by integration decisions.

The Model

- For a given firm, production in quality-adjusted units of output:

$$q = \left(\int_0^1 (\psi(i) x(i))^\alpha I(i) di \right)^{1/\alpha}, \tag{1}$$

$$I(i) = \begin{cases} 1, & \text{if input } i \text{ is produced after all inputs } i' < i, \\ 0, & \text{otherwise.} \end{cases}$$

where $x(i)$ is the services of compatible stage-i inputs.

- Analogous to Antràs and Chor (2013), but includes $\psi(i)$, reflecting input asymmetries in marginal productivity.
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Two key parameters:

- $\alpha \in (0, 1)$: degree of substitutability between stage inputs
- $\rho \in (0, 1)$: degree of concavity of revenue function $(pq = A^{1-\rho} q^{\rho})$

Incremental Revenue

- Revenue accrued up to stage m:

$$r(m) = A^{1-\rho}\left(\int_0^m (\psi(i)\,x(i))^{\alpha}\, I(i)di\right)^{\frac{\rho}{\alpha}}. \tag{2}$$

- *Incremental marginal revenue* generated at stage m:

$$r'(m) = \frac{\rho}{\alpha}\left(A^{1-\rho}\right)^{\frac{\alpha}{\rho}} r(m)^{\frac{\rho-\alpha}{\rho}} (\psi(m)x(m))^{\alpha}. \tag{3}$$

- How do upstream input services embodied in $r(m)$ affect $r'(m)$?

  Two cases:

  - $\rho > \alpha$: Sequential complements
  - $\rho < \alpha$: Sequential substitutes

Contracting Environment

- Firm specifies integration or outsourcing for each stage before contracting with suppliers.
- Contracts are incomplete. Agents' payoffs are determined in ex-post (generalized) Nash Bargaining.
- Baseline: Bargain with stage-i supplier over the *incremental marginal revenue* at that stage.

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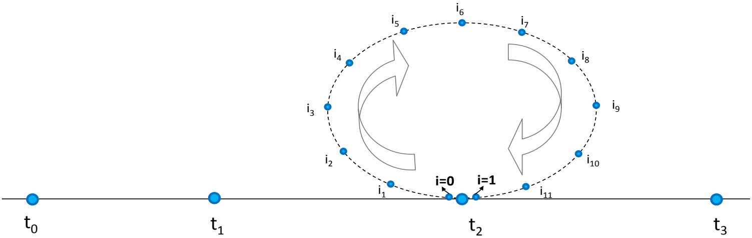
- Baseline: Bargain with stage-i supplier over the *incremental marginal revenue* at that stage.
- Tradeoff: Outsourcing provides supplier with better incentives to invest in compatible inputs, but integration confers the firm a better bargaining position by virtue of her residual rights of control ($\beta_V > \beta_O$).
- Sequentiality: Organizational decisions made upstream have *spillovers on downstream stages*.

Timing of Events



Firm posts **contracts** for each stage i ∈[0,1]

Contract states whether i is integrated or not

Suppliers apply and the firm **selects** one supplier for each i

Sequential production. At each stage i:

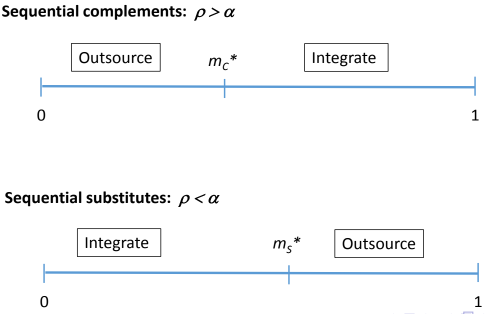
- the supplier is handed the semi-finished good completed up to i;
- after observing its value, the supplier chooses an input level, x(i);
- After observing x(i), the firm and supplier bargain over the supplier's addition to total revenue

Final good assembled and sold to consumers

Core Prediction

The core prediction of Antràs and Chor (2013) is preserved:

- Complements case ($\rho > \alpha$): Greater propensity to integrate *downstream*.
- Substitutes case ($\rho < \alpha$): Greater propensity to integrate *upstream*.
- (Robust to allowing for measurable subsets of exogenously outsourced stages.)



Introducing Contractibility

Mapping $\psi(i)$ to the degree of contractibility of inputs:

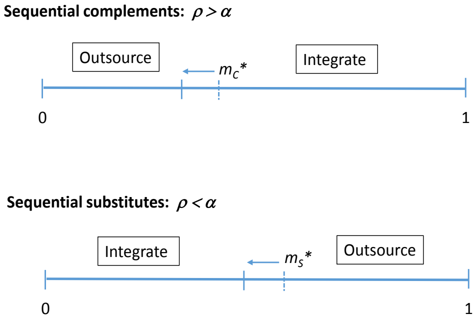
- Let $x(i)$ refer to the non-contractible investments embodied in input i (chosen by supplier i).
- Let $\psi(i)$ refer to contractible investments that can be specified in the initial contract (chosen by the firm at time t_0).
- Per unit contracting costs for specifying $\psi(i)$ are exogenously given by $\psi(i)^{\phi}/\mu(i)$, where $\phi > 1$
- The level of $\psi(i)$ specified in the initial contract is inversely related to $1/\mu(i)$, so long as $\phi > \alpha/(1-\alpha)$.

$\Rightarrow$ Can interpret a high value of $\psi(i)$ as reflecting high contractibility of that stage input.

The Profile of Contractibility

A higher level of "upstream contractibility"

- Complements case: *Greater* propensity to integrate upstream relative to downstream.
- Substitutes case: *Lower* propensity to integrate upstream relative to downstream.



Empirical Predictions

- P.1 (Cross): A firm's propensity to integrate upstream versus downstream inputs should fall with ρ_j. (alternatively, $\rho_j - \alpha_j$).
- P.2 (Cross): A greater degree of contractibility of upstream inputs should decrease a firm's propensity to integrate upstream relative to downstream inputs when the firm is in an industry with low ρ_j. Conversely, it should increase that propensity when the firm is in an industry with a high ρ_j.
- P.2 (Within): The upstreamness of an input should have a smaller effect on the propensity of a firm to integrate that input, the larger is ρ_j.
- P.2 (Within): A greater degree of contractibility of inputs upstream of a given input (relative to the inputs downstream of it) should decrease the propensity of a firm to integrate that input when the firm faces a low demand elasticity. Conversely, it should increase the propensity to integrate that input when the firm faces a high demand elasticity.

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Key Objects to Measure

For each output industry j:

- Identify which are the relevant inputs i in production
- Discern which of inputs are integrated (by firms in j) and which are not
- Determine the relative upstreamness of each input i in j's value chain
- Estimate the elasticity of demand (ρ_j) faced by final-good producers in j
- (Harder) estimate the elasticity of substitution α_j across inputs
- Proxy for the degree of contractibility ψ_i of each input i

Core Dataset: Dun & Bradstreet (D&B) WorldBase

- Comprehensive coverage of establishments in 120 countries (year: 2005)
- Compiled from different sources, including: registers, telephone directory records, websites, self-registration etc.
- Good information of a "business register" nature
  - Each observation has a unique identifier (DUNS number)
  - Name, Location, Global Parent (if any)
  - Up to six 4-digit SIC87 industry activities

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  - Name, Location, Global Parent (if any)
  - Up to six 4-digit SIC87 industry activities
- Extract 320,254 firms from 116 countries with a minimum total employment of 20 and primary SIC activity in manufacturing (*parents*)
- D&B enables us to link each of these to their subsidiaries, including information on country and SIC activities (70,008 *subsidiaries*)
- Average parent has 1.22 establishments; active in 1.05 countries and in 1.95 SIC activities. Details
- 6,370 of these parents are multinationals, i.e., $\geq$ 1 one foreign subsidiary

Merging D&B with Input-Output Data

- Some notation:
  - p to index parent
  - j to index parent *output* industry (primary SIC)
  - i to index SIC *input* industry
  - $S(j)$: set of inputs used in the production of j, i.e., for which the total requirements coefficient, $tr_{ij} > 0$ (from U.S. Input-Output Tables)

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  - $S(j)$: set of inputs used in the production of j, i.e., for which the total requirements coefficient, $tr_{ij} > 0$ (from U.S. Input-Output Tables)
- **Key idea:** View SICs of parent p and all its subsidiaries as inputs that p could in principle obtain within firm boundaries.
  - Call the set of these integrated SICs: $I(p)$.
  - Call the set of non-integrated SICs: $NI(p) = S(j) \setminus I(p)$.

Measuring Upstreamness

In an N-industry economy, accounting for the value of input i that goes into the production of \$1 of output j:

- d_{ij}: Value used directly (1 stage), aka direct requirements coefficient.
- $\sum_{k=1}^{N} d_{ik} d_{kj}$: Value used indirectly (2 stages).
- $\sum_{k=1}^{N} \sum_{l=1}^{N} d_{ik} d_{kl} d_{lj}$: Value used indirectly (3 stages), etc...

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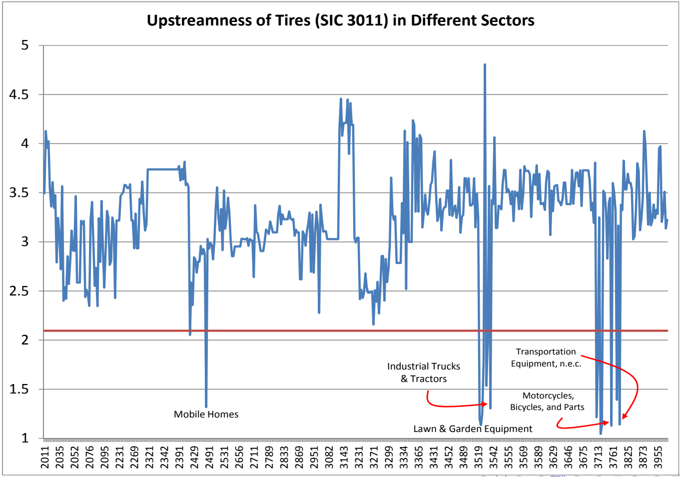
Define the following measure of i's upstreamness in the production of j:

$$upst_{ij} = \frac{d_{ij} + 2\sum_{k=1}^{N} d_{ik} d_{kj} + 3\sum_{k=1}^{N} \sum_{l=1}^{N} d_{ik} d_{kl} d_{lj} + \ldots}{d_{ij} + \sum_{k=1}^{N} d_{ik} d_{kj} + \sum_{k=1}^{N} \sum_{l=1}^{N} d_{ik} d_{kl} d_{lj} + \ldots}$$

- Weighted-average of the number of production stages to get from i to j, with weights proportional to the value of input use that takes the said number of stages.
- Note: Denominator is tr_{ij}.

Measuring Upstreamness: An Illustration

Comparing $upst_{ij}$ (this paper) against the upstreamness of i wrt final demand (from Antràs et al. 2012)



Other Variables

- Elasticity of demand ρ_j faced by final-good producers in j
  - Baseline: import demand elasticities estimated by Broda and Weinstein (2006) for HS10 product categories
  - Also pursue refinements that restrict construction of demand elasticities to consumption and/or capital goods (UN BEC classification)
- Elasticity of substitution α_j across inputs
  - Weighted average of demand elasticity of intermediate goods i used by industry j, with weights proportional to tr_{ij}.
- Input contractibility ψ_i
  - Contractibility follows Nunn (2007): Extent to which production involves the use of HS products classified as homogenous (Rauch 1999)

Regression Specifications: Dependent Variable

- Cross-firm regressions: dependent variable is "ratio-upstreamness":

$$R_{jp} \equiv \frac{\sum_{i \in I(p)} \theta^{I}_{ijp} upst_{ij}}{\sum_{i \in NI(p)} \theta^{NI}_{ijp} upst_{ij}}$$

where $\theta^{I}_{ijp} = tr_{ij} / \sum_{i \in I(p)} tr_{ij}$ and $\theta^{NI}_{ijp} = tr_{ij} / \sum_{i \in NI(p)} tr_{ij}$.

- Upstreamness of a parent's integrated inputs divided by upstreamness of its non-integrated inputs.
- By design, R_{jp} increases the greater is p's propensity to integrate relatively upstream inputs, while outsourcing its more downstream inputs.
- Also consider several variants of R_{jp} ("ever-integrated" inputs; manuf. inputs only; drop parent SIC; ...)

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- Also consider several variants of R_{jp} ("ever-integrated" inputs; manuf. inputs only; drop parent SIC; ...)
- Within-firm regressions: dependent variable is a 0-1 indicator for whether $i \in I(p)$.

Cross-Firm Analysis

$$\log R_{jpc} = \beta_0 + \beta_1 \mathbf{1}(\rho_j > \rho_{med}) + \beta_X X_j + \beta_W W_p + D_c + \epsilon_{jpc}$$

- Baseline uses differences in demand elasticities to distinguish between complements and substitutes cases, following Antràs and Chor (2013)
- Start with a median cutoff: $\beta_1 \mathbf{1}(\rho_j > \rho_{med})$.
  - Theory suggests: $\beta_1 < 0$.

    Propensity to integrate upstream inputs lower for high demand elasticity industries.
- Later use a set of quintile dummies: $\sum_{n=2}^{5} \beta_n \mathbf{1}(\rho_j \in Quint_n(\rho))$
- Additional check: use proxy for α_j to construct $\rho_j - \alpha_j$ (again median cutoff or quintile dummies).

Cross-Firm Analysis

$$\log R_{jpc} = \beta_0 + \beta_1 \mathbf{1}(\rho_j > \rho_{med}) + \beta_X X_j + \beta_W W_p + D_c + \epsilon_{jpc}$$

- X_j: Vector of industry controls ▸ Details
  - Log Nonproduction emp., Equipment capital, Plant capital, Materials (all in per worker terms) from NBER-CES
  - Log (0.001 + R&D expenditures/Sales) from Nunn and Trefler (2013)
- W_p: Vector of firm controls
  - Log number of subsidiaries, Indicator for MNC status, Year started
  - Log total employment, Log sales in USD
- D_c: Parent country fixed effects
- Cluster standard errors by output industry j
- Later introduce interactions with "Upstream Contractibility"

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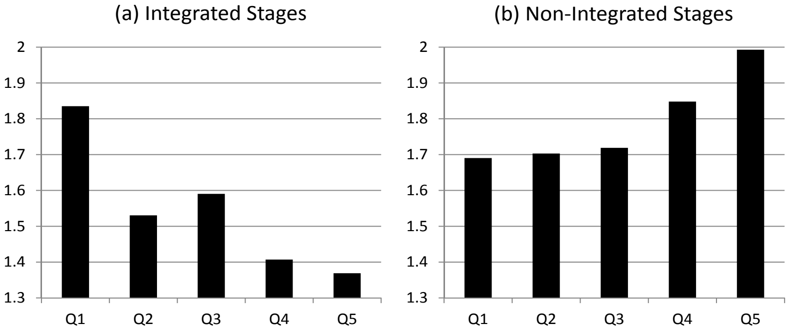
Before the Econometric Results...



- As the elasticity of demand faced by the parent company increases:
  - Upstreamness of integrated inputs declines
  - Upstreamness of non-integrated inputs increases
- Result holds in *cross-firm* and *within-firm* specifications.

Median Cutoff: Negative Coefficient on $\mathbf{1}(\rho_j > \rho_{med})$

Table 1: Upstreamness of Integrated vs Non-Integrated Inputs: Median Elasticity Cutoff

Dependent variable:	Log Ratio-Upstreamness					
	(1)	(2)	(3)	(4)	(5)	(6)
Ind.(Elas$_j$ > Median)	-0.0354*	-0.0612***	-0.0604***	-0.0593***	-0.1138***	-0.1073***
	[0.0204]	[0.0188]	[0.0185]	[0.0215]	[0.0261]	[0.0275]
Log (Skilled Emp./Workers)$_j$		0.0100	0.0091	0.0111	-0.0219	-0.0082
		[0.0243]	[0.0245]	[0.0278]	[0.0360]	[0.0364]
Log (Equip. Capital/Workers)$_j$		0.1139***	0.1120***	0.0808***	0.0835***	0.0960***
		[0.0206]	[0.0202]	[0.0207]	[0.0254]	[0.0262]
Log (Plant Capital/Workers)$_j$		-0.0405*	-0.0397*	-0.0174	-0.0320	-0.0417
		[0.0229]	[0.0225]	[0.0274]	[0.0322]	[0.0317]
Log (Materials/Workers)$_j$		-0.0279	-0.0289	-0.0393*	-0.0059	-0.0129
		[0.0222]	[0.0222]	[0.0229]	[0.0296]	[0.0294]
R&D intensity$_j$		0.0049	0.0039	0.0103	0.0058	0.0024
		[0.0058]	[0.0058]	[0.0074]	[0.0085]	[0.0091]
(Value-added/Shipments)$_j$		-0.1050	-0.1141	-0.0705	0.1683	0.1600
		[0.1278]	[0.1286]	[0.1294]	[0.1587]	[0.1573]
Log (No. of Establishments)$_p$			0.0574***	0.0614***	0.0661***	0.0652***
			[0.0032]	[0.0037]	[0.0049]	[0.0048]
Year Started$_p$			0.0001	0.0001	0.0002*	0.0002**
			[0.0001]	[0.0001]	[0.0001]	[0.0001]
Dummy: Multinational$_p$			0.0102**	0.0147**	0.0259***	0.0286***
			[0.0050]	[0.0065]	[0.0081]	[0.0083]
Log (Total Employment)$_p$			-0.0010	-0.0002	-0.0007	-0.0006
			[0.0016]	[0.0017]	[0.0019]	[0.0020]
Log (Total USD Sales)$_p$			0.0006	0.0000	0.0001	0.0005
			[0.0008]	[0.0010]	[0.0013]	[0.0013]
Elasticity based on:	All goods	All goods	All goods	BEC cons. & cap. goods	BEC cons. goods	BEC cons. & α proxy
Parent country dummies	Y	Y	Y	Y	Y	Y
Observations	316,977	316,977	286,072	206,490	144,107	144,107
No. of industries	459	459	459	305	219	219
R^2	0.0334	0.1372	0.1447	0.1511	0.2051	0.2027

Quintile Cutoff: Stronger Effect in Higher Quintiles of ρ_j

Table 2: Upstreamness of Integrated vs Non-Integrated Inputs: Elasticity Quintiles

Dependent variable:	Log Ratio-Upstreamness					
	(1)	(2)	(3)	(4)	(5)	(6)
Ind.(Quintile 2 $Elas_j$)	-0.0209	-0.0290	-0.0278	-0.0590	-0.0802*	0.0634
	[0.0345]	[0.0319]	[0.0314]	[0.0447]	[0.0474]	[0.0550]
Ind.(Quintile 3 $Elas_j$)	-0.0742**	-0.0802**	-0.0782**	-0.0569	-0.0982**	-0.0379*
	[0.0336]	[0.0316]	[0.0309]	[0.0454]	[0.0429]	[0.0224]
Ind.(Quintile 4 $Elas_j$)	-0.0480	-0.0893***	-0.0881***	-0.1068**	-0.1685***	-0.0942***
	[0.0365]	[0.0337]	[0.0331]	[0.0459]	[0.0457]	[0.0259]
Ind.(Quintile 5 $Elas_j$)	-0.0588	-0.0955***	-0.0947***	-0.1156***	-0.1849***	-0.1026***
	[0.0377]	[0.0325]	[0.0318]	[0.0420]	[0.0459]	[0.0317]
Log (Skilled Emp./Workers)$_j$		0.0080	0.0069	0.0073	-0.0290	-0.0215
		[0.0238]	[0.0239]	[0.0290]	[0.0379]	[0.0386]
Log (Equip. Capital/Workers)$_j$		0.1127***	0.1112***	0.0731***	0.0768***	0.0949***
		[0.0195]	[0.0192]	[0.0183]	[0.0205]	[0.0257]
Log (Plant Capital/Workers)$_j$		-0.0331	-0.0325	-0.0087	-0.0240	-0.0316
		[0.0210]	[0.0207]	[0.0228]	[0.0276]	[0.0290]
Log (Materials/Workers)$_j$		-0.0311	-0.0322	-0.0397*	-0.0099	-0.0190
		[0.0222]	[0.0222]	[0.0237]	[0.0290]	[0.0317]
R&D intensity$_j$		0.0053	0.0044	0.0113	0.0048	0.0017
		[0.0058]	[0.0057]	[0.0070]	[0.0086]	[0.0103]
(Value-added/Shipments)$_j$		-0.1270	-0.1356	-0.0840	0.1725	0.1453
		[0.1295]	[0.1301]	[0.1323]	[0.1699]	[0.1665]
Log (No. of Establishments)$_p$			0.0570***	0.0612***	0.0661***	0.0640***
			[0.0031]	[0.0037]	[0.0047]	[0.0052]
Year Started$_p$			0.0001	0.0001*	0.0002**	0.0003***
			[0.0001]	[0.0001]	[0.0001]	[0.0001]
Dummy: Multinational$_p$			0.0105**	0.0125**	0.0192**	0.0304***
			[0.0048]	[0.0060]	[0.0079]	[0.0085]
Log (Total Employment)$_p$			-0.0003	0.0004	0.0005	-0.0005
			[0.0016]	[0.0017]	[0.0019]	[0.0019]
Log (Total USD Sales)$_p$			0.0003	-0.0004	-0.0003	-0.0001
			[0.0008]	[0.0009]	[0.0011]	[0.0012]

Baseline with Quintile Cutoff (cont.)

Remarks:

- Magnitude of effects larger as we refine the ρ proxy to include information only on final good demand elasticities (UN BEC)
- Coefficient of $\mathbf{1}(\rho_j \in Quint_5(\rho))$: Corresponds to a decrease in the propensity to integrate upstream vs downstream stages of about one standard deviation (Column 5), when moving from Q1 to Q5
- Robust to controlling further for:
  - VI index used in Acemoglu et al. (2009), Alfaro et al. (2016)
  - Share of tr_{ij} that can be obtained from integrated foreign suppliers
  - Country dummy variables for establishment presence
  - Double marginalization motive: Weighted-average demand elasticity of inputs used

Effect of Upstream Contractibility: Empirical Specification

$$\log R_{jpc} = \beta_0 + \beta_1 \mathbf{1}(\rho_j > \rho_{med}) + \beta_{U1}\mathbf{1}(\rho_j < \rho_{med}) \times UpstCont_j + \beta_{U2}\mathbf{1}(\rho_j > \rho_{med}) \times UpstCont_j + \beta_X X_j + \beta_W W_p + D_c + \epsilon_{jpc}, \text{ and}$$

$$\log R_{jpc} = \beta_0 + \sum_{n=2}^{5} \beta_n \mathbf{1}(\rho_j \in Quint_n(\rho)) + \sum_{n=1}^{5} \beta_{Un}\mathbf{1}(\rho_j \in Quint_n(\rho)) \times UpstCont_j + \beta_X X_j + \beta_W W_p + D_c + \epsilon_{jpc}.$$

- Constructing $UpstCont_j$:
  - Contractibility follows Nunn (2007): Extent to which production involves the use of HS products classified as homogenous (Rauch 1999).
  - Then take the total requirements weighted-covariance between the upstreamness and contractibility of manufacturing inputs:

$$UpstCont_j = \sum_{i \in S^m(j)} \theta_{ij}^m \left(upst_{ij} - \overline{upst}_{ij}\right)\left(cont_i - \overline{cont}_i\right)$$

($S^m(j)$ is the set of manufacturing inputs used by j, i.e., $tr_{ij} > 0$.)

Effect of Upstream Contractibility: Empirical Specification

$$\log R_{jpc} = \beta_0 + \beta_1 \mathbf{1}(\rho_j > \rho_{med}) + \beta_{U1}\mathbf{1}(\rho_j < \rho_{med}) \times UpstCont_j + \beta_{U2}\mathbf{1}(\rho_j > \rho_{med}) \times UpstCont_j + \beta_X X_j + \beta_W W_p + D_c + \epsilon_{jpc}, \text{ and}$$

$$\log R_{jpc} = \beta_0 + \sum_{n=2}^{5} \beta_n \mathbf{1}(\rho_j \in Quint_n(\rho)) + \sum_{n=1}^{5} \beta_{Un} \mathbf{1}(\rho_j \in Quint_n(\rho)) \times UpstCont_j + \beta_X X_j + \beta_W W_p + D_c + \epsilon_{jpc}.$$

- In median cutoff regressions, expect:
  - $\beta_{U1} < 0$ and $\beta_{U2} > 0$. Upstream contractibility:

    Raises the propensity to integrate upstream in the complements case...

    ... but lowers it in the substitutes case! (Prediction P.2)

Effect of Upstream Contractibility

Table 3: Effect of Upstream Contractibility: Median Elasticity Cutoff

Dependent variable:	Log Ratio-Upstreamness			
	(1)	(2)	(3)	(4)
Ind.($Elas_j$ > Median)	-0.0910***	-0.1306***	-0.1432***	-0.1372***
	[0.0210]	[0.0256]	[0.0263]	[0.0249]
Upstream Contractibility$_j$				
× Ind.($Elas_j$ < Median)	-0.8943***	-1.1148***	-1.2395***	-1.2195***
	[0.2869]	[0.3838]	[0.4345]	[0.4363]
× Ind.($Elas_j$ > Median)	0.5044***	1.0224***	0.8871***	0.9451***
	[0.1717]	[0.1571]	[0.1505]	[0.1415]
p-value: Q5 at median $UpstCont_j$	[0.0001]	[0.0004]	[0.0000]	[0.0000]
Elasticity based on:	All goods	BEC cons. & cap. goods	BEC cons. goods	BEC cons. & α proxy
Industry controls	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y
Parent country dummies	Y	Y	Y	Y
Observations	286,072	206,490	144,107	144,107
No. of industries	459	305	219	219
R^2	0.1882	0.2609	0.2910	0.2888

Effect of Upstream Contractibility

Table 4: Effect of Upstream Contractibility: Elasticity Quintiles

Dependent variable:	Log Ratio-Upstreamness			
	(1)	(2)	(3)	(4)
Ind.(Quintile 2 $Elas_j$)	-0.0350	-0.0611	-0.0490	0.0763**
	[0.0300]	[0.0396]	[0.0429]	[0.0323]
Ind.(Quintile 3 $Elas_j$)	-0.1104***	-0.0566	-0.0683**	-0.0476**
	[0.0288]	[0.0405]	[0.0328]	[0.0223]
Ind.(Quintile 4 $Elas_j$)	-0.1207***	-0.1605***	-0.1611***	-0.1185***
	[0.0304]	[0.0292]	[0.0277]	[0.0236]
Ind.(Quintile 5 $Elas_j$)	-0.1409***	-0.1760***	-0.1643***	-0.1108***
	[0.0297]	[0.0306]	[0.0292]	[0.0260]
Upstream $Contractibility_j$				
× Ind.(Quintile 1 $Elas_j$)	-1.5540***	-1.5492***	-1.8562***	-0.8114
	[0.4934]	[0.4177]	[0.4446]	[0.5369]
× Ind.(Quintile 2 $Elas_j$)	-0.9810***	-0.5723	-0.6886	-2.0195***
	[0.3165]	[0.5973]	[0.7621]	[0.6896]
× Ind.(Quintile 3 $Elas_j$)	0.3271	-0.3234	-0.4171	0.1796
	[0.2408]	[0.3742]	[0.3855]	[0.1727]
× Ind.(Quintile 4 $Elas_j$)	0.3849	1.0662***	0.6855***	0.9811***
	[0.2867]	[0.2319]	[0.2106]	[0.2565]
× Ind.(Quintile 5 $Elas_j$)	0.7106***	1.0530***	1.1171***	1.0419***
	[0.2148]	[0.2149]	[0.2273]	[0.2275]
p-value: Q5 at median $UpstCont_j$	[0.0000]	[0.0000]	[0.0000]	[0.0005]
Elasticity based on:	All goods	BEC cons. & cap. goods	BEC cons. goods	BEC cons. & α proxy
Industry controls	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y
Parent country dummies	Y	Y	Y	Y
Observations	286,072	206,490	144,107	144,107
No. of industries	459	305	219	219
R^2	0.2204	0.2792	0.3064	0.3191

Robustness:

- Different samples:

  Single-establishment firms; Small firms (emp. $\geq$ 10); MNCs ▸ Details

- Alternative constructions of ratio-upstreamness ▸ Details
- Additional firm and industry controls ▸ Details
- Alternative contractibility measures ▸ Details
- Multi-industry parents ▸ Details

Within-Firm Analysis: Empirical Specification

Start with:

$$D\_INT_{ijp} = \gamma_0 + \sum_{n=1}^{5} \gamma_n \mathbf{1}(\rho_j \in Quint_n(\rho)) \times upst_{ij} + \gamma_S \mathbf{1}(i = j) + D_i + D_p + \epsilon_{ijp}$$

- Expand the dataset to the parent firm by SIC input level
- LHS: Indicator variable, D_INT_{ijp}, for whether parent firm p with output industry j has input i within firm boundaries
- Estimate as a linear probability model
- To make sure LHS variable not too sparse:
    - Focus on parents that have integrated at least one manufacturing input $i \neq j$
    - For each p, include the top 100 manufacturing inputs i by tr value

      (Covers between 88-98% of the tr value of the output industry)

Within-Firm Analysis: Empirical Specification

Start with:

$$D\_INT_{ijp} \quad = \quad \gamma_0 + \sum_{n=1}^{5} \gamma_n \mathbf{1}(\rho_j \in Quint_n(\rho)) \times upst_{ij} + \gamma_S \mathbf{1}(i = j) + D_i + D_p + \epsilon_{ijp}$$

- $\mathbf{1}(i = j)$: Self-SIC dummy
- D_p: Parent firm fixed effects
- D_i: SIC input fixed effects
- Cluster standard errors by i-j pair
- Theory suggests: $\gamma_1 > 0$ and $\gamma_5 < 0$.

  Propensity to integrate should be decreasing with $upst_{ij}$ most strongly in the complements case.

Within-Firm Regression Results

Table 8: Integration Decisions within Firms (Top 100 Inputs): Elasticity Quintiles

Dependent variable:	Indicator variable: Input Integrated?				
	(1)	(2)	(3)	(4)	(5)
Upstreamness$_{ij}$					
× Ind.(Quintile 1 Elas$_j$)	-0.0056***	0.0005	-0.0034**	0.0011	0.0030***
	[0.0009]	[0.0014]	[0.0016]	[0.0015]	[0.0011]
× Ind.(Quintile 2 Elas$_j$)	-0.0085***	-0.0001	-0.0038	0.0002	-0.0010
	[0.0019]	[0.0035]	[0.0035]	[0.0033]	[0.0027]
× Ind.(Quintile 3 Elas$_j$)	-0.0100***	-0.0001	-0.0018	0.0019	-0.0008
	[0.0012]	[0.0027]	[0.0026]	[0.0025]	[0.0046]
× Ind.(Quintile 4 Elas$_j$)	-0.0098***	0.0084***	0.0024	0.0064***	0.0070***
	[0.0021]	[0.0024]	[0.0016]	[0.0017]	[0.0019]
× Ind.(Quintile 5 Elas$_j$)	-0.0113***	0.0054*	0.0024	0.0059***	0.0060***
	[0.0021]	[0.0028]	[0.0019]	[0.0020]	[0.0020]
Contractibility up to i (in prod. of j)					
× Ind.(Quintile 1 Elas$_j$)		0.0234***	0.0217***	0.0108**	0.0157***
		[0.0052]	[0.0048]	[0.0049]	[0.0049]
× Ind.(Quintile 2 Elas$_j$)		0.0339***	0.0261***	0.0117	0.0047
		[0.0128]	[0.0093]	[0.0100]	[0.0073]
× Ind.(Quintile 3 Elas$_j$)		0.0365***	0.0304***	0.0146*	0.0132
		[0.0082]	[0.0080]	[0.0082]	[0.0141]
× Ind.(Quintile 4 Elas$_j$)		0.0669***	0.0398***	0.0239***	0.0254***
		[0.0157]	[0.0086]	[0.0086]	[0.0088]
× Ind.(Quintile 5 Elas$_j$)		0.0685***	0.0456***	0.0304***	0.0322***
		[0.0134]	[0.0095]	[0.0093]	[0.0090]
Dummy: Self-SIC	0.9794***	0.9699***	0.9340***	0.9313***	0.9313***
	[0.0018]	[0.0028]	[0.0085]	[0.0085]	[0.0085]
Log (Total Requirements$_{ij}$)				0.0055***	0.0054***
				[0.0009]	[0.0008]
p-value: Contractibility up to i, Quintile 1 minus Quintile 5	—	[0.0015]	[0.0217]	[0.0559]	[0.1000]
Elasticity based on:	BEC cons.	BEC cons.	BEC cons.	BEC cons.	BEC cons. & α proxy
Firm fixed effect	Y	Y	Y	Y	Y
Input industry i fixed effects	N	N	Y	Y	Y
Observations	4,707,722	4,707,722	4,707,722	4,707,722	4,707,722
No. of parent firms	46,992	46,992	46,992	46,992	46,992
No. of i-j pairs	21,836	21,836	21,836	21,836	21,836
R^2	0.5342	0.5359	0.5594	0.5598	0.5599

- Effect of $upst_{ij}$:

  Propensity to integrate upstream inputs falls for higher elasticity quintiles

Within-Firm Analysis: Empirical Specification (cont.)

Specification with Contractibility up to i:

$$\begin{aligned} D\_INT_{ijp} &= \gamma_0 + \sum_{n=1}^{5} \gamma_n \mathbf{1}(\rho_j \in Quint_n(\rho)) \times upst_{ij} \\ &+ \sum_{n=1}^{5} \delta_n \mathbf{1}(\rho_j \in Quint_n(\rho)) \times ContUpToi_{ij} + \gamma_S \mathbf{1}(i = j) + D_i + D_p + \epsilon_{ijp} \end{aligned}$$

- "Contractibility up to i in prod. of j"

$$ContUpToi_{ij} = \frac{\sum_{k \in S_i^m(j)} tr_{kj} cont_k}{\sum_{k \in S^m(j)} tr_{kj} cont_k}$$

  where $S_i^m(j) = \{k : upst_{kj} \geq upst_{ij}\}$ is the set of manufacturing inputs used by j upstream of and including i.

- Expect $\delta_1 < 0$ and $\delta_5 > 0$. $ContUpToi_{ij}$ would raise the propensity to integrate any given stage in the complements case but would reduce it in the substitutes case

Within-Firm Regression Results

Table 8: Integration Decisions within Firms (Top 100 Inputs): Elasticity Quintiles

Dependent variable:	Indicator variable: Input Integrated?				
	(1)	(2)	(3)	(4)	(5)
Upstreamness$_{ij}$					
× Ind.(Quintile 1 Elas$_j$)	-0.0056***	0.0005	-0.0034**	0.0011	0.0030***
	[0.0009]	[0.0014]	[0.0016]	[0.0015]	[0.0011]
× Ind.(Quintile 2 Elas$_j$)	-0.0085***	-0.0001	-0.0038	0.0002	-0.0010
	[0.0019]	[0.0035]	[0.0035]	[0.0033]	[0.0027]
× Ind.(Quintile 3 Elas$_j$)	-0.0100***	-0.0001	-0.0018	0.0019	-0.0008
	[0.0012]	[0.0027]	[0.0026]	[0.0025]	[0.0046]
× Ind.(Quintile 4 Elas$_j$)	-0.0098***	0.0084***	0.0024	0.0064***	0.0070***
	[0.0021]	[0.0024]	[0.0016]	[0.0017]	[0.0019]
× Ind.(Quintile 5 Elas$_j$)	-0.0113***	0.0054*	0.0024	0.0059***	0.0060***
	[0.0021]	[0.0028]	[0.0019]	[0.0020]	[0.0020]
Contractibility up to i (in prod. of j)					
× Ind.(Quintile 1 Elas$_j$)		0.0234***	0.0217***	0.0108**	0.0157***
		[0.0052]	[0.0048]	[0.0049]	[0.0049]
× Ind.(Quintile 2 Elas$_j$)		0.0339***	0.0261***	0.0117	0.0047
		[0.0128]	[0.0093]	[0.0100]	[0.0073]
× Ind.(Quintile 3 Elas$_j$)		0.0365***	0.0304***	0.0146*	0.0132
		[0.0082]	[0.0080]	[0.0082]	[0.0141]
× Ind.(Quintile 4 Elas$_j$)		0.0669***	0.0398***	0.0239***	0.0254***
		[0.0157]	[0.0086]	[0.0086]	[0.0088]
× Ind.(Quintile 5 Elas$_j$)		0.0685***	0.0456***	0.0304***	0.0322***
		[0.0134]	[0.0095]	[0.0093]	[0.0090]
Dummy: Self-SIC	0.9794***	0.9699***	0.9340***	0.9313***	0.9313***
	[0.0018]	[0.0028]	[0.0085]	[0.0085]	[0.0085]
Log (Total Requirements$_{ij}$)				0.0055***	0.0054***
				[0.0009]	[0.0008]
p-value: Contractibility up to i, Quintile 1 minus Quintile 5	—	[0.0015]	[0.0217]	[0.0559]	[0.1000]
Elasticity based on:	BEC cons.	BEC cons.	BEC cons.	BEC cons.	BEC cons. & α proxy
Firm fixed effect	Y	Y	Y	Y	Y
Input industry i fixed effects	N	N	Y	Y	Y
Observations	4,707,722	4,707,722	4,707,722	4,707,722	4,707,722
No. of parent firms	46,992	46,992	46,992	46,992	46,992
No. of i-j pairs	21,836	21,836	21,836	21,836	21,836
R^2	0.5342	0.5359	0.5594	0.5598	0.5599

- *ContUpToi* matters:
  - (i) Raises propensity to integrate in the complements case
  - (ii) Also does in the substitutes case, but more weakly so
- Robustness: Details

  Single establishment firms; Drop "self-SIC"; Firms with >1 integrated input etc

Plan of Talk

1. Introduction and Motivation
2. Theory
   - Baseline model
   - The role of contractibility
3. Empirical Setting
   - Data and measures
   - Regression specifications
4. Findings
   - From cross-firm variation
   - From within-firm, cross-input variation
5. **Conclusions**

Conclusion

- Production line position matters for firm organizational decisions.
- Available data on the production activities of firms operating in many countries and industries can be combined with information from I-O tables to study the organization of firms along global value chains.
- Evidence from WorldBase confirms that firms are less inclined to integrate upstream production stages as their demand elasticity increases.
- Above patterns are moderated in industries that exhibit greater "upstream contractibility".
  - Importantly: Entire profile of upstream inputs matters, not just the contractibility of the input itself.
  - Upstream contractibility reduces the need to rely on organizational mode to elicit desired effort levels from upstream suppliers to mediate downstream spillovers.

Thanks!

Back-Up Slides

Summary Statistics (Firm-level) ▸ Return

Table A-1: Firm Characteristics

	10th	Median	90th	Mean	Std Dev
A: Firm variables					
Number of Establishments (incl. self)	1	1	1	1.22	3.44
Number of countries (incl. self)	1	1	1	1.05	0.62
Number of integrated SIC codes	1	2	3	1.95	2.21
Year started	1948	1984	1999	1976.84	24.68
Log (Total employment)	3.045	3.807	5.557	4.088	1.080
Log (Sales in USD) (288,627 obs.)	12.522	15.202	17.059	14.803	2.573
MNCs only (6,370 obs.)					
Number of Establishments (incl. self)	2	3	17	8.48	22.74
Number of countries (incl. self)	2	2	6	3.47	3.64
Number of integrated SIC codes	2	5	17	8.10	11.88
Year started	1917	1968	1995	1960.29	33.88
Log (Total employment)	3.912	5.737	8.522	6.031	1.788
Log (Sales in USD) (5,891 obs.)	15.895	17.997	20.934	18.208	1.978

Relevance

First-pass evidence that the information in D&B is relevant in terms of input-output linkages:

- 98.0% of the observed (i, j) pairs in the D&B data have $tr_{ij} > 0$.
- 85.6% of these pairs exceed the median positive tr_{ij} value.
- Similar summary statistics if:
  - restrict to distinct (i, j) pairs within each parent firm.
  - restrict to manufacturing inputs.
  - drop pairs where $i = j$.

Return

Measuring Upstreamness ▸ Return

$$upst_{ij} = \frac{d_{ij} + 2\sum_{k=1}^{N} d_{ik} d_{kj} + 3\sum_{k=1}^{N}\sum_{l=1}^{N} d_{ik} d_{kl} d_{lj} + \ldots}{d_{ij} + \sum_{k=1}^{N} d_{ik} d_{kj} + \sum_{k=1}^{N}\sum_{l=1}^{N} d_{ik} d_{kl} d_{lj} + \ldots}$$

Straightforward to show that:

- $upst_{ij} \geq 1$;
- Numerator of $upst_{ij}$ is the (i,j)-th entry of $[I - D]^{-2} D$; and
- Denominator of $upst_{ij}$ is the (i,j)-th entry of $[I - D]^{-1} D$;

where D is the matrix of d_{ij}'s, and I is the identity matrix.

Use the above properties to compute both $upst_{ij}$ and tr_{ij} from the 1992 U.S. Benchmark Input-Output Tables.

Measuring Upstreamness: Practical Implementation Issues ▸ Return

- Applying the open-economy and net-inventories correction to D; see Antràs et al. 2012.)
- Original industry categories: IO1992
- Compute $upst_{ij}$ and tr_{ij} first for IO1992 codes, and then map to SIC.
- For manufacturing: Each SIC is mapped into by a unique IO1992
- For non-manufacturing: Can have multiple IO1992's mapping to an SIC.
- We focus on global parents whose primary output j is in manufacturing, so the mapping issue matters for non-manufacturing inputs.

  Different treatments considered: (pairwise correlation > 0.98)

  (i) Simple average of $upst_{ij}$ over constituent IO1992 input categories
  (ii) Simple median
  (iii) Random pick
  (iv) tr_{ij} weighted-average

- Separate issue: If an IO1992 input maps into multiple SICs, divide up the tr_{ij} coefficient using a simple average.

Ratio-Upstreamness Measures: Summary statistics

B: From Input-Output Tables					
Total Requirements coefficient	0.000006	0.000163	0.002322	0.001311	0.008026
Baseline Upstreamness measure (mean)	1.838	3.094	4.285	3.097	0.955
C: Ratio-Upstreamness measures					
Baseline (mean)	0.494	0.561	0.691	0.590	0.141
Baseline (random pick)	0.495	0.561	0.692	0.590	0.141
Ever-integrated inputs only	0.583	0.656	0.803	0.692	0.179
Manufacturing inputs only	0.548	0.633	0.798	0.657	0.174
Exclude parent sic, manufacturing only	0.590	1.100	2.128	1.269	0.625

- R_{jp} values tend to be < 1, but this appears to be driven by the parent SIC.
- Correlation between variants is high (typically > 0.8).

  Key exception: When excluding parent SIC, correlation with baseline measures drops to about 0.15.

Return

Summary Statistics (Industry Controls) ▸ Return

Table A-3: Industry Characteristics

	10th	Median	90th	Mean	Std Dev
Import demand elasticity (all codes)	2.300	4.820	20.032	8.569	10.181
Import demand elasticity (BEC cons. & cap.)	1.983	4.500	20.289	8.819	11.722
Import demand elasticity (BEC cons. only)	2.000	4.639	15.992	8.366	11.881
BEC cons. import demand elasticity minus α proxy	-9.086	-4.266	7.783	-1.294	12.314
Log (Skilled Emp./Workers)	-1.750	-1.363	-0.778	-1.308	0.377
Log (Equip. Capital/Workers)	2.869	4.043	5.163	4.039	0.867
Log (Plant Capital/Workers)	2.517	3.302	4.524	3.426	0.755
Log (Materials/Workers)	3.898	4.596	5.681	4.702	0.726
R&D intensity: Log (0.001+ R&D/Sales)	-6.908	-6.097	-3.426	-5.506	1.463
Value-added/Shipments	0.357	0.518	0.660	0.514	0.119
Contractibility	0.091	0.362	0.816	0.410	0.265
Upstream Contractibility	-0.069	0.018	0.101	0.015	0.069

Further Robustness Tests ▸ Return

1. Alternative Samples (single establishment, Global ultimate, MNCs, empl.>=10). ▸ Details

2. Alternative constructions of ratio-upstreamness ▸ Details

3. Additional contractibility measures: ▸ Details

   - Contractibility of j
   - To confirm that it is variation in production line position matters: $\mathbf{1}(\rho_j \in Quint_n(\rho))$ interacted with a tr-weighted variance of the contractibility of inputs used.

4. Secondary manufacturing SIC codes: ▸ Details

   - Restrict to parents with a single SIC output industry
   - Alternatively: Construct R_{jpc} for each output industry j.

     Run a regression with two-way clustering of standard errors by parent firm and by output industry j (Cameron, Gelbach and Miller 2011).

Robustness: Alternative Samples ▶ Return

Table 5: Different Subsamples and Additional Controls

Dependent variable:	Log Ratio-Upstreamness					
	Single estab.	MNC	Robustness to additional controls			
	(1)	(2)	(3)	(4)	(5)	(6)
Ind.(Quintile 2 $Elas_j$)	-0.0461	-0.0870***	-0.0429	-0.0491	-0.0492	-0.0418
	[0.0445]	[0.0288]	[0.0414]	[0.0430]	[0.0403]	[0.0386]
Ind.(Quintile 3 $Elas_j$)	-0.0630*	-0.0787***	-0.0549*	-0.0683**	-0.0532*	-0.0384
	[0.0338]	[0.0279]	[0.0305]	[0.0328]	[0.0308]	[0.0293]
Ind.(Quintile 4 $Elas_j$)	-0.1625***	-0.1103***	-0.1601***	-0.1613***	-0.1437***	-0.1444***
	[0.0284]	[0.0268]	[0.0253]	[0.0277]	[0.0230]	[0.0213]
Ind.(Quintile 5 $Elas_j$)	-0.1638***	-0.1206***	-0.1546***	-0.1642***	-0.1666***	-0.1565***
	[0.0299]	[0.0330]	[0.0269]	[0.0292]	[0.0258]	[0.0233]
Upstream $Contractibility_j$						
× Ind.(Quintile 1 $Elas_j$)	-1.8620***	-1.5014***	-1.6826***	-1.8554***	-1.6147***	-1.4820***
	[0.4612]	[0.3691]	[0.4083]	[0.4451]	[0.3643]	[0.3275]
× Ind.(Quintile 2 $Elas_j$)	-0.7401	0.2330	-0.6775	-0.6876	-0.5599	-0.6227
	[0.8055]	[0.3979]	[0.7338]	[0.7626]	[0.7994]	[0.7701]
× Ind.(Quintile 3 $Elas_j$)	-0.4965	0.2476	-0.5875	-0.4186	-0.4597	-0.6614*
	[0.3919]	[0.2838]	[0.3681]	[0.3854]	[0.4041]	[0.3966]
× Ind.(Quintile 4 $Elas_j$)	0.6749***	0.5686**	0.5891***	0.6850***	0.6457***	0.5434***
	[0.2162]	[0.2484]	[0.1714]	[0.2105]	[0.2157]	[0.1890]
× Ind.(Quintile 5 $Elas_j$)	1.1025***	0.9941***	0.9582***	1.1183***	1.1302***	0.9516***
	[0.2321]	[0.2949]	[0.2165]	[0.2272]	[0.2518]	[0.2393]
Vertical Integration $Index_p$			-1.1296***			-1.1144***
			[0.2065]			[0.2044]
Foreign integrated tr. $share_p$				-1.0690***		-0.2034*
				[0.1330]		[0.1214]
Log (Input $Elasticity)_j$					-0.2999***	-0.2853***
					[0.1099]	[0.1024]
Wtd. Cov. of Input $Elasticity_j$ and $upstreamness_{ij}$					-0.4963***	-0.4330***
					[0.1718]	[0.1555]
p-value: Q5 at median $UpstCont_j$	[0.0000]	[0.0030]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Elasticity based on:	BEC cons.	BEC cons.	BEC cons.	BEC cons.	BEC cons.	BEC cons.
Industry controls	Y	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y	Y
Parent country dummies	Y	Y	Y	Y	Y	Y
Subsidiary country dummies	N	N	N	Y	N	Y
Observations	117,956	2,490	144,107	144,107	144,107	144,107
No. of industries	219	199	219	219	219	219
R^2	0.2990	0.2467	0.3526	0.3079	0.3204	0.3655

Robustness: Alternative R_{jpc}'s ▸ Return

Table 6: Alternative Constructions of Ratio-Upstreamness

Dependent variable:	Random pick	"Ever-Integrated" inputs	Mfg. inputs only	Mfg. inputs only, drop parent SIC
	(1)	(2)	(3)	(4)
Ind.(Quintile 2 $Elas_j$)	-0.0481	-0.0240	-0.0385	-0.0262
	[0.0428]	[0.0413]	[0.0497]	[0.0926]
Ind.(Quintile 3 $Elas_j$)	-0.0687**	-0.0402	-0.0786**	-0.0642
	[0.0329]	[0.0341]	[0.0394]	[0.0514]
Ind.(Quintile 4 $Elas_j$)	-0.1574***	-0.1293***	-0.1825***	-0.1388**
	[0.0277]	[0.0307]	[0.0320]	[0.0661]
Ind.(Quintile 5 $Elas_j$)	-0.1652***	-0.1313***	-0.1762***	-0.2958***
	[0.0303]	[0.0261]	[0.0396]	[0.0934]
Upstream $Contractibility_j$				
× Ind.(Quintile 1 $Elas_j$)	-1.8583***	-0.8338***	-2.1696***	-1.1117*
	[0.4454]	[0.3137]	[0.4819]	[0.5749]
× Ind.(Quintile 2 $Elas_j$)	-0.6960	-0.8880	-0.9343	0.0021
	[0.7602]	[0.7960]	[0.9046]	[0.8379]
× Ind.(Quintile 3 $Elas_j$)	-0.4193	0.0377	-0.2726	-1.8093*
	[0.3873]	[0.4977]	[0.4890]	[0.9849]
× Ind.(Quintile 4 $Elas_j$)	0.6473***	0.9039***	0.8981***	-2.5374***
	[0.2126]	[0.3313]	[0.2504]	[0.7379]
× Ind.(Quintile 5 $Elas_j$)	1.1816***	1.3664***	1.1370***	-0.0754
	[0.2803]	[0.2992]	[0.3822]	[1.1158]
p-value: Q5 at median $UpstCont_j$	[0.0000]	[0.0000]	[0.0000]	[0.0013]
Elasticity based on:	BEC cons.	BEC cons.	BEC cons.	BEC cons.
Industry controls	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y
Parent country dummies	Y	Y	Y	Y
Observations	144,107	144,107	143,846	46,992
No. of industries	219	219	219	218
R^2	0.3059	0.1950	0.3311	0.1216

Robustness: Additional Firm and Industry Controls ▸ Return

Table 5: Different Subsamples and Additional Controls

Dependent variable:	Log Ratio-Upstreamness					
	Single estab.	MNC	Robustness to additional controls			
	(1)	(2)	(3)	(4)	(5)	(6)
Ind.(Quintile 2 $Elas_j$)	-0.0461	-0.0870***	-0.0429	-0.0491	-0.0492	-0.0418
	[0.0445]	[0.0288]	[0.0414]	[0.0430]	[0.0403]	[0.0386]
Ind.(Quintile 3 $Elas_j$)	-0.0630*	-0.0787***	-0.0549*	-0.0683**	-0.0532*	-0.0384
	[0.0338]	[0.0279]	[0.0305]	[0.0328]	[0.0308]	[0.0293]
Ind.(Quintile 4 $Elas_j$)	-0.1625***	-0.1103***	-0.1601***	-0.1613***	-0.1437***	-0.1444***
	[0.0284]	[0.0268]	[0.0253]	[0.0277]	[0.0230]	[0.0213]
Ind.(Quintile 5 $Elas_j$)	-0.1638***	-0.1206***	-0.1546***	-0.1642***	-0.1666***	-0.1565***
	[0.0299]	[0.0330]	[0.0269]	[0.0292]	[0.0258]	[0.0233]
Upstream $Contractibility_j$						
× Ind.(Quintile 1 $Elas_j$)	-1.8620***	-1.5014***	-1.6826***	-1.8554***	-1.6147***	-1.4820***
	[0.4612]	[0.3691]	[0.4083]	[0.4451]	[0.3643]	[0.3275]
× Ind.(Quintile 2 $Elas_j$)	-0.7401	0.2330	-0.6775	-0.6876	-0.5599	-0.6227
	[0.8055]	[0.3979]	[0.7338]	[0.7626]	[0.7994]	[0.7701]
× Ind.(Quintile 3 $Elas_j$)	-0.4965	0.2476	-0.5875	-0.4186	-0.4597	-0.6614*
	[0.3919]	[0.2838]	[0.3681]	[0.3854]	[0.4041]	[0.3966]
× Ind.(Quintile 4 $Elas_j$)	0.6749***	0.5686**	0.5891***	0.6850***	0.6457***	0.5434***
	[0.2162]	[0.2484]	[0.1714]	[0.2105]	[0.2157]	[0.1890]
× Ind.(Quintile 5 $Elas_j$)	1.1025***	0.9941***	0.9582***	1.1183***	1.1302***	0.9516***
	[0.2321]	[0.2949]	[0.2165]	[0.2272]	[0.2518]	[0.2393]
Vertical Integration $Index_p$			-1.1296***			-1.1144***
			[0.2065]			[0.2044]
Foreign integrated tr. $share_p$				-1.0690***		-0.2034*
				[0.1330]		[0.1214]
Log (Input $Elasticity)_j$					-0.2999***	-0.2853***
					[0.1099]	[0.1024]
Wtd. Cov. of Input $Elasticity_j$ and $upstreamness_{ij}$					-0.4963***	-0.4330***
					[0.1718]	[0.1555]
p-value: Q5 at median $UpstCont_j$	[0.0000]	[0.0030]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Elasticity based on:	BEC cons.	BEC cons.	BEC cons.	BEC cons.	BEC cons.	BEC cons.
Industry controls	Y	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y	Y
Parent country dummies	Y	Y	Y	Y	Y	Y
Subsidiary country dummies	N	N	N	Y	N	Y
Observations	117,956	2,490	144,107	144,107	144,107	144,107
No. of industries	219	199	219	219	219	219
R^2	0.2990	0.2467	0.3526	0.3079	0.3204	0.3655

Robustness: Additional Controls (Related to Contractibility)

Return

Dependent variable:	Log Ratio-Upstreamness			
	(1)	(2)	(3)	(4)
Ind.(Quintile 2 Elas_j)	-0.0407	-0.0509	-0.1187	-0.0939
	[0.0443]	[0.0438]	[0.1322]	[0.1350]
Ind.(Quintile 3 Elas_j)	-0.0626**	-0.0695**	-0.4769***	-0.4544***
	[0.0310]	[0.0327]	[0.1176]	[0.1156]
Ind.(Quintile 4 Elas_j)	-0.1576***	-0.1612***	-0.3214***	-0.3214***
	[0.0245]	[0.0278]	[0.1201]	[0.1169]
Ind.(Quintile 5 Elas_j)	-0.1576***	-0.1667***	-0.4507***	-0.4370***
	[0.0268]	[0.0290]	[0.1235]	[0.1221]
"Upstream Contractibility"				
X Ind.(Quintile 1 Elas_j)	-2.3570***	-2.0402***	-1.1739**	-1.6284**
	[0.5742]	[0.5299]	[0.5681]	[0.7426]
X Ind.(Quintile 2 Elas_j)	-1.1561	-0.8466	-0.3054	-0.6615
	[0.9567]	[0.7616]	[0.7066]	[0.8772]
X Ind.(Quintile 3 Elas_j)	-0.8615*	-0.5602	-0.9148**	-1.2697***
	[0.5148]	[0.4718]	[0.3602]	[0.4821]
X Ind.(Quintile 4 Elas_j)	0.2387	0.5423	0.5971**	0.1825
	[0.3747]	[0.3434]	[0.2828]	[0.4461]
X Ind.(Quintile 5 Elas_j)	0.6403*	0.9620***	0.7837***	0.3838
	[0.3713]	[0.3660]	[0.2736]	[0.4025]
Output SIC contractibility, j	-0.1376			-0.1243
	[0.0946]			[0.0932]
Wtd. Avg. input contractibility, j		-0.0973		0.0291
		[0.1706]		[0.1722]
Var. Input contractibility, j X Ind. (Quintile n Elas_j)	N	N	Y	Y
p-value: Q5 at median Upst. Cont.	[0.0000]	[0.0000]	[0.0006]	[0.0006]
Elasticity based on:	BEC cons.	BEC cons.	BEC cons.	BEC cons.
Industry controls?	Y	Y	Y	Y
Firm controls?	Y	Y	Y	Y
Parent country dummies?	Y	Y	Y	Y
Observations	144,107	144,107	144,107	144,107
No. of industries	219	219	219	219
R^2	[illegible]	[illegible]	[illegible]	[illegible]

Multi-industry Parents ▸ Return

Table A-4: Parent Firms with Multiple SIC Output Activities

Dependent variable:	Log Ratio-Upstreamness					
	Single mfg. output SIC		Most downstream mfg. output SIC		Firm by mfg. output SIC (two-way cluster)	
	(1)	(2)	(3)	(4)	(5)	(6)
Ind.(Quintile 2 $Elas_j$)	-0.0419	0.0937***	-0.0385	0.0637*	-0.0476	0.0687**
	[0.0464]	[0.0325]	[0.0413]	[0.0343]	[0.0428]	[0.0331]
Ind.(Quintile 3 $Elas_j$)	-0.1021***	-0.0279	-0.0218	-0.0604**	-0.0362	-0.0629***
	[0.0292]	[0.0235]	[0.0458]	[0.0242]	[0.0398]	[0.0228]
Ind.(Quintile 4 $Elas_j$)	-0.1521***	-0.1046***	-0.1453***	-0.1180***	-0.1642***	-0.1280***
	[0.0305]	[0.0237]	[0.0292]	[0.0261]	[0.0256]	[0.0247]
Ind.(Quintile 5 $Elas_j$)	-0.1521***	-0.0902***	-0.1479***	-0.1120***	-0.1680***	-0.1230***
	[0.0306]	[0.0270]	[0.0315]	[0.0287]	[0.0286]	[0.0264]
Upstream $Contractibility_j$						
× Ind.(Quintile 1 $Elas_j$)	-1.9121***	-0.3997	-1.5441***	-1.2602*	-1.7766***	-1.2353**
	[0.4691]	[0.4808]	[0.4565]	[0.6518]	[0.4150]	[0.6099]
× Ind.(Quintile 2 $Elas_j$)	-0.7892	-2.1371***	-0.4465	-1.6280**	-0.5588	-1.8332***
	[0.7723]	[0.6992]	[0.6290]	[0.6543]	[0.7887]	[0.7036]
× Ind.(Quintile 3 $Elas_j$)	0.1059	0.0528	-0.8717	0.3641**	-0.8416	0.3168*
	[0.2068]	[0.1843]	[0.6070]	[0.1795]	[0.5438]	[0.1813]
× Ind.(Quintile 4 $Elas_j$)	0.6619***	1.0140***	0.6961***	0.9758***	0.6808***	0.9299***
	[0.2346]	[0.2784]	[0.2113]	[0.2560]	[0.2039]	[0.2512]
× Ind.(Quintile 5 $Elas_j$)	1.1166***	1.0096***	1.2292***	1.1572***	1.1637***	1.1215***
	[0.2104]	[0.2307]	[0.2641]	[0.2593]	[0.2544]	[0.2371]
p-value: Q5 at median $UpstCont_j$	[0.0000]	[0.0067]	[0.0001]	[0.0017]	[0.0000]	[0.0001]
Elasticity based on:	BEC cons.	BEC cons. & α proxy	BEC cons.	BEC cons. & α proxy	BEC cons.	BEC cons. & α proxy
Industry controls	Y	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y	Y
Parent country dummies	Y	Y	Y	Y	Y	Y
Observations	97,174	97,174	146,844	146,844	211,232	211,232
No. of industries	219	219	219	219	—	—
R^2	0.3308	0.3471	0.2647	0.2807	0.2881	0.3023

Within-Firm Regressions (Robustness) ▸ Return

Table 9: Integration Decisions within Firms (Top 100 Inputs): Robustness

Dependent variable:	Indicator variable: Input Integrated?				
	Single estab.	# non-self-SIC integ. inputs ≥ 1	# integ. inputs ≥ 3	Drop self-SIC	Contractibility at i
	(1)	(2)	(3)	(4)	(5)
Upstreamness$_{ij}$					
× Ind.(Quintile 1 Elas$_j$)	0.0008	0.0019	0.0020	0.0006	0.0001
	[0.0014]	[0.0022]	[0.0039]	[0.0015]	[0.0014]
× Ind.(Quintile 2 Elas$_j$)	0.0001	0.0006	-0.0038	0.0001	0.0001
	[0.0033]	[0.0055]	[0.0098]	[0.0035]	[0.0033]
× Ind.(Quintile 3 Elas$_j$)	0.0027	0.0041	0.0047	0.0009	0.0017
	[0.0021]	[0.0035]	[0.0059]	[0.0026]	[0.0025]
× Ind.(Quintile 4 Elas$_j$)	0.0063***	0.0108***	0.0115***	0.0068***	0.0055***
	[0.0018]	[0.0026]	[0.0038]	[0.0017]	[0.0018]
× Ind.(Quintile 5 Elas$_j$)	0.0053***	0.0102***	0.0096**	0.0050**	0.0043**
	[0.0018]	[0.0031]	[0.0044]	[0.0023]	[0.0021]
Contractibility up to i (in prod. of j)					
× Ind.(Quintile 1 Elas$_j$)	0.0090*	0.0158**	0.0338***	0.0071	0.0094**
	[0.0046]	[0.0074]	[0.0128]	[0.0049]	[0.0046]
× Ind.(Quintile 2 Elas$_j$)	0.0114	0.0228	0.0271	0.0094	0.0163
	[0.0098]	[0.0166]	[0.0292]	[0.0105]	[0.0108]
× Ind.(Quintile 3 Elas$_j$)	0.0151**	0.0236**	0.0426**	0.0082	0.0176**
	[0.0076]	[0.0114]	[0.0189]	[0.0085]	[0.0084]
× Ind.(Quintile 4 Elas$_j$)	0.0231***	0.0393***	0.0527***	0.0253***	0.0221**
	[0.0088]	[0.0127]	[0.0188]	[0.0086]	[0.0093]
× Ind.(Quintile 5 Elas$_j$)	0.0270***	0.0501***	0.0599***	0.0256***	0.0206**
	[0.0087]	[0.0141]	[0.0200]	[0.0093]	[0.0095]
Dummy: Self-SIC	0.9333***	0.9031***	0.8409***		0.9312***
	[0.0092]	[0.0114]	[0.0165]		[0.0087]
Log (Total Requirements$_{ij}$)	0.0051***	0.0084***	0.0136***	0.0056***	0.0046***
	[0.0008]	[0.0013]	[0.0021]	[0.0008]	[0.0011]
p-value: Contractibility up to i, Quintile 1 minus Quintile 5	[0.0581]	[0.0282]	[0.2540]	[0.0798]	[0.2860]