Backward vs. Forward Integration of Firms in GVCs

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Overview

Motivation

- Production, trade, and investment increasingly organised within **global value chains (GVCs).**
- Different stages of production located **across national borders**.
- **Organizational structure** of global production networks of crucial importance.
- Key integration forms:
  - **Backward integration**: producer owns (upstream) input supplier.
  - **Forward integration**: input supplier owns (downstream) producer.
  - **Independence**: input demand and supply at arm's length.

Motivation

- Related literature focused on backward integration vs. independence.
- Data and anecdotal evidence suggest importance of forward integration:
- ORBIS dataset in 2007-2013:
  - Unique shareholders: 571,636
  - Unique affiliates: 999,531
  - Firm-to-firm links in average year: 12,229,737
  - **Backward integration for 52% of links** (affiliate is in a top-5 supplying country-sector).
  - **Forward integration for 52% of links** (affiliate is in a top-5 buying country-sector).
  - (Some cross-industry overlap in forward/backward integration and buying/supplying.)

Literature

- **Property-rights framework** for firm boundaries of Grossman and Hart (1986).
  - Focus on importance of **ownership rights** as source of power with incomplete contracts.
  - **Core result:** residual rights of control should be assigned to party whose investment contributes most to value of final output.
- **Vertical firm organization:** Nunn and Trefler (2008); Alfaro and Charlton (2009); Alfaro et al. (2016).
- **Organization of value chains:** within and across national borders; McLaren (2000); Antràs and Helpman (2004); Antràs and Chor (2013); Alfaro et al. (2019).

Literature

Recent work focuses on **backward integration**:

- Models of global sourcing (Grossman and Helpman, 2003; Antràs and Helpman, 2004).
- Organizational structure of global production networks (Antràs, 2005).
- Sequential multi-stage production networks (Antràs and Chor, 2013; Alfaro et al., 2019).

Contribution

- We build on model of **forward and backward** integration (Acemoglu et al., 2010).
- Extend model to include fixed integration costs.
- Empirically assess predictions regarding both integration directions.
- Provide evidence for property-rights framework for forward integration.
- Use large cross-country-cross-sector panel dataset on firm-to-firm links.

Model setup

- 2 parties:
  - Supplier (S)
  - Producer (P)
- 3 organizational forms:
  - Backward integration (B)
  - Forward integration (F)
  - Independence (I)

Model setup

Production of final output

$$Y(x_S, e_P^o, e_S^o) = \varphi x_S(pe_P^o + se_S^o + 1) + (1 - \varphi)(pe_P^o + 1), \qquad (1)$$

where

- $x_S \in (0, 1)$ is a customized input.
- φ indicates degree of reliance of final output on customized input; $(1 - \varphi)$ is importance of standard input.
- $e_P^o \geq 0$ and $e_S^o \geq 0$ are (endogenous) investment levels of P and S, respectively.
- p and s are respective marginal products of investment.

Timing

1. P offers organizational form $o \in \{F, I, B\}$ and transfers $T_P^o + T_S^o = 0$.
2. S decides whether to accept the offer.
3. S and P simultaneously decide on investment levels $e_P^o \geq 0, e_S^o \geq 0$.
4. After investments are realized, S and P bargain over shared revenues.

Outside options

To determine Nash-bargaining outcome, define outside options V_i^o under disagreement for player i and organizational form o, with retained-investment shares $\{\lambda^S, \lambda^P\}$ and outside-marketability share of customized input θ under disagreement:

	Producer	Supplier
Forward	0	$Y(x_S = 1, (1-\lambda^P)e_P^F, e_S^F)$
Independence	$Y(x_S = 0, e_P^I, 0)$	$\theta\varphi(se_S^I + 1)$
Backward	$Y(x_S = 1, e_P^B, (1-\lambda^S)e_S^B)$	0

Profits

Gross revenue for each party under each organizational form:

$$y_i^o(e_P^o, e_S^o) = V_i^o + \frac{1}{2}\left(Y(x_S = 1, e_P^o, e_S^o) - V_S^o - V_P^o\right). \tag{2}$$

Profits under fixed costs F_i^o and quadratic investment costs $C_i(e_i^o)$:

$$\pi_i^o = y_i^o - C_i(e_i^o) - F_i^o + T_i^o. \tag{3}$$

Optimal investment

Total surplus

Equilibrium organizational form maximizes total surplus $S^o = \pi_S^o + \pi_P^o$ at optimal investment levels and transfer balancing $T_P^o + T_S^o = 0$:

$$S^F = \frac{1}{2}\varphi s^2 + \frac{\lambda^P}{2}\left(1 - \frac{\lambda^P}{4}\right)p^2 + 1 - F, \tag{4}$$

$$S^I = 1 + \frac{1+\theta}{2}\varphi\left(1 - \left(\frac{1+\theta}{4}\right)\right)s^2 + \left(1 - \frac{\varphi}{2}\right)\left(\frac{1}{2} + \frac{\varphi}{4}\right)p^2, \tag{5}$$

$$S^B = \frac{1}{2}p^2 + 1 + \varphi\frac{\lambda^S}{2}\left(1 - \frac{\lambda^S}{4}\right)s^2 - F. \tag{6}$$

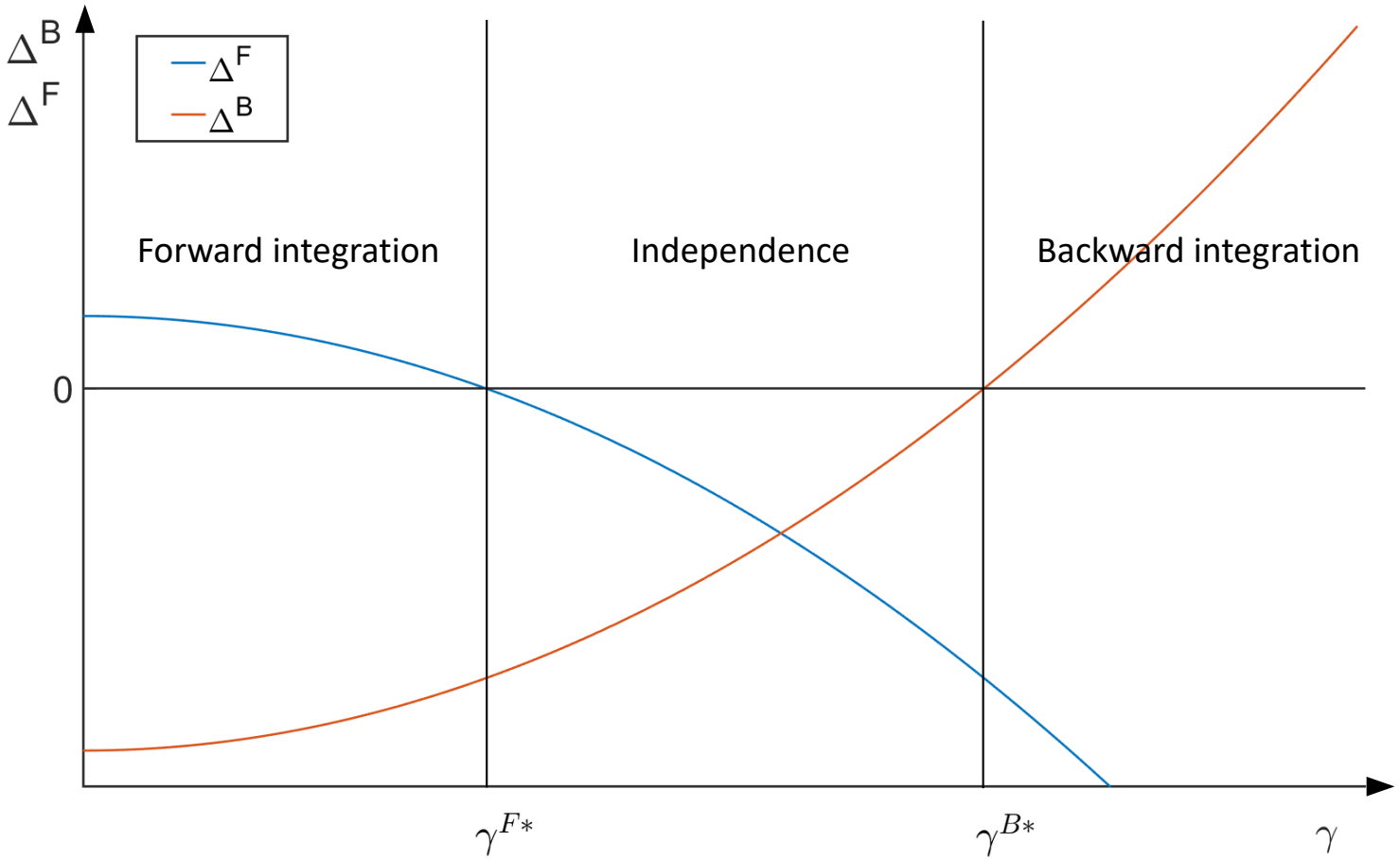
Total surplus

Which organizational form will be chosen depends on joint surplus.
Net profitability of integration relative to independence:

$$\Delta^F = S^F - S^I, \tag{7}$$
$$\Delta^B = S^B - S^I, \tag{8}$$

depends on relative marginal product of investment, $\gamma = \frac{p}{s}$.

Net profitability of integration



Predictions

Prediction 1: $\frac{\partial \Delta^F}{\partial \gamma} < 0$ and $\frac{\partial \Delta^B}{\partial \gamma} > 0$.

- Higher investment intensity of producer rel. to supplier induces backward integration (at $\gamma > \gamma^{B*}$).
- Higher investment intensity of supplier rel. to producer induces forward integration (at $\gamma < \gamma^{F*}$).
- Corollary: shareholders have relatively higher investment intensity than affiliates.

Predictions

Prediction 2: $\frac{\partial \gamma^{F*}}{\partial \theta} < 0$ and $\frac{\partial \gamma^{F*}}{\partial \varphi} > 0$; $\frac{\partial \gamma^{B*}}{\partial \theta} > 0$ and $\frac{\partial \gamma^{B*}}{\partial \varphi} < 0$.

- Marketability of the customized input (θ):
  higher $\theta \Rightarrow$ better outside option for $S \Rightarrow$ larger interval $[\gamma^{F*}, \gamma^{B*}] \Rightarrow$ any form of integration less likely.
- Reliance on customized input for final production (φ):
  higher $\varphi \Rightarrow$ worse outside option for $P \Rightarrow$ smaller interval $[\gamma^{F*}, \gamma^{B*}]$ $\Rightarrow$ any form of integration more likely.

Predictions

Prediction 3: $\frac{\partial \gamma^{F*}}{\partial F} < 0$ and $\frac{\partial \gamma^{B*}}{\partial F} > 0$.

- Fixed costs of integration (F):
  higher F $\Rightarrow$ any integration more costly $\Rightarrow$ larger interval $[\gamma^{F*}, \gamma^{B*}]$
  $\Rightarrow$ any form of integration less profitable/likely.

Predictions

Prediction 4: $\frac{\partial^2 \gamma^{F*}}{\partial F \partial \theta} < 0$ and $\frac{\partial^2 \gamma^{B*}}{\partial F \partial \theta} < 0$.

- Cross-derivative of fixed integration costs and input marketability on $\{\gamma^{B*}, \gamma^{F*}\}$:
  both F and θ shift Δ^F and Δ^B downwards $\Rightarrow$ Δ^F flatter at further-left γ^{F*} and Δ^B steeper at further-right γ^{B*} $\Rightarrow$ increase in θ raises marginal effect of F on Δ^F and reduces it on Δ^B.
- Prediction 4 inherited from quadratic-investment-costs assumption.

ORBIS data on ownership

Annual firm-level data on shareholders and affiliates including ownership relations:

- 7 years in 2007-2013 (t).
- 199 countries (i, j).
- 38 ISIC Rev. 4 non-manufacturing-one-digit and manufacturing-two-digit sectors (r, s).
- Use $\{ri\}$ for affiliates and $\{js\}$ for shareholders.
- $199^2 \cdot 38^2 = 57,183,844$ country-sector-pair cells of potential ownership links per year.
- Pooling over 2007-2013 yields panel dataset of 400,286,908 observations.

ORBIS data on ownership

CF_{ij}^{rs} as the number of affiliate firms in *ri* owned by shareholder firms in *sj* (number of connected firms).

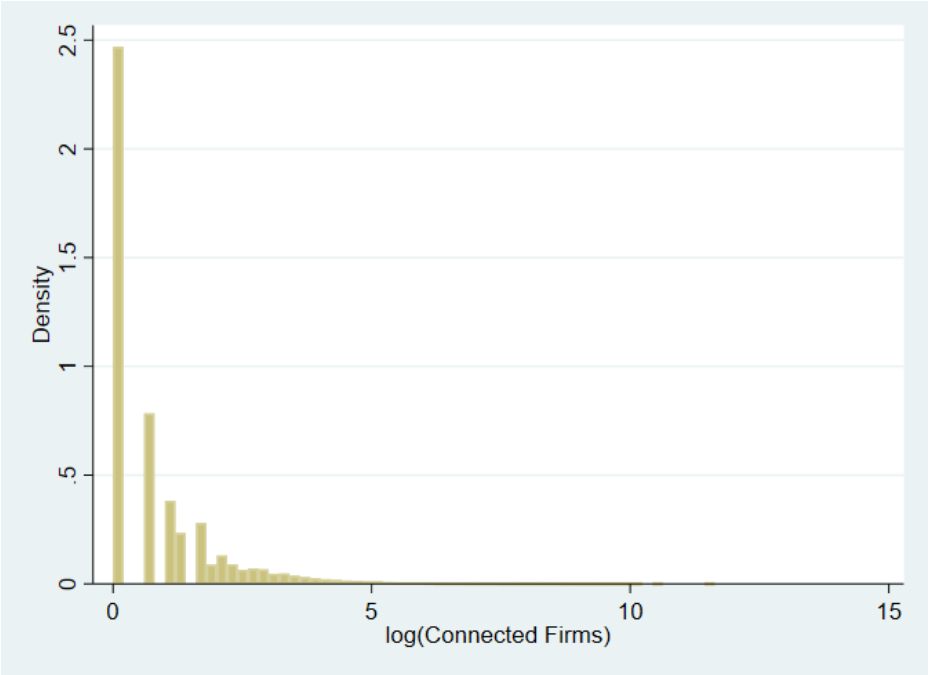


Figure: Number of Connected Firms

World Input-Output Table

Figure: World Input-Output Table - Antràs and Chor (2017)

			Input use & value added							**Final use**			**Total use**
			Country 1			···	Country J			Country 1	···	Country J	
			Industry 1	···	Industry S	···	Industry 1	···	Industry S				
Intermediate inputs supplied	Country 1	Industry 1	Z_{11}^{11}	···	Z_{11}^{1S}	···	Z_{1J}^{11}	···	Z_{1J}^{1S}	F_{11}^{1}	···	F_{1J}^{1}	Y_1^1
		···	···	Z_{11}^{rs}	···	···	···	Z_{1J}^{rs}	···	···	···	···	···
		Industry S	Z_{11}^{S1}	···	Z_{11}^{SS}	···	Z_{1J}^{S1}	···	Z_{1J}^{SS}	F_{11}^{S}	···	F_{1J}^{S}	Y_1^S
	···	···	···	···	···	Z_{ij}^{rs}	···	···	···	···	F_{ij}^{s}	···	Y_j^s
	Country J	Industry 1	Z_{J1}^{11}	···	Z_{J1}^{1S}	···	Z_{JJ}^{11}	···	Z_{JJ}^{1S}	F_{J1}^{1}	···	F_{JJ}^{1}	Y_J^1
		···	···	Z_{J1}^{rs}	···	···	···	Z_{JJ}^{rs}	···	···	···	···	···
		Industry S	Z_{J1}^{S1}	···	Z_{J1}^{SS}	···	Z_{JJ}^{S1}	···	Z_{JJ}^{SS}	F_{J1}^{S}	···	F_{JJ}^{S}	Y_J^S
Value added			VA_1^1	···	VA_1^S	VA_j^s	VA_J^1	···	VA_J^S				
Gross output			Y_1^1	···	Y_1^S	Y_j^s	Y_J^1	···	Y_J^S	···			

Input-output coefficients

- **Input coefficient ($a^{rs}_{j,t} = \frac{\sum_i Z^{rs}_{ij,t}}{Y^s_{j,t}}$):** normalized input purchases by firms in sector-country *sj* and year *t* from input suppliers in *r* (regardless of country of origin).
- **Output coefficient ($b^{rs}_{i,t} = \frac{\sum_j Z^{rs}_{ij,t}}{Y^r_{i,t}}$):** normalized input supply by firms in sector-country *ri* and year *t* to producers in *s* (regardless of country of destination).
- $(\tilde{a^{rs}_j}, \tilde{b^{rs}_i})$ are average coefficients over 2007-2013.

Backward and Forward variables

$$\text{Backward}_j^{rs} = \begin{cases} 1 & \text{if } a_j^{\tilde{rs}} \in \{\text{Top 5 } a_j^{\tilde{rs}} \text{ for js}\}, \\ 0 & \text{otherwise.} \end{cases}$$

Indicates whether affiliate sector *r* is among the top-5 supplying sectors for shareholder-sector-country *sj*.

$$\text{Forward}_j^{rs} = \begin{cases} 1 & \text{if } b_j^{\tilde{rs}} \in \{\text{Top 5 } b_j^{\tilde{rs}} \text{ for sj}\}, \\ 0 & \text{otherwise.} \end{cases}$$

Indicates whether shareholder-sector-country in *sj* are among the top-5 using sectors for affiliate sector *r*.

Measuring investment intensity (γ)

- Proxy γ with relative shareholder/affiliate R&D intensity (expenditures on R&D over total sales of a firm; $r\&d$).
- Use $r\&d^s$ for shareholder-sector s and $r\&d^r$ for affiliate-sector r.
- Define indicator for whether $r\&d^s \geq r\&d^r$:

$$\tilde{\gamma}^{rs} = \begin{cases} 1 & \text{if } r\&d^s \geq r\&d^r, \\ 0 & \text{otherwise.} \end{cases}$$

From Corollary of Prediction 1: expect positive parameter on $\tilde{\gamma}^{rs}$ for backward and forward integration.

Investment intensity (γ). Assessing Prediction 1

Table: R&D Investment Intensity

Number of Firm-to-Firm Connections ($CF^{rs}_{ij,t}$)	(1)	(2)	(3)
Rel. high shareholder R&D intensity ($\tilde{\gamma}^{rs}_t$)	0.689***	0.745***	0.541***
	(0.065)	(0.069)	(0.067)
Backward$^{rs}_j$	0.339***		0.360***
	(0.060)		(0.063)
Backward$^{rs}_j \times \tilde{\gamma}^{rs}_t$	0.560***		0.324***
	(0.075)		(0.079)
Forward$^{rs}_j$		0.327***	0.339***
		(0.051)	(0.057)
Forward$^{rs}_j \times \tilde{\gamma}^{rs}_t$		0.531***	0.281***
		(0.056)	(0.068)
Country-pair FE	✓	✓	✓
Shareholder-country-industry-year FE	✓	✓	✓
Affiliate-country-industry-year FE	✓	✓	✓
Domestic-year FE	✓	✓	✓
Obs.	28,484,832	28,484,832	28,484,832
R^2	0.92838	0.92813	0.93018

Standard errors are clustered at country-industry-pair level and reported in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Competition (θ)

Proxy θ as ratio of total number of firms in downstream sector-country over upstream sector-country:

$$\theta^{rs}_{ij,t} = \begin{cases} \theta^{rsB}_{ij,t} = \dfrac{\#firms^{s}_{j,t}}{\#firms^{r}_{i,t}} & \text{for backward integration,} \\ \\ \theta^{rsF}_{ij,t} = \dfrac{\#firms^{r}_{i,t}}{\#firms^{s}_{j,t}} & \text{for forward integration.} \end{cases}$$

Prediction 2: expect negative parameter on $\theta^{rs}_{ij,t}$ for backward and forward integration.

Competition (θ). Assessing Prediction 2

Table: Competition Effects

Number of Firm-to-Firm Connections ($CF^{rs}_{ij,t}$)	(1)	(2)	(3)
Market thickness of shareholder-to-affiliate industry ($\theta^{rsB}_{ij,t}$)	−0.000023***		−0.000011***
	(0.000)		(0.000)
Backward$^{rs}_{j}$	0.915836***		0.765719***
	(0.054)		(0.046)
Backward$^{rs}_{j}$ × $\theta^{rsB}_{ij,t}$	−0.000218***		−0.000204***
	(0.000)		(0.000)
Market thickness of affiliate-to-shareholder industry ($\theta^{rsF}_{ij,t}$)		0.000012***	0.000015***
		(0.000)	(0.000)
Forward$^{rs}_{j}$		0.802499***	0.624699***
		(0.058)	(0.052)
Forward$^{rs}_{j}$ × $\theta^{rsF}_{ij,t}$		−0.000023***	−0.000026***
		(0.000)	(0.000)
Country-pair FE	✓	✓	✓
Shareholder-country-industry-year FE	✓	✓	✓
Affiliate-country-industry-year FE	✓	✓	✓
Domestic-year FE	✓	✓	✓
Obs.	28,600,089	28,600,089	28,600,089
R^2	0.92432	0.92314	0.92713

Standard errors are clustered at country-industry-pair level and reported in parentheses.

Column (3) also includes Output coef. × θ^B and Input coef. × θ^F as controls.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Input-consumption effects (φ)

Proxy customized-input-reliance parameter φ by share of total input consumption over production:

$$\varphi_{j,t}^{sB} = \sum_{r=1}^{R} a_{j,t}^{rs}$$

$$\varphi_{i,t}^{rF} = \sum_{s=1}^{S} a_{i,t}^{sr}$$

Prediction 2: expect positive parameter on $\varphi_{j,t}^{s}$ for backward and forward integration.

Input-consumption effects (φ). Assessing Prediction 2

Table: Total Input-consumption Effects

Number of Firm-to-Firm Connections ($CF^{rs}_{ij,t}$)	(1)	(2)	(3)
Backward$^{rs}_{j}$	−0.031		−1.109***
	(0.145)		(0.184)
Backward$^{rs}_{j}$ × Rel. importance of inputs for shareholder ($\varphi^{sB}_{j,t}$)	1.985***		1.636***
	(0.266)		(0.225)
Forward$^{rs}_{j}$		−0.102	−0.206
		(0.175)	(0.195)
Forward$^{rs}_{j}$ × Rel. importance of inputs for affiliate ($\varphi^{rF}_{i,t}$)		1.933***	0.941***
		(0.346)	(0.270)
Country-pair FE	✓	✓	✓
Shareholder-country-industry-year FE	✓	✓	✓
Affiliate-country-industry-year FE	✓	✓	✓
Domestic-year FE	✓	✓	✓
Obs.	28,576,343	28,560,530	28,536,807
R^2	0.92498	0.92368	0.92921

Standard errors are clustered at country-industry-pair level and reported in parentheses.

Column (3) also includes Output coef. × φ^B and Input coef. × φ^F as controls.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Fixed integration costs (F)

Proxy a **reduction** of fixed integration costs ($F^{-}1$) by Bilateral Investment Treaty (BIT) coming into force.

$$F_{ij,t}^{-1} = BIT_{ij,t} = \begin{cases} 1 & \text{if a BIT is in force between } i \text{ and } j \text{ in } t, \\ 0 & \text{otherwise.} \end{cases}$$

Prediction 3: expect positive parameter on $F_{ij,t}^{-1}$ for backward and forward integration.

Fixed integration costs (F). Assessing Prediction 3

Table: Fixed-integration-cost Effects

Number of Firm-to-Firm Connections ($CF^{rs}_{ij,t}$)	(1)	(2)	(3)
BIT ($F^{-1}_{ij,t}$)	−0.036	−0.005	−0.053
	(0.030)	(0.031)	(0.034)
Backward$^{rs}_{j}$	0.901***		0.753***
	(0.056)		(0.048)
Backward$^{rs}_{j}$ × $F^{-1}_{ij,t}$	0.267***		0.206***
	(0.047)		(0.044)
Forward$^{rs}_{j}$		0.792***	0.615***
		(0.059)	(0.053)
Forward$^{rs}_{j}$ × $F^{-1}_{ij,t}$		0.172***	0.095**
		(0.048)	(0.045)
Country-pair FE	✓	✓	✓
Shareholder-country-industry-year FE	✓	✓	✓
Affiliate-country-industry-year FE	✓	✓	✓
Domestic-year FE	✓	✓	✓
Obs.	28,600,089	28,600,089	28,600,089
R^2	0.92433	0.92314	0.92711

Standard errors are clustered at country-industry-pair level and reported in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Adding all up. Assessing Predictions 1-3

Table: All paramters

Number of Firm-to-Firm Connections ($CF^{rs}_{ij,t}$)	(1)	(2)	(3)
Rel. high shareholder R&D intensity ($\tilde{\gamma}^{rs}_t$)	0.699***	0.714***	0.515***
	(0.065)	(0.072)	(0.068)
BIT ($F^{-1}_{ij,t}$)	−0.050	−0.024	−0.079**
	(0.031)	(0.032)	(0.034)
Backward$^{rs}_j$	−0.485***		−0.517***
	(0.133)		(0.128)
Market thickness of shareholder-to-affiliate industry ($\theta^{B\,rs}_{ij,t}$)	−0.000***		−0.000***
	(0.000)		(0.000)
Backward$^{rs}_j$ × $\tilde{\gamma}^{rs}_t$	0.524***		0.300***
	(0.074)		(0.076)
Backward$^{rs}_j$ × Rel. importance of inputs for shareholder ($\varphi^{sB}_{j,t}$)	1.753***		1.833***
	(0.249)		(0.238)
Backward$^{rs}_j$ × $F^{-1}_{ij,t}$	0.294***		0.236***
	(0.045)		(0.042)
Backward$^{rs}_j$ × $\theta^{B\,rs}_{ij,t}$	−0.000***		−0.000***
	(0.000)		(0.000)
Forward$^{rs}_j$		−0.824***	−0.683***
		(0.171)	(0.156)
Market thickness of affiliate-to-shareholder industry ($\theta^{F\,rs}_{ij,t}$)		0.000***	0.000***
		(0.000)	(0.000)
Forward$^{rs}_j$ × $\tilde{\gamma}^{rs}_t$		0.599***	0.332***
		(0.058)	(0.065)
Forward$^{rs}_j$ × Rel. importance of inputs for affiliate ($\varphi^{rF}_{i,t}$)		2.373***	2.162***
		(0.342)	(0.303)
Forward$^{rs}_j$ × $F^{-1}_{ij,t}$		0.205***	0.105**
		(0.046)	(0.044)
Forward$^{rs}_j$ × $\theta^{F\,rs}_{ij,t}$		−0.000***	−0.000***
		(0.000)	(0.000)
Country-pair FE	✓	✓	✓
Shareholder-country-industry-year FE	✓	✓	✓
Affiliate-country-industry-year FE	✓	✓	✓
Domestic-year FE	✓	✓	✓
Obs.	28,461,136	28,445,367	28,421,694
R^2	0.92897	0.92897	0.93164

Standard errors are clustered at country-industry-pair level and reported in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Cross-derivative Effects. Assessing Prediction 4

Table: Competition and Fixed-integration-cost Interaction Effects

Number of Firm-to-Firm Connections ($CF^{rs}_{ij,t}$)	(1)	(2)	(3)
BIT ($F^{-1}_{ij,t}$)	−0.050309	−0.022309	−0.074162**
	(0.031)	(0.032)	(0.034)
Rel. high shareholder R&D intensity ($\tilde{\gamma}^{rs}_t$)	0.688817***	0.743656***	0.539057***
	(0.064)	(0.069)	(0.067)
Market thickness of shareholder-to-affiliate industry ($\theta^{Brs}_{ij,t}$)	−0.000013**		−0.000006
	(0.000)		(0.000)
Backward$^{rs}_j$	0.324891***		0.351065***
	(0.061)		(0.064)
Backward$^{rs}_j \times \tilde{\gamma}^{rs}_t$	0.560554***		0.323106***
	(0.075)		(0.079)
Backward$^{rs}_j \times \theta^{Brs}_{ij,t}$	−0.000147***		−0.000183***
	(0.000)		(0.000)
Backward$^{rs}_j \times F^{-1}_{ij,t}$	0.315138***		0.246816***
	(0.048)		(0.046)
Backward$^{rs}_j \times F^{-1}_{ij,t} \times \theta^{Brs}_{ij,t}$	−0.000193***		−0.000201***
	(0.000)		(0.000)
Market thickness of affiliate-to-shareholder industry ($\theta^{Frs}_{ij,t}$)		0.000013***	0.000012***
		(0.000)	(0.000)
Forward$^{rs}_j$		0.320228***	0.334782***
		(0.053)	(0.058)
Forward$^{rs}_j \times \tilde{\gamma}^{rs}_t$		0.533085***	0.284629***
		(0.056)	(0.068)
Forward$^{rs}_j \times \theta^{Frs}_{ij,t}$		−0.000035**	−0.000036**
		(0.000)	(0.000)
Forward$^{rs}_j \times F^{-1}_{ij,t}$		0.212350***	0.121372***
		(0.046)	(0.046)
Forward$^{rs}_j \times F^{-1}_{ij,t} \times \theta^{Frs}_{ij,t}$		0.000022	0.000022
		(0.000)	(0.000)
Country-pair FE	✓	✓	✓
Shareholder-country-industry-year FE	✓	✓	✓
Affiliate-country-industry-year FE	✓	✓	✓
Domestic-year FE	✓	✓	✓
Obs.	28,484,832	28,484,832	28,484,832
R^2	0.92844	0.92818	0.93028

Standard errors are clustered at country-industry-pair level and reported in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Robustness

- **Different definitions of Forward/Backward:** creating Top-H Input$_j^{rs}$ for Backward and Top-H Output$_j^{rs}$ for Forward with H measuring whether a sector is among the H most-important ones with $H \in \{1, ..., 10\}$.
- **Different measure of investment intensity (γ):** using physical-capital-investment intensity (expenditures on physical-capital investment over total sales).
- **Sub-sample of the data:** keeping only the countries included in the WIOT.

Thank You!

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Investment level

Using (3) we can compute the optimal level of investment under each organizational form taking the other party's investment as given:

$$e_S^{F*} = s, e_P^{F*} = \frac{\lambda^P}{2} p, \tag{9}$$

$$e_S^{I*} = \frac{1+\theta}{2} s, e_P^{I*} = (1 - \frac{\varphi}{2}) p, \tag{10}$$

$$e_S^{B*} = \frac{\lambda^S}{2} s, e_P^{B*} = p. \tag{11}$$

back