Vertical Integration, Supplier Behavior, and Quality Upgrading among Exporters

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Introduction

- Why do so many economic transactions occur within firm boundaries (Coase 1937, Antras 2003, Lafontaine Slade 2007)?
- Vertical integration occurs for many different reasons, and motives vary by context

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- Vertical integration occurs for many different reasons, and motives vary by context
- But a particular potential motive—integrating in order to raise output quality—has gained increased relevance in recent decades

- As incomes rise and globalization reduces barriers to trade, many firms experience greater access to wealthier markets

- With opportunities to sell to high willingness-to-pay buyers tend to come rising returns to quality upgrading (Sutton 1991+1998, Hallak 2005, Verhoogen 2008, Manova Zhang 2012)

- But to produce high quality output, firms need high quality inputs (Goldberg et al 2010, Kugler Verhoogen 2012, Halpern et al 2015, Amodio Martinez-Carrasco 2018)...

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- $\rightarrow$ firms' organizational structure may play a crucial role in their ability to meet demand for quality

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- To isolate a direct relationship between output quality objectives and integration, exogenous variation in firm-specific incentives to upgrade quality—firms' *quality premium*—is needed

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  1. Independent and integrated suppliers deliver inputs of hard-to-observe quality to manufacturers. Manufacturers convert into a vertically differentiated but otherwise homogeneous product

  2. Observe the industry's entire chain of production, transactions, and output quality grades

  3. Fluctuations in other countries' demand+supply of high/low quality grades generate frequent variation in quality premium. Affect firms differently depending on their scope for upgrading quality and past export destinations

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4. In conclusion, present suggestive evidence that the integration-quality relationship we identify in Peru may apply more broadly in export manufacturing industries

Related literatures:

1. Causes+consequences of firms' org. structure (OS) in dev'g countries
   - Woodruff 2002, Natividad 2014, Macchiavello Miquel-Florensa 2017, Martinez-Carrasco 2017
   - **New here**:
     - trace out the chain: identify an overlooked force that leads firms to change their OS, but also show *how effective* the OS strategy is at meeting firms' objectives, and *why*
     - focus on particular firm objective: output quality (esp. important ind dev'g countries)
2. Broader literature on boundaries of the firm
   - Gibbons 2005, Lafontaine Slade 2007, Bresnahan Levin 2012, Mullainathan Sharfstein 2001, Baker Hubbard 2003+2004, Forbes Lederman 2009+2010, Breza Liberman 2017, MM 2017
   - **New here**:
     - how firms change their org'l structure when *objectives* change
     - how getting integrated changes a supplier's behavior
     - how vertically integrating causally affects output quality
3. Quality upgrading in firms and economic development
   - Schott 2004, Hallak 2005, Verhoogen 2008, Goldberg et al 2010, Brambilla et al 2012, Bastos et al 2016+++
   - **New here**:
     - linking quality upgrading to the boundaries of the firm

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Background: Sector profile

- Fishmeal is a brown powder made by burning or steaming fish
- During our data period, 2009 to 2016, Peru produced 30% of the world's exports and exported 95% of its production (to many different countries)
- 2009: 94 plants, in 22 towns/ports, owned by 37 firms, supplied by around 800 (independent and firm/plant-owned) boats
- Heterogeneity in firm/plant and boat profile/characteristics. Changes in installed technology are observed in our data, and rare

Background: Product differentiation and quality

- Output quality given by a single—measurable—dimension: protein content. Batches w/ protein content above specified threshold labeled "prime" quality
- Some firms primarily produce high quality grades, others low grades
- Price differentials within quality grade$\times$time period negligible
- *Input* quality difficult to quantify/measure at point of purchase
- But protein content depends crucially on freshness and integrity of the fish (FAO 1986)
- Fish freshness depends on several choices made by the boat's captain before/during a trip (amount of ice, how tighly fish is packed, trip length)

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  - 32 instances of independents acquiring a fishmeal-owned supplier

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  - 32 instances of independents acquiring a fishmeal-owned supplier
  - 50 instances of firm-to-firm sale (also imply pair-level status change)

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  - 103 instances of a fishmeal firm acquiring an independent supplier
  - 32 instances of independents acquiring a fishmeal-owned supplier
  - 50 instances of firm-to-firm sale (also imply pair-level status change)

- Observe not only *ownership* but also *use* of suppliers at time of production. Average share of inputs coming from integrated suppliers ("Share VI"): 45%

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- Observe not only *ownership* but also *use* of suppliers at time of production. Average share of inputs coming from integrated suppliers ("Share VI"): 45%

- Suppliers that get integrated/de-integrated supply the integrating/de-integrating firm/plant almost as often before/after the change in status (63% of trips to firm when not VI, 80% when VI / 45% of trips to most frequent plant when not VI, 40% when VI)

Background: Contracting and supplier incentives

- Captains/crews of VI boats generally are paid a fixed wage, in some cases with a bonus tied to some measure of performance
- Independent captains/crews are paid quantity multiplied by a going price (location$\times$week FEs explain 99% if input price variation)
- Formal contracts over when/where to deliver a catch appear difficult to write: we are not aware of any

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- Intuition: spot market's incentives to produce quantity can lead to actions that are wasteful or harmful to quality (Holmstrom Milgrom 1991)
- In Peruvian fishmeal industry:
  - Fish quality is difficult to ascertain at point of purchase
  - Contracts over where to deliver a catch are difficult to write ex-ante
  - Some firms primarily produce high quality grades, others low grades
- Logic of our model familiar from Baker et al. (2001, 2002), based on integration as asset ownership (Grossman Hart 1986):
  - Independent suppliers have alternative buyers that value quantity and may thus invest in producing quantity to improve their bargaining position
  - Integration can be valuable because it mutes market incentives (Williamson 1971, Holmstrom Milgrom 1994, Gibbons 2005)

- Static game with two actors: suppliers and quality-oriented firms
- Suppliers have quantity-oriented action a_1 and quality-oriented action a_2

$$c(a_1, a_2) = \frac{1}{2}a_1^2 + \frac{1}{2}a_2^2.$$

- a_1, a_2 impact the "quality surplus" Q (if delivering inputs to quality focused firm) and the "quantity surplus" P (some alternative firm):

$$P = a_1$$
$$Q = Q_0 - \gamma a_1 + \delta a_2 \text{ (with } \gamma, \delta > 0)$$

- Neither P nor Q contractible, only P observable
- Alternative firm will provide at least P to ind. supplier
  - Alternative use sets a minimum for ind. supplier when bargaining
  - Ind. supplier chooses $a_1 > 0$ to improve bargaining position with quality oriented firm
    - Even though it lowers the total surplus!
- Vertical integration $\Rightarrow$ firm captures all surplus $\Rightarrow$ alt. use irrelevant
  - Removes incentive to take counter-productive action ($a_1 = 0$)

- Three empirical predictions that we test in the remainder of the paper:
  1. Firms' org'l structure responds to variation in the *relative* profitability of producing high vs low quality. Increase in the quality premium—e.g. due to increased demand for high quality grades—leads to more integration

  2. Reason is that the actions of a supplier change when the supplier is integrated. Suppliers that get integrated reduce their effort to produce quantity, especially in ways that benefit quality

  3. As a result, firms that use inputs from integrated suppliers produce higher quality output

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Data

- **Plant production**. From the regulator (MoP). All plants' monthly production of high and low quality type fishmeal. Audited
- **Plant registry**. Monthly info on (Low and High) tech prod'n capacity, and plant owner. Also use to link exports and production
- **Export transactions**. Universe of exports from customs. Date, export port, destination country, weight, value, exporting firm (not plant)
- (Combine w/ week×export port×protein content level price data recorded by a consulting company to infer *exact* quality grade. Validate the procedure using internal data from a large firm and comparison to directly observed "high quality share of production")
- **Internal data from a large firm**. Internal records on sales and supplier payments. Include info on specific plant that produced a shipment
- **Supply transactions**. MoP records all transactions between plants and boats. Date, boat, plant, amount, (not price), also within-firm
- **Supplier registry**. Owner, wood vs steel, capacity, engine, cooling system
- **Boat GPS data**. Boats transmit GPS signal. MoP store latitude, longitude, speed, direction, ∼each hour. We (but not manufacturers) observe both integrated and independent boats' GPS records

$$\text{Quality}_{it} = \alpha + \beta_1 \text{VI}_{it} + \beta_2 \text{HighTech}_{it} + \gamma_i + \delta_t + \varepsilon_{it}$$

Output quality and number of suppliers owned

Dep. var:	High Quality Share of Prod.		Protein Content	
	(1)	(2)	(3)	(4)
Asinh(Number of suppliers owned)	0.078	0.058	0.220**	0.188**
	(0.061)	(0.039)	(0.086)	(0.069)
High technology share of capacity	No	Yes	No	Yes
Season FEs	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Mean of Dep. Var.	0.75	0.75	65.7	65.7
N	275	275	208	208

Output quality and Share of inputs from VI suppliers

Dep. var:	High Quality Share of Prod.		Protein content	
	(1)	(2)	(3)	(4)
Share of inputs from VI suppliers	0.377**	0.375**	0.982***	1.040***
	(0.166)	(0.164)	(0.293)	(0.283)
High technology share of capacity	No	Yes	No	Yes
Season FEs	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
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Output quality and Share of inputs from VI suppliers

Dep. var:	High Quality Share of Prod.			Protein Content		
	(1)	(2)	(3)	(4)	(5)	(6)
Share of inputs from VI suppliers	0.313*	0.373**	0.313*	1.153**	0.936***	1.190**
	(0.159)	(0.148)	(0.159)	(0.457)	(0.260)	(0.461)
Share of inputs from steel boats	−0.098		−0.092	−1.152		−1.153
	(0.164)		(0.161)	(0.808)		(0.794)
Share of inputs from boats with high capacity	0.152		0.139	0.988		1.036
	(0.166)		(0.164)	(1.003)		(0.976)
Share of inputs from boats with cooling system	0.191		0.202	−0.232		−0.282
	(0.123)		(0.124)	(0.979)		(0.986)
Share of industry's production		−0.807	−0.748		1.799	1.889
		(0.925)	(0.891)		(3.869)	(3.930)
High technology share of capacity	Yes	Yes	Yes	Yes	Yes	Yes
Season FEs	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
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- Robust correlation btw changes in firms' organizational structure and changes in their output quality. VI positively associated with output quality
- Holds measuring VI as *number of suppliers owned* and *share of inputs* from VI suppliers (Share VI)
- A 10 percentage point increase in Share VI is associated with a 3-4% increase in high quality share of production
- Consistent with our hypothesis, but also with other plausible explanations
- In what follows focus primarily on Share VI—useful for a few reasons
  - Consistently defined for both firms and individual plants—allows analysis of VI *within* firm
  - Avoids assumptions on scale effects (2 small boats = 1 large boat?)

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The Quality Premium and Vertical Integration

- Model predicts that VI is efficient organizational structure to produce high quality output
- Empirically, do firms adopt a more vertically integrated structure when incentives to upgrade quality strengthen?
- First show that, *as a whole*, firms
  - **Are not** more likely to integrate suppliers when average fishmeal prices rise
  - **Are** more likely to integrate suppliers when the *Quality Premium*—the relative price of high quality fishmeal—increases

Dep. var:	Share of inputs from VI suppliers (t) - Share of inputs from VI suppliers (t-1)					
	OLS	OLS	OLS	IV	IV	OLS
	(1)	(2)	(3)	(4)	(5)	(6)
Log(Average Price)	0.030					
	(0.052)					
Quality Premium		0.265**				
		(0.114)				
Upgradable share of production (t-1) × Quality premium			3.014**	3.382***	2.591*	
			(1.091)	(1.050)	(1.393)	
Firm specific price (weighted by past production)						−1.225*
						(0.596)
Upgradable share of production (t-1)	No	No	Yes	Yes	Yes	No
Season FEs	No	No	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var.	0.01	0.01	0.01	0.01	0.01	0.01
N	190	190	190	190	190	190
Kleibergen-Paap LM p-value (Under-id)				0.01	0.01	
Kleibergen-Paap Wald F statistic (Weak inst)				38.3	209.1	

- If integration enables quality upgrading, firms producing mostly low quality should see their incentive to VI increase more than firms already producing mostly high quality output when the quality premium rises

- Define USP_{it}: Upgradable share of production at time t

- We estimate:

$$VI_{it} - VI_{it-1} = \alpha + \beta_1 \text{QualityUpgradingIncentives}_{it} + \beta_2 USP_{it-1} + \gamma_i + \delta_t + \varepsilon_{it}$$

with $\text{QualityUpgradingIncentives}_{it} = USP_{it-1} \times \text{Quality Premium}_t$

- Note: control for USP_{it-1} (in addition to γ_i and δ_t)—not a traditional Bartik IV (Goldsmith-Pinkham Sorkin 2018)

- Possible concern: could Quality Premium in Peru be endogenous to individual firms' decisions (on quality and integration)?
- To isolate exogenous variation in upgrading incentives, instrument for $\text{QualityUpgradingIncentives}_{it}$ with
  - Prices in other high quality fishmeal exporter countries (correlate with prices in Peru but not exactly the same—no world price)
  - Or alternatively, total quantities exported by other fishmeal producer countries (typically the result of national quotas. Affect prices of high and low quality fishmeal in Peru)
- Satisfy an exclusion restriction

1st stage

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	OLS	OLS	OLS	IV	IV	OLS
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- When quality premium increases 10%, firm producing only low quality increases its Share VI by 30% more than firm already producing only high quality
- Does not mask an underlying response to *firm-level* average price

- Difficult to reconcile with alternative theories in which higher output quality is an unforeseen by-product of VI driven by other motives
- And with stories wherein organizational structure and output quality are not causally related in the "minds" of firms
- In alt. approach in Appendix, exploit different form of variation, find consistent results: firms VI when faced w/ greater relative *demand* for high quality
  - Exploit fluctuations in demand from high vs low quality importers interacted with Peruvian firms prior export destinations
  - Follows many fruitful applications of such approach in trade lit. (e.g. Park et al 2009, Brambilla et al 2012, Bastos et al 2018, Tintelnot et al 2017)
- $\rightarrow$ *quality upgrading itself is an important motive for integrating suppliers*

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Vertical Integration and Supplier Behavior

- To shed light on *why* firms vertically integrate in order to produce high quality output, consider supplier behavior
- Do suppliers engage in less quantity-increasing-but-quality-decreasing behavior when integrated, as model predicts?
- 3 measures of behavior capture quantity-quality tradeoff (FAO, 1986): total quantity supplied, max. distance from delivery port, total time at sea
- Focus primarily on "switchers". Include supplier$\times$plant FEs
- Recall: suppliers that get integrated/sold deliver to the acquiring/selling firm almost as often *before* getting acquired (/*after* getting sold)

Vertical Integration and Supplier Behavior

- We estimate:

$$B_{ijt} = \alpha + \beta \mathbf{I}[\text{VI} \times \text{supplies owner firm}]_{ijt} + \gamma_{ij} + \delta_t + \varepsilon_{ijt}$$

Identified from all switchers (Independent to VI, VI to Independent and VI to VI)

Dep. var:	Log(Quantity supplied)	Log(Max. distance from the plant's port)	Log(Total time spent at sea)
	(1)	(2)	(3)
I[VI × supplies owner firm]	-0.096^{***}	-0.054^{***}	-0.030^{*}
	(0.023)	(0.019)	(0.016)
Date FEs	Yes	Yes	Yes
Supplier × Plant FEs	Yes	Yes	Yes
N	315,442	137,278	159,724

- When integrated and supplying a parent plant, relative to when supplying the same plant while independent, a boat's manager and crew reduce their effort to produce quantity in ways that benefit input quality

- Consistent with our hypothesis

- But other forms of incentives that arise due to integration could also play a role
  - Perhaps most plausible possibility: associated knowledge transfers (Atalay et al. 2014)

- To investigate: compare *integrated* supplier's behavior when supplying parent firm vs other firms

Identified only from VI switchers changing ownership (VI to VI)			
Dep. var:	Log(Quantity supplied)	Log(Max. distance from the plant's port)	Log(Total time spent at sea)
	(1)	(2)	(3)
I[Always VI $\times$ supplies owner firm]	-0.147^{***}	-0.082^{***}	-0.073^{***}
	(0.027)	(0.026)	(0.023)
Date FEs	Yes	Yes	Yes
Supplier $\times$ Plant FEs	Yes	Yes	Yes
N	315,442	137,274	159,724

- $\rightarrow$ Results consistent with w/ firms VI'ing when attempting to quality upgrade because VI allows better control of the incentives suppliers with a quantity-quality trade-off face

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- In this context, it is integration *per se*—not repeated interactions—that influences a supplier's quality-increasing actions (consistent w/ dynamic version of model). [Model extension and empirical results in paper, not shown here]

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Vertical Integration and Output Quality

- Have shown that firms use VI as a strategy for quality upgrading
- And changes in supplier behavior when get integrated/de-integrated consistent with this strategy achieving changes in input quality that may help increase output quality
- To conclude, show more direct evidence consistent with VI being an *effective* strategy for producing high quality output
- First repeat earlier motivational firm level regressions, now at plant level:

$$\text{Quality}_{it} = \alpha + \beta_1 \text{VI}_{it} + \beta_2 \text{HighTech}_{it} + \gamma_i + \delta_t + \varepsilon_{it}$$

Dep. var:	Impact of Share of VI Inputs on Quality High Quality Share of Production					
	OLS	OLS	IV: Ind. Boats		IV: Wooden Boats	
	(1)	(2)	(3)	(4)	(5)	(6)
Share of inputs from VI suppliers	0.102**	0.064**	0.213***	0.169**	0.160***	0.142**
	(0.038)	(0.030)	(0.080)	(0.068)	(0.060)	(0.060)
Has high technology	No	Yes	No	Yes	No	Yes
Month FEs	Yes	Yes	Yes	Yes	Yes	Yes
Plant FEs	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var.	0.85	0.85	0.85	0.85	0.85	0.85
N	2647	2647	2487	2487	2647	2647

- When a higher fraction of a firm's VI suppliers begins supplying a particular *plant*, the plant starts producing higher quality output
- Holds also when we use internal data from a large firm/in sample of plants all belonging to same firm
- Results imply that plant's "Share high quality" would be 7% higher if parent firm were to integrate all the plant's suppliers

Dep. var:	Plants Within a Major Firm Protein Content			
	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)
Share of inputs from VI suppliers	1.369**	1.338**	1.469*	1.390
	(0.654)	(0.656)	(0.807)	(0.918)
Has high technology	No	Yes	No	Yes
Month FEs	Yes	Yes	Yes	Yes
Plant FEs	Yes	Yes	Yes	Yes
Mean of Dep. Var.	65.8	65.8	65.8	65.8
N	66	66	66	66

- If interpret causally: the use of integrated suppliers directly enables the production of higher quality output
- Plant level findings difficult to reconcile w/ alternative explanations not operating at plant (sub-firm)$\times$month level
- Might plant specific shocks *independently* affect plant's output quality & managers' desire/ability to $\uparrow$ plant's Share VI?
- To investigate, construct an instrument for a plant's Share VI at particular point in time

- IV approach uses current, local presence of independent suppliers as source of variation in a plant's Share VI
  - # of independent boats present
  - Or # of wooden boats (independent by law) present
- A scarcity of independent supplier options mechanically shifts plants toward higher Share VI—even holding quality incentives constant
- Of course, plant's quality objectives may themselves influence independent suppliers' whereabouts $\rightarrow$ use leave-firm-out measures
- Important for interpretation:
  - Strong first stage, expected negative sign
  - Beyond presence of independent suppliers, there is no time-varying, *port level* component of quality

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Month FEs	Yes	Yes	Yes	Yes	Yes	Yes
Plant FEs	Yes	Yes	Yes	Yes	Yes	Yes
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- IV results reaffirm OLS findings
- Recall paper's central finding: firms VI when incentives to produce high *relative to* low quality output rise for exogenous reasons

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Conclusion

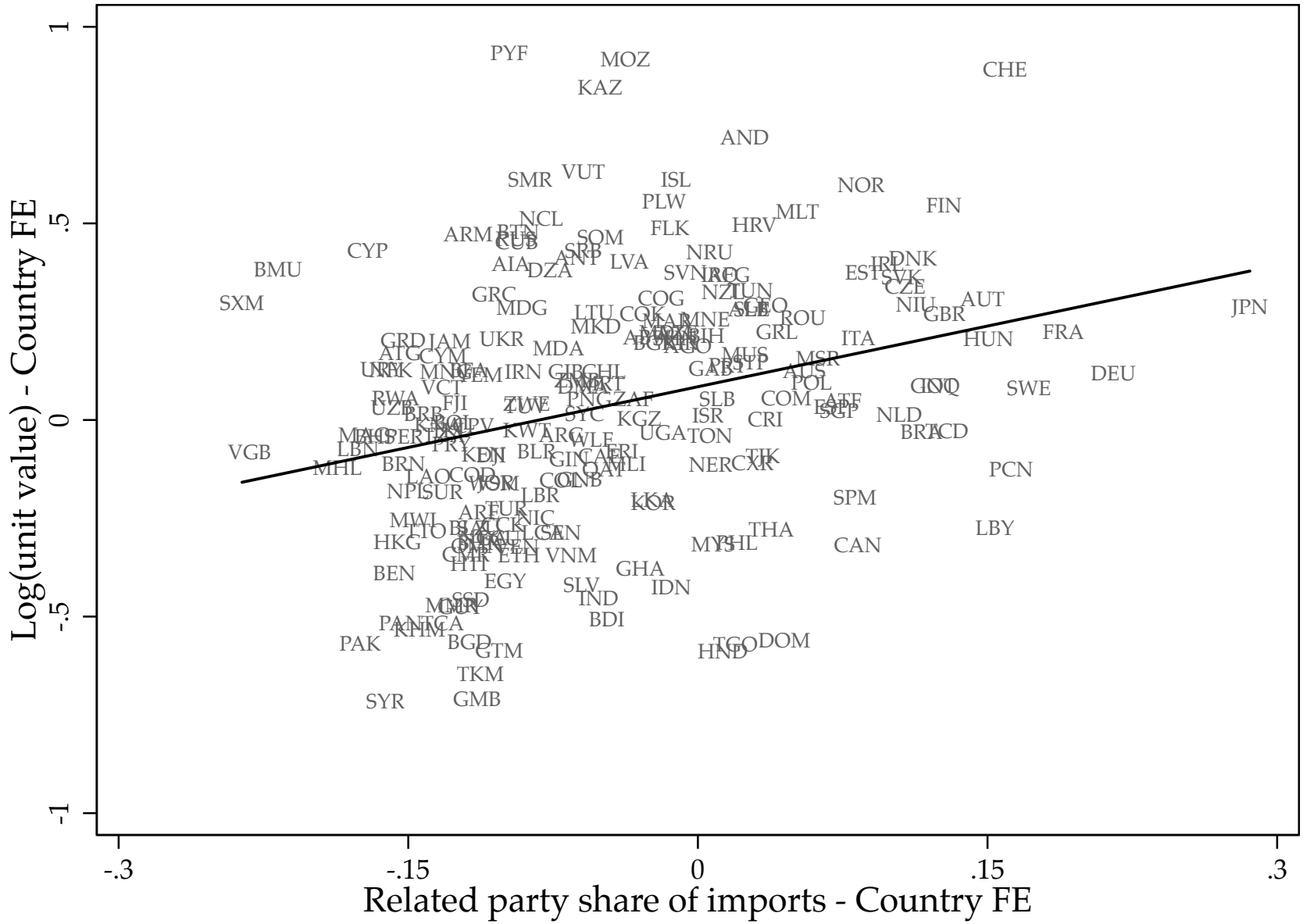
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- Does the integration-quality relationship hold outside of Peru?


Log(unit value) - Country FE
1
.5
0
-.5
-1
-.3
-.15
0
.15
.3
Related party share of imports - Country FE
PYF
MOZ
CHE
KAZ
AND
SMR
VUT
ISL
NOR
PLW
FIN
NCL
MLT
FLK
HRV
ARM
SOM
CYP
NRU
BMU
AIA
DZA
ANP
LVA
DNK
EST
SVK
CZE
SXM
GRC
COG
NZL
AUT
NIU
JPN
MDG
LTU
ROU
GBR
MKD
GRL
ITA
HUN
FRA
JAM
UKR
MDA
DEU
SWE
VCT
SLB
COM
NLD
ISR
CRI
KGZ
VGB
PCN
SPM
LBR
THA
LBY
CAN
HKG
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- Relationship between average unit values of products a country exports to the U.S. and share transacted within "related parties" suggests that our findings **may** reflect a more general relationship in export manufacturing
- Despite VI *overall* being more common among firms in developing world, may thus be that extent of VI there is sub-optimally low, given importance of quality upgrading

THANK YOU!

First Stage

Dep. var:	First Stage: Share of Inputs From VI Suppliers					
	OLS	OLS	IV: Ind. Boats		IV: Wooden Boats	
	(1)	(2)	(3)	(4)	(5)	(6)
Number of Independent Boats in Port (Leave-Out)			−0.001***	−0.001***		
			(0.000)	(0.000)		
Number of Wooden Boats in Port (Leave-Out)					−0.002***	−0.002***
					(0.000)	(0.000)
Kleibergen-Paap LM p-value (Under-id)			0.011	0.011	0.010	0.010
Kleibergen-Paap Wald F statistic (Weak inst)			23.55	23.73	27.69	27.69
Anderson-Rubin Wald test p-value			0.01	0.01	0.01	0.01

Back

Demand for Output Quality and Vertical Integration

- Exploit quality-differentiated firm-specific demand shocks to show that quality a meaningful part of why firms adopt an integrated org'l structure
- Our test relies on two facts about the fishmeal sector:
  - Firms export different qualities to different destinations
  - Firms can change supply strategy in response to demand shocks
- "Demand pull" approach similar to Bastos et al (2016). 2nd & 1st stage:

$$\text{VI}_{it} = \alpha + \beta_1 \text{Quality}_{it} + \gamma_i + \delta_t + \varepsilon_{it}$$

$$\text{Quality}_{it} = \gamma_i + \delta_t + \sum_j \beta_j \ (\text{I}^j_{i2008} \ S^j_{-i,t}) + \varepsilon_{it}$$

- j is a destination country, and $\text{I}^j_{i2008} \ S^j_{-i,t}$ are excluded instruments.
  - I^j_{i2008} is a dummy $=1$ if firm i exported to j in 2008
  - $S^j_{-i,t}$ is the leave-firm-out share of Peru's fishmeal exports going to country j in season t
  - ε_{it} clustered at firm level as above

Demand for Output Quality and Vertical Integration

Dep. var:	Share of inputs from VI suppliers			
	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)
Protein content	0.030***	0.028***	0.128**	0.141***
	(0.010)	(0.009)	(0.051)	(0.054)
Log(Sales)		0.008		−0.042*
		(0.015)		(0.024)
Season FEs	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Kleibergen-Paap LM p-value (Under-id)			0.40	0.38
Kleibergen-Paap Wald F statistic (Weak inst)			11.0	15.8
Anderson-Rubin Wald test p-value			0.000	0.000
Mean of Dep. Var.	0.45	0.45	0.45	0.45
N	220	220	220	220

Demand for Output Quality and Vertical Integration

Dep. var:	Number of Boats			
	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)
Protein content	0.507	0.337	2.123**	2.366**
	(0.312)	(0.308)	(0.849)	(1.008)
Log(Sales)		0.822		−0.069
		(0.514)		(0.753)
Season FEs	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Kleibergen-Paap LM p-value (Under-id)			0.40	0.38
Kleibergen-Paap Wald F statistic (Weak inst)			11.0	15.8
Anderson-Rubin Wald test p-value			0.000	0.000
Mean of Dep. Var.	24.5	24.5	24.5	24.5
N	220	220	220	220

- A one percentage point increase in the average protein content demanded (about 20% of the range observed) would induce firms to:
  - Acquire 2.1 additional suppliers (↑ in stock of about 9%)
  - Source 29% more of their supply from suppliers that were integrated
- Our interpretation: firms vertically integrate *in order to be able to produce high quality output*

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  1. Suppliers that get VI'ed ↓ quantity-effort in ways that ↑ quality
  2. ↑ in firm/plant use of integrated suppliers causally ↑ output quality

- To isolate exogenous variation in upgrading incentives, run following first stage:

$$\text{QualityUpgradingIncentives}_{it} = \gamma_i + \delta_t + \text{USP}_{it-1} \sum_c \beta_c \ (HQP_{ct}) + \beta_2 \text{USP}_{it-1} + \varepsilon_{it}$$

- HQP_{ct} is average price for (high quality) fishmeal in country c
- In alternative specification, replace HQP_{ct} with QE_{ct}, quantity exported by country c

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