

The Network Origins of Firm Dynamics

Contracting Frictions and Dynamism with Long-Term Relationships

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Motivation: Firms and Aggregate Productivity

Large literature, starting with Hopenhayn, that considers firm dynamics — and the process of reallocation across firms — as underpinning aggregate productivity:

- Entry, exit
- Growth, decline

Reallocation: most productive firms should “rise to the top”

But: many productive firms struggle to scale up, large unproductive firms stay in the market etc

- Foster et al. (2008): TFPQ only weakly correlated with exit
- Verhoogen (2023), Goldberg and Reed (2023), Bassi et al. (2022, 2025)

How does this process of “rising to the top” happen? What shapes firm’s demand and dynamics?

This paper: firm-to-firm relationships and firm dynamics

This paper: study the role that firm-to-firm relationships play in shaping firm dynamics and allocative efficiency.

1. Motivational facts (Pakistan, India) point to important role of extensive margin of sales relationships for explaining firm dynamics
2. Quantitative model with firm dynamics built on firm-to-firm trade
 - Stochastic arrival of new potential matches; new relationship replace existing ones when new supplier is better than old one \Rightarrow new supplier scales up, old supplier sees reduction in demand
 - Aggregate productivity is shaped by the process of match formation
3. Calibrate multi-sector version of model to Indian/Pakistani setting
 - Compare firm dynamics in model to data
4. **Application:** Study role of contracting frictions in shaping relationships, firm dynamics, and aggregate productivity
 - In data & model: contracting frictions make relationships stickier
 - Results in dynamic losses $\approx 3x$ static losses from increased transaction costs
(Boehm-Oberfield, 2020)

Literature

- Firm Dynamics:
 - Customer Capital: Luttmer (2011), Gourio Rudanko (2014) , Afrouzi Drenik Kim, Argente Fitzgerald Moreira Priolo, Einav Klenow Levin Murciano-Goroff, Foster Haltiwanger Syverson (2016)
 - Input-Switching: Gopinath Neiman (2014), Lu Mariscal Mejia (2024), Damijan Konings Polanec (2014), Monarch (2022) Baqaee Burstein Duprez Farhi (2023)
 - Kortum-Klette: Lentz Mortensen (2008), Akcigit Kerr (2018), Garcia-Macia Hsieh Klenow (2019)
- Firm-to-firm trade
 - Firm heterogeneity, static: Oberfield (2018), Bernard Moxnes Ultveit-Moe (2018), Eaton Kortum Kramarz (2024), Bernard Dhyne Magerman Manova Moxnes (2022)
 - Deterministic Life Cycle: Chaney (2014) Aekka Khanna (2025)
 - Dynamics with Frictions: Huneeus, Miyauchi, Martin Mejean Parenti (2023) and Fontaine Martin Mejean (2023)
- Frictions and Dynamism: Hopenhayn, Rogerson (1993), Hsieh, Klenow (2014), Akcigit Alp Peters (2021)
- Contracting frictions: Boehm (2022), Amirapu (2021), Boehm Oberfield (2020)
- Relational contracts: Kranton (1996), Hemous, Olsen (2018), Macchiavello Morjaria (2015,2021)

Data

- **Indian Annual Survey of Industries**, 1989/90-2014/15 (with gaps)
 - Plant-level panel survey of manufacturing plants
 - Sales/purchases by 5-digit outputs and inputs
- Supplement with **Pakistan Value Added Tax** data 2011-2019
 - Monthly Firm-to-Firm sales transactions, aggregated to annual level
 - 4-digit industry codes

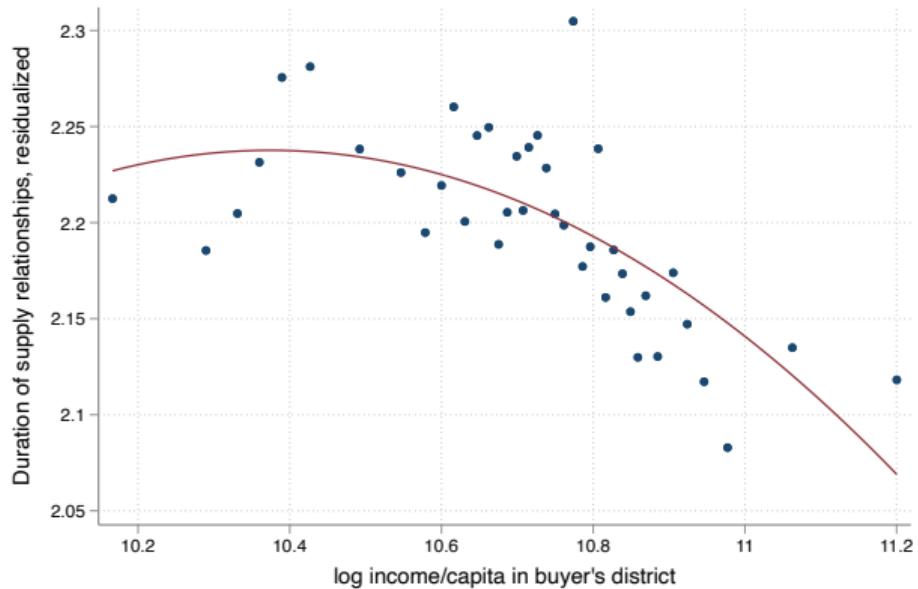
Will use Pakistani when firm-to-firm/relationship data is required, otherwise India (more detail).

Motivation: Dynamism and Development

Richer districts (Pakistan) on average have *shorter* firm-to-firm relationships

- y-axis: duration of firms' relationships with supplier
- x-axis: log district income/capita

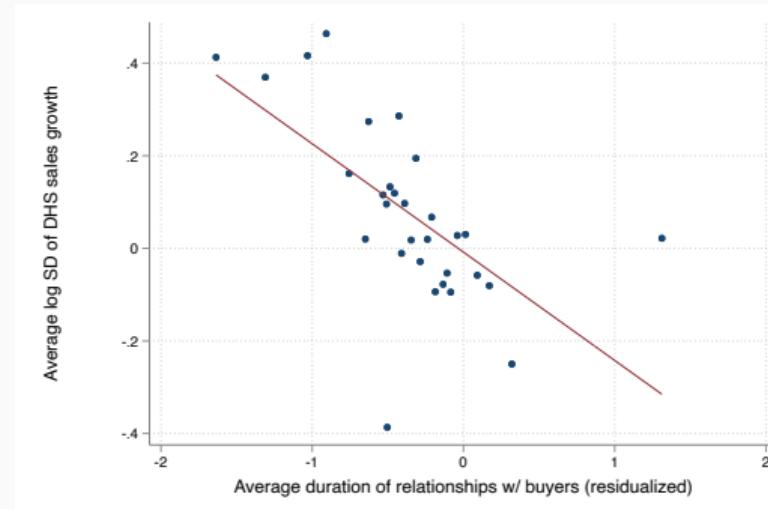
Regression conditions on industry pair fixed effects



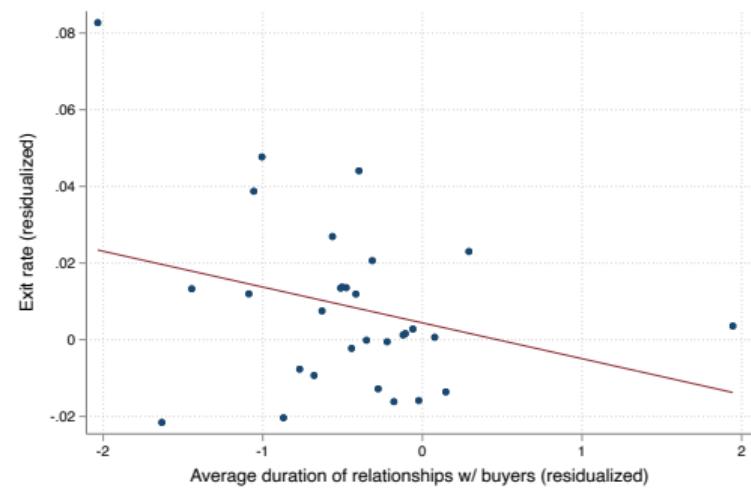
Relationship duration correlates with other measures of dynamism

Districts with shorter relationships have

- less volatile firms (lower sd of DHS sales growth)
- lower exit rates



(a) Volatility and Rel. Duration



(b) Exit rates and Rel. Duration

Much of the variation in sales growth is due to extensive margin changes

Table 1: Sales growth decomposition

Contribution of extensive margin changes to firm sales volatility, by time aggregation										
Order	Quarterly			Annual			Biennial			
	All	Small	Large	All	Small	Large	All	Small	Large	
0	0.744	0.752	0.731	0.792	0.813	0.734	0.832	0.858	0.788	
1	0.741	0.748	0.73	0.79	0.814	0.731	0.839	0.867	0.794	
2	0.736	0.745	0.725	0.787	0.813	0.725	0.842	0.871	0.796	

Table shows coefficient in regression of EXT^k on g , where:

$$g_i = \frac{\text{Sales}_{i,t+1} - \text{Sales}_{i,t}}{(\text{Sales}_{i,t+1} + \text{Sales}_{i,t})/2}$$

$$EXT_i^0 = \frac{\sum_{j \in B_{i,t+1}^{\text{new}}} \text{Sales}_{i,t+1} - \sum_{j \in B_{i,t}^{\text{old}}} \text{Sales}_{i,t}}{(\text{Sales}_{i,t+1} + \text{Sales}_{i,t})/2}, \quad EXT^{k+1} = \sum_{n=0}^k \Omega^n EXT^0$$

Model: Single Industry

- Growing industry with many firms. Two types of firms: manufacturers, retailers
- Each firm produces using labor and one input:

$$y_b = A(z_{bs}x_s)^\alpha l^{1-\alpha}, \quad A \equiv \alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)}$$

- Single shocks process: new potential buyer-supplier matches arrive via Poisson process
 - Each new potential match: random supplier s , random match-specific productivity z_{bs}
 - Buyer's decision: switch or not
- Large number of retailers
 - Same production function & supplier arrival process as manufacturers
 - Sell output to household (but not to other manufacturers or retailers)
 - Manufacturers sell to other firms and to retailers, but not to household

Static Equilibrium

- Representative Household
 - Dixit-stiglitz preferences across varieties sold by retailers (elast. ε)
 - Households inelastically supplies a growing quantity of labor L (growth rate γ)
 - Labor used for production or to create new manufacturers and retailers
- Market structure
 - Monopolistic Competition across retailers
 - Bilateral contracts in firm-to-firm trade (quantity, transfer)
 - Countably stable: no countable coalition wants to alter/drop contracts
⇒ Efficient production within supply chains (quantities)

$$c_b = \left(\frac{c_s}{z_{bs}} \right)^\alpha w^{1-\alpha}$$

- Many ways to split surplus
 - Focus on equilibrium in which surplus split according to cost shares

Keeping the model tractable

- State variable for a firm is, in principle, very large
- We focus on one economic decision:
 - New supplier comes along: switch or not
 - Easy if each supplier's (log) cost is random walk with the same distribution of increments: lower cost now \implies better distribution of future cost (FOSD)
- Key characteristic: no mean reversion in cost

What makes this work?

- Productivity of new potential match inspired by current supply chain
- No option to go back to old supplier
- No supplier death

Productivity of new potential match inspired by current supply chain

- Productivity delivered by current chain is

$$q \equiv z_0 z_1^\alpha z_2^{\alpha^2} \dots$$

where z_0, z_1, z_2, \dots are firm's own, its supplier's, its supplier's supplier's...

- match-specific prod. with new potential supplier:

$$z = \underbrace{b}_{\text{original component}} + \underbrace{q}_{\text{spillover from current chain}}$$

- The arrival rate of new suppliers with original component larger than b is

$$\kappa b^{-\beta}$$

⇒ Arrival rate of supplier that delivers cost reduction larger than x is

$$\phi x^{-\beta}, \quad \phi \equiv \kappa \int (c_s/w)^{-\beta} dF(c_s)$$

Entry and Exit

To have an ergodic distribution for cost, assume a growing mass of entrants

- Population grows at rate γ , $L_t = L_0 e^{\gamma t}$
- Entry
 - Free entry: unit of labor \implies flow χ of manufacturers and χ_R of retailers
 - \implies Along BGP, flow of entrants grows at population growth rate, γ
 - Each entrant draws potential suppliers:
The number of draws of techniques with match-specific component larger than z is Poisson with mean $\kappa_0 z^{-\beta}$
- Exit
 - Firms never die. But if no customers, output is zero
 - A firm “exits” when it loses its last customer
 - May gain customers later, still draws new suppliers, etc
- Under these assumptions: MGF of change in $\log \frac{w}{cost}$ over interval with length τ

$$\mathbb{E} \left[\left(\frac{cost_{j,t}}{cost_{j,t+\tau}} \right)^s \right] = e^{-\tau \phi \sum_{k=1}^{\infty} \frac{s}{\beta \alpha^{-k} + s}}$$

Aggregate Output along BGP

Aggregate output is

$$Y_t = \left(|R_t| \int_0^\infty c^{1-\varepsilon} dF(c) \right)^{\frac{1}{\varepsilon-1}} (1-\eta)L_t$$

In special case where $\beta = \varepsilon - 1$, output per capita is

$$\frac{Y_t}{L_t} = (1-\eta) \left(\frac{\eta \chi_R}{\gamma} L_0 \right)^{\frac{1}{\beta}} \left[\frac{\kappa_0^\alpha \Gamma(1-\alpha)}{1 + \frac{\phi}{\gamma} \sum_{k=1}^{\infty} \frac{1}{1-\alpha^{-k}}} \right]^{\frac{1}{1-\alpha} \frac{1}{\beta}} e^{\frac{\gamma}{\beta} t}$$

→ Semi-endogenous growth

- Distribution of cost in cross section is constant over time
- Growth from gains from variety
- Firm-level dynamics matter for **level** of output along BGP

One shock, many subtle firm dynamics patterns

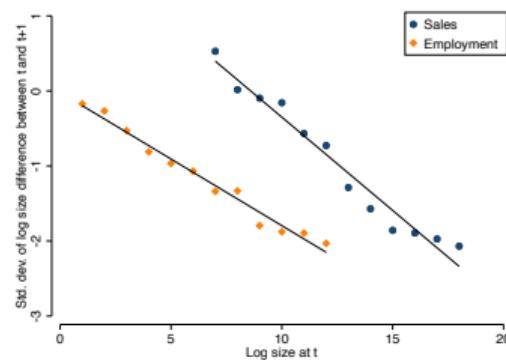
Firm size depends on fundamentals (cost) but also on demand (number & size of customers)

Model explains key firm dynamics facts:

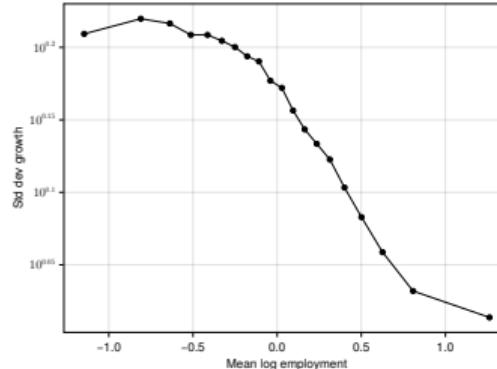
- Size-variance relationship
- Fat tails in firm growth rates
- Exit rates declining in size
- Existence of “gazelles”

Standard Deviation of Growth Rates by Size

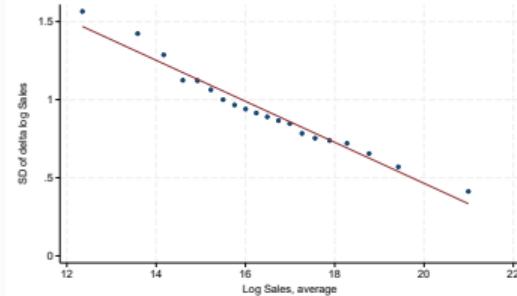
Data (US, Factset):



Simulation:



Data (Pakistan):



- Larger \implies lower standard deviation of growth rates (Hymer and Pashigian, 1962)
 - Usual mechanism: Large firms composed of more subunits \implies diversification
 - Here: Large firm tends to have more customers
- Declines more slowly than $\sqrt{\text{size}}$
 - Usual mechanism: correlation across subunits, granular subunits
 - Here: granular customers (also some correlation from cost changes)

▶ Comparison

Determinants of Firm Growth Volatility

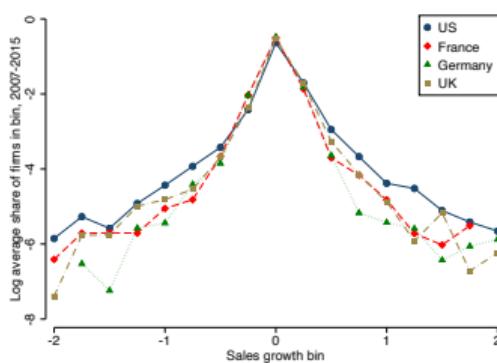
	Data (Pakistan)					Simulation				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\log(\text{Sales})$	-0.138 (0.0018)		-0.092 (0.0025)	-0.105 (0.0022)	-0.103 (0.0022)	-0.3021 (0.0007)		-0.2424 (0.0009)	-0.2259 (0.0008)	-0.2256 (0.0008)
$\log(\text{Buyers})$		-0.217 (0.0031)	-0.111 (0.0042)				-0.4962 (0.0014)	-0.1845 (0.0018)		
$\log(\text{HHI})$				0.152 (0.0055)	0.202 (0.0067)				0.3179 (0.0017)	0.4224 (0.0112)
$\log(\text{HHI (weighted)})$					-0.051 (0.0037)					-0.1058 (0.0112)
<i>Fixed Effects</i>										
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Statistics</i>										
R^2	0.263	0.244	0.286	0.287	0.289	0.7667	0.7393	0.7713	0.781	0.781
$R^2\text{-within}$	0.197	0.175	0.221	0.223	0.225	0.2674	0.1814	0.282	0.3123	0.3124
Observations	23,034	23,034	23,034	23,034	22,552	538,784	538,784	538,784	538,784	538,784

Standard errors in parentheses. The dependent variable is the log standard deviation of $\log \text{sales}_{t+1} - \log \text{sales}_t$.

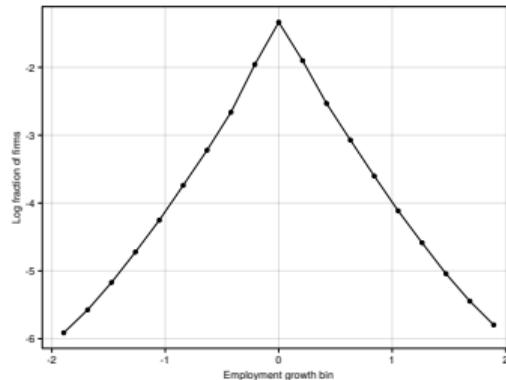
▶ Back

Distribution of Growth Rates has Fat Tails

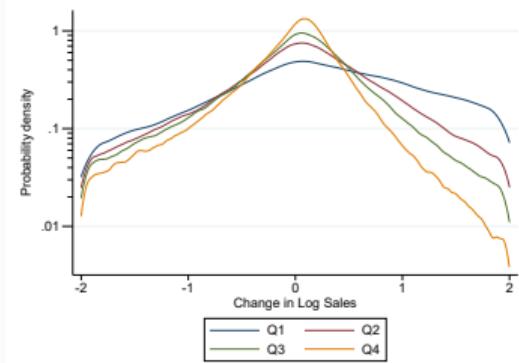
Data (Factset):



Simulation:

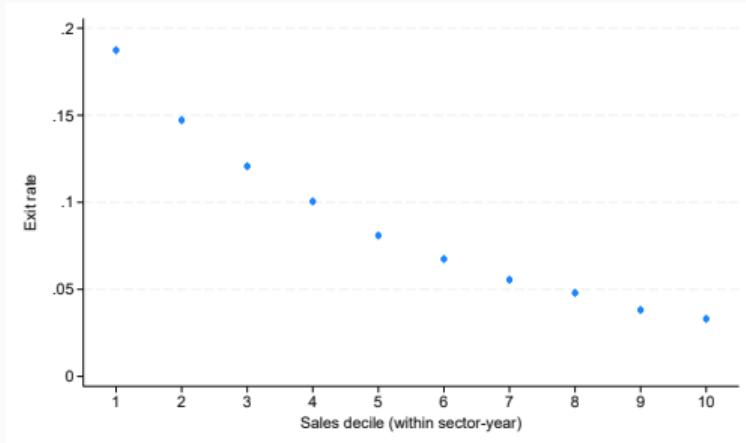
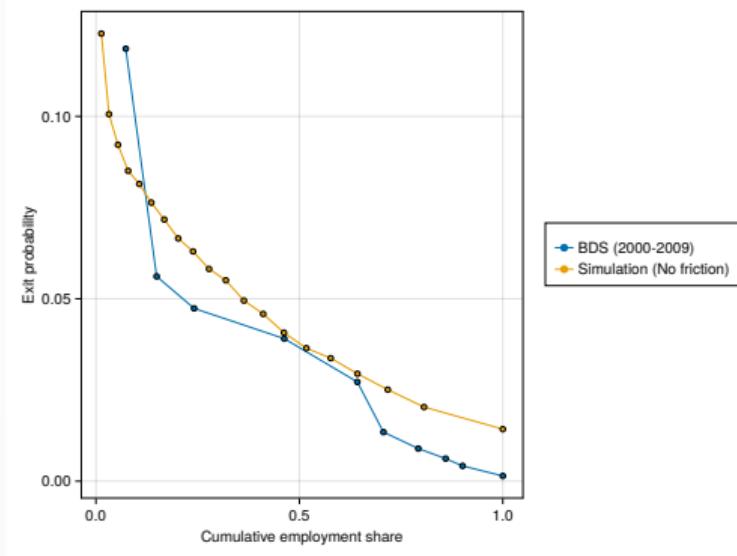


Data (Pakistan):



- Fat tails: Ashton, 1926, Laplace dist: Stanley, et al. (1996)
- Here: Mixture of getting one large customer, many small customers

Exit rates decline with size



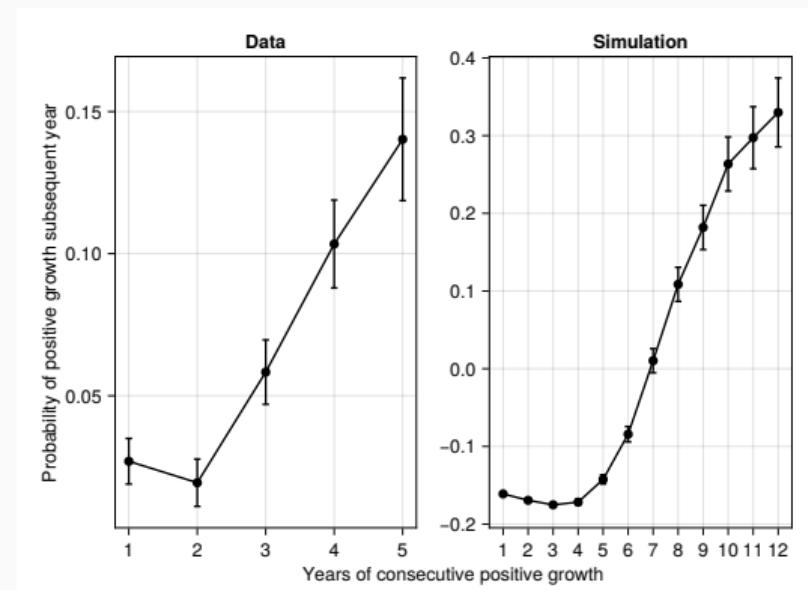
- Firms exit when they lose last customer
- Large firms can have one large customer
- Number of buyers is a good predictor of exit

“Gazelles” / “rockets” / type dependence / ex ante heterogeneity

- Luttmer (2011): Need “rockets” that eventually slow to explain why largest firms are not so old
- Sedlacek, Sterk, Pugsley (2021): Hidden “ex ante heterogeneity” explains most of size dispersion at young ages, almost half of size dispersion at twenty
- Coad, Daunfeldt, Halvarsson (2018): autocorrelation of growth rates is positive for young firms and negative for older firms

Here: cost is hidden type

- Cost determines inflow of customers
- Low cost at birth \implies persistent growth until inflows equals outflows
- Cost evolves over time



Application: Contracting Frictions

Contracting Frictions in India & Pakistan

Courts in India and Pakistan are heavily congested: Average age of pending cases

- India: High courts. Range of avg age: 1-4.5 years
- Pakistan: District courts. Range: 1-3 years

Static transaction costs due to hold up (Nunn, 2007, Amirapu 2021, Boehm & Oberfield, 2020)

But also long-term agreements (relational contracts) to overcome hold up

- Makes relationships stickier
- Static gain (avoid transaction cost), but potentially dynamic loss

Prior empirical evidence: Johnson, McMillan, Woodruff (2002), Monarch (2020)

Contracting frictions

Approach: Contracting frictions in output market present when:

firms output is relationship-specific AND firm located in region with poor contract enforcement

Standardized vs. Relationship-specific (Rauch)

- Standardized ≈ sold on an organized exchange, ref. price in trade pub.
- Relationship-specific ≈ everything else
- India: ~ 70% of sales are rel-spec
- Pakistan: ~ 60% of sales is rel-spec

Contract enforcement quality: Average age of pending cases

Correlation with GDP/capita

- India: High courts. Range of avg age: 1-4.5 years. IV: age of court (Boehm-Oberfield 2020)
- Pakistan: District courts. Range: 1-3 years

Contracting friction in output markets \Rightarrow longer relationships (Pak)

	Dependent variable: Length of Relationship (in Years)				
	(1)	(2)	(3)	(4)	(5)
Age of pending cases (S) \times RelSpec _S	0.206*		0.172*		
	(0.086)		(0.076)		
Age of pending cases (B) \times RelSpec _S		0.187*	0.146*		
		(0.083)	(0.071)		
Age of pending cases (Min(B,S)) \times RelSpec _S				0.296**	0.301**
				(0.038)	(0.039)
B \times S 4-digit Industry FE	Yes	Yes	Yes	Yes	Yes
B District FE	Yes	Yes	Yes	Yes	
S District FE	Yes	Yes	Yes	Yes	
S District \times S 4-digit Industry FE					Yes
B District \times B 4-digit Industry FE					Yes
R ²	0.119	0.119	0.119	0.120	0.162
Observations	1628710	1628182	1627686	1629206	1627434

Standard errors in parentheses, clustered at the origin-destination district level.

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Calibrate multi-sector version of model

- Firm b in industry ω

$$y_b = A_\omega l^{\alpha_{\omega I}} \prod_{\omega'} (z_{bs'} x_{s'})^{\alpha_{\omega \omega'}}$$

$$\alpha_{\omega I} + \sum_{\omega'} \alpha_{\omega \omega'} = 1$$

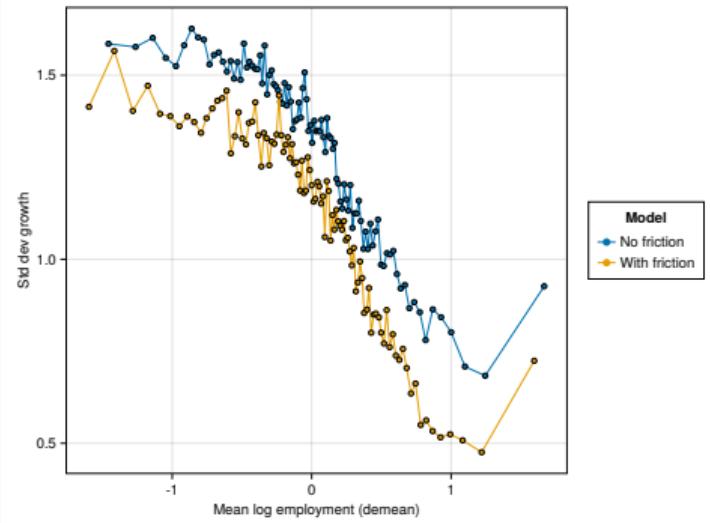
with

$$A_\omega \equiv \alpha_{\omega I}^{-\alpha_{\omega I}} \prod_{\omega'} \alpha_{\omega \omega'}^{-\alpha_{\omega \omega'}}$$

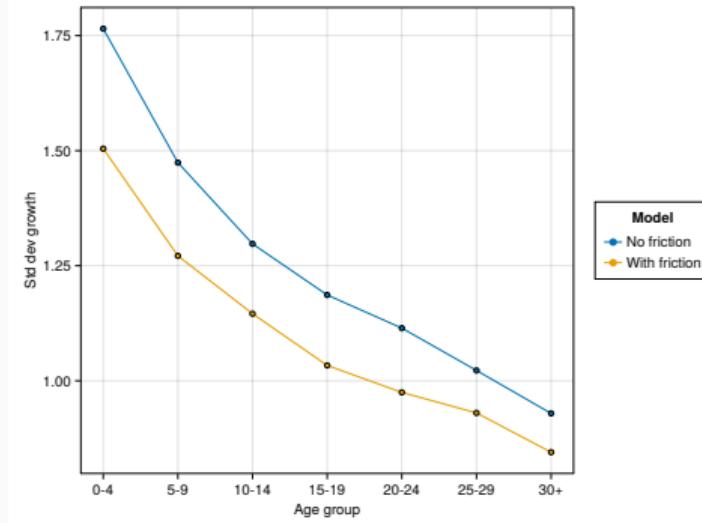
- Calibrate to Indian data on 5-digit industries
- Some industries ω produce relationship specific goods
 - Less efficient courts \Rightarrow lower arrival rate κ for relationship-specific inputs
 - For now behavioral assumption, microfoundation is work-in-progress

Parameter	Value	Target	Target value	Data source
Population growth (γ)	0.04	Employment share by age		Hsieh & Klenow (2014)
New technique shape (β)	3.52	Δ cost from new suppliers	-0.284	Baqae et al. (2023)
New supplier arrival rate (ϕ)	0.37	Mean rel. survival prob.	0.69 years	Pakistan data
Observation threshold	varies	<u>Median sales above threshold</u> Threshold	6.36	Pakistan data
Number of retailer firms ratio	60	Annual exit probability	0.05	
Household EoS (ε)	4.52	$\beta + 1$		

Standard Deviation of Growth Rates: Frictions vs No Frictions (Model)



(c) Volatility by Size



(d) Volatility by Age

Lower arrival rate of shocks \Rightarrow lower variance of growth rates

Contracting frictions in output markets \Rightarrow lower variance of sales growth

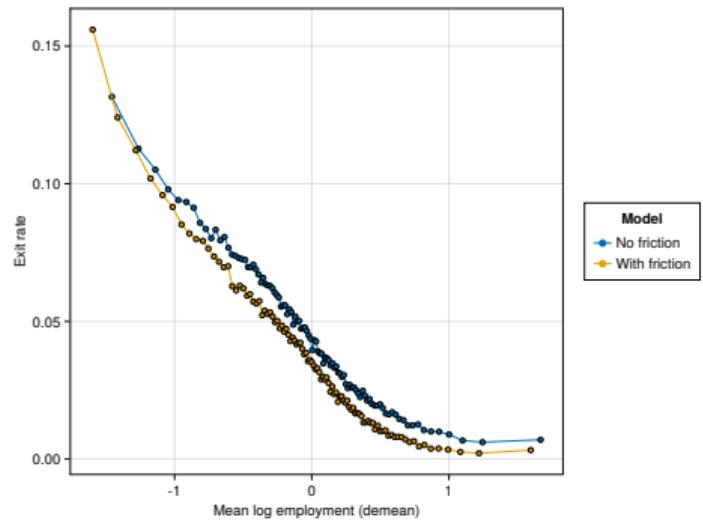
	Dependent variable: $\sigma(\Delta \log \text{Sales})_{d\omega}$			
	(1)	(2)	(3)	(4)
Avg age of civil cases \times Rel. spec.	-0.0177* (0.0089)	-0.0187* (0.0088)	-0.0401* (0.016)	-0.0385* (0.016)
$(\Delta \log \text{Sales})_{d\omega}$		-0.273** (0.024)		-0.273** (0.024)
State FE	Yes	Yes	Yes	Yes
5-digit Industry FE	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	IV	IV
R^2	0.287	0.302	-0.000369	0.0207
Observations	7574	7574	7574	7574

Regression at the state \times industry level. Only state-industry cells with more than 5 observations used.

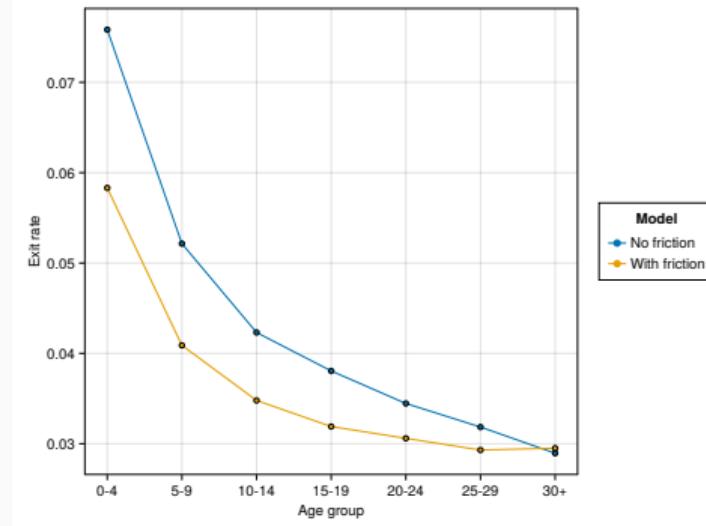
Dependent variable: standard deviation of residualized (by age, year, state and industry) annualized sales growth in each state-industry cell

Data from ASI, India

Exit Rates: Frictions vs No Frictions (Model)



(e) Exit Rates By Size



(f) Exit Rates by Age

Lower arrival rate of shocks \Rightarrow lower probability of losing last customer

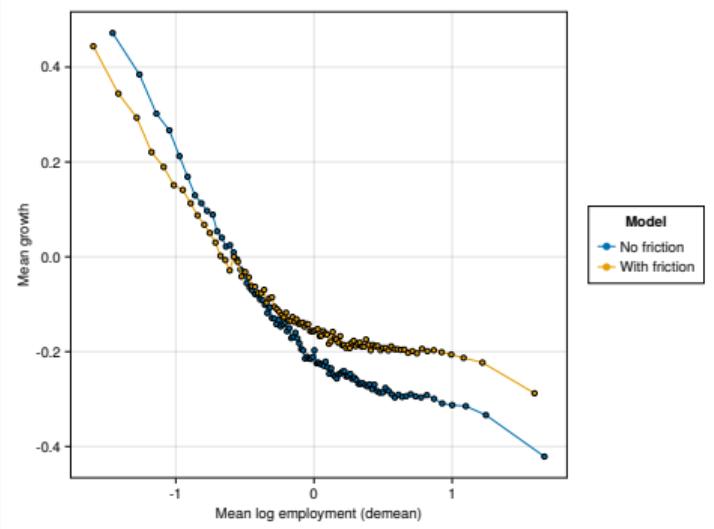
In the data

Contracting frictions in output markets \Rightarrow lower exit rates (across all size bins)

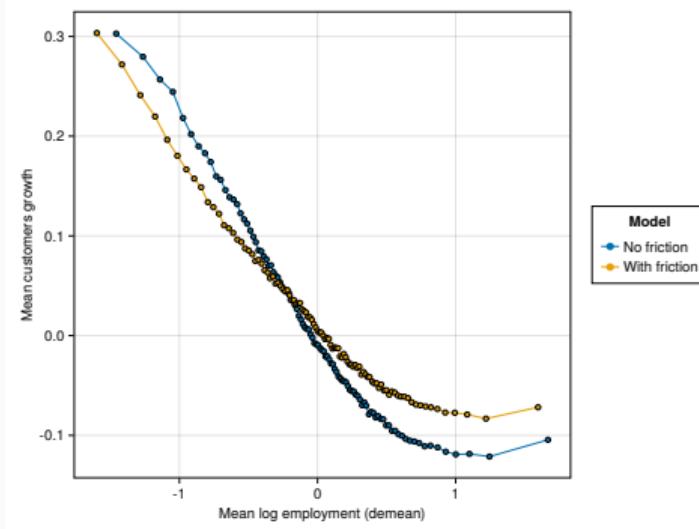
(Data from Pakistan)

	Dependent variable: P(exit)		
	(1)	(2)	(3)
Q1 Dummy	0.0739** (0.0018)		
Q2 Dummy	0.0253** (0.0016)	-0.0510** (0.0042)	-0.0493** (0.0046)
Q3 Dummy	0.0131** (0.00091)	-0.0611** (0.0046)	-0.0636** (0.0053)
Q4 Dummy	0.00789** (0.00062)	-0.0715** (0.0045)	-0.0770** (0.0053)
Q1 \times RelSpec \times AvgAgeCourts		-0.00621** (0.0024)	-0.00552* (0.0023)
Q2 \times RelSpec \times AvgAgeCourts		-0.00384* (0.0015)	-0.00422** (0.0015)
Q3 \times RelSpec \times AvgAgeCourts		-0.00469** (0.0013)	-0.00367** (0.0011)
Q4 \times RelSpec \times AvgAgeCourts		-0.00162 (0.0014)	
4-digit Industry \times Year FE		Yes	Yes
District \times Year FE			Yes
4-digit Industry \times District FE			Yes
R^2	0.0522	0.0536	0.0764
Observations	407189	300384	299802

Mean Reversion: Frictions vs No Frictions (Model)



(g) Sales



(h) Number of Customers

According to the model, no mean reversion in *cost*

But: mean reversion in *sales* towards a long-run level commensurate with costs

With frictions (\rightarrow less turnover) slower mean-reversion in sales

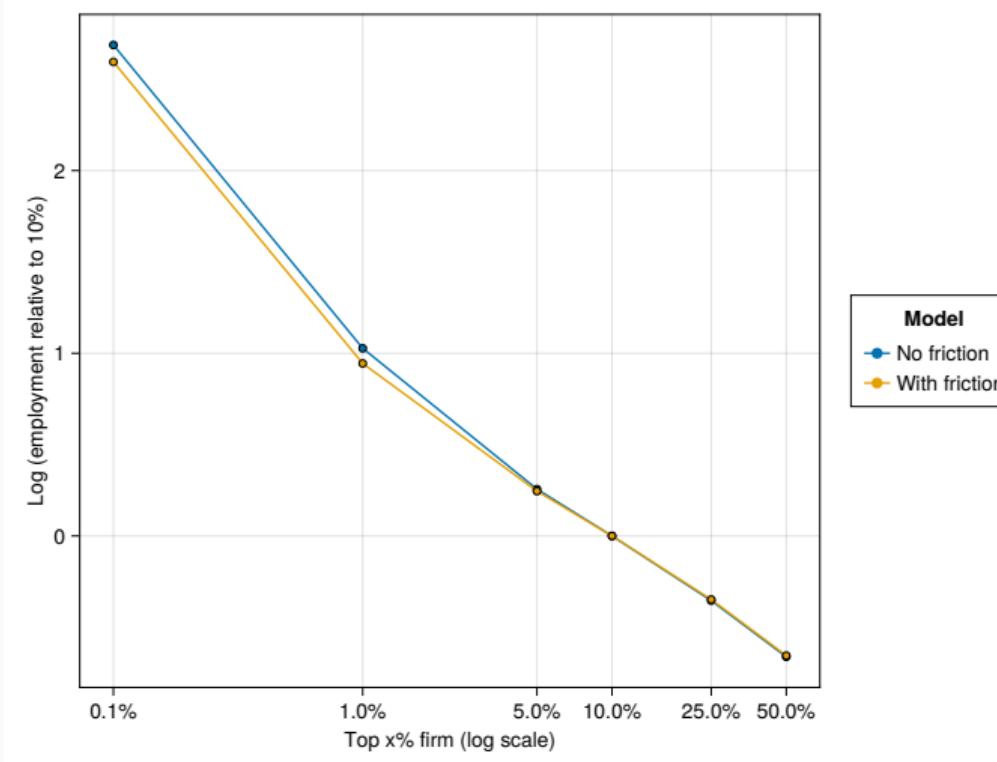
Mean reversion in firm size: slower with frictions

	Dependent variable: Change in log Sales					
	(1)	(2)	(3)	(4)	(5)	(6)
log Sales _{t-1}	-0.403** (0.011)	-0.427** (0.025)	-0.555** (0.037)	-0.403** (0.012)	-0.436** (0.028)	-0.583** (0.038)
log Sales _{t-1} × Age civ. cases × relspec	0.00709+ (0.0037)	0.0206* (0.0096)	0.0249+ (0.015)	0.00687 (0.0044)	0.0256* (0.012)	0.0405* (0.019)
Plant × 5-digit Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes			Yes		
Year × Previous Year FE	Yes			Yes		
Age FE		Yes	Yes		Yes	Yes
Industry × District × Year FE		Yes			Yes	
Industry × District × (t, t - 1) FE			Yes			Yes
Method	OLS	OLS	OLS	IV	IV	IV
R ²	0.457	0.636	0.671	0.256	0.250	0.278
Observations	204518	78053	51401	204518	78053	51401

Standard errors in parentheses, clustered at the state × industry level.

Size Distribution: less fat tails with frictions

Model simulation:



Contracting frictions in output markets \Rightarrow lower skewness in size distribution

	Dependent variable: Skewness of log Sales					
	(1)	(2)	(3)	(4)	(5)	(6)
Relspec x Court Congestion	-0.360*	-0.671*	-0.799**	-0.624 ⁺	-1.312*	-0.905
	(0.168)	(0.287)	(0.294)	(0.349)	(0.598)	(0.578)
R^2	0.540	0.435	0.554	0.001	0.000	0.007
State FE	Yes	Yes	Yes	Yes	Yes	Yes
5-digit Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	OLS	IV	IV	IV
Statistic	25-75	50-75	50-90	25-75	50-75	50-90
Observations	3008	3008	1448	3008	3008	1448

$$\text{Skewness}_{sw} = \frac{\log(\text{Share of plants above } S_1) - \log(\text{Share of plants above } S_0)}{\log S_1 - \log S_0}$$

S_0 and S_1 are different quantiles of overall plant size distribution (25th, 50th, and 75th, 90th)

Similar with Pakistan data



Counterfactual: reduce contracting frictions

Reducing average age of pending court cases by 1 year

⇒ 0.26 years longer relationships on average (for rel-spec. industries)

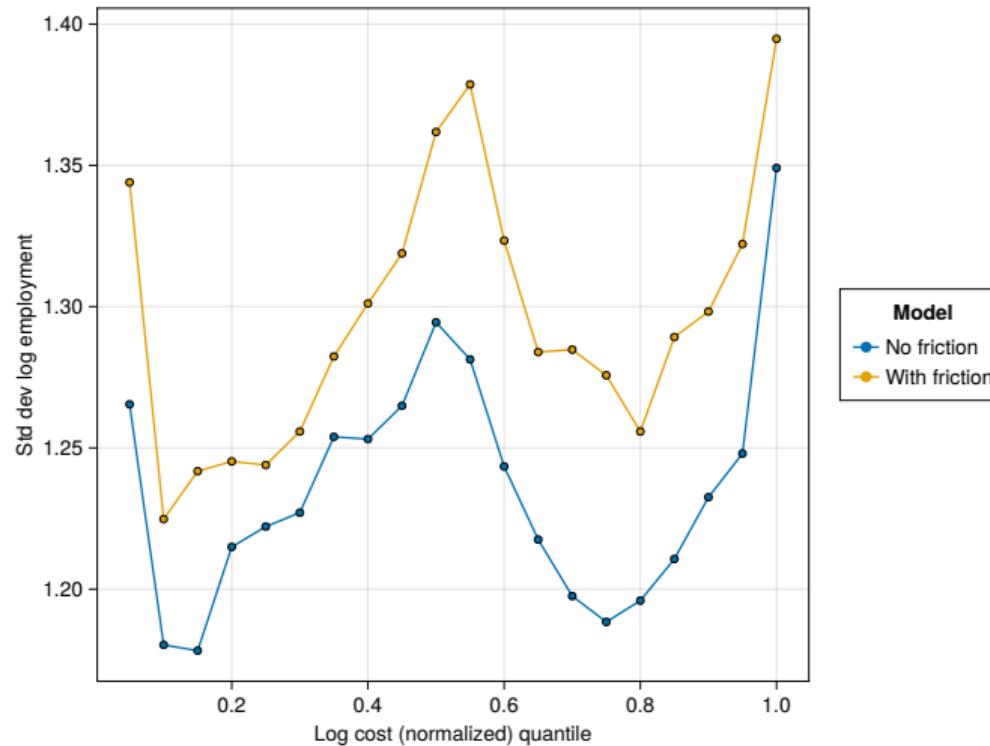
Counterfactual: change arrival rate of new suppliers κ (or ϕ) accordingly, to move from average age of pending cases of 4 years to 1 year

Reduces misallocation: firms with low cost get drawn as suppliers more often, large but unproductive firms shrink

	No friction	With friction
Mean income growth	0.015	0.015
Log real income difference	0.000	-0.162

Agg. productivity loss from dynamic misallocation ≈ 3x static loss (Boehm & Oberfield, 2020)

Reducing friction \Rightarrow reduce size dispersion within each cost quantile



Thank you!

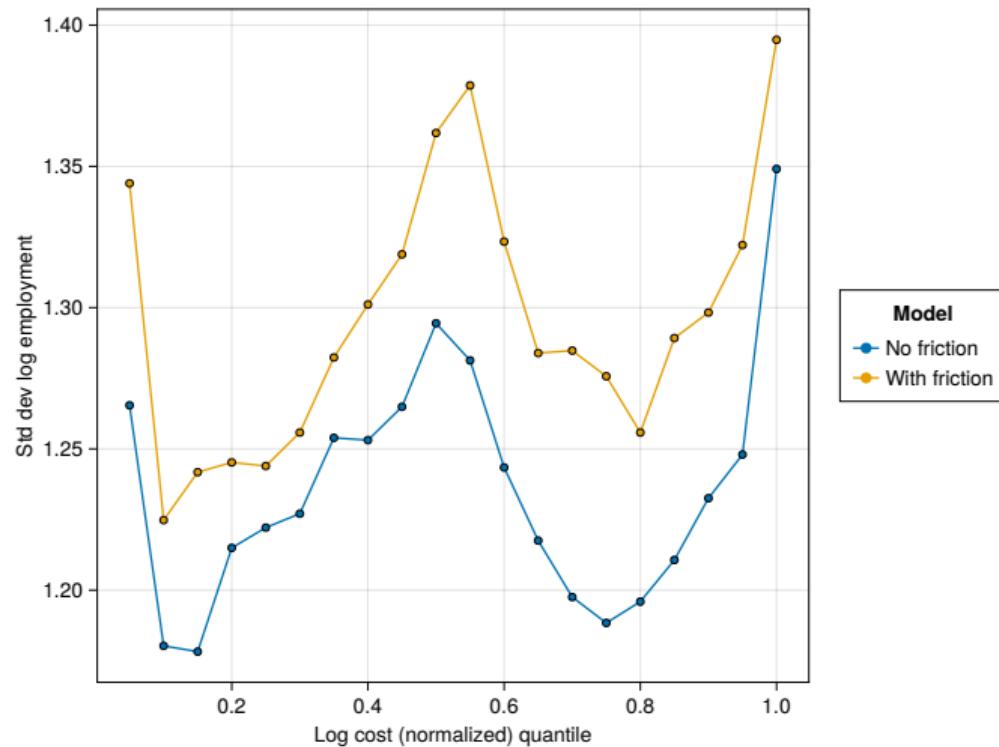
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Implications for Aggregate Productivity

Productivity

- Productivity growth is $\frac{\gamma}{\varepsilon-1}$
 - Gains from variety/Population growth
- Weak enforcement affects level of productivity
- Misallocation: Firms use worse suppliers than they would with better enforcement

Misallocation: Dispersion in Size



Misallocation: Correlation of Log Cost and Log Employment

Model	Correlation (demeaned)	Correlation (normalized)
No friction	-0.281	-0.370
With friction	-0.260	-0.340

Aggregate Productivity

	No friction	With friction
Mean income growth	0.015	0.015
Log real income difference	0.000	-0.162

- Note: In counterfactuals, entry rate held fixed
- More severe contracting frictions \implies lower entry (impact on welfare not obvious)

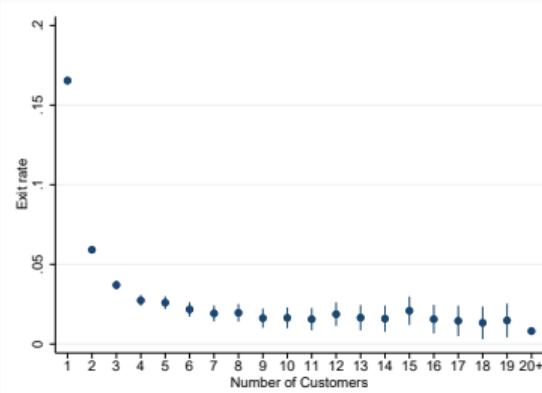
Conclusion

- One response to weak contract enforcement is to use relational contracts
- Static benefits, but less switching
 - ⇒ Slower firm dynamics
 - ⇒ Cost penalty builds up over time
 - Not switching in past \implies large impact on current aggregate productivity
- Dynamic costs of bad enforcement are ~ 3 times the size of static costs

Appendix

Number of Buyers is Good Predictor of Exit

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Dependent variable: P(exit)

	(1)	(2)	(3)	(4)
Constant	0.0878** (0.00039)	0.0879** (0.00038)	0.0878** (0.00038)	0.0879** (0.00038)
Fixed Effects	Year	Year, #Buyers	Year, Sales vingtiles	Year, #Buyers, Sales vingtiles
R ²	0.0293	0.0889	0.0976	0.112
Observations	501828	501431	501828	501431

Standard errors in parentheses, clustered at the industry-region level.

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

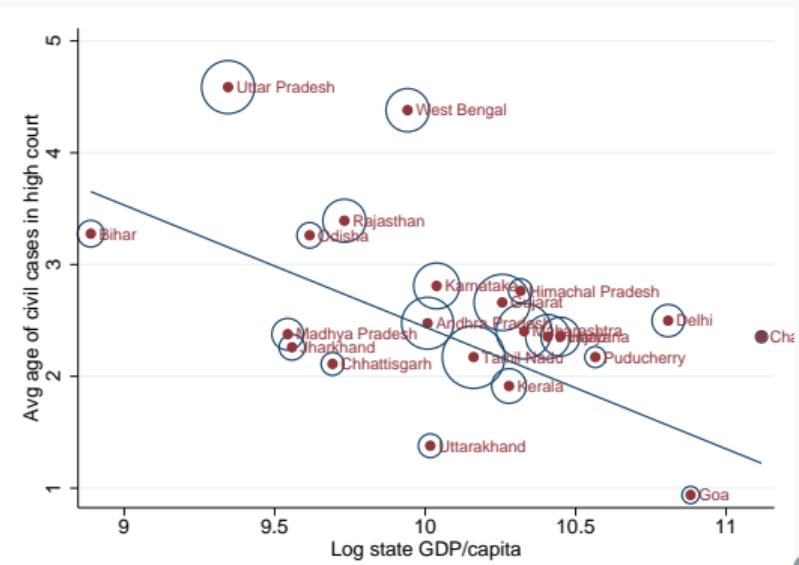
Determinants of Firm Growth Volatility

	Data (Pakistan)					Simulation				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
log(Sales)	-0.138 (0.0018)		-0.092 (0.0025)	-0.105 (0.0022)	-0.103 (0.0022)	-0.3021 (0.0007)		-0.2424 (0.0009)	-0.2259 (0.0008)	-0.2256 (0.0008)
log(Buyers)		-0.217 (0.0031)	-0.111 (0.0042)				-0.4962 (0.0014)	-0.1845 (0.0018)		
log(HHI)				0.152 (0.0055)	0.202 (0.0067)				0.3179 (0.0017)	0.4224 (0.0112)
log(HHI (weighted))					-0.051 (0.0037)					-0.1058 (0.0112)
<i>Fixed Effects</i>										
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Statistics</i>										
R ²	0.263	0.244	0.286	0.287	0.289	0.7667	0.7393	0.7713	0.781	0.781
R ² -within	0.197	0.175	0.221	0.223	0.225	0.2674	0.1814	0.282	0.3123	0.3124
Observations	23,034	23,034	23,034	23,034	22,552	538,784	538,784	538,784	538,784	538,784

Standard errors in parentheses. The dependent variable is the log standard deviation of $\log \text{sales}_{t+1} - \log \text{sales}_t$.

Slow Courts

- Contract disputes between buyers and sellers
- District courts can de-facto be bypassed, cases would be filed in high courts
- Court quality measure: average age of pending civil cases in high court



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Mean Reversion: Pakistan

Dependent variable: Change in log Sales			
	(1)	(2)	(3)
log Sales _{t-1}	-0.310** (0.0053)	-0.347** (0.018)	-0.359** (0.022)
log Sales _{t-1} × Age civ. cases × rel.spec.		0.0191* (0.0082)	0.0216* (0.0095)
Firm × 4-digit Industry FE	Yes	Yes	Yes
District FE	Yes	Yes	
Year FE	Yes	Yes	
Age FE			Yes
Industry × District × Year FE			Yes
R ²	0.368	0.370	0.432
Observations	214380	164552	154912

Standard errors clustered at the district × industry level. Conditions on $|\Delta \log \text{Sales}| < 1$.

Skewness of Size Distribution: Pakistan

	Dependent variable: Skewness of log Sales		
	(1)	(2)	(3)
Avg age of civil cases × Rel. spec.	-1.627* (0.795)	-2.347** (0.798)	-2.603* (1.240)
District FE	Yes	Yes	Yes
4-digit Industry FE	Yes	Yes	Yes
Statistic	25-75	25-90	50-90
R^2	0.540	0.623	0.546
Observations	854	653	653

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

$$\text{Skewness}_{sw} = \frac{\log(\text{Share of plants above } S_1) - \log(\text{Share of plants above } S_0)}{\log S_1 - \log S_0}$$

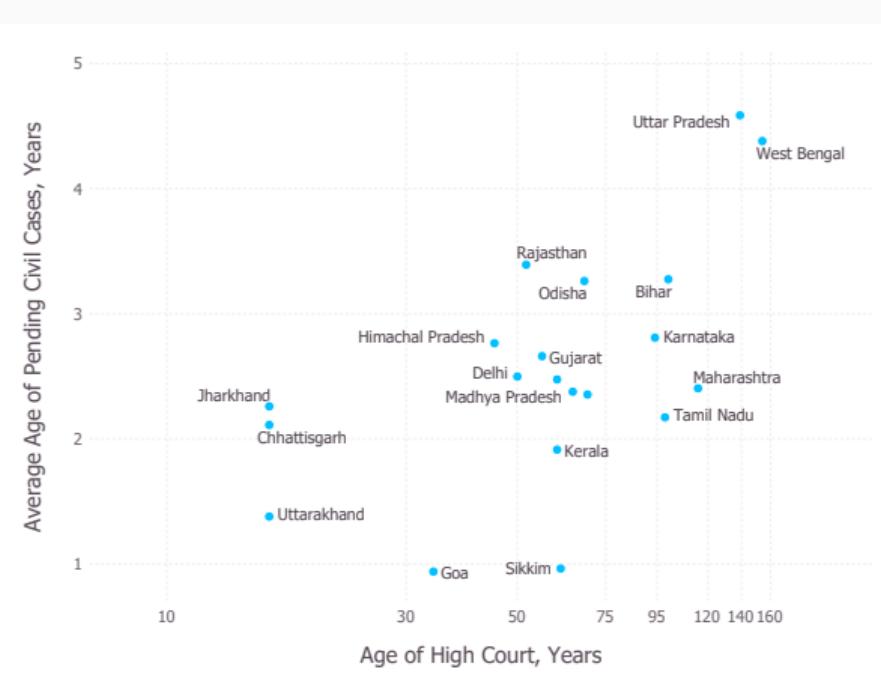
S_0 and S_1 are different quantiles of overall plant size distribution (25th, 50th, and 75th, 90th)

Notes on Pakistan

- 7 states, almost all economic activity is in two states, Sindh and Punjab
- All of our data is in district courts
- VAT data: Size threshold: varies across years. 2-3k per year - 15k per year
- Can still register for VAT
- Small firms effectively face sales tax
- Some sectors (notably agriculture, some services, companies owned by army) excluded from VAT
- For manufacturing, sum across firms of reported VA in data of firms represents 89% manufacturing VA as reported by National Accounts (for whole economy, much lower 30-40%)
- Currently use all transactions, whether reported by one or both parties. If parties disagree on value, use geometric mean of reported transactions
- Firms reports total sales separately from transactions For size, use declared sales of firm, not sum of transactions
- Remove invoice mills
- For firm: age (date registered), two digit industry codes (sometimes there is a product

Endogeneity: IV

- Since independence: # judges based on state population
⇒ backlogs have accumulated over time
- But: new states have been created, with new high courts and clean slate



Aggregate Output along BGP

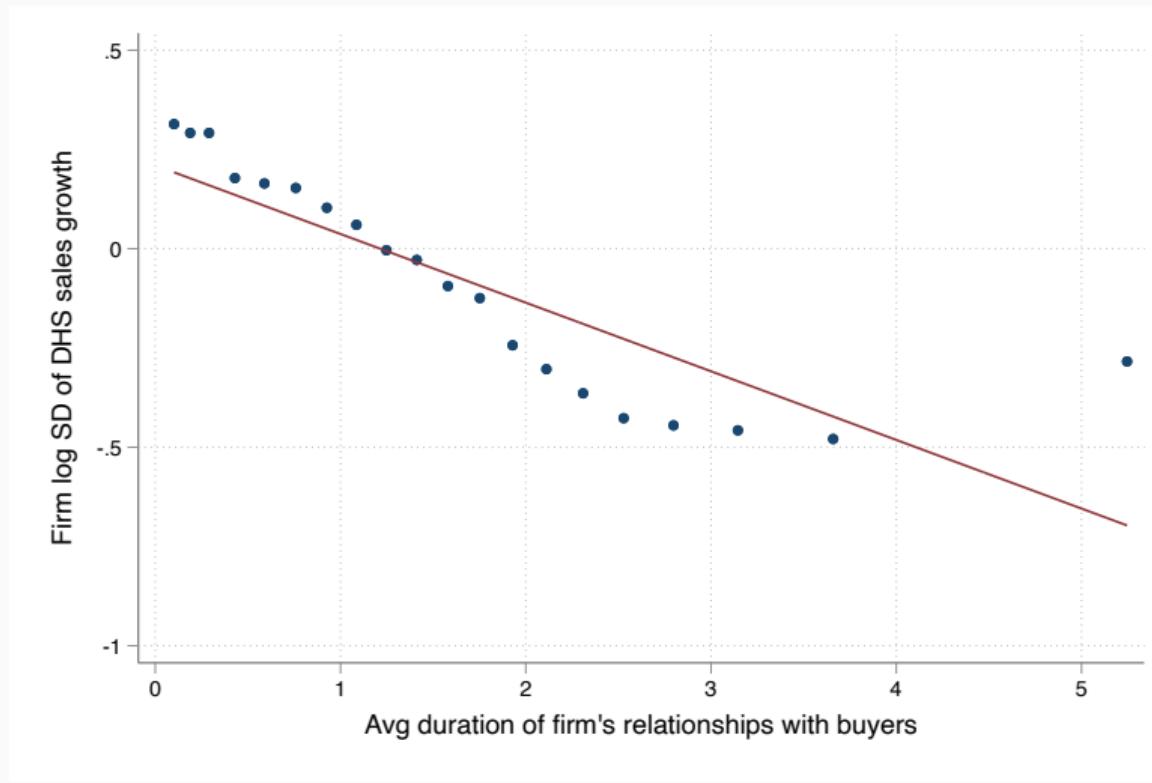
Output per capita along the BGP when $\beta \neq \varepsilon - 1$ is

$$\frac{Y_t}{L_t} = (1 - \eta)^{\frac{\beta}{\varepsilon-1}} \left(\frac{\eta \chi_R}{\gamma} L_0 \right)^{\frac{1}{\varepsilon-1}} \left[\frac{\Gamma \left(1 - \frac{\alpha}{\beta} (\varepsilon - 1) \right)}{1 + \frac{\phi}{\gamma} \sum_{k=1}^{\infty} \frac{\varepsilon-1}{\varepsilon-1-\beta\alpha^{-k}}} \right]^{\frac{1}{\varepsilon-1}} \left[\frac{\kappa_0 \Gamma (1 - \alpha)}{1 + \frac{\phi}{\gamma} \sum_{k=1}^{\infty} \frac{1}{1-\alpha^{-k}}} \right]^{\frac{\alpha}{1-\alpha} \frac{1}{\beta}} e^{\frac{\gamma}{\varepsilon-1} t}$$

Weak Enforcement and Relational Contracts

- Contract specifies level of defectiveness $\delta \in [0, 1]$. Surplus maximized at $\delta = 0$.
 - Supplier can produce defective input. Saves in cost, but possibility output will be defective.
 - Claim can be enforced in court.
 - But delay in court reduces value of payment
 - Cost proportional to value of transaction
- Static Nash: Supplier makes defective input, court. Priced in, but static surplus ↓
- Relational contract
 - Supplier chooses $\delta = 0$
 - Buyer chooses lower arrival rate of new suppliers (observable to supplier, not court)
 - Backloads payoff, raises surplus of the relationship
 - Enforcement: Trigger strategies
 - If supplier does not customize, buyer does not reduce arrival of new suppliers
 - Punishment for defective inputs: **Relationship ends faster + enforcement in court**
 - If buyer does not reduce arrival rate, supplier stops customizing

Firm volatility is lower when buyer-seller relationships last longer



Data from Pakistan.

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