

# Corruption, Firm Dynamics, and Distance to Frontier

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<sup>1</sup>The views expressed in this paper are solely those of the author and may differ from official Bank of Canada views.

## Motivation

- In May 2018, IMF published a new framework for “enhanced” engagement with countries on corruption.
- Judicial reforms that target corruption crucial to boost median run growth potential in developing countries.
- This paper studies the macroeconomic effects of corruption through its impacts on *firm dynamics*.

## **Empirical finding**

- Higher incidence of bribery is associated with lower firm growth volatility, faster growth of capital and labor, and lower growth in labor productivity.

## **A general equilibrium model of firm dynamics**

- Corruption is an endogenous entry barrier that protects incumbents.
- In the presence of financial frictions, corruption can have positive growth effects if it helps entrepreneurs grow out of financial friction.

## **Extension with productivity growth and distance to frontier**

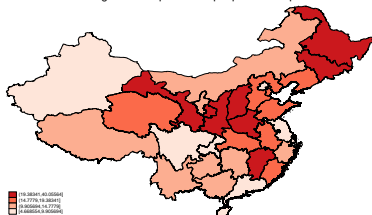
- Corruption and productivity growth.
- Effects of corruption on innovation.
- Effectiveness of anti-corruption campaign.

# Empirical Motivation

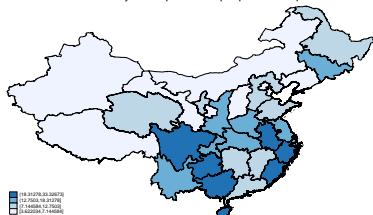
# Measurement

## corruption across provinces of mainland China

number of graft cases per million people in each province



number of bribery cases per million people in each province



We measure corruption at the province-level in mainland China using the number of corruption cases (graft or bribery) during the anti-corruption campaign.

Source: China Judgements Online (2014-17)

# Corruption and firm growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
corruption (bribery)	0.00346 (0.0476)	0.0954*** (0.0309)	0.122** (0.0438)	-0.108** (0.0504)	0.0418 (0.0450)	0.102*** (0.0275)	0.139*** (0.0391)	-0.0830* (0.0482)
corruption (graft)					0.152 (0.0887)	0.0342 (0.0349)	0.0881 (0.0520)	0.0901 (0.0824)
log of initial workers	-3.616*** (0.976)	-6.816*** (0.681)	-4.276*** (1.138)	6.478*** (1.369)	-2.624*** (0.904)	-6.492*** (0.609)	-3.686*** (1.107)	7.214*** (1.272)
log of initial GDP p.c.	-3.760*** (0.826)	-0.992** (0.378)	-1.337** (0.643)	-2.619*** (0.865)	-2.333*** (0.806)	-0.581 (0.492)	-0.654 (0.671)	-1.841** (0.827)
initial GDP p.c. growth	10.62** (4.291)	3.180 (2.324)	7.923*** (2.723)	6.046 (5.430)	7.098** (3.028)	2.239 (2.198)	6.160** (2.234)	4.295 (4.246)
initial firm growth					0.0702*** (0.00504)	0.0274*** (0.00395)	0.0428*** (0.00577)	0.0372*** (0.00178)
share of long-term debt					1.289 (0.991)	0.743 (0.602)	-3.050*** (0.704)	-0.785 (1.427)
leverage ratio					0.0447 (0.0306)	-0.0314 (0.0220)	0.0306 (0.0263)	0.110*** (0.0327)
Dependent variable	sales gr	employment gr	assets gr	lab. prod. gr	sales gr	employment gr	assets gr	lab. prod. gr
Sector FE	Y	Y	Y	Y	Y	Y	Y	Y
Firm type FE	Y	Y	Y	Y	Y	Y	Y	Y
N	22821	22861	22848	22815	22696	22696	22695	22693
AR2	0.0857	0.220	0.123	0.118	0.167	0.245	0.167	0.147

Higher incidence of bribery cases is associated with higher growth in input factors and lower growth in productivity.

Source: China Judgements Online (2014-17) and Annual Industrial Survey (1998-2007)

Note: Standard errors clustered at province-level.

## Corruption, volatility and financial frictions

	(1)	(2)	(3)	(4)	(5)	(6)
corruption (bribery)	-0.213*** (0.0319)	-0.215*** (0.0318)	-0.114* (0.0609)	-0.117* (0.0604)	-0.00557 (0.0365)	-0.00404 (0.0360)
corruption X DEF above median			-0.139* (0.0822)	-0.140* (0.0820)	0.0735*** (0.0246)	0.0743*** (0.0247)
DEF above median			0.528 (1.453)	0.541 (1.451)	0.334 (0.643)	0.322 (0.638)
log of initial workers	-0.188 (0.948)	-0.149 (0.939)	0.308 (0.955)	0.345 (0.945)	-3.442*** (0.974)	-3.487*** (0.967)
log of initial GDP p.c.	0.758 (0.485)	0.647 (0.492)	0.941 (0.581)	0.785 (0.592)	-2.380*** (0.829)	-2.328** (0.839)
initial GDP p.c. growth	-12.93*** (1.951)	-12.73*** (1.958)	-13.45*** (2.259)	-13.19*** (2.249)	7.271** (3.187)	7.190** (3.167)
Dependent variable	s.d. sales gr	s.d. sales gr	s.d. sales gr	s.d. sales gr	mean sales gr.	mean sales gr.
Sector FE	Y	Y	N	N	N	N
Firm type FE	Y	Y	Y	Y	Y	Y
N	22852	22850	22852	22850	22698	22696
AR2	0.398	0.398	0.389	0.389	0.151	0.151

Higher incidence of bribery is associated with lower growth volatility and higher firm growth in output and input factors. The correlation is more prominent for sectors that rely more on external financing.

Source: China Judgements Online (2014-17) and Annual Industrial Survey (1998-2007).

Note: Standard errors clustered at province-level.

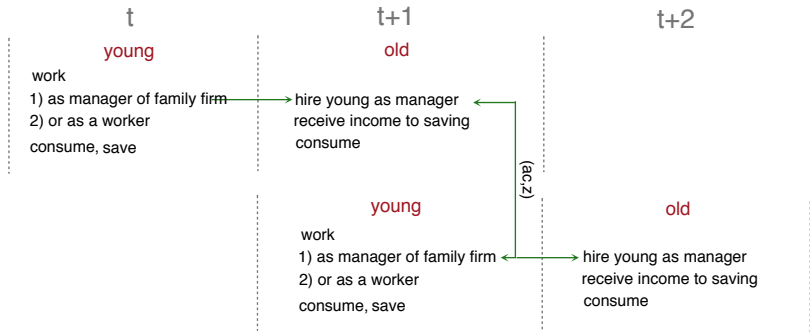
# Model



## Key ingredients

- Two-period OLG households, only work when they are young.
- Young individuals can be entrepreneurs or workers.
- A continuum of product markets. In each market, incumbent and entrant engage in Bertrand price competition.
- Search for formal financing is frictional. Entrepreneurs can self-finance when they have enough wealth.
- Entrants push out incumbents if they have a lower unit cost of production.
- (for now) Productivity is exogenously given. The economy is on the upward transition path towards steady state.

# Household and timing



## Goods and production technology

- A continuum of intermediate goods, Each is produced by an entrepreneur

$$y_i = z_i k_i^\alpha l_i^{1-\alpha},$$

- Intermediate goods are aggregated into final good,

$$Y = \left( \int_i y_i^{\frac{\rho-1}{\rho}} di \right)^{\frac{\rho}{\rho-1}}.$$

- The unit cost of production is

$$\frac{1}{z_i} \left( \frac{R_i}{\alpha} \right)^\alpha \left( \frac{w}{1-\alpha} \right)^{1-\alpha},$$

which decreases with  $z_i$  and increases with  $R_i$ .

- Productivity distribution  $z_i \sim G(z)$  is exogenously given.

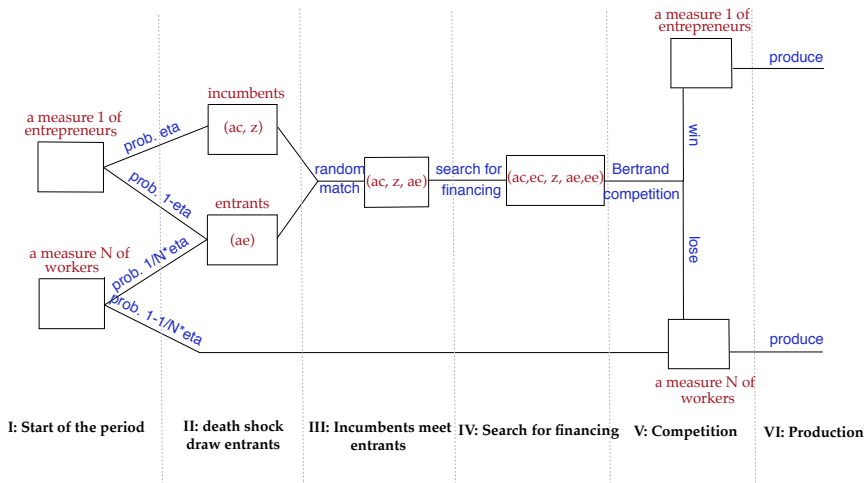
## Bertrand competition

- Each market has 1 incumbent and 1 potential entrant.
- The entrepreneur with lower unit cost wins and monopolizes the market.
- Productivity  $z_i$  is good- or market-specific, the entrepreneur with lower interest rate cost  $R_i$  wins.

## Financial frictions

- A representative bank with a unit of 1 bankers making 0 profit.
- Entrepreneurs search for bankers.
- With probability  $p$ , search successful,
  - Formal financing, interest rate  $R_i = r + \delta$ .
- With probability  $1 - p$ , search fails,
  - Self-financing, (implicit) interest rate  $R_i = r + \delta$ .
  - Informal financing,  $R_i = r + \epsilon + \delta$ .
- Entrepreneurs can grow out of financial frictions (self-finance) by saving.

# Timing within the period



## Outcome

- Frequent entry/exit.
- Entrepreneurs can't stay in the market long enough to grow out of financial frictions.
- Slow convergence to steady state.

## Corruption

- Each market is governed by a corruptible official issuing an operation permit.
- Bribery to obtain permit is a bidding competition between incumbent and entrant.
- Bribery has to come out of the pocket  $b(a) \in [0, m(a)]$ , where  $m(a)$  the available funds is an increasing function of  $a$ .
- The entrant wins the bid if  $a^e > a^c$  and  $\pi(a^e, z) - m(a^c) > w$ . The size of the bid is  $m(a^c)$ .



## Outcome with corruption

- Less entry/exit.
- Only permit holders search for financing. Higher probability of finding formal financing.
- Incumbents stay in market longer. Easier to grow out of financial friction. Faster convergence to steady state.
- Higher inequality between incumbents and entrants.

# Extension

## A dynamic view

- The trade-off of corruption is capital accumulation v.s. productivity gain through firm entry.
- The former is more important at early stage of development.
- Corruption generates larger incumbents and smaller entrants, making firm entry more difficult over time.

## Corruption and distance to frontier

	(1)	(2)	(3)	(4)	(5)	(6)
corruption (bribery)	0.591** (0.240)	0.547*** (0.126)	0.455*** (0.127)	0.572** (0.233)	0.542*** (0.127)	0.443*** (0.128)
log initial lab. pro. X bribery	-0.0882** (0.0329)	-0.0694*** (0.0171)	-0.0524*** (0.0184)	-0.0815** (0.0314)	-0.0678*** (0.0172)	-0.0490** (0.0182)
corruption (graft)				0.150 (0.0892)	0.0351 (0.0363)	0.0765 (0.0500)
log of initial workers	-2.782*** (0.943)	-6.737*** (0.688)	-3.065*** (0.959)	-2.623*** (0.899)	-6.676*** (0.655)	-2.976*** (0.968)
log of initial GDP p.c.	-3.490*** (0.825)	-0.990** (0.375)	-1.084* (0.589)	-2.351*** (0.806)	-0.699 (0.522)	-0.624 (0.609)
initial GDP p.c. growth	9.834** (4.392)	3.140 (2.312)	6.767** (2.827)	7.097** (3.035)	2.441 (2.217)	5.612** (2.231)
share of long-term debt				1.287 (0.983)	1.024 (0.650)	-2.252*** (0.669)
leverage ratio				0.0450 (0.0304)	-0.0253 (0.0254)	0.0339 (0.0239)
Dependent variable	sales gr	wkr gr	assets gr	sales gr	wkr gr	assets gr
Sector FE	Y	Y	Y	Y	Y	Y
Firm type FE	Y	Y	Y	Y	Y	Y
N	22698	22861	22757	22696	22859	22755
AR2	0.164	0.221	0.252	0.167	0.222	0.254

Higher incidence of bribery is positively correlated with higher growth in output and input factors, but the correlation is lower for sectors that have higher initial labor productivity.

Source: China Judgements Online (2014-2017) and Annual Industrial Survey (1998-2007)

Note: Standard errors clustered at province- and sector-level. All regressions control for initial firm-level growth

## Corruption and patents granted

	(1)	(2)	(3)	(4)	(5)	(6)
corruption (bribery)	0.00160*** (0.000459)	0.00125*** (0.000371)	0.00127*** (0.000380)	0.00169*** (0.000422)	0.00136*** (0.000338)	0.00138*** (0.000345)
corruption (graft)		-0.00231*** (0.000499)	-0.00241*** (0.000536)		-0.00214*** (0.000488)	-0.00224*** (0.000533)
log of initial workers	-0.165*** (0.0193)	-0.168*** (0.0188)	-0.167*** (0.0190)	-0.143*** (0.0182)	-0.146*** (0.0177)	-0.144*** (0.0178)
log of initial GDP p.c.	0.0481*** (0.00826)	0.0313*** (0.00937)	0.0337*** (0.00951)	0.0464*** (0.00762)	0.0309*** (0.00836)	0.0332*** (0.00854)
initial GDP p.c. growth	-0.0690 (0.0404)	-0.0281 (0.0332)	-0.0330 (0.0337)	-0.0641 (0.0402)	-0.0262 (0.0316)	-0.0300 (0.0317)
dummy patents 98-99				0.507*** (0.0324)	0.506*** (0.0326)	0.509*** (0.0340)
share of long-term debt			0.0718** (0.0276)			0.0701** (0.0273)
leverage ratio			-0.00249*** (0.000873)			-0.00233** (0.000891)
Dependent variable	dummy 98-07	dummy 98-07	dummy 98-07	dummy 00-07	dummy 00-07	dummy 00-07
Firm type FE	Y	Y	Y	Y	Y	Y
Sector FE	Y	Y	Y	Y	Y	Y
N	22861	22861	22859	22861	22861	22859
AR2	0.0882	0.0894	0.0909	0.105	0.106	0.108

Higher incidence of bribery cases is positively correlated with higher probability of being granted a patent.

Source: China Judgements Online (2014-17), Annual Industrial Survey (1998-2007), and SIPO (1998-2007).

Note: Standard errors clustered at province-level.

## Determinants of innovation activities

	(1)	(2)	(3)	(4)
log initial worker	0.00420 (0.00435)	0.00278 (0.00428)	0.00596 (0.00486)	0.00459 (0.00477)
log initial labor productivity	-0.00285 (0.00285)	-0.00344 (0.00280)	-0.00169 (0.00321)	-0.00267 (0.00314)
log initial assets	0.0571*** (0.00347)	0.0532*** (0.00342)	0.0675*** (0.00384)	0.0630*** (0.00379)
log initial oper profit	0.0165*** (0.00169)	0.0163*** (0.00168)	0.0181*** (0.00189)	0.0175*** (0.00187)
dummy patent granted 98-99		0.437*** (0.0369)		
dummy patent filed 98-99				0.365*** (0.0286)
Dependent variable	dummy granted	dummy granted 00-07	dummy filed	dummy filed 00-07
SectorXProvince FE	Y	Y	Y	Y
Firm type FE	Y	Y	Y	Y
N	17546	17546	17546	17546
AR2	0.179	0.189	0.200	0.210

Firms with higher initial operating profit and more asset are more likely to innovate. Corruption could results in more innovation if the major constraint of innovation is financial friction.

Source: China Judgements Online (2014-17), Annual Industrial Survey (1998-2007), and SIPO (1998-2007).

Note: Standard errors clustered at province- and sector-level.

## Conclusion

- Corruption introduces static distortion, but, in the presence of financial frictions, could lead to a dynamic gain through faster capital accumulation.
- The effectiveness of anti-corruption campaign depends on 1) the stage of development and 2) financial capacity of non-corrupt firms.