Email: federico.kochen@nyu.edu
Website: www.federicokochen.com

Finance Over the Life Cycle of Firms

Federico Kochen
New York University

Motivation

- Large literature argues *finance* important for macro and development
- In theory, firms are more dependent on external financing early in their life
- Yet little is known about importance of financial frictions at different stages of firms' lifetimes
- ***Questions***: How constrained are young firms? Does lack of financing force young firms to exit? What are the macroeconomic consequences?
- ***Approach***: Answer these questions using firm-level micro data from high and middle-income European countries and a quantitative macro model

Data and Empirical Specification

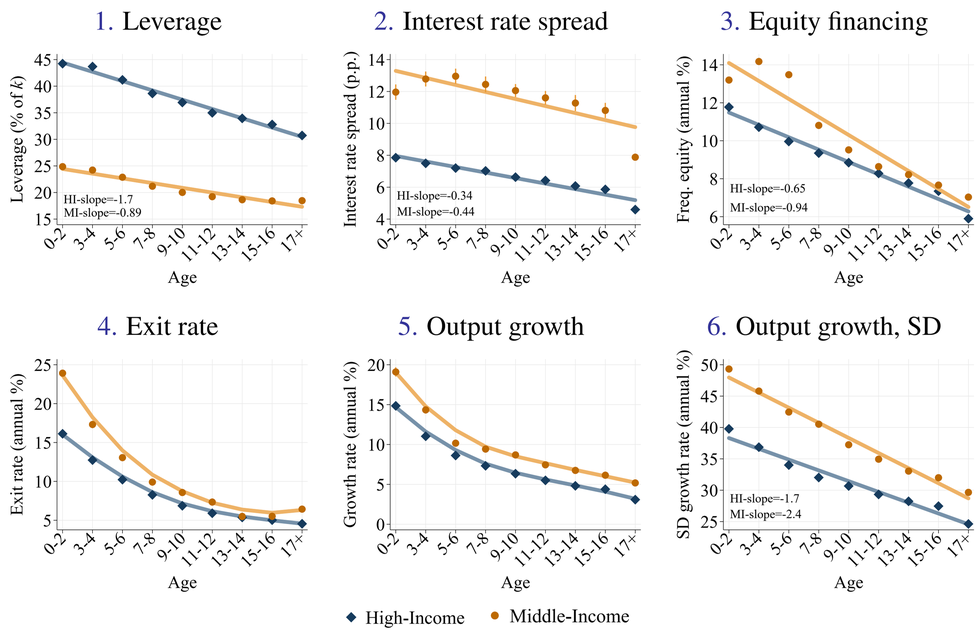
- *Orbis* database (Moody's Bureau van Dijk) from 1996-2018
  - Annual balance sheet and income statements for *privately-held* firms
- For each variable y, run the non-parametric regression

$$y_{it} = \sum_{a \in \mathcal{A}} (\gamma_a + \gamma_a^{\text{MI}} \text{MI}_i) \text{D}_{it}^a + \alpha_n + \alpha_c + \alpha_t + \epsilon_{it}$$

  - $\mathcal{A}$ includes 9 age groups, and D_{it}^a equals 1 if firm i belongs to group a in t
  - MI_i is equal to one if firm i is located in one of the middle-income countries
  - α_n denotes NACE 4-digit industry fixed effects, α_c and α_t correspond to cohort and time fixed effects

Life Cycle Facts

- Younger firms (vs. older firms)
  - Borrow more, face higher spreads, receive more equity injections, exit more, have higher and more volatile growth
- Firms in middle-income countries (vs. high-income countries)
  - Borrow less, pay higher spreads, exit more, higher and more dispersed growth
  - Differences are more pronounced among *younger* firms



Notes: High-income countries are Austria, Belgium, Denmark, Finland, France, Germany, Italy, Norway, Spain, Sweden, and the United Kingdom. Middle-income countries are the Czech Republic, Croatia, Hungary, Poland, Romania, Slovenia, and Slovakia.

Model

- Novel SOE model of firm dynamics, learning, and financial frictions
  - Use the model as a laboratory to quantify aggregate implications of financing frictions and better understand cross-country differences
- The model features two key building blocks

1. Firms can *finance* their operations using internal funds, defaultable long-term debt (endogenous interest rate spreads), and costly equity injections

$$\underbrace{k_{it+1} - (1-\delta)k_{it}}_{\text{capital investments}} = \underbrace{\pi(k_{it}, z_{it}) - \exp(z_{it})c_{Fit} - (\phi + r)b_{it}}_{\text{internal funds}} \underbrace{- x_{it}}_{\text{equity injection}}$$
$$\underbrace{+ \boldsymbol{q}_{t+1}(k_{it+1}, b_{it+1}, \hat{s}_{it+1})[b_{it+1} - (1-\phi)b_{it}]}_{\text{new debt}}$$

   s.t. bankruptcy costs, and fixed and convex costs of equity injections

2. Firms *learn* about their profitability over time and face age-specific volatility

   firm i at age t observe $\quad z_{it} = \underbrace{s_{it}}_{\text{persistent}} + \underbrace{\varepsilon_{it}}_{\text{transitory}} \quad$ (not s_{it} and ε_{it} separately)

$$s_{it} = \rho_s s_{it-1} + u_{it},\ s_{i0} \sim \mathcal{N}(\hat{s}_{i0}, \Sigma_0),\ u_{it} \sim \mathcal{N}(0, \sigma_u^2),\ \varepsilon_{it} \sim \mathcal{N}(0, \sigma_{\varepsilon t}^2),\ \sigma_{\varepsilon t}^2 = (1 + \rho_\varepsilon^t C_\varepsilon)^2 \sigma_\varepsilon^2$$

$\Rightarrow$ Allow the model to account for *younger firms relying more on external financing while, at the same time, facing higher uncertainty and risk*

Quantifying the Model

- Separately calibrate key parameters to high and middle-income countries to minimize distance between real and financial moments in data and model
  - Severity of financing frictions chosen to match leverage, spreads, and equity

Entrants and Real Variables

	High-Income		Middle-Income	
	Data	Model	Data	Model
Entrants (age 0-2)				
Output growth	0.15	0.17	0.19	0.21
Exit rate	0.16	0.21	0.24	0.24
Real Variables				
Exit rate	0.08	0.08	0.12	0.14
log Output, SD	1.71	2.13	2.09	2.17
Output growth				
Mean	0.06	0.07	0.08	0.09
SD	0.29	0.32	0.37	0.38
SD age-slope	-0.017	-0.023	-0.024	-0.022
Profits/k	0.08	0.11	0.12	0.12
Profits/k, SD	0.18	0.08	0.20	0.16

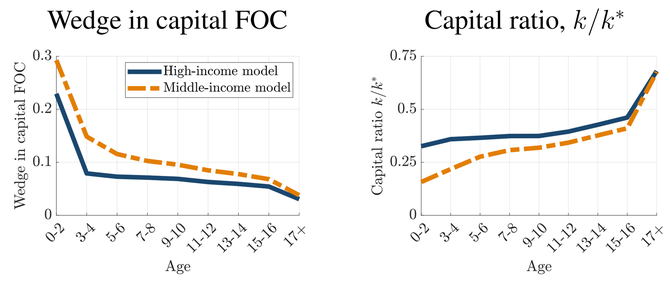
Financial Variables

	High-Income		Middle-Income	
	Data	Model	Data	Model
Leverage				
Age-slope	-0.017	-0.020	-0.009	-0.009
Mean age 9-10	0.37	0.29	0.20	0.18
SD	0.35	0.16	0.28	0.14
Interest Rate Spread				
Age-slope	-0.003	-0.003	-0.004	-0.005
Mean age 9-10	0.066	0.074	0.121	0.096
SD	0.119	0.103	0.178	0.117
Equity Financing				
Fr., age-slope	-0.007	-0.006	-0.009	-0.014
Fr., age 9-10	0.09	0.09	0.10	0.06
Size, mean	0.14	0.15	0.16	0.13
Size, SD	0.23	0.17	0.27	0.18

- The model does a good job replicating the entire pattern of the six life cycle facts
- ***Insights***: To match the data, firms in the middle-income model (vs. high-income)
  - Less initial capital and higher uncertainty, and face more volatile ex post shocks
  - Similar bankruptcy costs, hence differences in spreads due to idiosyncratic risk
  - Sizable *equity financing costs*, 60% larger than in high-income model

How Constrained Are Young Firms?

- Entrants start at 0.31 and 0.17 k/k^* in high and middle-income countries
  - The typical firm in high and middle-income exit at 0.42 and 0.3 k/k^*



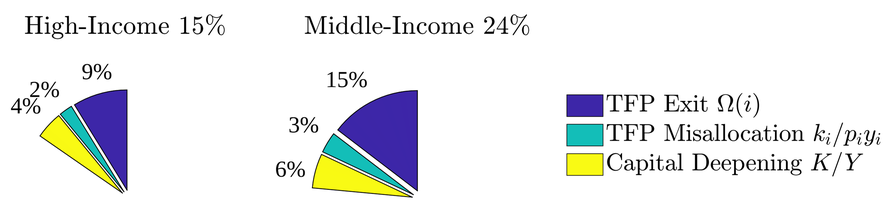
- Firms in middle-income countries are more likely to be constrained, they exit sooner, and remain smaller throughout their lives

Aggregate Implications of Financial Frictions

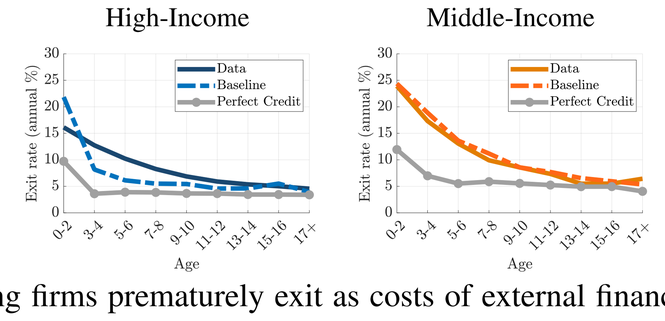
- Financial frictions generate sizable losses in output per worker of 15% and 24%

	High-Income		Middle-Income	
	Perfect Credit	Baseline	Perfect Credit	Baseline
	(a) *Relative to Perfect Credit Benchmark*			
Y/L	1.00	0.85	1.00	0.76
TFP	1.00	0.92	1.00	0.87
K/Y	1.00	0.91	1.00	0.88
$m(\Omega)$	1.00	0.48	1.00	0.41
$m(\mathcal{C}[\Omega])$	1.00	0.46	1.00	0.37
$m(\mathcal{E})$	1.00	0.97	1.00	1.09
	(b) *Levels*			
Exit Rate	0.04	0.08	0.06	0.14
$\mathbb{E}$[lifespan]	25.3	12.5	17.9	7.1

- ***Main finding***: The bulk of the losses in output per worker $\frac{Y}{L} = \text{TFP}^{\frac{1}{1-\alpha}} \left(\frac{K}{Y}\right)^{\frac{\alpha}{1-\alpha}}$ is explained by a *new* channel distorting firms' *exit* decisions



- Distortions in exit margin driven by young firms, little effect on older firms



- ***Intuition***: Young firms prematurely exit as costs of external financing are higher than the option value of learning
- ***Policy implications***: Results suggest that policies targeting young firms (*age* criterion) rather than SMEs (*size* criterion) are potentially more beneficial