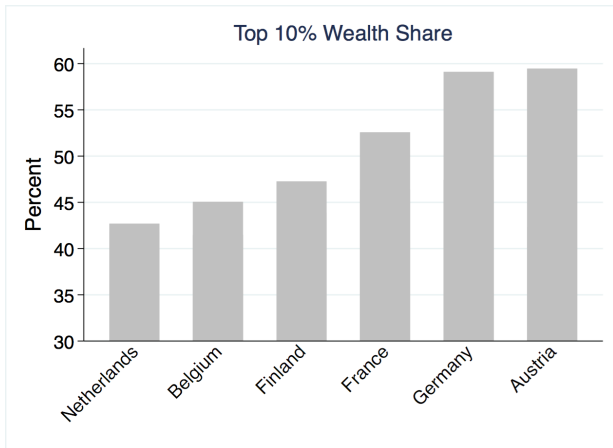# Owning Up:
Closely Held Firms and Wealth Inequality

Alessandra Peter

NYU

HFC Conference, Central Bank of Ireland, December 2019

# Differences in Wealth Inequality across Europe

Top 10% Wealth Share

▶ Share of net worth held by top 10% of households: 43% to 60%

Introduction

▶ Is wealth inequality shaped by financial market frictions?

▶ With higher frictions, entrepreneurs keep more inside equity
  ▶ Fewer public, more private firms
  ▶ Higher insider shares of public firms

▶ How does wealth inequality relate to inside equity positions?
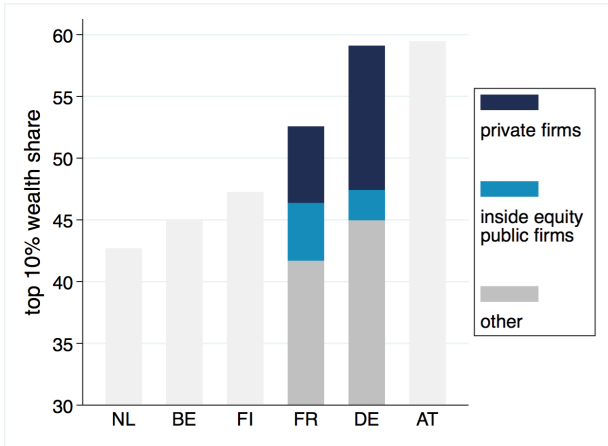
Inside Equity and Inequality
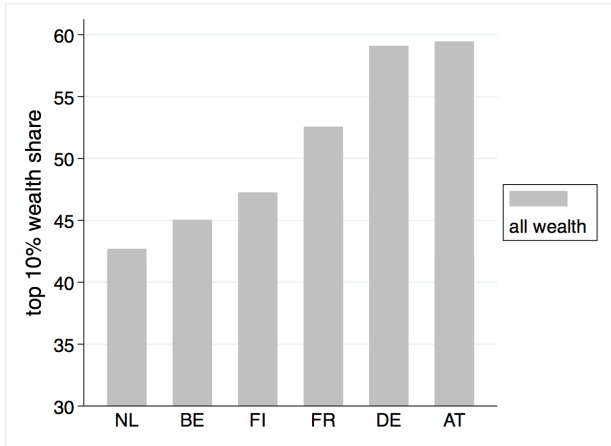
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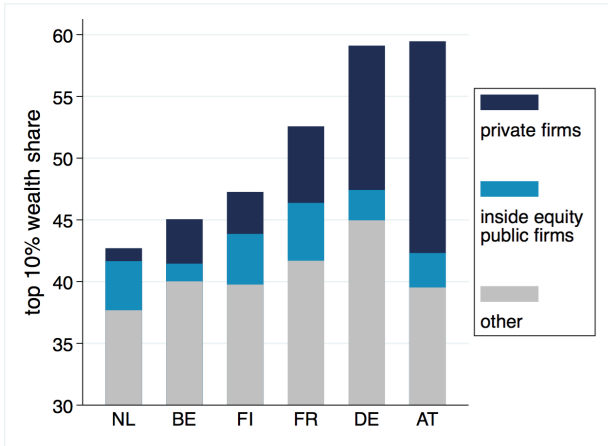
▶ Both types of inside equity important for differences in inequality

Inside Equity and Inequality

▶ Both types of inside equity important for differences in inequality

Mechanism

Financial market frictions drive inequality in DE ($\approx$60%) vs FR ($\approx$53%)

- ▶ 35% of difference: lower debt frictions
    - ▶ Germany has a traditionally stronger banking system
    - ▶ Higher investment, profits, entrepreneurial wealth, and inequality

- ▶ 58% of difference: higher equity frictions
    - ▶ Germany has higher IPO costs, more inside equity
    - ▶ Lower investment, but entrepreneurs exposed to more risk
    - ▶ Higher precautionary savings, wealth accumulation, and inequality

Mechanism

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    - ▶ **Higher inequality and higher output**

- ▶ 58% of difference: **higher equity frictions**
    - ▶ Germany has higher IPO costs, more inside equity
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    - ▶ Higher precautionary savings, wealth accumulation, and inequality
    - ▶ **Higher inequality and lower output**

Outline

Dynamic GE Model of Eurozone Countries
    Entrepreneurs choose firm financing s.t. country-specific cost
    Financing costs affect household wealth distribution

Data and Quantification
    New moments on external finance of firms
    Baseline country: France
    Across countries: moments identify financial market frictions

Results and Counterfactuals
    Model predicts wealth inequality across countries
    Equality-efficiency trade-off with debt, not with equity

Outline

Small Open Economies, Entrepreneurs & Workers

In all Eurozone countries

▶ Common interest rate R, labor markets clear domestically

▶ All shocks are idiosyncratic, no aggregate risk

Variation across countries

▶ Firm productivity distribution & 3 financial market frictions

Entrepreneurs choose to run private or public firm

▶ Private firms finance with debt and inside equity   Ownership private firms

▶ Public firms issue outside equity, but controlled by entrepreneur
  ▶ Average public firm: 40% of equity held by insiders   Insider Shares

▶ Trade-off: financing & risk sharing vs agency cost

Overview

▶ Continuum of agents
- ▶ Workers:
  - ▶ stochastic skill, fixed labor supply, consume and save.
- ▶ Entrepreneurs
  - ▶ productivity z_t, hire workers, invest capital.

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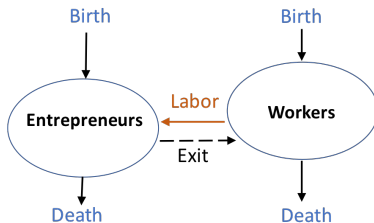
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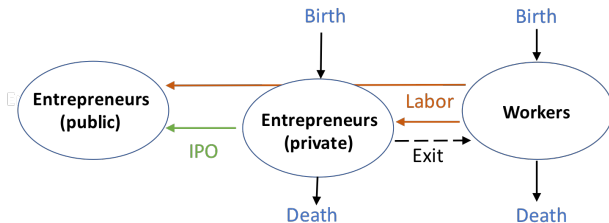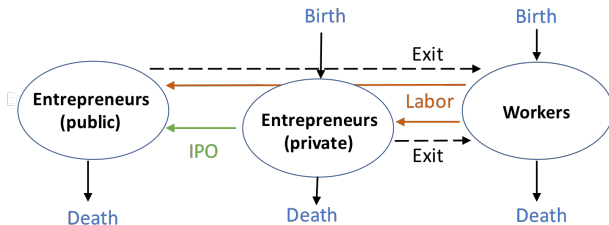   - ► productivity z_t, hire workers, invest capital.

Preferences & Technology

Preferences:

$$\mathbb{E}_0 \left[\sum_{t=0}^{\infty} \left[\beta(1 - \pi_d) \right]^t u(c_t) \right]$$

- ▶ π_d: i.i.d. death probability
- ▶ Child starts with $(1 - \chi)$ parental bequests $+ \chi$ average wealth

Technology:

$$y_t = z_t^{1-\psi} (k_t^{\alpha} l_t^{1-\alpha})^{\psi}, \quad k_t \text{ chosen in } t-1$$

- ▶ Idiosyncratic productivity z_t: Markov process with absorbing state
  - ▶ $\mathbb{P}(z_t = 0) = \eta$, i.i.d across firms and time, z_t constant o.w.
  - ▶ firm exits, undepreciated capital $(1 - \delta)k_t$ resold

Agents Save in Bonds & Equity

- Inside equity
  - Private firms: entirely owned by entrepreneur
  - Public firms: entrepreneurs choose share of inside equity

- Outside equity
  - Held by investment fund
  - Diversified portfolio $\rightarrow$ fund earns return R

- Bonds (& outside equity) $a \geq 0$
  - Workers & entrepreneurs can save, but not borrow

Firms Finance with Debt & Equity

Debt

- Leverage constraint: $R\, b_{t+1} \leq \lambda\,(1-\delta)\,k_{t+1}$
    - $\lambda \leq 1$ varies across countries & captures creditor protection

Equity

- Claim to a share of dividends $\{D_{t+s}\}_{s=0}^{\infty}$
    - $D_t \equiv y_t - wl_t - [k_{t+1} - (1-\delta)k_t] - Rb_t + b_{t+1} \lessgtr 0$

- φ: share of equity held by outsiders
    - Entrepreneur receives $(1-\varphi)D_t \rightarrow$ incentive to divert funds
    - Investment fund needs to pay a monitoring cost $= c_M\,\varphi\,y$
        - c_M varies across countries & captures shareholder protection
    - Investment fund receives $\varphi D_t - c_M\,\varphi\,y$

Entrepreneurs Choose Investment & Share Sold

Except IPO period, entrepreneurs choose

  ▶ cons c, savings a' ▶ investment k', labor l, debt $b' \leq \frac{(1-\delta)}{R}\lambda k'$

▶ Budget constraint: $c + a' = Ra + (1-\varphi)D$

IPO: choose share sold $\boldsymbol{\varphi} \in (0,1)$

▶ $c + a' = Ra + (1-\boldsymbol{\varphi})D + P(\boldsymbol{\varphi}, z, \mathsf{CoH}, c_M)$

  ▶ Competitive market for investment funds

    ▶ $P(\varphi, z, \mathsf{CoH}, c_M) = \mathbb{E}[\text{ pdv } (\varphi D_t - c_M \varphi y \text{)}]$

Entrepreneurs Choose Investment & Share Sold

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  - ▶ One-off fixed cost of IPO c_{IPO}
    - ▶ Varies across countries & captures underwriting fees

Entrepreneurs Choose Investment & Share Sold

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- ▶ cons c, savings a' ▶ investment k', labor l, debt $b' \leq \frac{(1-\delta)}{R}\lambda k'$
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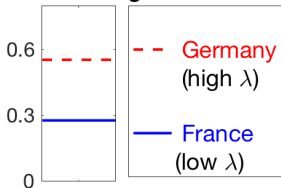- ▶ $c + a' = Ra + (1-\varphi)D + P(\varphi, z, \text{CoH}, c_M) - c_{\text{IPO}}$

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    - ▶ Trade-off: financing and risk-sharing vs c_{IPO} and c_M
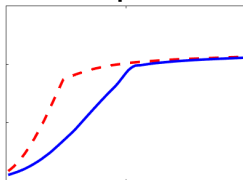
Mechanism: Financial Frictions and Wealth

▶ Wealth: savings $a + (1 - \varphi) V_{\text{firm}} \begin{cases} \text{public: market value of equity} \\ \text{private: pdv of cash-flows} \end{cases}$

▶ Model simulation

    ▶ Two entrepreneurs, identical productivity and cash on hand
    ▶ Assume particular realization: no shocks

1. Effect of higher frictions in debt markets?

2. Effect of higher frictions in equity markets?
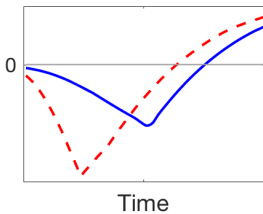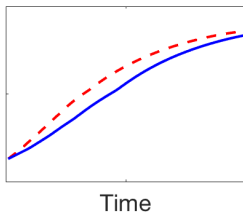
Debt Market Frictions Reduce Wealth

Max Leverage

0.6
0.3
0
--- Germany (high λ)
— France (low λ)

Capital

Bonds

0

Time

Wealth

Time

Mechanism: Financial Frictions and Wealth

▶ Wealth: savings $a + (1 - \varphi) \, V_{\text{firm}}$

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1. Effect of higher frictions in debt markets

  ▶ Investment lower, slower capital accumulation

  ▶ Lower wealth holdings

2. Effect of higher frictions in equity markets?
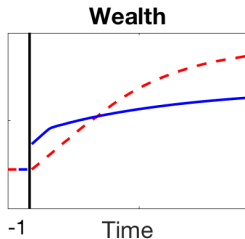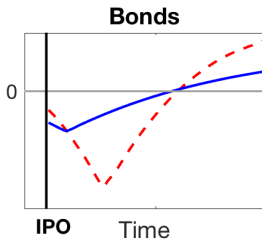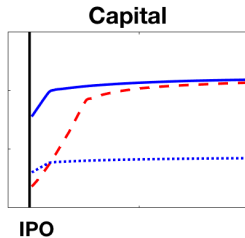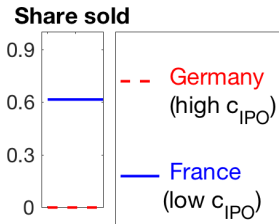
Equity Market Frictions Eventually Increase Wealth

Mechanism: Financial Frictions and Wealth

▶ Wealth: savings $a + (1 - \varphi) V_{\text{firm}}$

▶ Model simulation

    ▶ Two entrepreneurs, identical productivity and cash on hand

    ▶ Assume particular realization: no shocks

1. Effect of higher frictions in debt markets

    ▶ Investment lower, slower capital accumulation

    ▶ Lower wealth holdings

2. Effect of higher frictions in equity markets

    ▶ Investment lower, slower accumulation of capital

    ▶ Initially, wealth holdings lower

    ▶ Higher insider share, riskier portfolio & eventually higher wealth

Outline

Dynamic GE Model of Eurozone Countries

Entrepreneurs choose firm financing s.t. country-specific cost

Financing costs affect household wealth distribution

Data and Quantification

New moments on external finance of firms

Baseline country: France

Across countries: moments identify financial market frictions

Results and Counterfactuals

Model predicts wealth inequality across countries

Equality-efficiency trade-off with debt, not with equity

Quantification Within and Across Countries

Baseline country: France

- ▶ Set of parameters separately estimated or externally set
  - ▶ exit and death, AR(1) worker skill, depreciation rate

- ▶ Key parameters
  - ▶ TFP distribution
  - ▶ Max leverage constraint
  - ▶ Fixed & monitoring cost
  - ▶ Discount factor

- ▶ Target moments
  - ▶ Firm size distribution
  - ▶ Average leverage
  - ▶ Outside equity (2 margins)
  - ▶ Wealth inequality

Across countries: Germany, Austria, Netherlands

- ▶ Match *firm* moments using productivity and financial frictions

- ▶ Wealth inequality no longer a target

Summary

Quantification Within and Across Countries

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Summary

Data: Two Margins of Outside Equity

- **Extensive margin: share of private firms**
  - Value of private firms: HFCS
  - Value of public firms: Compustat Global

- **Intensive margin: insider share of public firms**
  - Amadeus Ownership : shareholders of publicly traded companies
    - Match firms to their owners to find ultimate 'person' shareholders
    - Exclude banks and financial institutions from insiders
  - Insider = top 3 domestic shareholders
  - Top 1-5   Insider Share and Size   Private Firms

other moments

France: Match Firm Moments and Inequality

$z \in \{z_1, z_2, z_3\}$ with population shares $\{.8, .18, .02\}$

Parameter	Value	Moment	Value
z_2/z_1	12.6	employment share top 25%	81.1%
z_3/z_1	53.0	employment share top 1%	18.3%
λ	0.53	aggregate leverage	48.5%
c_{IPO}	0.04	share of private firms	37.0%
c_M	0.06	aggregate insider share	33.4%
β	0.96	top 10% wealth share	52.6%

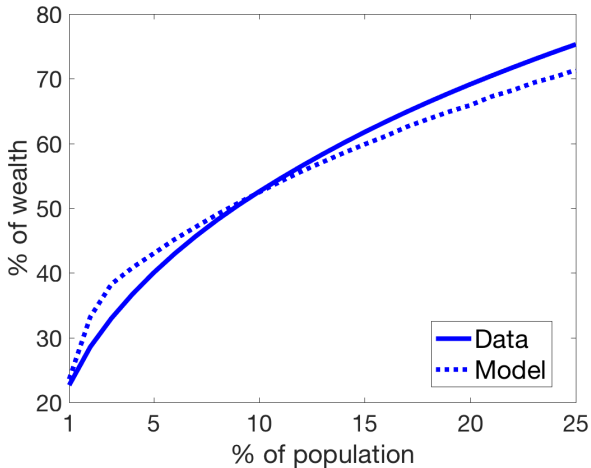Other parameters Firm size distribution

▶ Identification of c_M and c_{IPO} Details
  ▶ Similar effects on extensive margin, opposite on intensive margin

Top Wealth Shares - Model and Data

Model Fit

Financial Market Frictions Across Countries

▶ Re-estimate
- ▶ TFP distribution
- ▶ Max leverage constraint
- ▶ Monitoring & fixed cost

▶ Target
- ▶ Firm size distribution
- ▶ Average leverage
- ▶ Outside equity (2 margins)

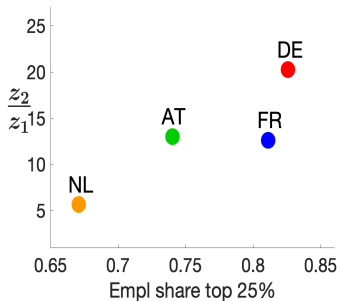▶ Wealth inequality not a target (discount factor constant)

Financial Market Frictions Across Countries
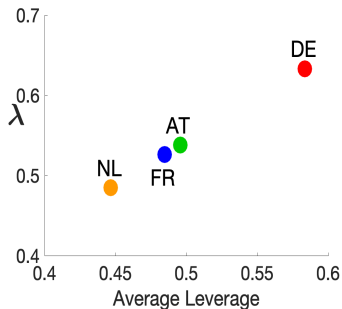
- ▶ Re-estimate
    - ▶ **TFP distribution**
    - ▶ **Max leverage constraint**
    - ▶ Monitoring & fixed cost

- ▶ Target
    - ▶ **Firm size distribution**
    - ▶ **Average leverage**
    - ▶ Outside equity (2 margins)

Financial Market Frictions Across Countries

- ► Re-estimate
  - ► TFP distribution
  - ► Max leverage constraint
  - ► **Monitoring & fixed cost**

- ► Target
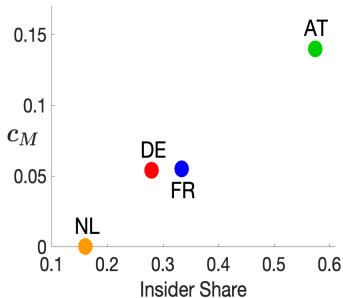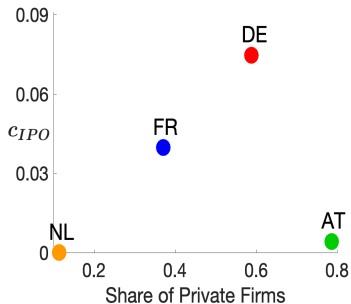 - ► Firm size distribution
  - ► Average leverage
  - ► **Outside equity (2 margins)**

Outline

Top 10% Wealth Shares Across Countries
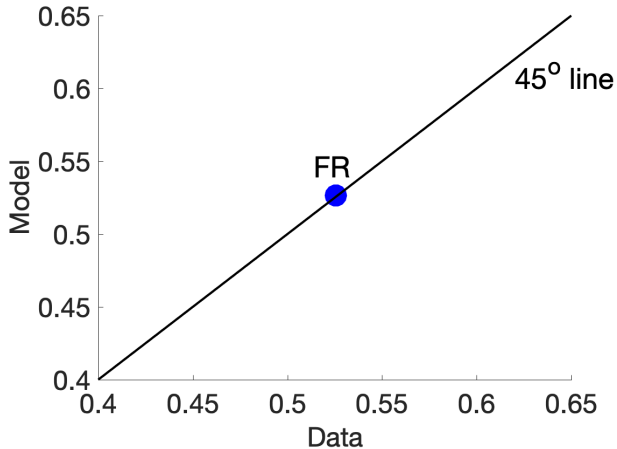
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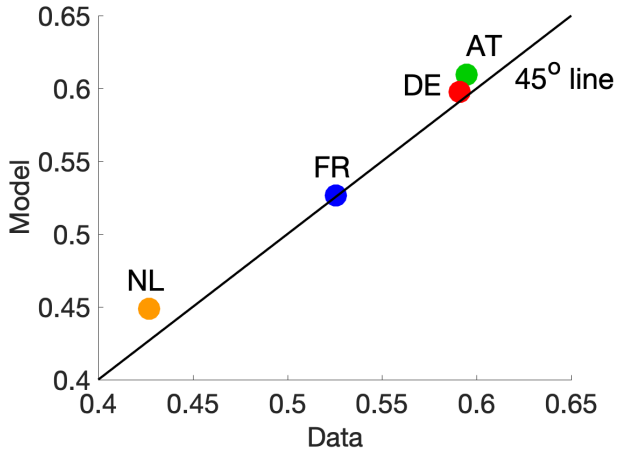
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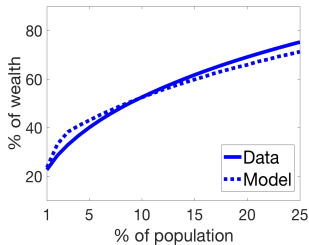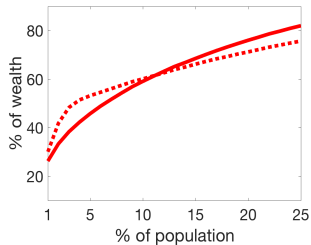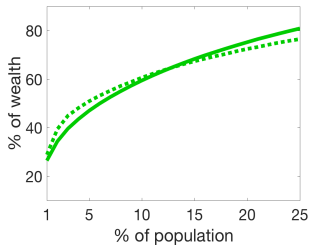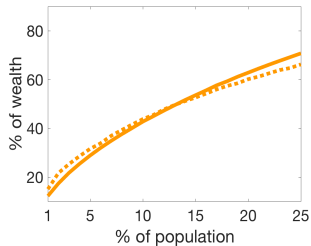
Financial Frictions and Differences in Inequality

▶ Counterfactuals

    ▶ Start from AT, DE, NL baseline

    ▶ Introduce French TFP distribution, financial frictions

    ▶ Comparisons of steady states

	FR	DE	AT	NL
Baseline	52.6%	59.7%	61.0%	44.9%
French TFP process				

Summary

Financial Frictions and Differences in Inequality

▶ Differences in inequality not driven by TFP distribution

	FR	DE	AT	NL
Baseline	52.6%	59.7%	61.0%	44.9%
French TFP process		59.1%	60.5%	45.4%

Summary

Financial Frictions and Differences in Inequality

▶ Differences in inequality are driven by financial frictions

	FR	**DE**	**AT**	**NL**
Baseline	52.6%	59.7%	61.0%	44.9%
Financial frictions λ: max leverage c_{IPO}: fixed cost c_M: monitoring cost				
all together		53.1%	54.3%	53.0%
Change in Output		+0.3%	+2.7%	-2.3%

Summary

Financial Frictions and Differences in Inequality

- France has lower λ than Germany
  - $\lambda^{\mathsf{FR}} = 53\%$ $\lambda^{\mathsf{DE}} = 63\%$

- Reducing λ reduces output and inequality

	FR	**DE**	**AT**	**NL**
Baseline	52.6%	59.7%	61.0%	44.9%
Financial frictions				
λ: max leverage		56.4%		
c_{IPO}: fixed cost				
c_M: monitoring cost				
all together		53.1%	54.3%	53.0%
Change in Output		-0.5%	+2.7%	-2.3%

Financial Frictions and Differences in Inequality

▶ France has lower λ and lower c_{IPO} than Germany

  ▶ $c_{\text{IPO}}^{\text{FR}} = 4.0\%$ $c_{\text{IPO}}^{\text{DE}} = 7.5\%$

▶ Reducing c_{IPO} increases output and reduces inequality

	FR	DE	AT	NL
Baseline	52.6%	59.7%	61.0%	44.9%
Financial frictions				
λ: max leverage		56.4%		
c_{IPO}: fixed cost		54.3%		
c_M: monitoring cost				
all together		53.1%	54.3%	53.0%
Change in Output		+1.1%	+2.7%	-2.3%

Financial Frictions and Differences in Inequality

- Equality-efficiency trade-off with debt, not with equity
- Together: more equity, less debt $\rightarrow$ less inequality, same output.

	FR	DE	AT	NL
Baseline	52.6%	59.7%	61.0%	44.9%
Financial frictions				
λ: max leverage		56.4%		
c_{IPO}: fixed cost		54.3%		
c_M: monitoring cost				
all together		53.1%	54.3%	53.0%
Change in Output		+0.3%	+2.7%	-2.3%

Summary

Financial Frictions and Differences in Inequality

▶ France has lower c_M than Austria

    ▶ $c_{\mathsf{M}}^{\mathsf{FR}} = 5.5\%$ $c_{\mathsf{M}}^{\mathsf{AT}} = 14\%$

▶ Reducing c_M increases output and reduces inequality

	FR	DE	AT	NL
Baseline	52.6%	59.7%	61.0%	44.9%
Financial frictions				
λ: max leverage		56.4%		
c_{IPO}: fixed cost		54.3%		
c_M: monitoring cost			52.5%	
all together		53.1%	54.3%	53.0%
Change in Output		+0.3%	+3.6%	-2.3%

Summary

Financial Frictions and Differences in Inequality

- FR financial markets:
  - DE: more equity, less debt $\rightarrow$ less inequality, same output.
  - AT: more equity $\rightarrow$ less inequality, more output.

	FR	DE	AT	NL
Baseline	52.6%	59.7%	61.0%	44.9%
Financial frictions				
λ: max leverage		56.4%		
c_{IPO}: fixed cost		54.3%		
c_M: monitoring cost			52.5%	
all together		53.1%	54.3%	53.0%
Change in Output		+0.3%	+2.7%	-2.3%

Conclusion

Financial frictions shape differences in wealth inequality across Europe.

- ▶ Dynamic GE model with choice of debt, inside & outside equity
  - ▶ Choice of external finance depends on frictions
  - ▶ Debt and equity frictions can have opposite effects on inequality

- ▶ Quantitative Results
  - ▶ Frictions identified by leverage, two margins of outside equity
  - ▶ In more unequal countries, more debt and less equity financing
  - ▶ Three frictions quantitatively explain differences in inequality

- ▶ Counterfactuals
  - ▶ Equality-efficiency trade-off with debt, not with equity frictions

Welfare

BACK-UP SLIDES

Summary of Counterfactuals

▶ Differences in wealth inequality driven by financial frictions
  ▶ Effect of TFP distribution quantitatively small

▶ Different frictions at play in different countries

<table>
<tr><td>Germany</td><td>Austria</td></tr>
<tr><td>▶ Less tight max leverage λ</td><td>▶ Higher monitoring cost c_M</td></tr>
<tr><td>▶ Higher cost of IPO c_{IPO}</td><td></td></tr>
</table>

▶ Counterfactual with French financial market institutions
  ▶ $\Delta GDP \approx 0$ ▶ $\Delta GDP \approx +4\%$

▶ Equality-efficiency trade-off with debt, not with equity.

Discussion: What are Financial Frictions?

Equity markets

- ▶ Monitoring cost , ex-post punishment
    - ▶ Ex-ante monitoring : accounting and disclosure standards
        - ▶ LaPorta et.al. (1997) Accounting Standards and Insider Share
    - ▶ Ex-post punishment: in DE and AT, shareholders cannot sue
- ▶ Fixed cost of IPO
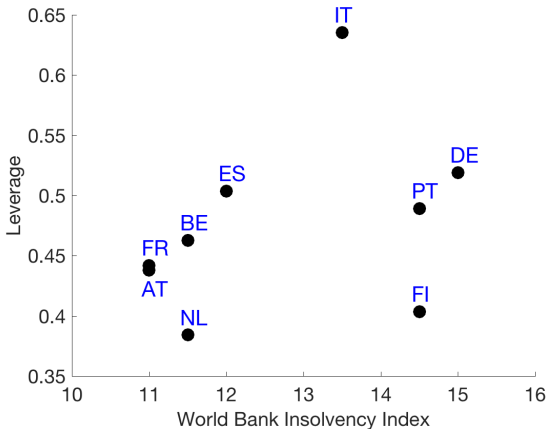   - ▶ Underwriting fees higher in DE than FR (Abrahamson et.al. (2010))

Debt markets

- ▶ Creditor rights & efficiency of insolvency framework World Bank Measure

Back

Accounting Standards and Insider Share
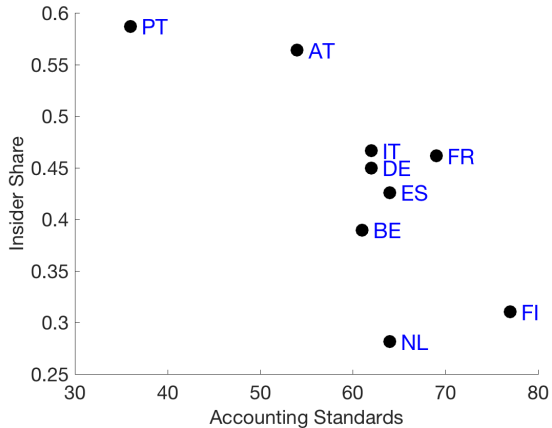
Creditor Rights and Leverage

Welfare Effect of Financial Market Frictions

Direct effects:

- λ: all entrepreneurs benefit from higher λ
  - Poor entrepreneurs rely more on external finance

- c_{IPO}, c_M: only affects entrepreneurs who IPO
  - Type 1 never IPO
  - Type 2 & 3: $\exists$ threshold level of wealth s.t. c_{IPO}, c_M irrelevant
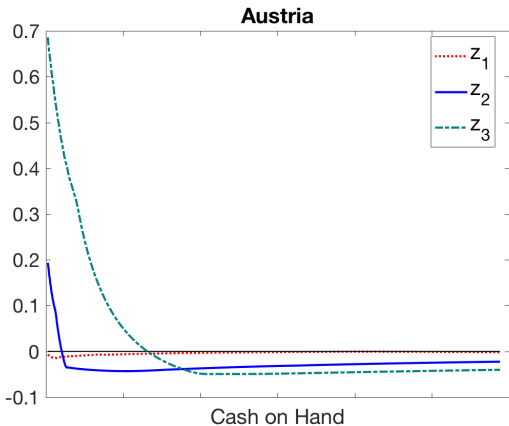
General Equilibrium: wage

- Any reduction in financial frictions increases the wage
  - Workers benefit from high wage
  - Entrepreneurs dislike high wage

DE with FR fin market institutions: lower λ & c_{IPO}
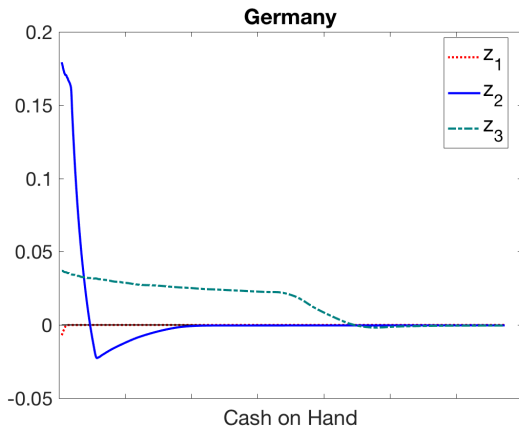
▶ Workers gain .04% of consumption

AT with FR fin market institutions: lower c_M, higher w

Austria

▶ Workers gain 3.1% of consumption

Investment is Increasing in Share Sold

$$c + \tilde{a}' + (1 - \varphi)k' = X$$
$$\tilde{a}' \geq -\lambda \frac{\rho(1-\delta)}{R}(1 - \varphi)k'$$
$$X' = R\tilde{a}' + (1 - \varphi)[zk'^\alpha + (1-\delta)k']$$
$$X'_f = R\tilde{a}' + (1 - \varphi)\rho(1-\delta)k'$$

▶ The higher is φ
  ▶ The less of k' the entrepreneur has to finance
  ▶ The less risk the entrepreneur is exposed to
  ▶ → investment k' is increasing in φ

▶ Since technology has decreasing returns
  ▶ $(1 - \varphi)k'$ decreasing in φ

Optimal Choice of Share Sold φ

Entrepreneurs chooses share of firm φ that maximizes

$$\max \{\max_{\varphi} V_{PUB}(\hat{X}(\varphi), \varphi; z), V_{PRIV}(X; z)\}$$

$$\text{where } \hat{X}(\varphi) = X + P(X, \varphi, z) - c_{IPO}$$

At optimal interior choice $(\varphi^*, \hat{X}^*)$

$$\underbrace{\frac{\partial V_{PUB}(\hat{X}^*, \varphi^*; z)}{\partial(\hat{X}^*)} \frac{\partial \hat{X}(\varphi^*)}{\partial(\varphi^*)}}_{\text{Value of extra cash from selling more}} = \underbrace{-\frac{\partial V_{PUB}(\hat{X}*, \varphi^*; z)}{\partial(\varphi^*)}}_{\text{Loss of } (1-\varphi) \text{ of revenues}}$$

- λ mostly affects $V_{PRIV} \rightarrow$ IPO
- c_M shifts both φ^* & $V_{PUB}(\hat{X}^*, \varphi^*; z) \rightarrow$ insider share & IPO

HFCS: Details

Country	Sample (Hh)	Sample (ppl)	Oversampling top 10%	Pop (Hh, mio)
BE	2,364	11,376	47%	4.7
DE	3,565	20,501	117%	39.7
ES	6,197	11,782	192%	17.0
FR	15,006	21,627	129%	27.9
IT	2,364	15,592	4%	23.8
NL	15,006	2,263	87%	7.4
AT	2,364	4,436	1%	3.8
PT	3,565	8,000	16%	3.9
FI	15,006	13,525	68	2.5

Amadeus: Sample

Country	# firms	# firms (assets > 1mio)	# firms (public)
AT	2,364	4,436	60
BE	2,364	11,376	143
FI	15,006	13,525	439
FR	15,006	21,627	747
DE	3,565	20,501	685
IT	2,364	15,592	276
NL	15,006	2,263	143
PT	3,565	8,000	54
ES	6,197	11,782	439

Amadeus Ownership: Details

Country	# firms (public)	avg (med) # SH	avg (med) % recorded	held by P/F/B/D
AT	60	3.9 (3)	83 (96)	21/ 49/ 14/ 14
BE	143	5.3 (5)	76 (86)	11/ 36/ 26/ 18
FI	439	22.1 (21)	67 (72)	23/ 23/ 41/ 1
FR	747	7.9 (6)	84 (92)	22/ 34/ 24/ 12
DE	685	5.1 (4)	79 (90)	19/ 37/ 19/ 18
IT	276	6.3 (4)	76 (76)	16/ 47/ 27/ 5
NL	143	6.9 (6)	55 (54)	11/ 28/ 44/ 3
PT	54	8.2 (8)	92 (100)	9/ 59/ 29/ .1
ES	439	8.6 (3)	74 (85)	32/ 30/ 34/ .1

Larger Firms Have Smaller Insider Shares
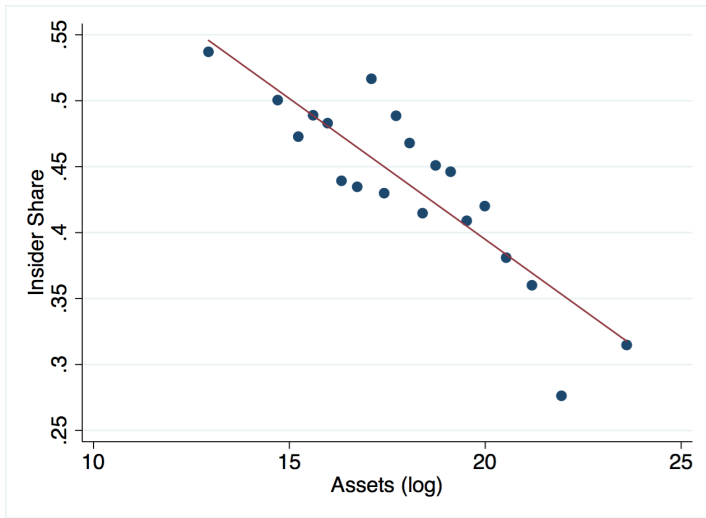
Country and Size Both Matter

Figure: Scatter plot titled "Insider Share of Equity" (y-axis, ranging .2 to .7) versus country (x-axis: NL, FI, BE, ES, DE, IT, FR, AT, PT), showing country mean (filled circle), 25th percentile (+), and 75th percentile (diamond).
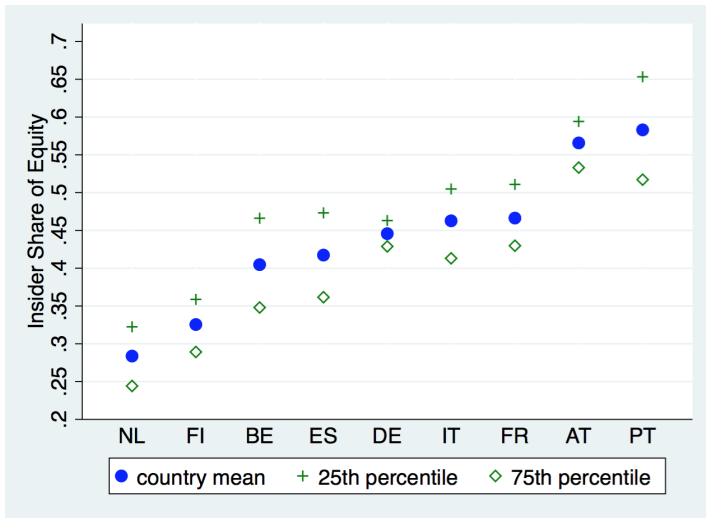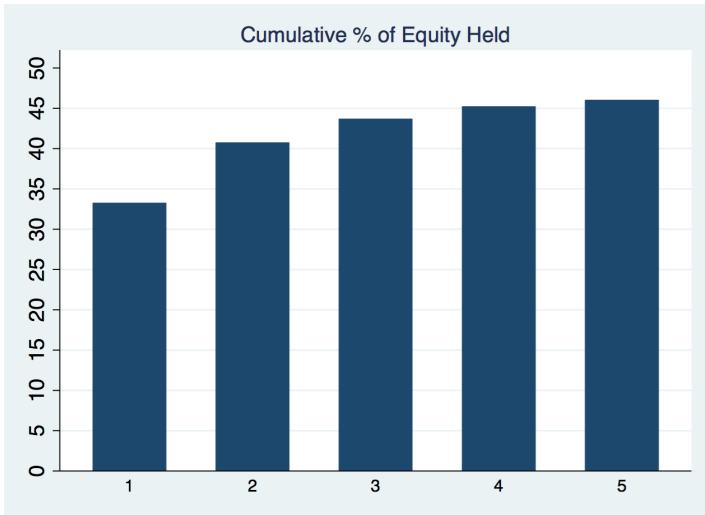
Back

Country Matters Independently of Size
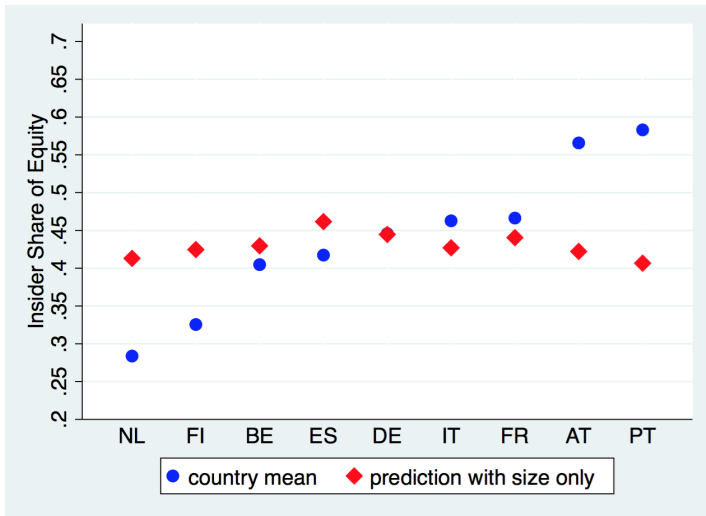
Share of Equity Held by Top 5 Shareholders

Cumulative % of Equity Held

Back

Ownership of German Public and Private Firms
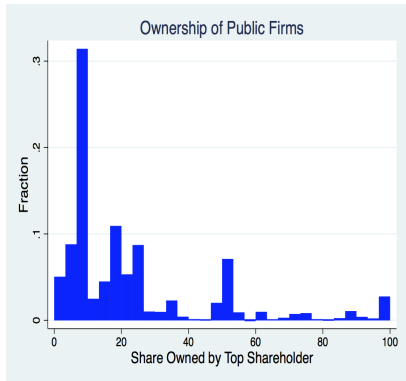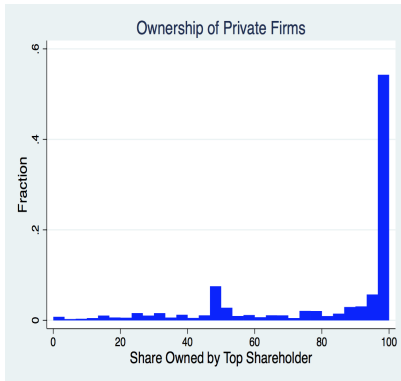
Leverage Higher Where Fewer Public Firms
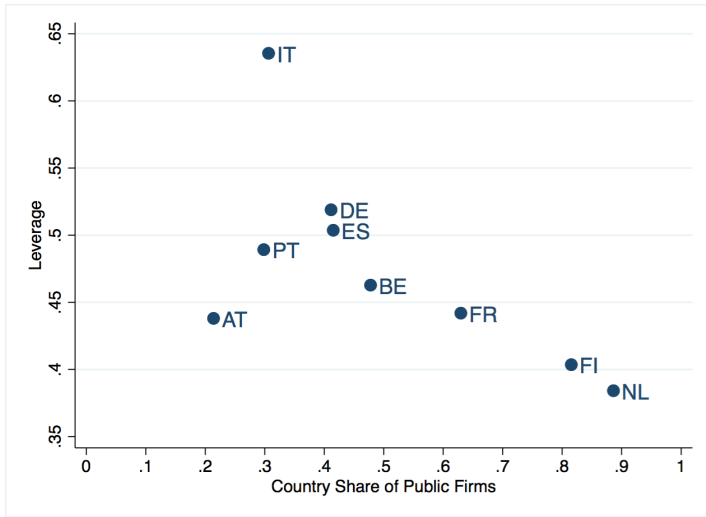
Fewer Public Firms in Unequal Countries
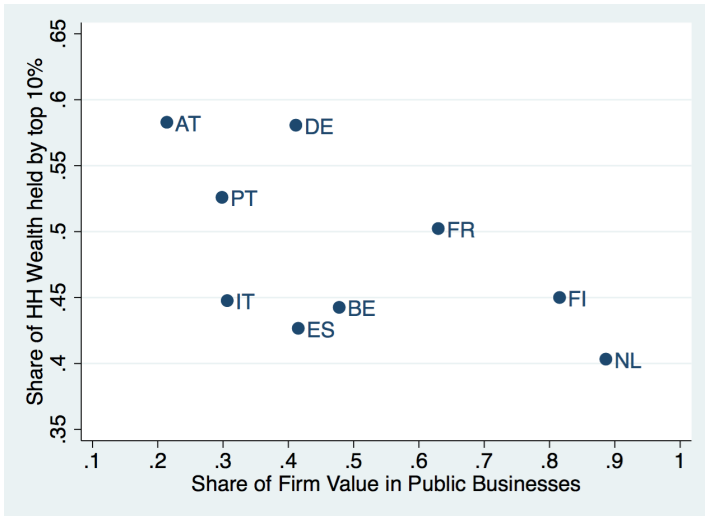
Germany has more leverage, fewer public firms

Parameter	Value	Moment	Value
z_2/z_1	20.2	share of employment in top 25%	82.6%
z_3/z_1	64.5	share of employment in top 1%	16.1%
λ	0.63	average leverage	58.3%
c_{IPO}	0.07	share of private firms (value)	58.9%
c_M	0.05	aggregate insider share	28.0%

Austria has a higher insider share

Parameter	Value	Moment	Value
z_2/z_1	13.0	share of employment in top 25%	74.0%
z_3/z_1	35.0	share of employment in top 1%	13.1%
λ	0.54	average leverage	49.6%
c_{IPO}	0.004	share of private firms (value)	78.6%
c_M	0.14	aggregate insider share	57.4%

The Netherlands have strong equity markets

Parameter	Value	Moment	Data	Model
z_2/z_1	5.3	share of employment in top 25%	67.1%	67.1%
z_3/z_1	19.4	share of employment in top 1%	12.7%	12.7%
λ	0.48	average leverage	44.7%	44.7%
c_{IPO}	0.0	share of private firms (value)	11.4%	13.1%
c_M	0.0	aggregate insider share	16.1%	15.5%

Model Fit: France

Moment	Data	Model
Top 25% wealth share	75.3%	70.7%
Top 5% wealth share	39.9%	42.7%
Top 1% wealth share	22.6%	24.3%
Share of Hh with wealth ≤ 0	3.9%	1.4%
Wealth Gini	0.66	0.64
Top 10% labor share	62.7%	62.1% %
Top 5% labor share	48.8%	40.7%
Slope of insider share wrt size	-.024	-.033
Share of wealth held by private entrep	23.7%	25.3%
Wealth to GDP	3.5	5.4

France: Alternative Quantification

$z \in \{z_1, z_2, z_3\}$ with population shares $\{.8, .18, .02\}$

Parameter	Value	Moment	Value
z_2/z_1	13.7	employment share top 25%	81.1%
z_3/z_1	60.7	employment share top 1%	18.3%
λ	0.55	aggregate leverage	48.5%
c_{IPO}	0.03	share of private firms	37.0%
c_M	0.06	aggregate insider share	33.4%
β	.902	top 10% wealth share	52.6%
R	1.07	wealth/GDP	3.4

Main result in both quantifications

	top 10% wealth share		
	Data	Baseline Model	Alternative
France	52.6%	52.6%	52.6%
Germany	59.1%	59.7%	59.2%
Austria	59.4%	60.1%	61.2%
Netherlands	42.6%	44.9%	43.4%

Inequality and Entrepreneurs Across Countries

	NWsh top 10%		NWsh top 1%		NWsh Entrep	
	Data	Model	Data	Model	Data	Model
FR	52.6%	52.6%	22.6%	24.2%	22.6%	25.3%
DE	59.1%	59.7%	26.2%	31.5%	31.6%	34.6%
AT	59.4%	60.1%	26.4%	30.5%	30.4%	37.1%
NL	42.6%	44.9%	12.2%	15.9%	7.9%	17.2%

Top 1% Wealth Shares Across Countries

back
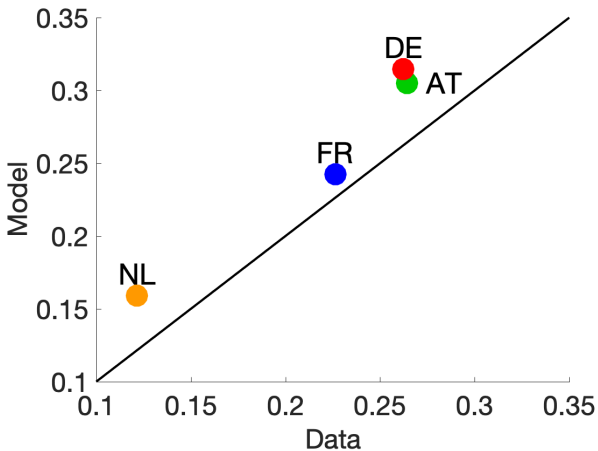
No Relationship between age and insider Share
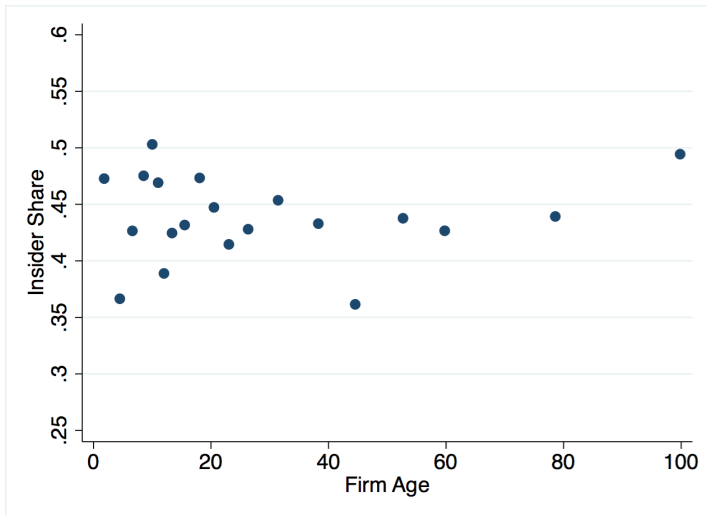
Value Function of Public Entrepreneurs

$$V_{\mathsf{PUB}}(X; \tilde{z}, \varphi) = \max_{\{c, \tilde{a}', k', X'\}} u_e(c) +$$
$$\beta(1 - \pi_d)\Big\{(1 - \eta)\, V_{\mathsf{PUB}}(X'; \tilde{z}, \varphi) + \eta\, \mathbb{E}_{\theta'|\tilde{z}}[V_W(X', \theta'; w)]\Big\}$$

s.t.
$$c + \tilde{a}' + (1 - \varphi)k' = X$$
$$X' = (1 - \varphi)\left[\tilde{z}'k'^{\nu} + (1 - \delta)k'\right] + R\tilde{a}'$$
$$\tilde{a}' \geq -(1 - \varphi)\lambda\frac{(1 - \delta)}{R}k'$$

Value Function of Private Entrepreneurs

$$V_{\mathsf{PRIV}}(X; \tilde{z}) = \max_{\{c, \tilde{a}', k', X'\}} u_e(c) +$$
$$\beta(1 - \pi_d)\Big\{(1 - \eta)\, V'(X'; \tilde{z}) + \eta\, \mathbb{E}_{\theta'|\tilde{z}}[V_W(X', \theta'; w)]\Big\}$$

s.t.
$$c + \tilde{a}' + k' = X$$
$$X' = [\tilde{z}'k'^{\nu} + (1 - \delta)k'] + R\tilde{a}'$$
$$\tilde{a}' \geq -\lambda\frac{(1 - \delta)}{R}k'$$

V' includes the option value of going public:

$$V'(X', \tilde{z}) = \max\Big\{V_{\mathsf{priv}}(X', \tilde{z}), \max_{\varphi}\{V_{\mathsf{pub}}(\underbrace{X' + P(\varphi, \tilde{z}, X') - c_{\mathsf{IPO}}}_{\text{Post-IPO cash-on-hand}}, \tilde{z}, \varphi)\}\Big\}$$

Value Function of Workers

$$V_{\mathsf{W}}(X;\theta) = \max_{\{c,\tilde{a}',X'\}} u_w(c) \; + \; \beta(1-\pi_d)\, \mathbb{E}_{\theta'|\theta}[V_{\mathsf{W}}(X',\theta')]$$
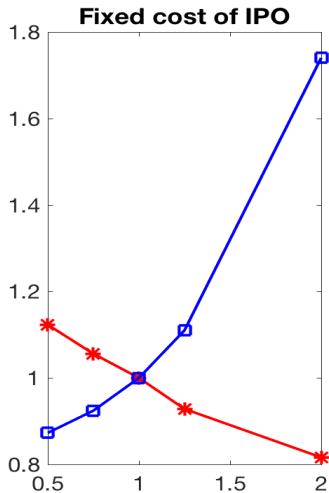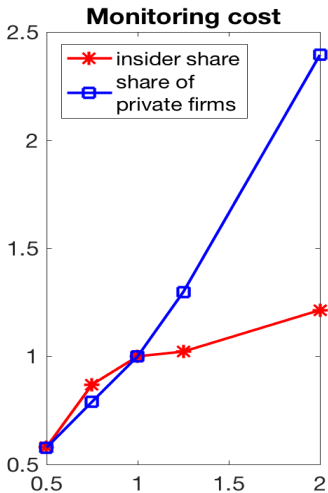
s.t.

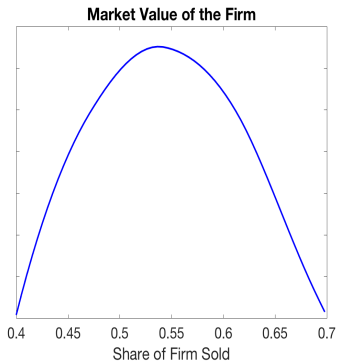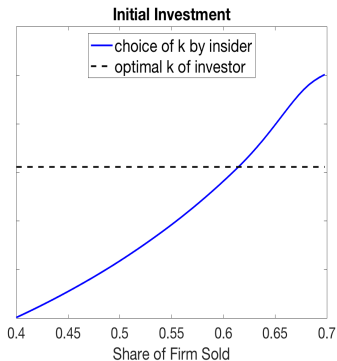$$c + \tilde{a}' = X$$
$$X' = R\tilde{a}' + w\theta'$$
$$\tilde{a}' \geq -0$$
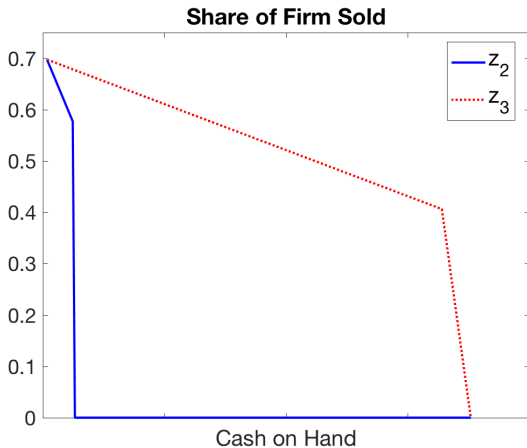
Back

c_M & c_{IPO} are separately identified

Share Price is Non-Monotonic in Outsider Stake

Initial Investment

choice of k by insider
optimal k of investor

Share of Firm Sold

Market Value of the Firm

Share of Firm Sold

▶ Firms with more outside equity are larger

▶ Insider and outsider disagree on optimal investment

Back

φ higher for poor & high TFP entrepreneurs

Back

Externally Set Parameters

	Value	Description	Comment
R	1.02	risk-free rate	
σ	2	CRRA	
π_d	.02	death probability	average working life of 50 years
δ	.06	depreciation	Stokey & Rebelo (1995)
η	.0514	exit probability	average firm age 14 years
p_{yo}	.1	maturing probability	firm age at IPO
ν	.9	returns to scale	
α	1/3	exponent on capital	capital share
ρ_θ	.9	persistence of worker prod	
σ_θ	.65	st.dev. of worker prod	Fuchs-Schuendeln et al (2010)
S_w	.924	share of workers	share of workers
χ	.5	parent wealth in starting assets	share of wealth inherited

Amadeus   HFCS   External

Back

Quantitative Strategy - France

6 parameters
- ▶ TFP distribution (2)
- ▶ Maximum leverage constraint
- ▶ Monitoring Cost
- ▶ Fixed Cost
- ▶ Discount factor

6 moments
- ▶ Firm size distribution (2)
- ▶ Average leverage
- ▶ Insider share of public firms
- ▶ Share of private firms
- ▶ Top 10% wealth share

- ▶ Share of private firms
    - ▶ Combine household survey (HFCS) with Compustat

- ▶ Insider share of public firms
    - ▶ Insider = top 3 domestic person shareholders
   - ▶ Use Amadeus to identify ultimate person shareholders

Top Wealth Shares - Model and Data

Model Fit
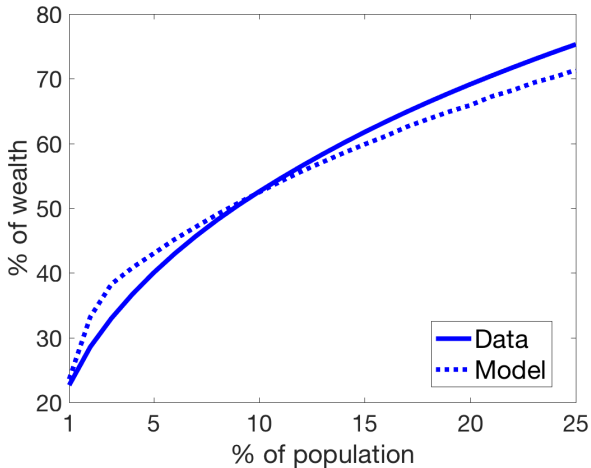
Quantitative Strategy - DE, AT, NL

- ▶ Re-estimate
  - ▶ TFP distribution
  - ▶ Max leverage constraint
  - ▶ Monitoring & fixed cost

- ▶ Target
  - ▶ Firm size distribution
  - ▶ Average leverage
  - ▶ Outside equity (2 margins)

- ▶ Wealth inequality not a target (discount factor constant)

- ▶ Identify cost of external finance from firm choices
  - ▶ e.g. Infer higher c_{IPO} from Germany's higher private share

- ▶ Consistent with direct estimates from empirical literature Details
  - ▶ e.g. higher underwriting spreads in German IPOs
  - ▶ Debt (equity) correlates with creditor (shareholder) protection
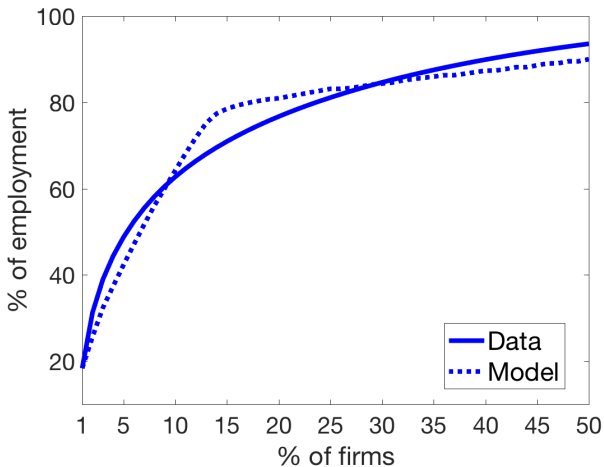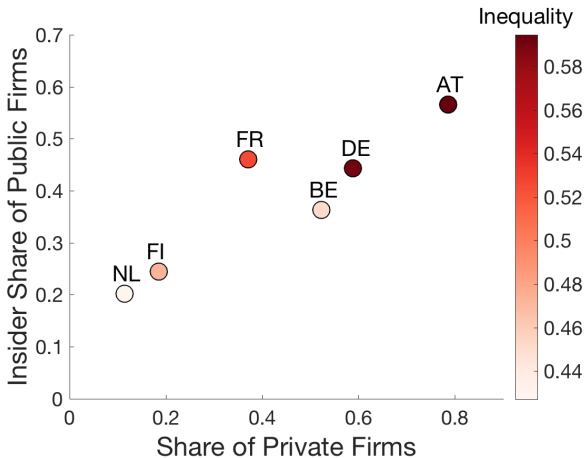
Poor Entrepreneurs Sell More

Share of Firm Sold

Cash on Hand
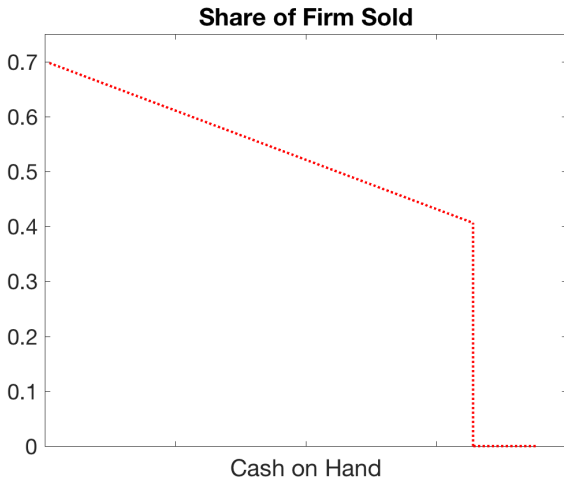
Productive and Poor Entrepreneurs Sell More

Share of Firm Sold
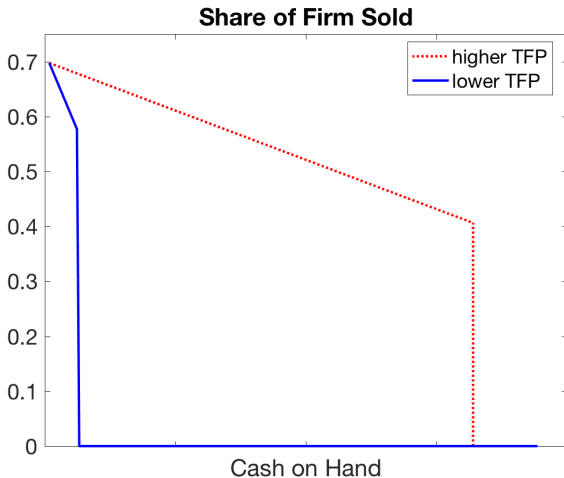
Firm Size Distribution - Model and Data

back

More Inequality in Countries with More Inside Equity

Data: Household Wealth, Firm Size & Leverage

- **Wealth Inequality**
  - Household Finance and Consumption Survey
  - Share of wealth held by the top 10%

- **Distribution of firm size**
  - Amadeus Financials - wide coverage of private and public firms
  - Size distribution measured as shares of aggregate wage bill

- **Average leverage of private firms**
  - Amadeus Financials
  - Leverage $= \frac{\text{Outstanding Liabilities - Cash}}{\text{Total Assets - Cash}}$