Risky Investments with Limited Commitment

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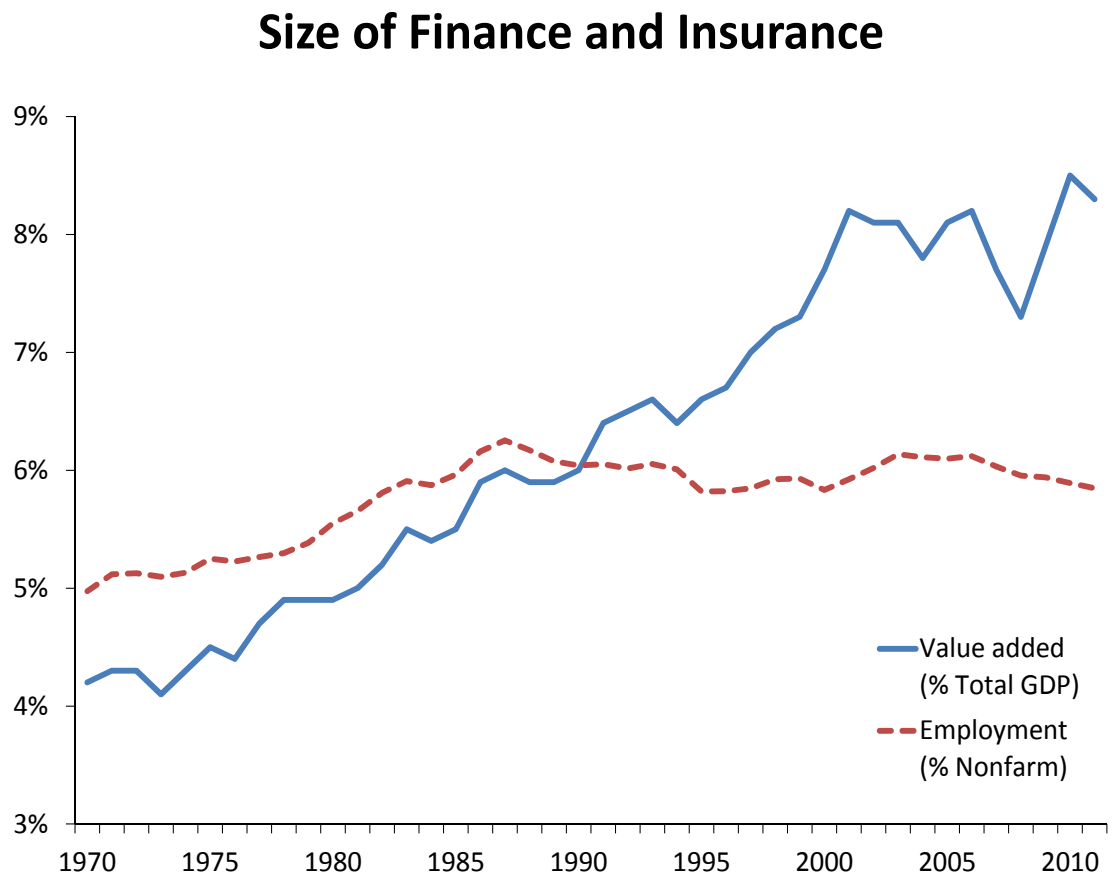
The changing financial sector and its characteristics.

1. Greater size and productivity of the financial sector in US (& not only in the US)

Greater size and productivity of the financial sector in US

Finance & insurance share of Value Added and Employment



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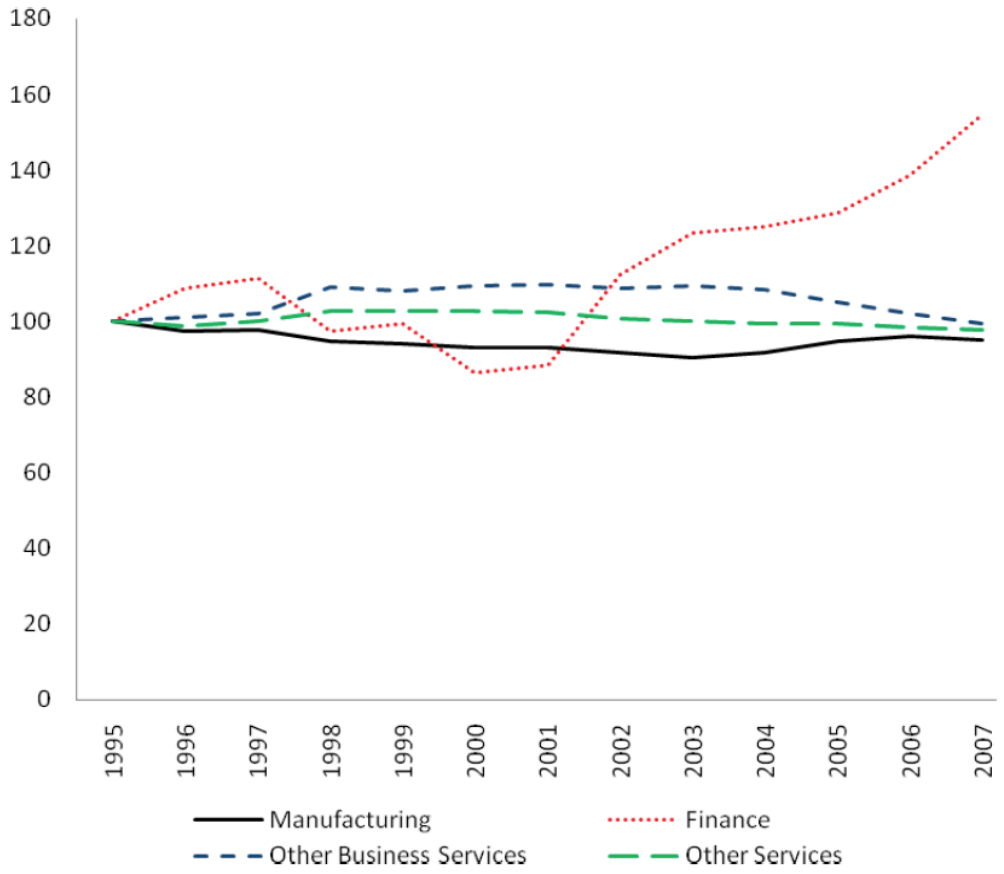
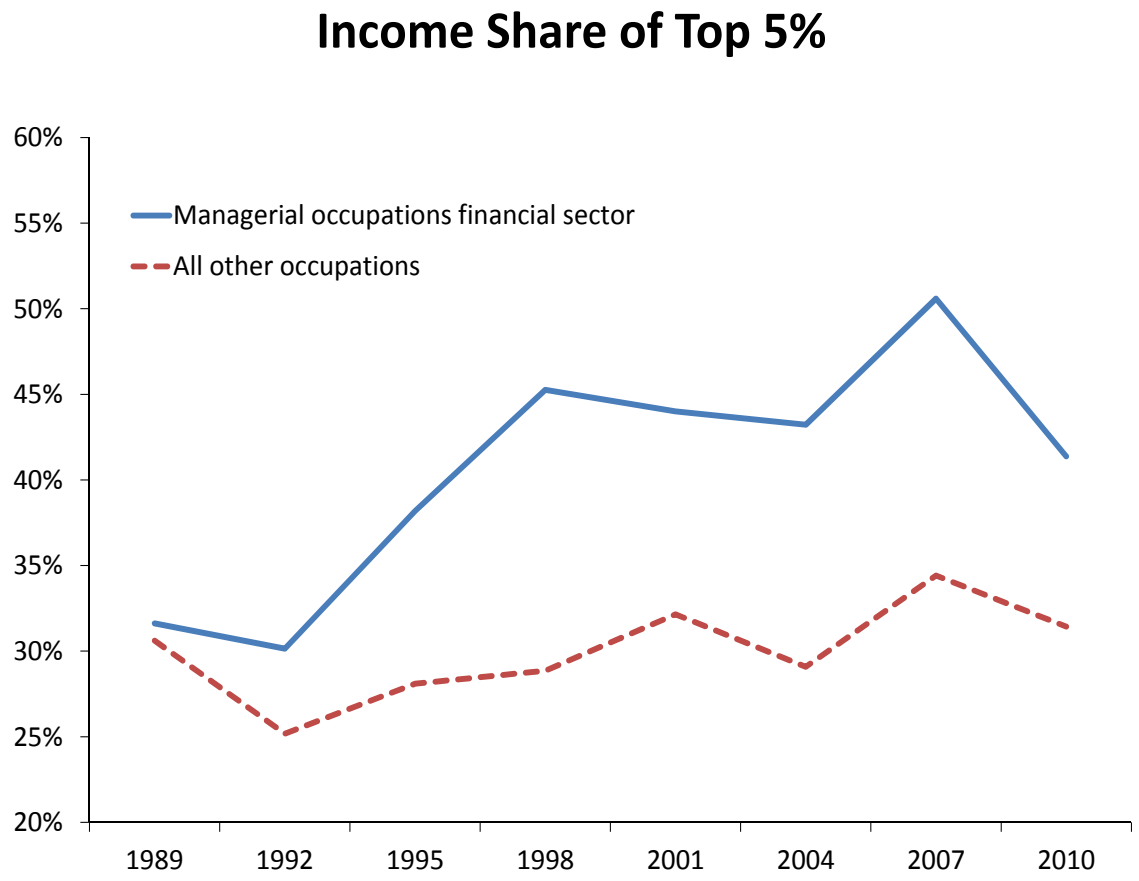
3. Greater income inequality within and between sectors (financial and non financial)

U.K. Value Added per Employee, 1995=100



Greater income inequality within the financial sector



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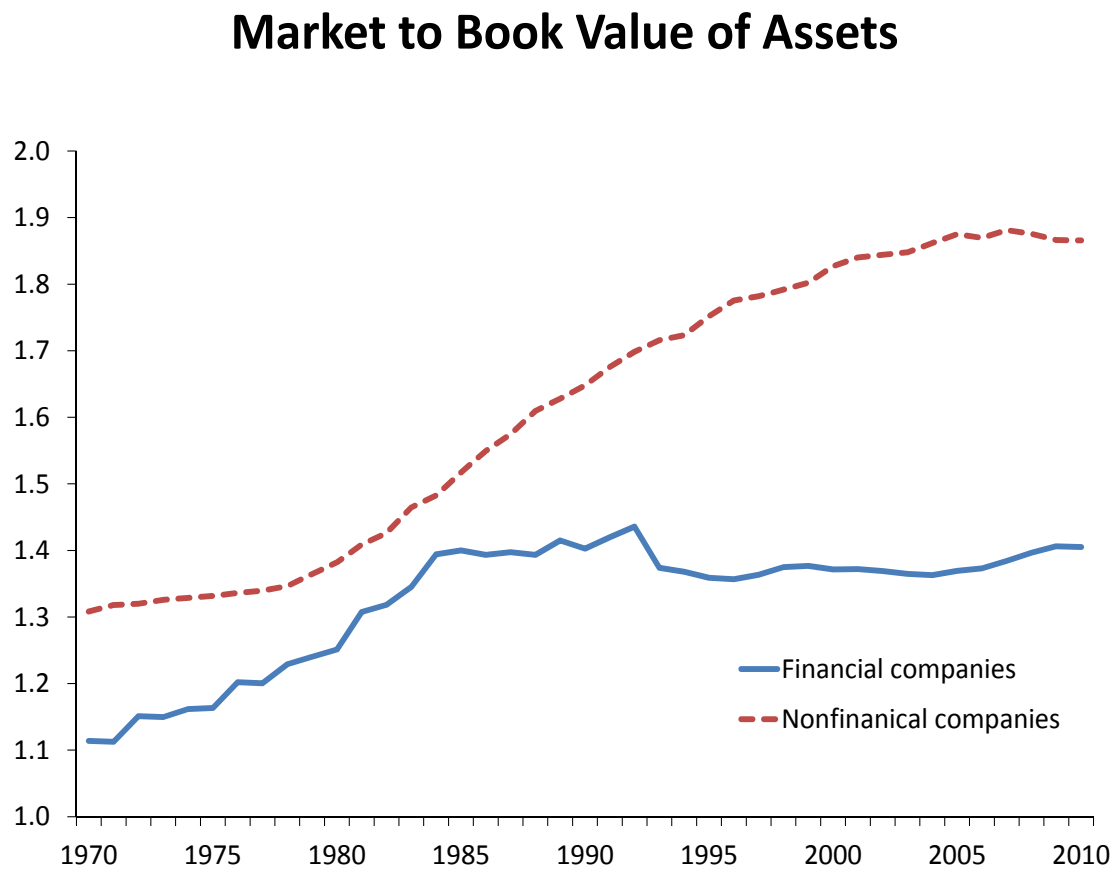
Lower stock market valuation of financial firms.



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The evolution of governance in the financial sector:

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The evolution of governance in the financial sector:

* **The historical trend of a move away from partnership financial firms.**

The move away from the partnership & the new financial giants.

- Change in NYSE Rules in 1970
- Merrill Lynch went public in 1971
- Bear Stearns in 1984
- Morgan Stanley in 1985
- Lehman Brothers in 1994
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An IPO could give them signficantly greater capital for their proprietary trading.

Charles Ellis, *The Partnership: The Making of Goldman Sachs*, 2008.

The move away from the partnership & the competition for financial managers.

In time there was an erosion of the simple principles of the partnership days. Compensation for top managers followed the trend into excess set by other public companies. Competition for talent made recruitment and retention more difficult and thus tilted negotiating power further in favor of stars. You had to pay everyone well because you never knew what next year would bring, and because there was always someone trying to poach your best trained people, whom you didn't want to lose even if they were not superstars. Consequently, bonuses in general became more automatic and less tied to superior performance. Compensation became the industry's largest expense, accounting for about 50% of net revenues.

Roy Smith, former partner of Goldman Sachs, *Wall Street Journal* February 7, 2009.

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* **The further move away from the partnership form for financial firms in a competitive financial sector.**

IN THIS PAPER

- We propose a theory where **Facts 1 - 4 can result from less contract enforceability & commitment (the $*$ Fact) and greater competition for managers**.

- Central to our theory are the assumptions that
  - investors need to delegate the choice of risky projects to managers,
  - successful projects enhance the outside value for managers,
  - managers have always the option to quit and take outside options, and
  - the commitment of investors may also be limited.

- In a *Dynamic General Equilibrium Model*, we show how increased competition and limited commitment can reinforce each other.

THE FINANCIAL SECTOR TECHNOLOGY

- Choice of risky investment projects: $\lambda \in [0,\ 1]$, $0 = \text{minrisk}$, $1 = \text{maxrisk}$.
- Output in period $t + 1$:

$$Y_{t+1} = y(\lambda_t)h_t,$$

where $y' < 0$, $y'' > 0$, $y(1) = 0$.

THE TECHNOLOGY

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  where $y' < 0$, $y'' > 0$, $y(1) = 0$.

- The value added of a new project is:

$$i_{t+1} = \lambda_t \varepsilon_{t+1} h_t.$$

- Stochastic human capital accumulation, through successful innovation:

$$h_{t+1} = h_t + i_{t+1} \equiv g(\lambda_t, \varepsilon_{t+1}) h_t \equiv (1 + \lambda_t \varepsilon_{t+1}) h_t,$$

  where $\varepsilon_{t+1} \in \{0, \bar{\varepsilon}\}$, i.i.d. The probability of the good outcome $\bar{\varepsilon}$ is denoted by p.

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  where $\varepsilon_{t+1} \in \{0, \bar{\varepsilon}\}$, i.i.d. The probability of the good outcome $\bar{\varepsilon}$ is denoted by p.

- Therefore, $E_t h_{t+1} \geq h_t$, with $>$ if $\lambda_t > 0$.

MANAGERS & INVESTORS

- **Managers providing the human capital:**

  - The lifetime utility is

$$E_t \sum_{t=0}^{\infty} \beta^t \Big[u(C_t) - e(\lambda_t) \Big],$$

with $u' > 0, u'' < 0$ and $e' > 0, e'' > 0, e(0) = 0, e(1) = \infty$.

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- **Investors providing the capital:**

  - Infinite lived with linear utility and residual claimants:

$$E_t \sum_{t=0}^{\infty} \beta^t \left(\beta Y_{t+1} - C_t \right)$$

TIMING OF THE CONTRACT

- Starting period t with h_t, within the period the timing is:

  1. λ_t and C_t are chosen and implemented,
  2. Output $Y_{t+1} = y(\lambda_t)h_t$ is produced and ε_{t+1} is realised; therefore, h_{t+1},
  3. If there is limited enforcement, the manager decides whether to quit or continue.

PARTNERSHIP CONTRACTS

1. *Full commitment* (just as a benchmark.)

2. ***Limited enforcement*** (i.e. one-sided limited commitment: managers can quit but investors commit). The contract must account for:

   (a) *enforcement constraints* and, when the manager controls investment decisions, also

   (b) *incentive compatibility constraints*.

3. ***Double-sided limited commitment***: managers can quit and investors cannot fully commit.

Full commitment (not exactly a traditional partnership)

$$\max_{\{C_t,\lambda_t\}_{t=0}^{\infty}} E_0 \left\{ \sum_{t=0}^{\infty} \beta^t \Big(\beta y(\lambda_t) h_t - C_t \Big) + \tilde{\mu}_0 \sum_{t=0}^{\infty} \beta^t \Big(u(C_t) - e(\lambda_t) \Big) \right\}$$

$$\text{s.t. } h_{t+1} = g(\lambda_t, \varepsilon_{t+1}) h_t; \text{ and } h_0 \text{ given,}$$

where $\tilde{\mu}_0$ guarantees the initial reservation values $\underline{V}$ and $\underline{D}$ to investors and managers, respectively.

Enforcement constraints

- Human capital is inalienable: managers can quit with h_t and $i_{t+1} = (h_{t+1} - h_t) = \lambda_t \varepsilon_{t+1} h_t$.
- We ***assume that ideas depreciate faster than innovations***; i.e. i_{t+1}, depreciates faster than h_t, when is not implemented.

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- A manager with h_t, who attains h_{t+1}, can quit the financial firm and

  - with prob. ρ receive an offer with value $\overline{Q}_{t+1}(h_{t+1})$, or
  - with prob. $(1 - \rho)$ receive no offer, which has a value of $\underline{Q}_{t+1}(h_t)$.

  Assumption 1: $\overline{Q}'_{t+1} > 0$.

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  Assumption 1: $\overline{Q}'_{t+1} > 0$.
- The expected outside value after the realization of ε_{t+1} is:

$$D(h_t, h_{t+1}, \rho) = (1 - \rho) \cdot \underline{Q}_{t+1}(h_t) + \rho \cdot \overline{Q}_{t+1}(h_{t+1}).$$

Enforcement constraints

- The probability ρ captures *the degree of competition* for managers.
- The *limited enforcement constraint*, with multiplier $\tilde{\gamma}(\varepsilon_{t+1})$, is:

$$E_{t+1}\sum_{n=0}^{\infty}\beta^n\left(u(C_{t+1+n})-e(\lambda_{t+1+n})\right)\geq D(h_t,\,h_{t+1},\rho),\quad t\geq 0$$

- Notice that, by Assumption 1, $D_{2,3}>0$.

Incentive compatibility constraints

- As in a Principal Agent problem, the investor anticipates managerial distortions.
- The best the manager can do is to choose:

$$\hat{\lambda}(h,\rho) = \arg\max_{\lambda} \left\{ -e(\lambda) + \beta E D(h,\ g(\lambda,\varepsilon')h, \rho') \right\}.$$

- Let

$$\hat{D}(h,\rho) = \left\{ -e(\hat{\lambda}) + \beta E D(h,\ g(\hat{\lambda},\varepsilon')h, \rho) \right\},$$

- The *incentive compatibility constraint (IC)*, with multiplier $\tilde{\chi}_t$, is:

$$-e(\lambda_t) + \beta E_t \sum_{n=0}^{\infty} \beta^n \left(u(C_{t+1+n}) - e(\lambda_{t+1+n}) \right) \geq \hat{D}(h_t, \rho_t), \quad t \geq 0,$$

The recursive contract

$$\widetilde{W}(h,\tilde{\mu}) = \min_{\tilde{\chi},\tilde{\gamma}(\varepsilon')} \max_{C,\lambda} \Bigg\{ \beta y(\lambda)h - C + \tilde{\mu}\Big(u(C) - e(\lambda)\Big) - \tilde{\chi}\Big(e(\lambda) - e(\hat{\lambda})\Big)$$

$$+\beta E\Big[\widetilde{W}(h',\tilde{\mu}') - \tilde{\chi} D\Big(h, g(\hat{\lambda},\varepsilon')h, \rho\Big) - \tilde{\gamma}(\varepsilon') D(h,h',\rho)\Big]\Bigg\}$$

$$\textbf{s.t.} \quad h' = g(\lambda,\varepsilon')h, \quad \tilde{\mu}' = \tilde{\mu} + \tilde{\chi} + \tilde{\gamma}(\varepsilon'),$$

where $\tilde{\gamma}(\varepsilon')$ is the Lagrange multiplier of the enforcement constraint and $\tilde{\chi}$ is the Lagrange multiplier of the incentive-compatibility constraint.

Partnership regimes and policies

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- The consumption policy is given by

$$C_t = u'^{-1}\left(\frac{1}{\tilde{\mu}_t}\right).$$

- Let $\mu_t = \tilde{\mu}_t / h_t$ and $c_t = C_t / h_t$. *Full commitment* $\tilde{\mu}_t = \tilde{\mu}_0$ and $\mu_t \searrow 0$ and $c_t \searrow$

- With *limited enforcement* $\mu_t \searrow \underline{\mu} > 0$ and $c_t \searrow \underline{c}$.

The effect of increasing competition on investment

- Let $Q(h, \mu)$ be the manager's value, given h and normalised μ.

Proposition 1. *Increasing competition for managers, ρ:*
- *has no direct effect with full commitment (just on the initial distribution), and*
- *with limited enforcement has a direct effect if and only if $\tilde{\gamma}_t > 0$, in which case it lowers λ^*, provided $Q_{h,\mu}(h', \mu') \leq 0$.*

- The last condition, $Q_{h,\mu} \leq 0$, is satisfied if managers have CRRA preferences for consumption with an elasticity of substitution no greater then one (as in the log case).

The effect of increasing competition on investment

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- The *investment policy* solves the FOC:

$$(\mu_t + \chi_t)\, e_\lambda(\lambda_t) - \beta y_\lambda(\lambda_t) \geq \beta E_t \Big[\Big(v\left(\mu_{t+1}\right) + \\ \left(\mu_t + \chi_t + \gamma_t(\varepsilon_{t+1})\right) Q_h(h_{t+1}, \mu_{t+1}) - \gamma_t(\varepsilon_{t+1}) D_2\left(h_t, h_{t+1}, \rho\right) \Big) \varepsilon_{t+1} \Big].$$

Double-sided limited commitment

With investment *controlled by the manager*, the contract with ***double-sided limited commitment*** solves the problem

$$\widetilde{W}(h,\tilde{\mu}) = \min_{\tilde{\gamma}(\varepsilon')} \max_{C} \left\{ \beta y(\hat{\lambda})h - C + \tilde{\mu}\Big(u(C) - e(\hat{\lambda})\Big) + \beta E\left[\widetilde{W}\Big(g(\hat{\lambda},\varepsilon')h, \tilde{\mu}'\Big) - \tilde{\gamma}(\varepsilon')D\Big(h, g(\hat{\lambda},\varepsilon')h, \rho\Big)\right]\right\}$$

$$\text{s.t.} \quad \tilde{\mu}' = \tilde{\gamma}(\varepsilon').$$

Proposition 3. *Increasing competition, ρ, increases $\hat{\lambda}$.*

- We also consider cases of partial limited commitment (e.g. *external matching offers*).

The log case

- Let

$$u(C) - e(\lambda) = \ln(C) + \alpha \ln(1 - \lambda) = \ln(c) + \ln(h) + \alpha \ln(1 - \lambda).$$

- The manager's value $\overline{Q}_{t+1}(h_{t+1})$ is normalised as:

$$\overline{q} = \overline{Q}_{t+1}(h_{t+1}) - (1 - \beta)^{-1} \ln(h_{t+1}),$$

and similarly,

$$\underline{q} = \underline{Q}_{t+1}(h_t) - (1 - \beta)^{-1} \ln(h_t),$$

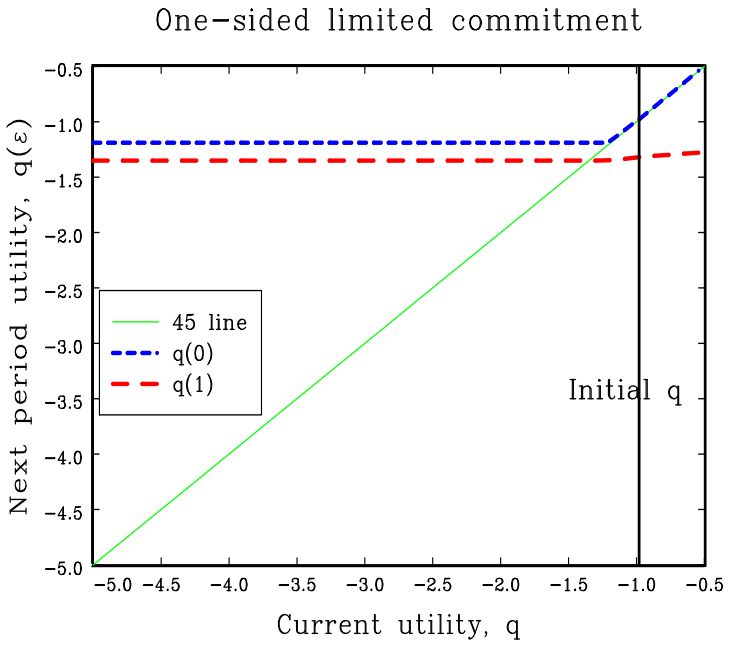
The log case

- Investor's normalised value $v_t = V_t/h_t$ satisfies:

$$v_t = \beta y(\lambda_t) - c_t + \beta E_t g(\lambda_t, \varepsilon_{t+1}) v_{t+1}, .$$

- Manager's normalised value q_t satisfies:

$$q_t = \ln(c_t) + \alpha \ln(1-\lambda_t) + \beta E_t \left[(1-\beta)^{-1} \ln\Big(g(\lambda_t, \varepsilon_{t+1}) \Big) + q_{t+1} \right].$$


One−sided limited commitment
Next period utility, q(ε)
Current utility, q
45 line
q(0)
q(1)
Initial q
−0.5
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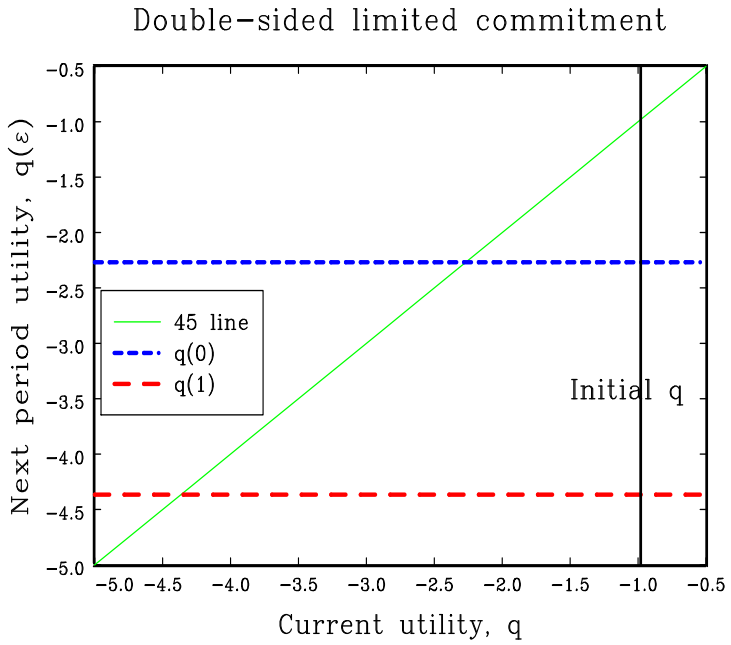
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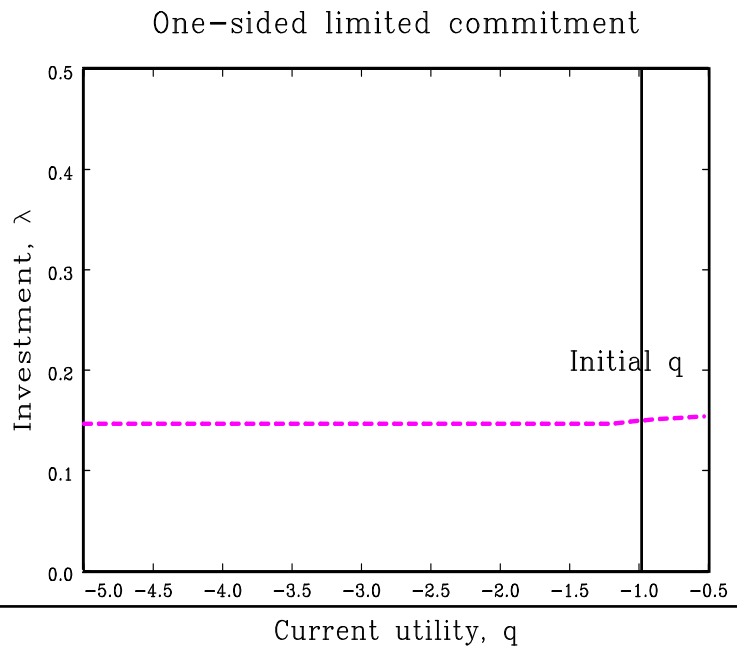
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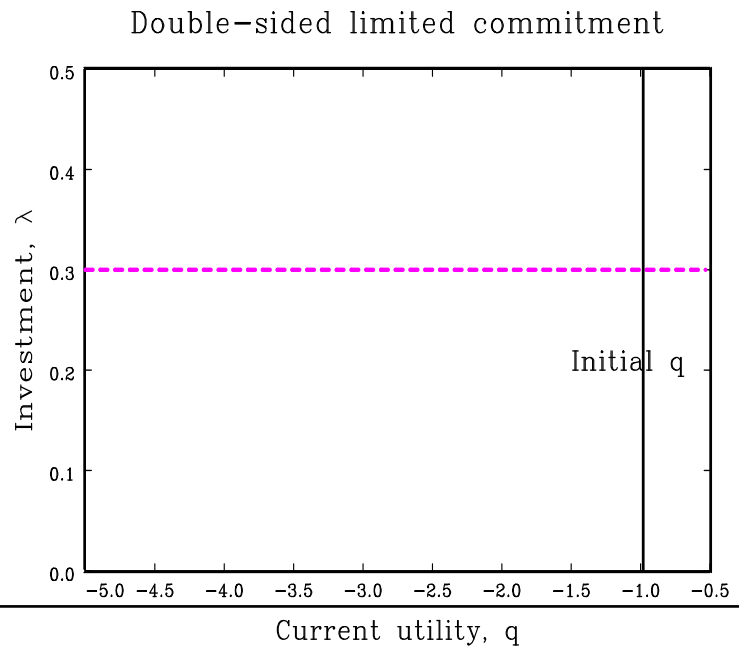
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General equilibrium model

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- A fraction ψ of new born skilled-workers have the ability to become managers in the financial sector.

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- A fraction ψ of new born skilled-workers have the ability to become managers in the financial sector.
- The nonfinancial sector is competitive with technology $F(H) = zH$, where z is a constant and H is the aggregate (efficiency-units) employment in the sector.

General equilibrium model: financial sector

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- The cost of posting a vacancy for a manager with human capital h is τh.
- Matching function: $m(X, U)$, where:
  - $X(h, \overline{Q})$: vacancies offering $\overline{Q}(h)$ to managers with h, and
  - $U(h, \overline{Q})$: managers with h applying to jobs offering $\overline{Q}(h)$.

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  - $X(h, \overline{Q})$: vacancies offering $\overline{Q}(h)$ to managers with h, and
  - $U(h, \overline{Q})$: managers with h applying to jobs offering $\overline{Q}(h)$.
- Since the investor's contract-value is linear in h, he offers:

$$\overline{Q}(h) = \overline{q} + (1 - \beta)^{-1} \ln(h).$$

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Lemma 1. The contract value $\overline{q}$ offered to the manager is increasing in ρ.

Inequality in the financial sector

- We focus on the coefficient of variation in human capital

$$\text{Inequality index} \equiv \frac{\text{Std}(h)}{\text{Ave}(h)}.$$

Lemma 2. The average human capital and the inequality index for financial managers is strictly increasing in $\hat{\lambda}$.

General equilibrium model

Proposition 4. *In the environment with double-sided limited commitment, a steady state equilibrium with a lower value of τ features:*

1. *Greater risk-taking, that is, higher $\hat{\lambda}$.*
2. *Higher share and relative productivity of the financial sector.*
3. *Lower stock market valuation of financial institutions.*
4. *Greater income inequality between sectors (financial and nonfinancial) and within the financial sector.*

NUMERICAL EXAMPLE

- Financial sector technology: $y(\lambda) = 1 - \lambda^2$
- Matching function: $m(X, U) = AX^{\eta}U^{1-\eta}$

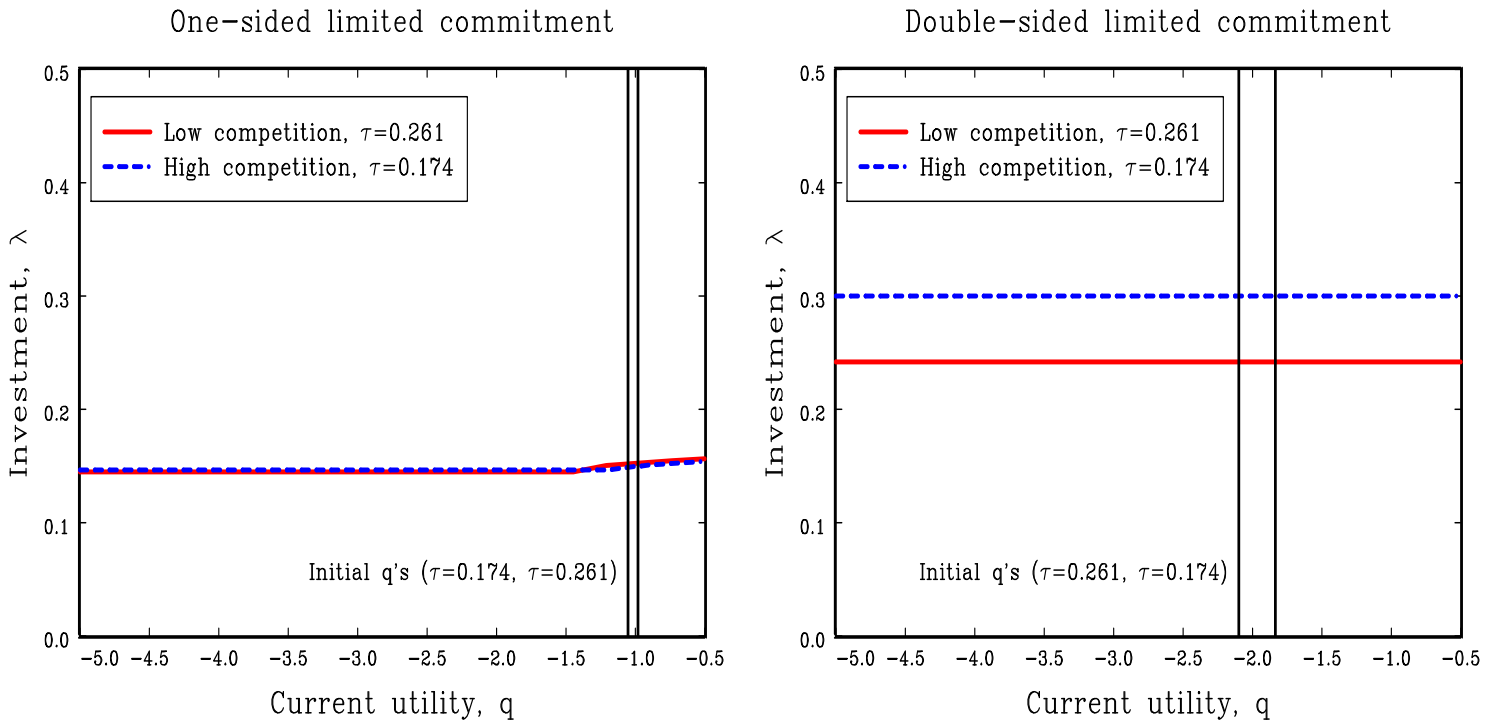
Calibrated parameters

$\hat{\beta}$	Discount factor	0.962
ω	Death probability	0.025
z	Productivity in the nonfinancial sector	0.731
ψ	Fraction of workers searching for financial jobs	0.042
p	Probability of successful innovation	0.035
α	Utility parameter for dis-utility innovation effort	0.139
τ	Cost of posting a vacancy in the financial sector	0.174
A	Matching productivity	0.500
η	Matching share parameter (pre-set)	0.500

Calibration moments (2000s)

Interest rate	0.04
Life expectancy of workers	40.00
Employment share in finance	0.04
Value added share in finance	0.08
Inequality index (coeff. variation) in financial sector	2.00
Time allocated to innovation in finance	0.30
Probability of finding an occupation in finance	0.50
Probability of filling a vacancy	0.50

The effect of decreasing τ on λ^*



Steady state properties with different values of τ

Limited commitment	*One-sided*	*Double-sided*
Low competition ($\tau = 0.261$)		
Offer probability, ρ	0.445	**0.441**
Average value of λ	0.151	0.242
Coefficient of variation	0.356	0.826
Share of employment financial sector	0.040	0.040
Share of output financial sector	0.065	0.073
Initial investor value $\bar{v}$	0.464	0.460
Average investor value $Ev(q)$	0.581	0.716
Earnings in the nonfinancial sector	0.731	0.731
Earnings in the financial sector	1.110	1.257
Within inequality fin sector	0.056	0.369
Between inequality fin sector	0.071	0.313
High competition ($\tau = 0.174$)		
Offer probability, ρ	0.497	**0.500**
Average value of λ	0.147	0.300
Coefficient of variation	0.351	2.000
Share of employment financial sector	0.040	0.040
Share of output financial sector	0.065	0.080
Initial investor value $\bar{v}$	0.388	0.348
Average investor value $Ev(q)$	0.442	0.537
Earnings in the nonfinancial sector	0.731	0.731
Earnings in the financial sector	1.116	1.388
Within inequality fin sector	0.054	3.110
Between inequality fin sector	0.069	0.890

The effect of increasing competition (decreasing τ)

Proposition 5. *In the environment with double-sided limited commitment, a steady state equilibrium with a lower value of τ features:*

1. *Greater risk-taking, that is, higher $\hat{\lambda}$.*
2. *Higher share and relative productivity of the financial sector.*
3. *Lower stock market valuation of financial institutions.*
4. *Greater income inequality between sectors (financial and nonfinancial) and within the financial sector.*

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Proposition 7. *In the environment with double-sided limited commitment, a steady state equilibrium with a lower value of τ features:*

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The effect of increasing competition (decreasing τ)

- Decreasing investor rents and his *ex post* willingness to maintain commitments?

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Proposition 8. *In the environment with double-sided limited commitment, a steady state equilibrium with a lower value of τ features:*

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- We have proposed a model where managers have an incentive to implement risky projects; competition for managers exacerbates this incentive.

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- The model captures several of the changes experienced by the US economy, following *changes in the organisational structure of the financial sector*.
- The model also help us to better understand how Competition & Commitment interact.

Thanks Tom !