Arms Races in Finance

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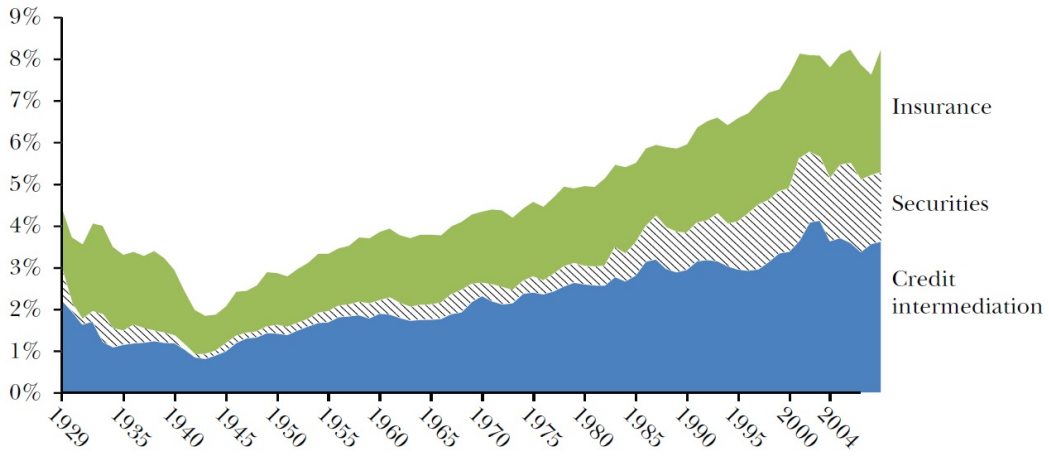
A Few Facts about the Financial Sector

The financial sector now represents roughly one tenth of the U.S. economy [Shiller 2012; Greenwood and Scharfstein 2013]:

Figure 1
The Growth of Financial Services
(value added share of GDP)



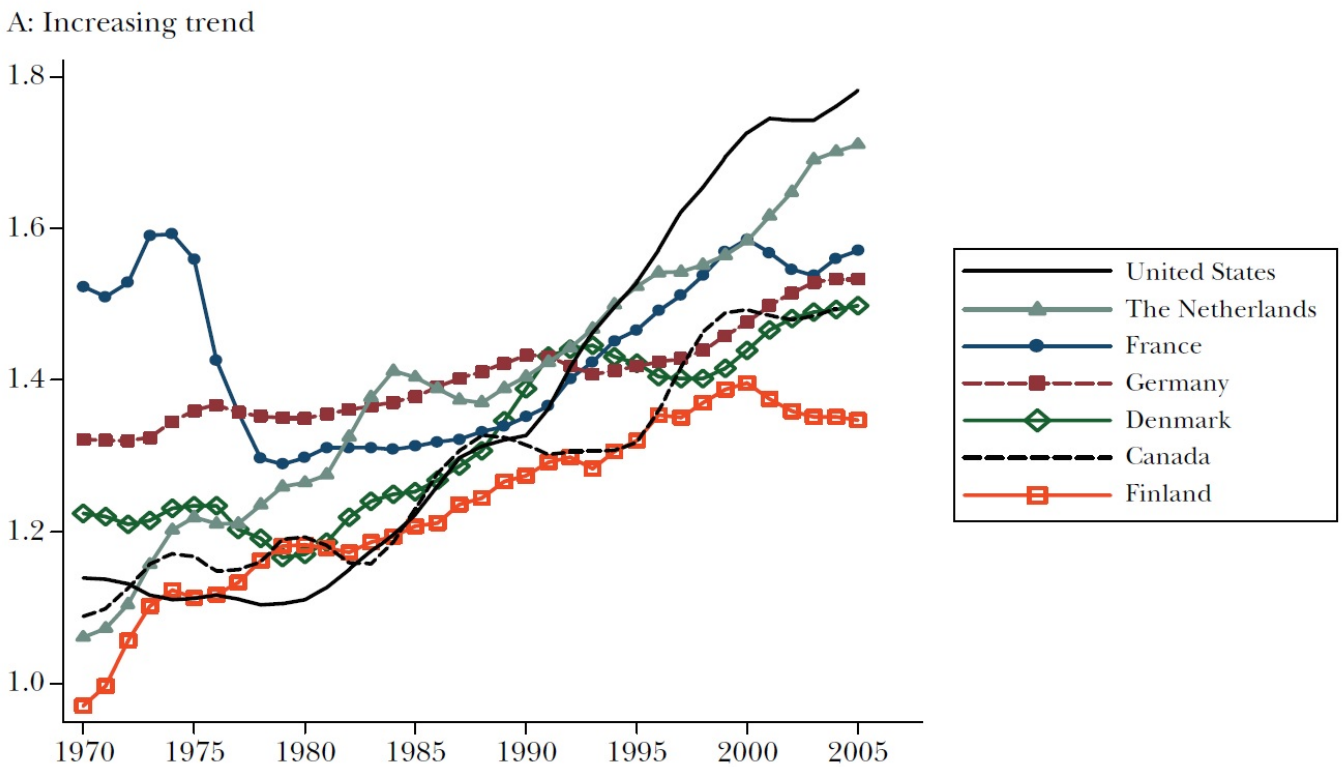
Source: Authors' calculations using data from National Income and Product Accounts (1947–2009) and the National Economic Accounts (1929–1947).
Notes: The finance sector includes the insurance, securities, and credit intermediation subsectors. The securities subsector includes the activities typically associated with investment banks and asset management firms, and it comprises two different categories in later sample years ("Securities" and "Funds, trusts, and other vehicles"); we combine them into one category for consistency.

[FYI: 12.9% in Switzerland]

A Few Facts about the Financial Sector

Compensation is abnormally high in finance [Philippon and Reshef 2012, 2013]:

Figure 4
Relative Wage in Finance



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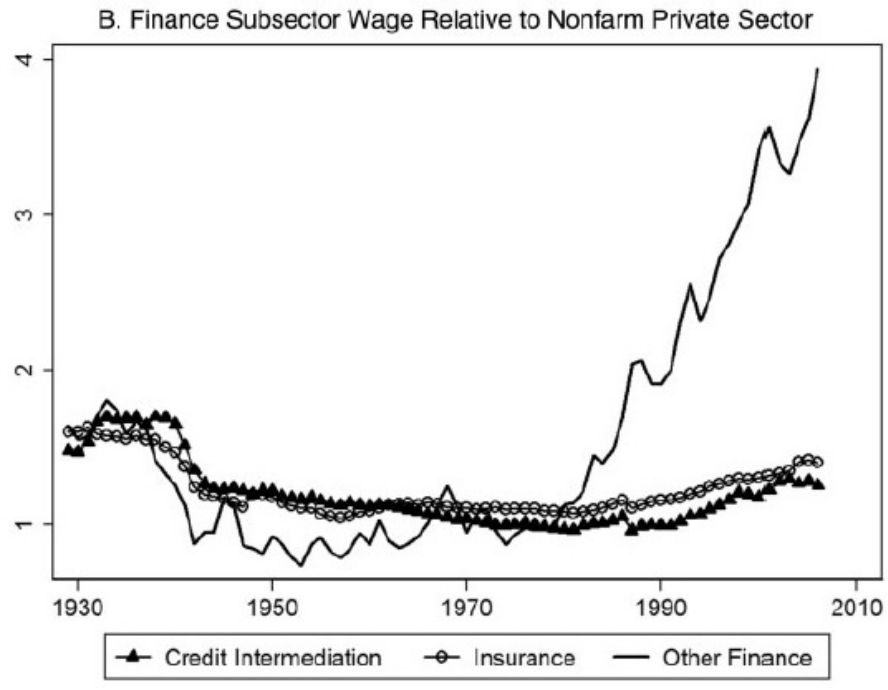


FIGURE V

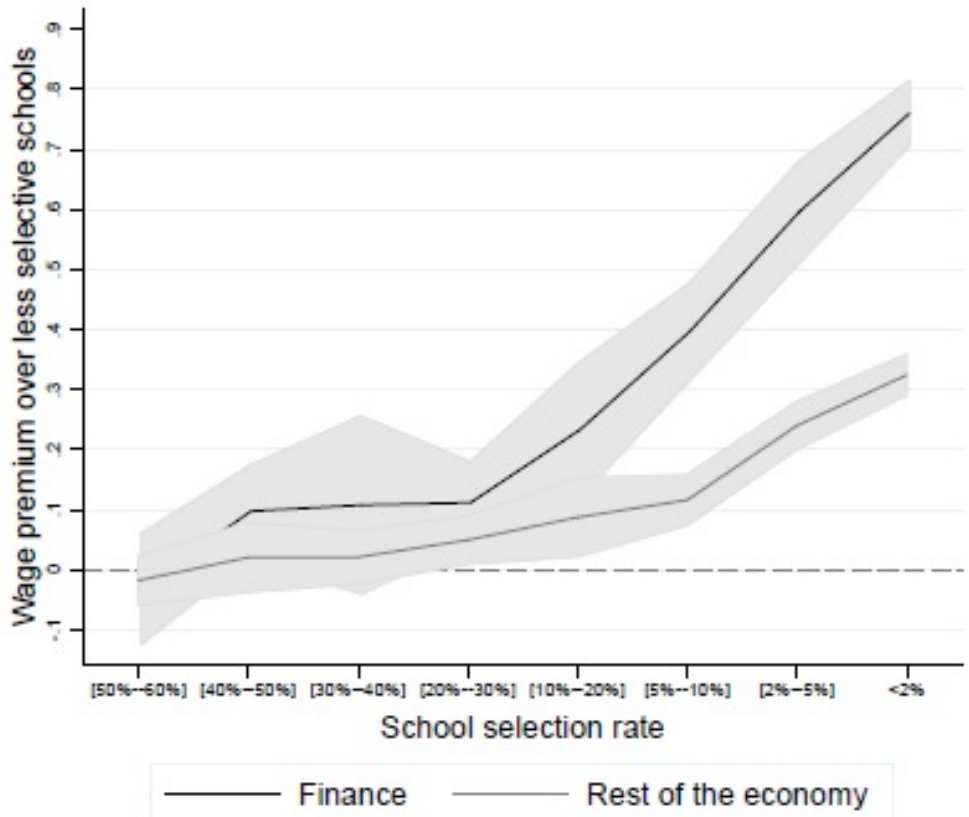
Employment Shares and Relative Wages of Financial Subsectors.

After controlling for hours worked, education, experience, and unemployment risk, Philippon and Reshef (2012) find a finance wage premium of $20\%+$

A Few Facts about the Financial Sector

Finance wage premium is concentrated at top of talent distribution [Célérier and Vallée 2019]:

Figure 3. Returns to talent: Finance versus other industries



A Few Facts about the Financial Sector

More talent has been allocated to finance [Philippon and Reshef 2012; Célérier and Vallée 2019]:

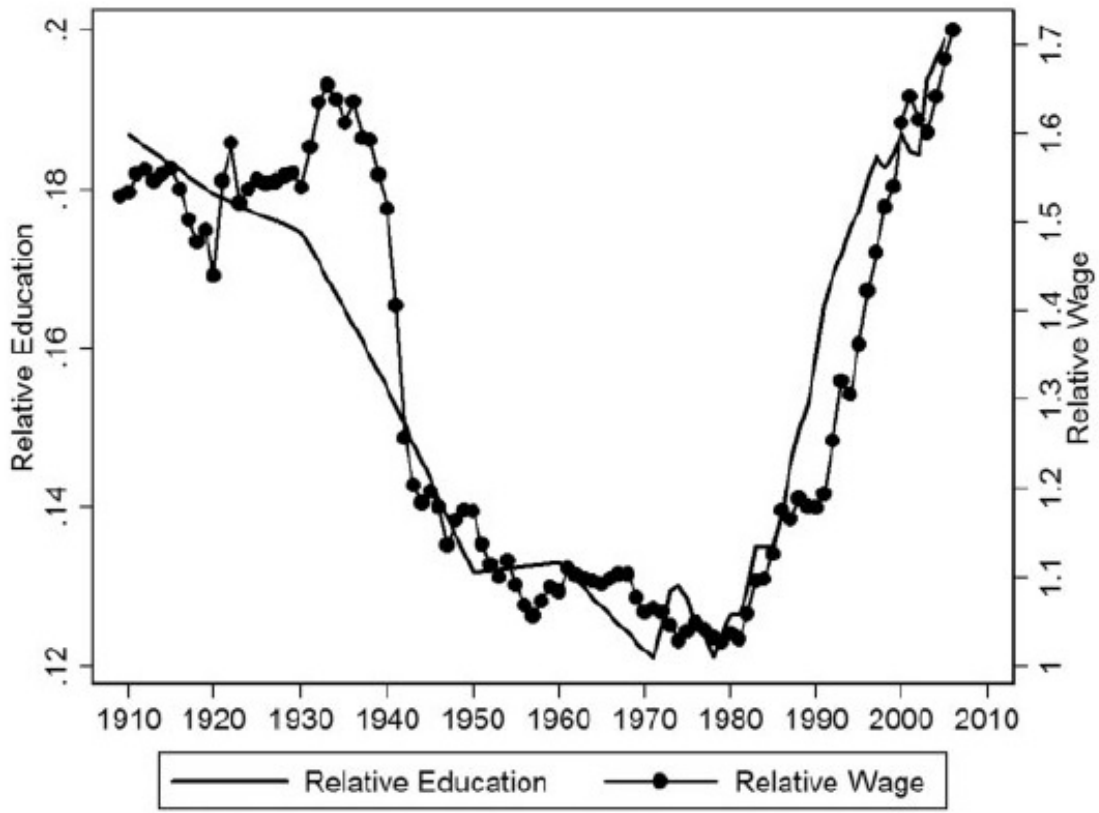


FIGURE I

Finance Relative Wage and Relative Education

A Few Facts about the Financial Sector

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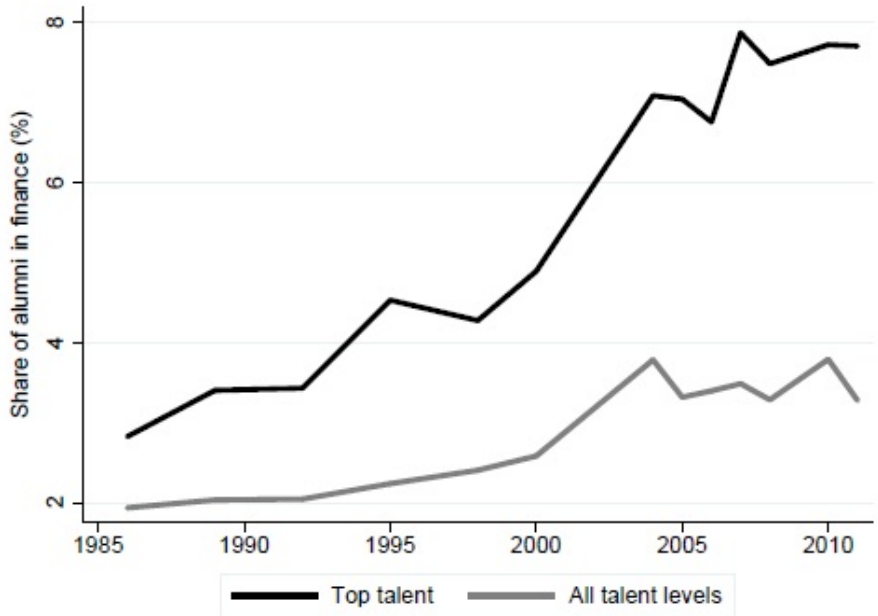
Figure 5. Engineer allocation to finance by level of talent and over time



Financial sector attracts 36% of graduating students at Princeton, 30% at Penn, and 17% at Harvard [Roose 2014]

Our Contribution

In two papers coauthored with Richard Lowery and Rick Green, we tried to understand **financial firms' incentives to invest in, attract, and compensate talent/expertise**:

- Glode, Vincent, Richard C. Green, and Richard Lowery, 2012, "Financial Expertise as an Arms Race," *Journal of Finance* 67, 1723-1759.

- Glode, Vincent, and Richard Lowery, 2016, "Compensating Financial Experts," *Journal of Finance* 71, 2781-2808.

$\Rightarrow$ We found that **"fixed-sum" nature** of several financial activities provides financial firms with incentives to **overinvest in and overcompensate financial expertise**

A (Basic) Model of the Financial Sector

N ex-ante identical financial firms:

- search for and invest in profitable investment opportunities whose final value v is uncertain at the time of investment [stage 1]
- value and trade for investment opportunities found by other firms affected by liquidity shock [stage 2]

Firm i's probability of finding a profitable investment in stage 1 is π_i [otherwise, no investment is made]

Each profitable investment is equally likely to produce payoffs $v_h \equiv E[v] + \sigma$ and $v_l \equiv E[v] - \sigma$

$\frac{N}{2}$ firms are hit by liquidity shock and try to sell their investments in stage 2

- selling firm values investment at zero and quotes ultimatum price to randomly matched counterparty with liquidity
- buying firm receives signal about v that is accurate with probability $\frac{1}{2} + \theta_j$

Financial Expertise

To summarize, firm i has two levels of expertise, π_i [i.e., "banking" expertise], and θ_i [i.e., "trading" expertise], which we assume to be observable

Trading stage:

- say firm i is potential buyer [i.e., firm with liquidity]
  - $E[v|s = v_h] = \left(\frac{1}{2} - \theta_i\right) v_l + \left(\frac{1}{2} + \theta_i\right) v_h = E[v] + 2\sigma\theta_i$
  - $E[v|s = v_l] = \left(\frac{1}{2} + \theta_i\right) v_l + \left(\frac{1}{2} - \theta_i\right) v_h = E[v] - 2\sigma\theta_i$

- seller can quote $p = E[v|s = v_l]$, which buyer accepts to pay with probability 1, or $p = E[v|s = v_h]$, which buyer accepts to pay with probability $\frac{1}{2}$

- seller optimally quotes low price, which maximizes social surplus from trade as well as buyer's, whenever:

$$E[v] - 2\sigma\theta_i \geq \frac{1}{2}(E[v] + 2\sigma\theta_i),$$

  which can be rewritten as:

$$\theta_i \leq \bar{\theta} \equiv \frac{E[v]}{6\sigma}$$

Payoffs to Financial Expertise

Assuming $\theta_j \leq \bar{\theta}$ for all other firms, firm i's ex ante expected payoff, before knowing role as buyer/seller and identity of counterparty, is:

$$\frac{1}{2}\left[\underbrace{\pi_i E[v]}_{\text{Keeping security } i} + \underbrace{E[\pi_j] 2\sigma\theta_i \cdot \mathbb{I}(\theta_i \leq \bar{\theta})}_{\text{Buying security } j}\right] + \frac{1}{2}\left[\underbrace{\pi_i(E[v] - 2\sigma E[\theta_j])}_{\text{Selling security } i}\right]$$

which simplifies to:

$$\pi_i E[v] + E[\pi_j \theta_i - \pi_i \theta_j]\sigma \quad if \quad \theta_i \leq \bar{\theta}$$

or

$$\pi_i E[v] + E[0 - \pi_i \theta_j]\sigma \quad if \quad \theta_i > \bar{\theta}$$

Observation: Firm i would benefit from increasing trading expertise θ_i as long as it does not lead counterparties to quote high, inefficient price

Arms Race in Trading Expertise

We will now derive results related to the "arms race" in trading expertise by setting $\pi_i = \pi$ for all firms

Firm i's expected payoff simplifies to:

$$\pi E[v] + \pi\sigma E[\theta_i - \theta_j] \qquad if \quad \theta_i \leq \bar{\theta} \equiv \frac{E[v]}{6\sigma}$$

Observations:

- if $\theta_i = \theta_j$, expertise is neutralized
- cutoff $\bar{\theta}$ is tighter when σ is high

Arms Race in Trading Expertise

Stage 0: firms can acquire trading expertise at an (exogenous) cost $c(\theta)$

- if $c'(\bar{\theta})$ is small enough, ALL firms acquiring $\bar{\theta}$ of trading expertise is the unique equilibrium
  - traders maximize their bargaining payoffs as buyers without destroying surplus from trade
    $\Rightarrow$ **inefficiency:** any θ_i, $\theta_j > 0$ is socially wasteful

Now, suppose that with probability ρ volatility in asset value jumps to $\lambda\sigma$ where $\lambda > 1$

- ALL firms acquiring $\bar{\theta}$ of trading expertise remains the unique equilibrium as long as high-volatility state is rare enough, i.e.: $\rho < \bar{\rho}(\lambda)$
  - traders maximize their bargaining payoffs as buyers in low-volatility state without destroying surplus from trade
  - but such level of expertise violates condition for efficient trade in high-volatility state
    $\Rightarrow$ **inefficiency:** gains to trade are destroyed with prob. $\rho/2$

Punchline from Glode, Green, and Lowery (2012)

Equilibrium in expertise acquisition has **"arms race"** structure:

1. investment in financial expertise confers an advantage on any one firm when bargaining with counterparties in the trading process
2. this advantage is neutralized in equilibrium by the offsetting investments of competitors
3. investment in financial expertise is destabilizing, in that it creates a risk of destruction of the gains to trade when there is an exogenous shock to the level of uncertainty in the economy

Observation: Financial firms are entirely responsible for these inefficient outcomes, as they could have acquired no expertise and reached first best

Modeling Labor Market: Glode and Lowery (2016)

We now study **firms' strategic interactions when competing for financial expertise/talent**

- replacing Stage 0's exogenous cost function with formal model of labor market

Labor market for financial experts works as follows:

- mass ξ of identical, skilled workers [with reservation wage of 0]
- hiring mass e_i of workers yields probability $\frac{1}{2} + e_i$ that firm i's signal is correct [i.e., mass of workers hired e_i = expertise θ_i for now]
- firms simultaneously submit single wage offer w_i (per unit of workers) and fraction $x_i \in [0, 1]$ of ξ workers they are willing to hire
- workers are allocated across firms based on their wage bids and demands

Assumption: $E[v] > 3\sigma$

- firms benefit from improving trading expertise, whenever possible

Traders' Compensation

When supply of workers is low enough, workers not hired by firm i all work for some of firm i's potential counterparties:

$$\pi E[v] + \pi\sigma(e_i - E[e_j]) - e_i w_i = \pi E[v] + \pi\sigma\left(e_i - \frac{\xi - e_i}{N-1}\right) - e_i w_i$$

Benefit from hiring workers can be decomposed into two components:

- Offense: trading **profits** from improving own expertise
- Defense: trading **savings** from lowering average expertise of my counterparties

Equilibrium wage for traders: When $\xi \leq \frac{N-1}{2}$, in equilibrium all firms pay their traders a wage of:

$$w^* = \underbrace{\pi\sigma}_{\text{internal marginal product}} + \underbrace{\pi\sigma\left(\frac{1}{N-1}\right)}_{\text{defense premium}}$$

Traders' Compensation

Observation: concentration in financial sector impacts traders' compensation

- as number of firms decreases, firm i is more likely to trade against any worker it does not hire
- poaching expert traders becomes more beneficial
- defense premium goes up

Cross-sectional evidence: interest-rate options trading more concentrated (1.7X) and better paid (2X) than foreign-exchange options trading [see Cetorelli et al. 2007 and Options Group 2011]

Magnitudes: using findings from Atkeson, Eisfeldt, and Weill (2013) and Begenau, Piazzesi, and Schneider (2013) that OTC trading of complex securities in the U.S. is overwhelmingly concentrated among 3-5 firms, our model predicts that traders should earn premium between 25% - 50% of their internal marginal product [consistent with average finance wage premium estimated by Philippon and Reshef 2012 and Célérier and Vallée 2019]

Bankers and Traders

Firms can now hire workers to increase either their trading expertise θ_i or their banking expertise π_i

Labor market for financial experts now works as follows:

- mass of ξ workers indexed uniformly by type $h \in [0, 1]$
- κh: extra benefit of assigning worker of type h to banking [we will focus on $\kappa \to 0$ but heterogeneity pins down unique equilibrium]
- each firm submits, for all types $h \in [0, 1]$:
  - wage: $w_i(h)$
  - demand: $x_i(h)$
  - task: $\tau_i(h) \in \{\text{banking,trading}\}$

As $\kappa \to 0$, firm i expects to collect from hiring mass e_i of traders and mass b_i of bankers [gross of compensation expenses]:

$$S(b_i)E[v] + E[S(b_j)e_i - S(b_i)e_j]\sigma$$

Worker Assignment Between Tasks

Optimal assignment of workers within firm will follow threshold pattern

- anticipating symmetric equilibrium, division of task given by h^*:

$$S'\left(\frac{\xi}{N}(1-h^*)\right)[E[v]-\sigma e^*]+\kappa h^*=\sigma S(b^*)$$

  where $e^* \equiv \frac{\xi}{N}h^*$ and $b^* \equiv \frac{\xi}{N}(1-h^*)$
- workers with $h \geq h^*$ are assigned to banking
- workers with $h < h^*$ are assigned to trading

Marginal product of both jobs is equalized **within** each firm [denote as $\bar{w}$]
$\Rightarrow$ **inefficiency:** in spirit of earlier results, firm's allocation of resources is socially inefficient! [only bankers create social surplus in our model]

Compensation of Traders vs. Bankers

Assumption: $\frac{S'\left(\frac{\xi}{N}\right)}{S\left(\frac{\xi}{N}\right)} < \frac{\sigma}{E[v]}$ and $\frac{S'(0)}{S(0)} > \frac{\sigma}{E[v]-\sigma\frac{\xi}{N}}$

- firms employ bankers and traders

When $\xi \leq \frac{N-1}{2}$ and $\kappa \to 0$, in equilibrium all firms employ a positive mass of traders who earn a wage of:

$$w_t^* = \bar{w}\left(1 + \frac{1}{N-1}\right)$$

and a positive mass of bankers who earn a wage of:

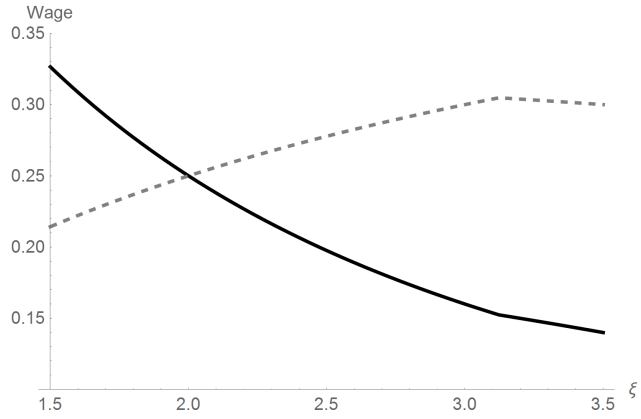
$$w_b^* = \bar{w} - \sigma e^* S'(b^*)\left(\frac{1}{N-1}\right)$$

Bankers are paid less than traders and less than internal marginal product, since they produce positive rather than negative externalities when poached

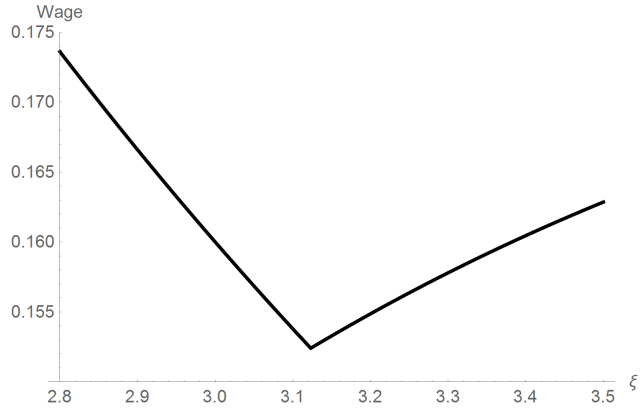
- as counterparties employ more traders, firms are willing to pay less to hire bankers
- as counterparties employ more bankers, firms are willing to pay more to hire traders

Compensation "Dynamics"

Our model can also reconcile historical increases in supply of workers and in finance wage premium mentioned at beginning of my talk



Shadow compensation for both jobs. Solid line represents w_b^* and dotted line represents (shadow) w_t^*



Average worker compensation in equilibrium.

To Conclude: Policy Implications

Our two papers highlight financial firms' incentives to **overinvest and overpay for trading expertise**

While compensation affects which firm will employ a given worker, firms decide where to allocate employees based on their internal marginal product

- this is what regulation should target, i.e.,

$$S'\left(\frac{\xi}{N}(1-h^*)\right)[E[v]-\sigma e^*]+\kappa h^*=\sigma S(b^*)$$

Possible policy interventions [and their realism outside the model]:

- Tax on speculative activities? [without taxing liquidity provision]
- Volcker rule? [whoever provides liquidity has incentives to acquire excessive trading expertise – number of trading desks vs. banks matter]
- Cap on compensation? [only if it impacts workers' training – work in progress!]