CEOs and the economics of superstars

Nobel Symposium on Inequality, August 2022

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Motivation

- This talk is about the economics of superstars – inequality in income at the very top
- I'll focus first on CEOs (Chief Executive Officers = head of companies)
- Then I'll come back to more general superstars
- And the rest of the economy
- And policy

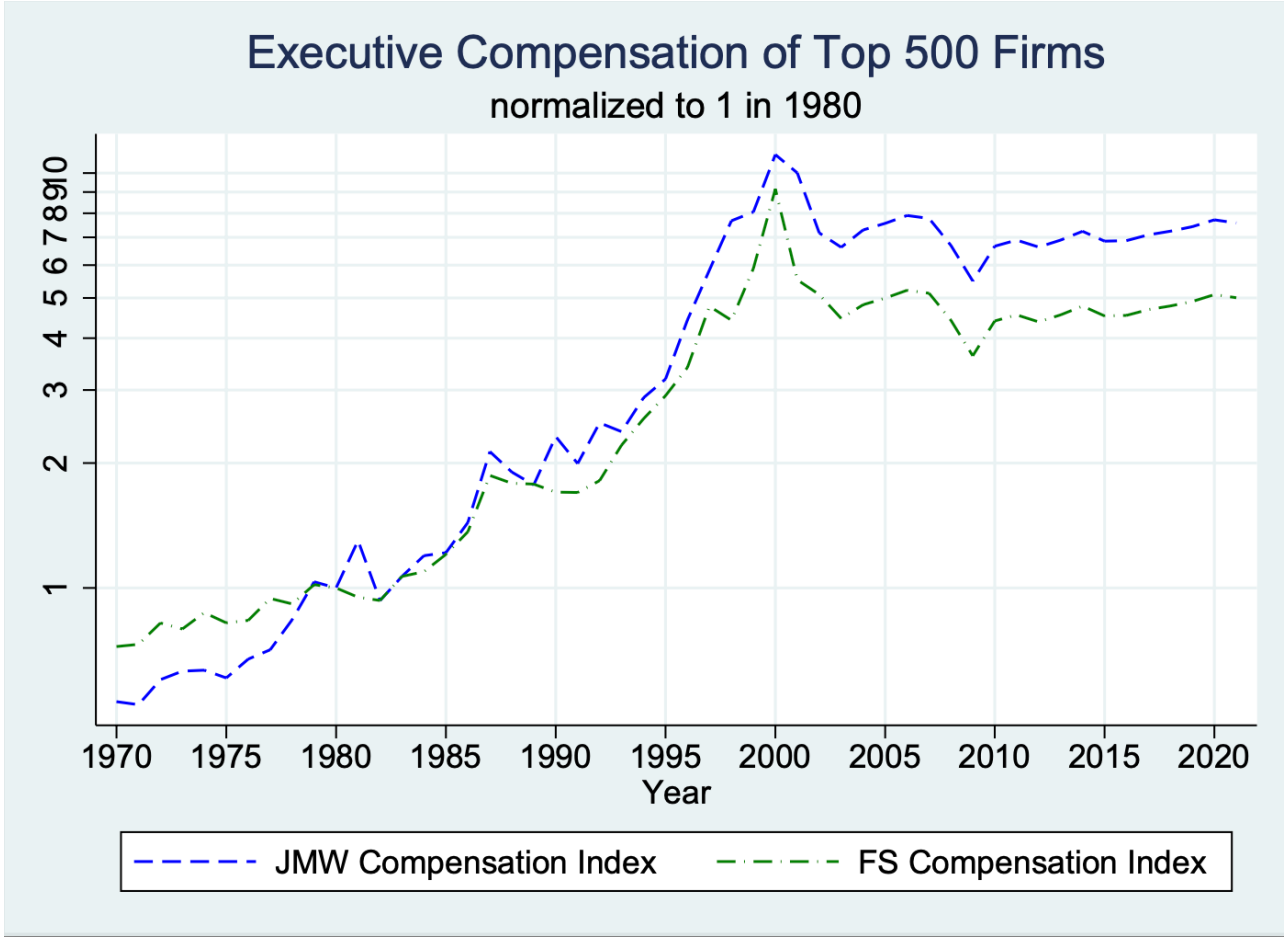
- Thanks to my coauthors: Alex Edmans, Dirk Jenter, Augustin Landier, Yuliy Sannikov, Julien Sauvagnat, Tomasz Sadzik

Why care about CEOs?

- Large popular and academic focus on the increase of CEO pay in the US since the 80s.
- Lots of good data (from forced disclosure) on CEO pay -> We can do precise work
- I'll start from G. Landier "Why has CEO pay increased so much?" (QJE '08)
- Changes in firm size appear to explain much of the variations in CEO pay, across time (since 1970s at least), industries, countries

Short Literature Review:

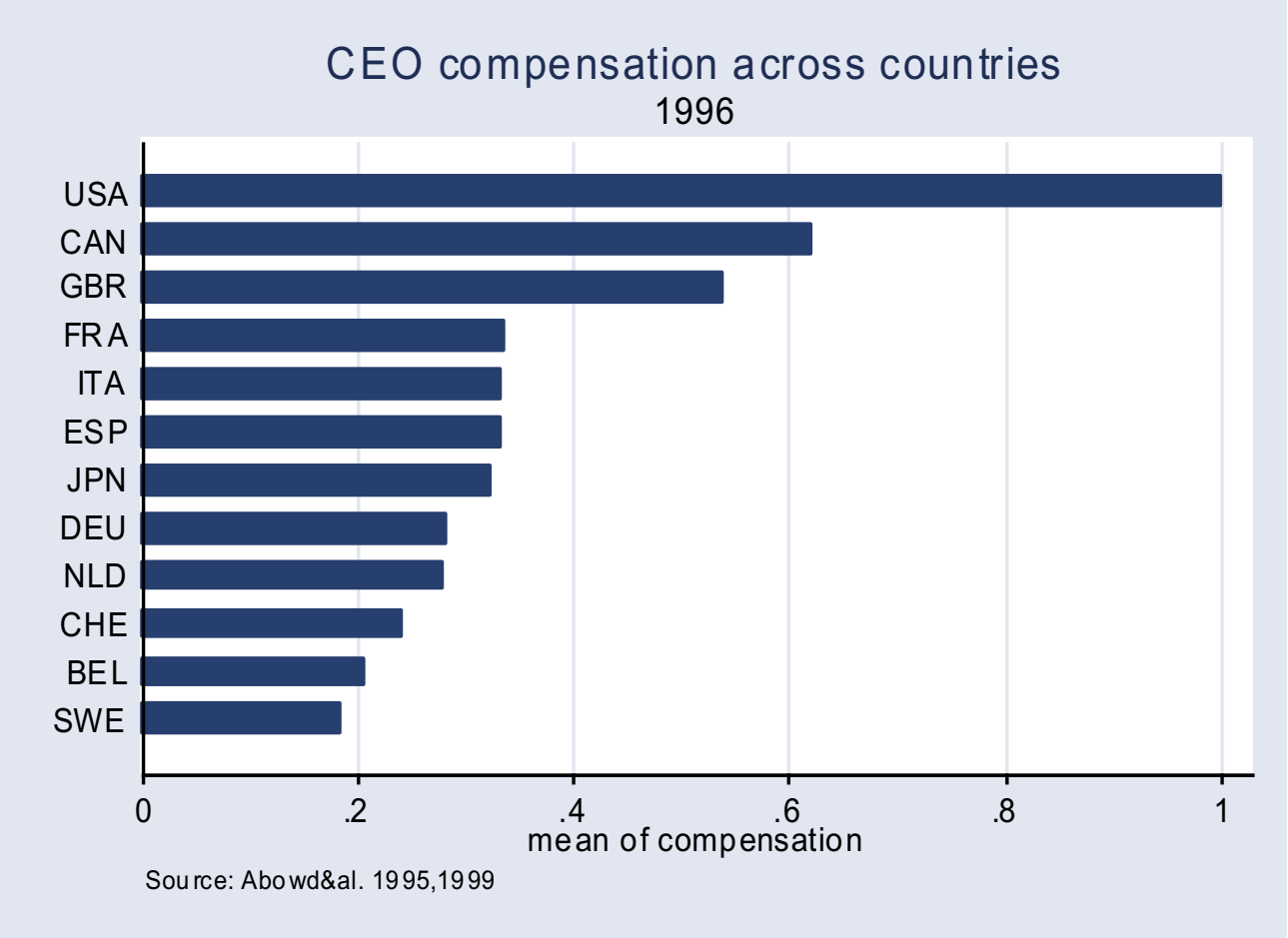
- **Fact 1:** CEO pay has been multiplied by ***5 to 7*** between 1980 and 2003, with smallish rise afterwards



Source: Jensen Murphy Wruck (2003); Frydman Saks (2010), G. Landier Sauvagnat (2014)

Short Literature Review: Reminder of 2 facts and 3 theories…

- **Fact 2:** US top CEOs are paid more than their foreign counterparts. (Kaplan (1994), Abowd and D.Kaplan (1998), Fernandes et al. (2013))



Short Literature Review: Reminder of 2 facts and 3 theories…

- **Theory 1: Higher Incentives → Rents**
  - Murphy (1985), Jensen-Murphy (1990):
    importance of market-based incentives
  - Holmstrom –Kaplan (2001,2003):
    discovery of high-powered incentives in the 80s?

Need strong *limited liability* & *risk-aversion* frictions to explain such higher *rents*.

(calibration: e.g. Gayle & Miller 2009, 2015)

Short Literature Review: Reminder of 2 facts and 3 theories…

- **Theory 2: "Skimming View"**
  - Bertrand Mullainathan (2001), Kuhnen Zwiebel (2009)
  - Bebchuk Fried (2004)
    - Increased entrenchment & "camouflage" techniques
  - Hall Murphy (2003), Jensen Murphy Wruck (2004)
    - Boards underestimate the cost of stock-options
  - Difficulties with that view:
    - Governance seems to have improved, not worsened
    - Private equity firms pay their CEOs a lot, even more than publicly traded firms (Kaplan Rauh 2013, Cronqvist Fahlenbrach 2013)

Short Literature Review: Reminder of 2 facts and 3 theories…

- **Theory 3: Changes in CEO job/labor market**
  - Murphy and Zabojnik (2004), Frydman (2005)
    - Higher importance of general (vs. specific) skills
      → higher CEO outside options, more external hires
  - Garicano and Rossi-Hansberg (2006)
    - Technological change and hierarchies in equilibrium
  - See also Bertrand and Schoar (2003), Bloom et al. (2006), Daines, Nair, Kornhauser (2005), Malmendier and Tate (2005), Geerolf (2018)

Our Approach: the "Size of Stakes" View

- Focus on one important source of variation:
  - ***firm size***
- Assortative matching of firms and managers
  - Lucas (1978), Sattinger (1979), Rosen (1981,82), Himmelberg and Hubbard (2000), Tervio (2008)
- Frictionless talent market
- CEO pay = price of talent
  - Depends on:
    - Asset distribution
    - Production function
    - Talent distribution (unobservable!)
- General results using Extreme Value Theory

CEO Pay in Equilibrium

- *N* firms to match with *N* managers
  - Firms have size *S(m) (descending order)*
  - Managers talent *T(n),* paid *w(n)* in equilibrium.

- Firm's Program: Hiring the CEO increases earnings by:

$$\max_{n} \underbrace{C \times T(n) \times S^{\gamma}}_{\text{CEO impact}} - w(n)$$

Price of talent #n

- Relevant size measure?
  - **Permanent CEO impact → S=market value (D+E)**
  - Temporary CEO impact → S=earnings

- Benchmark case: constant returns of talent
  - γ=1, empirically validated

Equilibrium:

An equilibrium consists of:

- (i) a compensation function *W(T),* which specifies the wage of a CEO of talent T
- (ii) an assignment function *M(m),* which specifies the index *n=M(m)* of the CEO heading firm *m* in equilibrium,such that
- (iii) each firm chooses its CEO optimally:

$$M(m) \in \arg\max_{n} C \times S(m)^{\gamma} \times T(n) - W(T(n))$$

- (iv) the CEO market clears, i.e. each firms gets a CEO.

Equilibrium:

- First order condition: $C \times S(m)^{\gamma} \times T'(n) = w'(n)$
- **Assortative matching:**
  - Firm ***#n*** is matched with manager ***#n***

$$\Rightarrow w(n) = w(N) - \int_{n}^{N} \underbrace{C \times S(m)^{\gamma} \times T'(m)}_{<0} \, dm$$

- Equilibrium wages depend on
  - Productivity
  - Scarcity of talent
- How do we go further?

Distributions

- **Firms: observable**

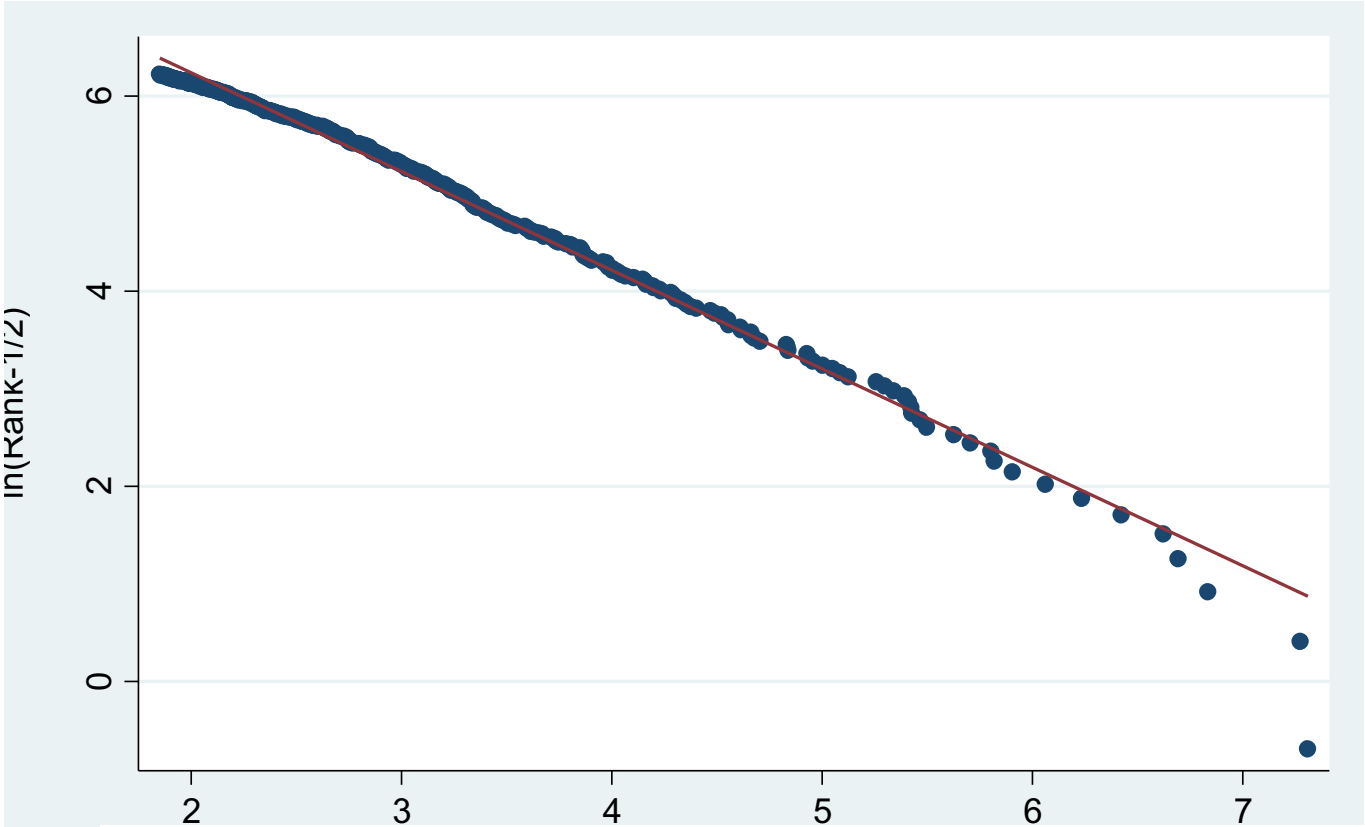
$$S(n) = \frac{A}{n^{\alpha}}$$

  - Useful for calibration: Zipf's law

$$(\alpha \approx 1)$$

  - Simon (1955), Gabaix (1999, 2009 and ref. therein), Axtell (2001), Luttmer (2005, 2018), Axtell and Guerrero (2022)…

Zipf's law for size (market value) of firms



- Largest 500 firms in the US in 2004
- Ln(Rank-1/2) = a - 1.01 ln Size, R^2=0.99
- (Rank-1/2:Gabaix Ibragimov 2011)

Distributions

$$w(n) = w(N) - \int_n^N C \times S(m)^{\gamma} \times T'(m)\, dm$$

Talent: unobservable → use *Extreme Value Theory*

$$T'(n) = -Bn^{\beta-1}$$

- Valid approximation for all "regular" distributions
  - Gaussian, log-normal, Weibull, log-gamma, etc.
- Exact for uniform, exponential, Pareto

Main Proposition

$$S(m) = Am^{-\alpha}, -T'(m) = Bm^{\beta-1}$$

$$w(n) = w(N) - \int_n^N C \times S(m)^{\gamma} \times T'(m)dm \rightarrow w(n) = \frac{A^{\gamma} BC}{\alpha\gamma - \beta} \times \frac{1}{n^{\alpha\gamma-\beta}}$$

- Using def. of A and B, get:

$$w(n) = D \times S_{n*}^{\beta/\alpha} \times S_n^{(\gamma-\beta/\alpha)}$$

$$w(n) = D \times S^{1/3} \times S_*^{2/3}$$

Own Firm Size

Reference Size
Can be country specific

$$D = \frac{-n_* T'(n_*)}{\alpha\gamma - \beta} \times C$$

Main Predictions $w(n) = D \times S_{n^*}^{\beta/\alpha} \times S_n^{(\gamma-\beta/\alpha)}$

- Cross-sectional: (change *n*)

$$w(n) = (cste) \times S_n^{(\gamma-\beta/\alpha)}$$

- Cross-time: (change *A* in $S(n) = A/n^{\alpha}$, keep *n* constant)

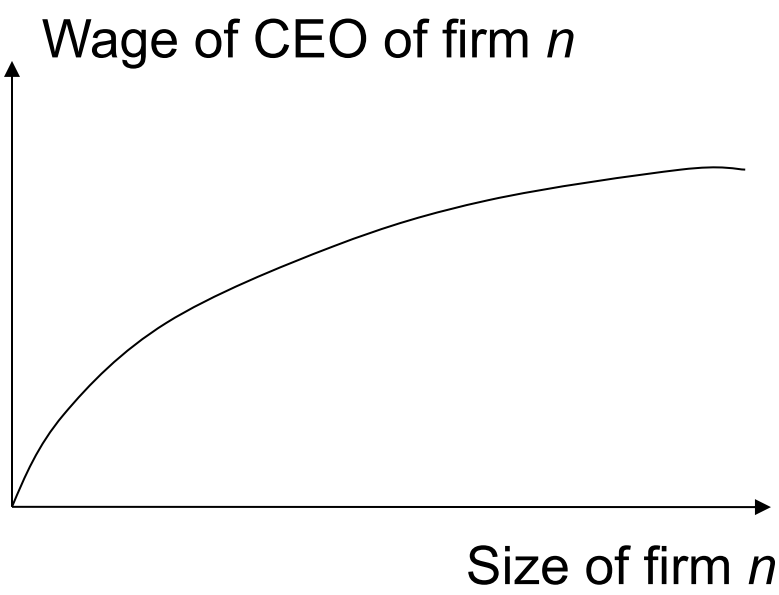
$$w(n^*) = (cste) \times S_{n^*}^{\gamma}$$

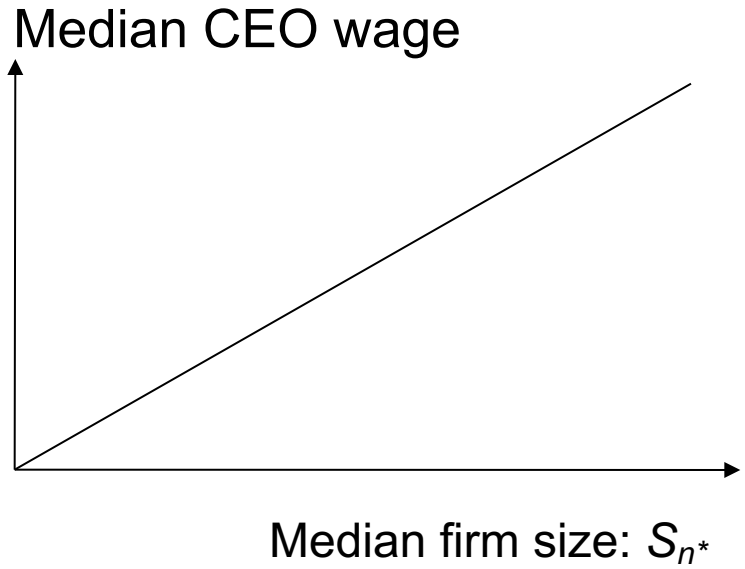
- Cross-country: (keep *S(n)* & *Pop. Size* constant)

$$w(S) = (cste) \times S_{n^*}^{\beta/\alpha}$$

Main Predictions

$$w(n) = D \times S_{n*}^{2/3} \times S_n^{1/3}$$





Cross-section: Wage is a **concave** function of size:

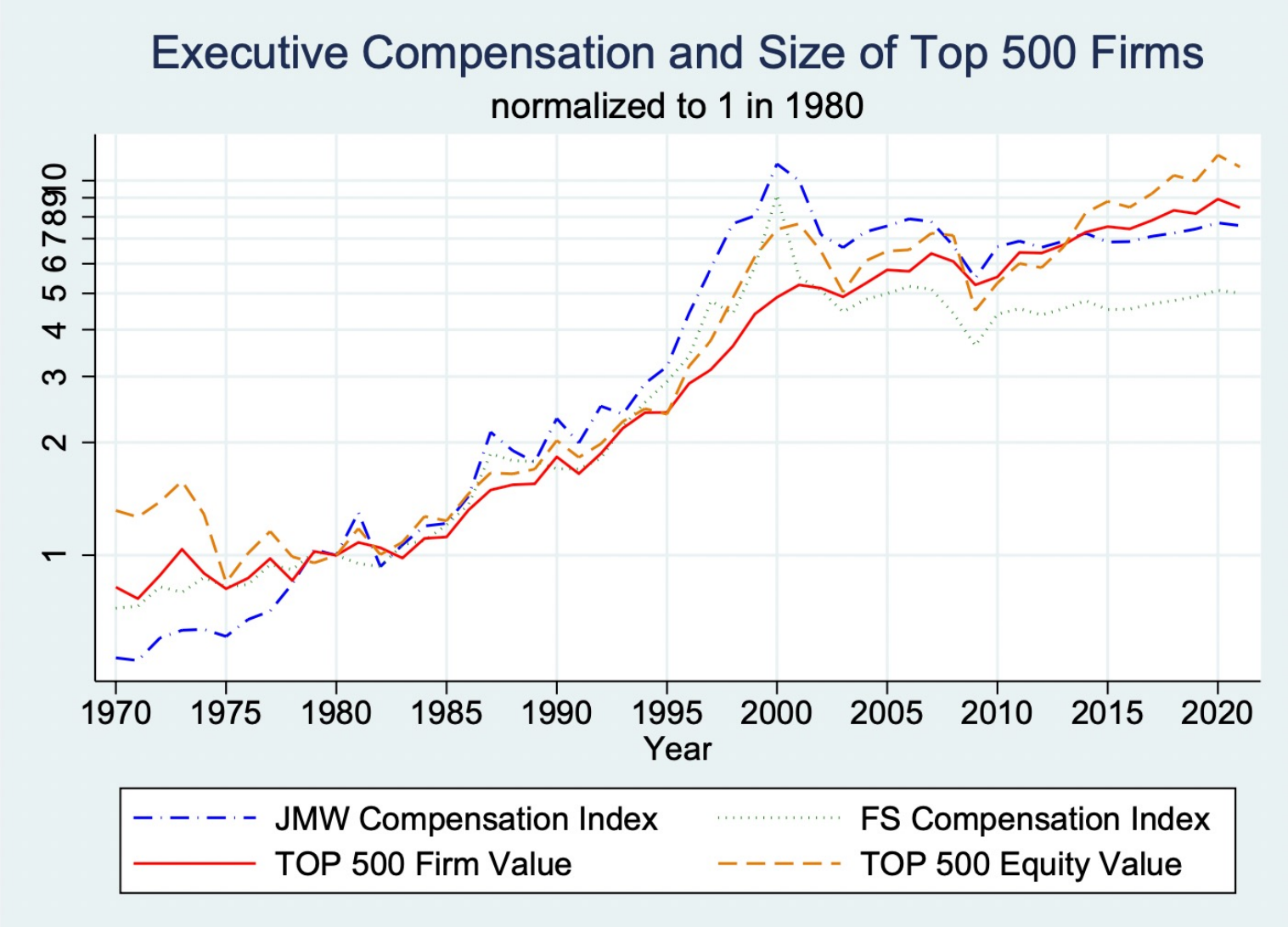
$$w_n = k\, S_n^{1/3}$$

Time series: Aggregate wage is a **linear** function of aggregate size:

$$w_{n*} = k' S_{n*}$$

The relationship between size and pay is very different in the cross section and the time-series

Update (G, Landier, Sauvagnat 2014)



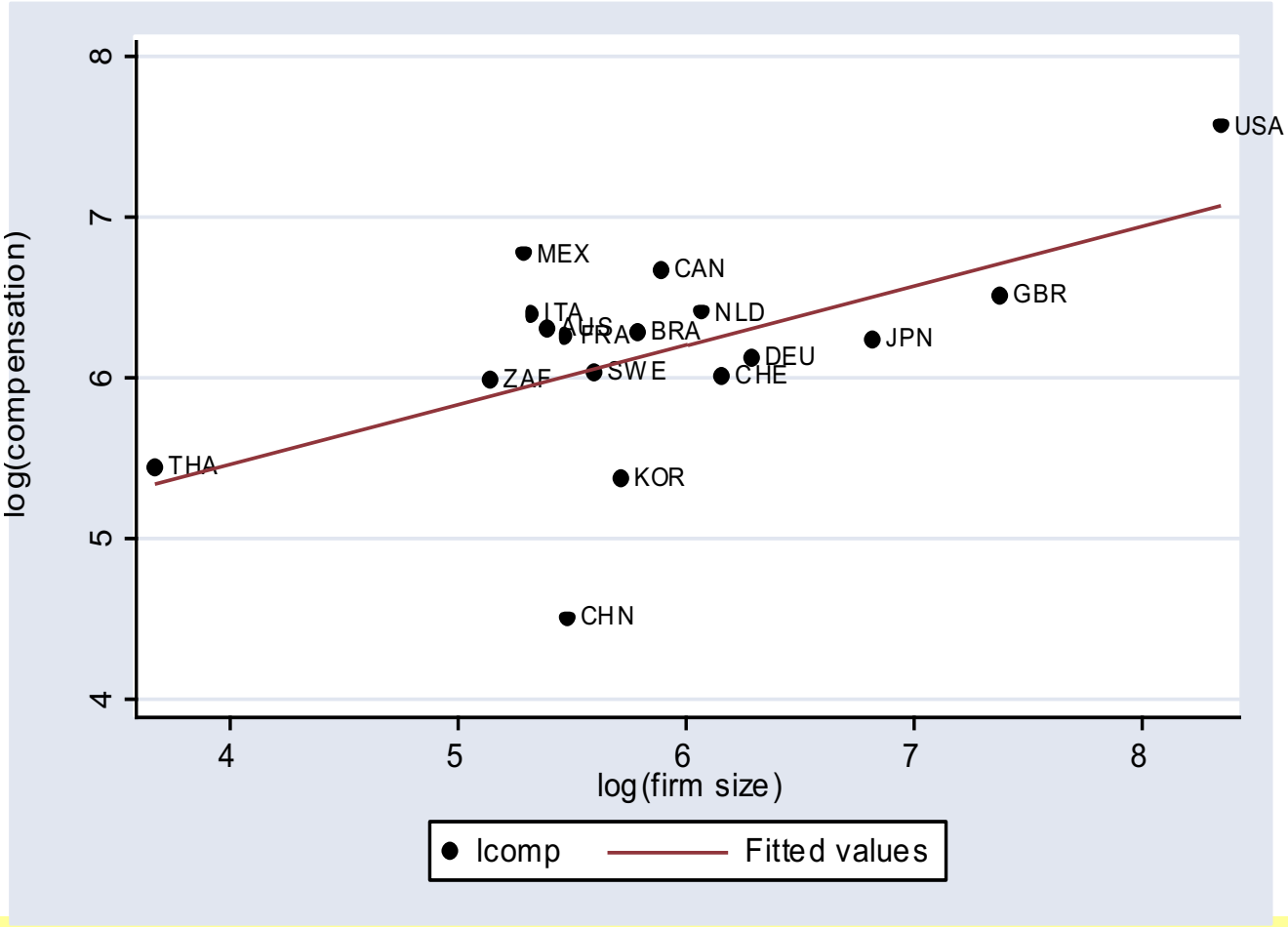
Thanks to J. Sauvagnat for the update

Panel Evidence: USA, 1992-2004

$$w_n = D \times S_n^{(\gamma-\beta/\alpha)} \times S_{n^*}^{\beta/\alpha}$$

	ln(total compensation)			
	Top 1000			
ln(Market cap)	.37	.37	.38	.26
	(18.28)	(18.84)	(16.59)	(4.60)
	(24.20)	(25.13)	(29.94)	(6.14)
ln(Market cap of firm #250)	.72	.66	.68	.78
	(13.60)	(12.22)	(11.37)	(14.97)
	(10.70)	(10.06)	(10.84)	(9.71)
GIM governance index			0.019	
			(1.80)	
			(6.82)	
Industry Fixed Effects	NO	YES	YES	NO
Firm Fixed Effects	NO	NO	NO	YES
Observations	7661	7661	6257	7661
R-squared	0.22	0.29	0.32	0.60

Empirical Evidence: cross-country



Source: Towers-Perrin (2001) for CEO compensation
Compustat Global (2000) for firm size

Empirical Evidence: cross-country

ln(total compensation)				
ln(median net income)	0.38	0.41	0.36	0.36
	(3.7)	(4.2)	(3.8)	(3.1)
ln(pop)		-0.16		
		(1.76)		
ln(gdp/capita)			0.12	
			(1.8)	
"Social Norm"				-0.018
				(1.5)
Observations	17	17	17	17
R-squared	0.48	0.57	0.58	0.52

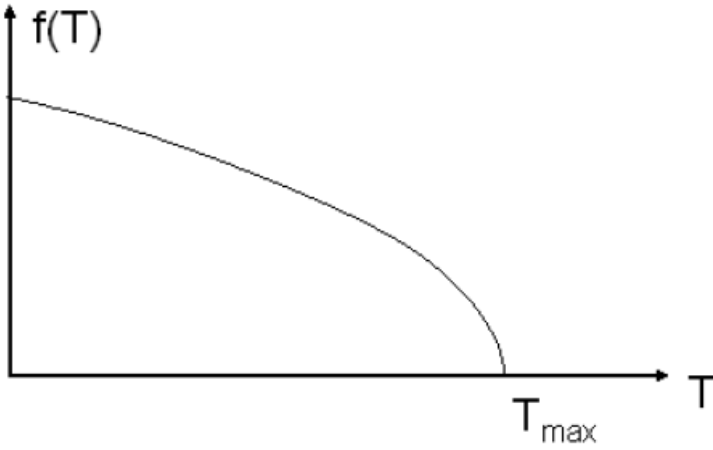
Social Norm= mean agreement to
"We need large income differences as incentives for individual effort"
in World Value Survey, 1990. S.e. of Social Norm is 10.

Calibration, I

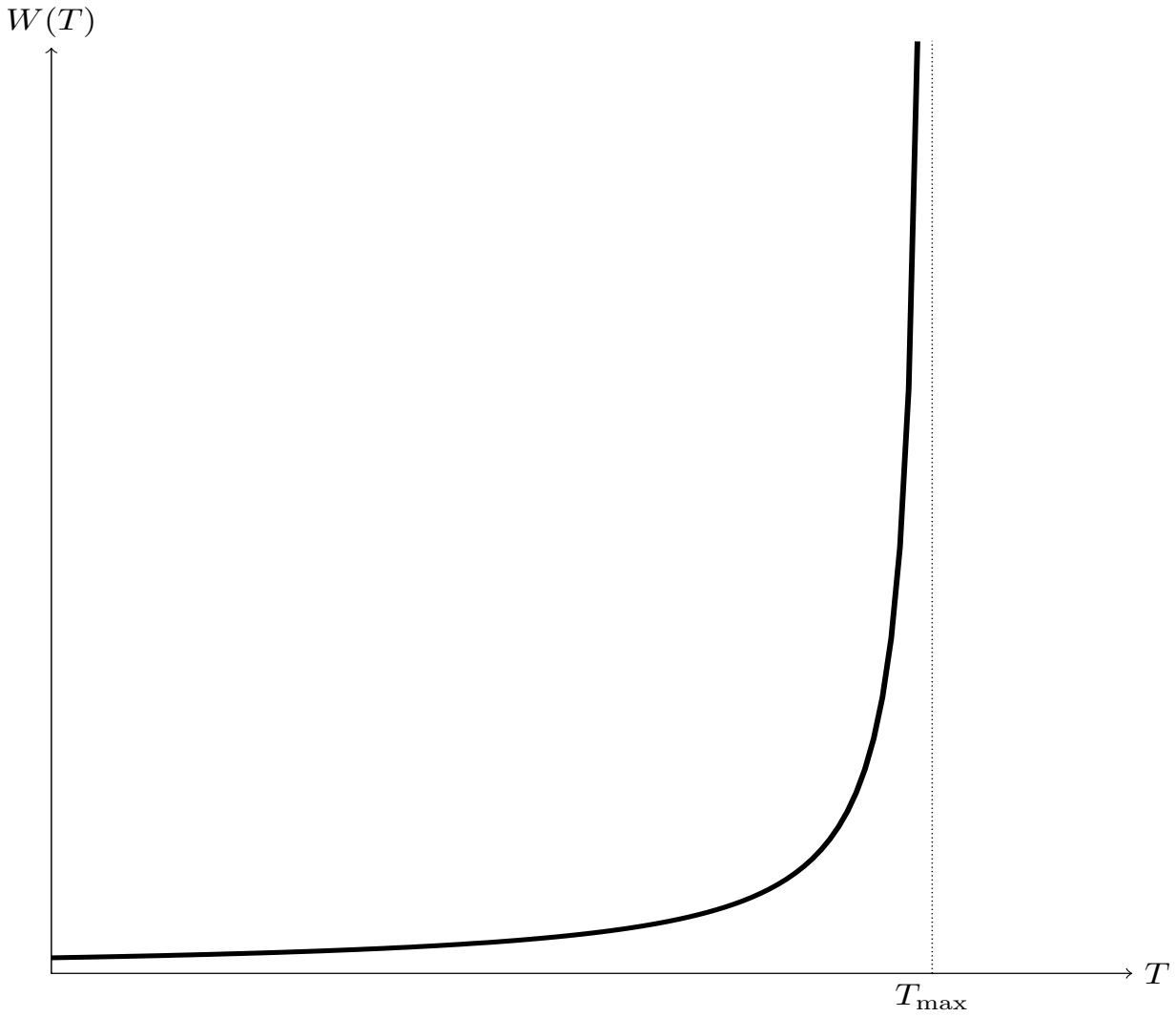
- α=1 (Zipf's law)
- γ =1 from time-series
- Distribution of talent: $w \sim S^{1/3}$

$$\frac{1}{3} = \gamma - \frac{\beta}{\alpha} \rightarrow \beta = 2/3 \rightarrow \qquad f(T) = k(T_{\max} - T)^{1/\beta - 1} = k(T_{\max} - T)^{1/2}$$

- It would be interesting to compare to: movie stars, lawyers pianists, sport stars…



Wage $W(T) \sim (T_{max} - T)^{-1/2}$ as a function of talent T



Conclusion for all of us: work hard and accumulate talent, the rewards are very large (unbounded here)

Calibration, II

- Take year=2004. Look at median of *top 500* firms and top CEOs. A la Tervio ('08)
  - n*=250: W(n*)=$8.3 Mil, S*=$25 Bil

$$\Rightarrow BC = (\alpha - \beta)\frac{w_* n_*^{-\beta}}{S_*} = 2.6 \times 10^{-6}$$

- Interpretation: #1 CEO, compared to #250 CEO
  - increases market value by:

$$C(T(1) - T(250)) = \frac{BC}{\beta} \times (250^{\beta} - 1) = 0.02\%$$

  - Gets paid more by:

$$\frac{w}{w_*} - 1 = \left(\frac{S}{S_*}\right)^{1/3} - 1 \approx 250^{1/3} - 1 \approx 500\%$$

Calibration, II'

- This small differential in talent is a robust implication
- Suppose that there's a CEO who can increase value of firm 250 by 1%
- She's worth S* x 1% =$25B * 1%= $250 million
- As the CEO is paid "only" $8 million, she must increase the pay by <0.1%
- So, the differential of ~0.02% makes sense.

Why the increase in firm size?

What caused the increase in firm size?

1. Globalization (larger Earnings): General Motors sells worldwide

3. **Higher valuation multiples (larger Price / Earnings ratio)** for stocks and bonds, themselves due to:

- Lower interest rate r (savings glut?, demographics?)
- Lower risk premia (greater optimism about capitalism's resilience; the rich being less risk averse)?

2. **IT**: makes it easier to manage a very large firm

Extension: Top H executives

- Assume human cap increases firm value by factor:

$$1+\sum_{1}^{H} C_h \times T_h \rightarrow \max S \times \left(1+\sum_{1}^{H} C_h \times T_h\right) - \sum_{1}^{H} w(T_h)$$

- Think of firm S_i as H C_i-scaled assets each looking for manager :

$$\left(C_1 \times S_i, \ldots, C_H \times S_i\right)$$

- In equilibrium, executive #h at firm i earns:

$$w_{i,h} = D \times C_h^{1-\beta/\alpha} \times S_*^{\beta/\alpha} \times S_i(x)^{1-\beta/\alpha}$$

- Steepness of wage ratio and firm organization: $\frac{w_1}{w_h} = \left(\frac{C_1}{C_h}\right)^{1-\beta/\alpha}$

Rise in the supply of CEO talent: CEOs born in India

CEO of Google 🇮🇳
CEO of Microsoft 🇮🇳
CEO of Adobe 🇮🇳
CEO of Twitter 🇮🇳
CEO of Mastercard 🇮🇳
CEO of Pepsi 🇮🇳
CEO of IBM🇮🇳
CEO of Albertsons🇮🇳
CEO of Micron 🇮🇳
CEO of Netapp🇮🇳
CEO of Nokia🇮🇳
CEO of Palo Alto🇮🇳
CEO of Arista 🇮🇳
CEO of Novartis🇮🇳

Source: @stats_feed, 8/26/22

Extension: How wages fall when talent supply increases

- Suppose that the talent supply of is multiplied by M
- Then, for a given ranking n, pay falls by a factor $M^{\beta} = M^{2/3}$
- So, if you double the talent supply, wages fall by 40%
- This increase in the talent supply (from India, MBAs etc) may explain the fact that US CEO pay has increased little since 2003
- It may also explain the relatively small rise before 1970 (increase in talent supply similar to Goldin-Katz)

Extension: Model with incentives

- Lots of people opine that incentives are a part of the story
- Is that true?
- Add incentives, both in theory and in calibrated empirics: work with Edmans, Landier, Sannikov, Sadzik (09, 11ab, 12):
- Findings
  - Incentives matter to set the optimal fraction of variable vs fixed pay
  - Incentives matter in the cross-section: If a firm is riskier, it needs to pay more
  - Incentives do not matter in the aggregate for the average level of pay: that's determined by productivity
  - …if all firm are riskier, aggregate pay doesn't change

Remark: Could a "stealing" model work?

- Objection: wouldn't a "stealing" model work?
- Simplest model of stealing: a CEO in a firm of size S can extract a pay a S, for a coefficient a
- But then, you violate Roberts' law, $\mathrm{w(n)} \sim S(n)^{1/3}$: empirically, pay is less than proportional to size
- OK, imagine that we manage to contrive a reason why $\mathrm{w(n)} \sim S(n)^{1/3}$. Then, you still don't get the time series right, i.e. don't get

$$w(n) = D \times S_{n*}^{2/3} \times S_n^{1/3}$$

- So it seems very hard for stealing models to get the double scaling in the cross-section and time series

Caveat: of course, CEOs are not perfect

- There is a lot of extra richness:
- What do CEOs do? (Bloom et al, Bertrand Schoar 2003)
- There are interesting deviations from a perfect market
  - CEOs are overconfident (Malmendier and Tate 2005,8)
  - CFOs can be miscalibrated (Ben-David et al 2013)
  - Options are sticky in "number of shares" (Shue and Townsend 2017)
  - Talent is hard to identify (Tervio 2009)
  - Contagion effects might be strong (G. Landier 2008, Benabou Tirole 2016)
  - Wealth matters (Becker 2006, Edmans G. 2011)
- Still, the matching model, with a huge rise in size of stakes (6x), offers a useful 1st order point of departure

Conclusion for CEOs

1. **Simple CEO pay model.**
   Under general assumptions:

$$w(n) = D \times S_{n*}^{\kappa} \times S_{n}^{1-\kappa}$$

   - "Reference firm" size, S*, matters

2. **Empirical implications:** CEO compensation across *firms, time, countries, industries*
3. *"Size of stakes" is the key driver.* *Probably, incentives, social norms, etc. matter much less* (Kaplan Rauh 2013)

Other superstars markets

Other markets:

- Top programmers: affect huge projects
- Top fund managers: affect large pools of money
- Top athletes: affect odds of winning, audience, value of ads
- Top actors: affect a lot the value of a movie
- Top lawyers: affect probability of success

Diffusion in market equilibrium:

- Top works of art, real estate: wealthy people buy nice real estate, works of art, hire top divorce lawyers, surgeons etc

- So, diffusion of superstars economics across the whole economy

Non-stars:

- Small stakes, no scope for scaling: nurses, school teachers, construction workers

Policy?

- *If talent supply is inflexible*: you could have 99% tax rate, nothing is distorted
- *If talent supply is flexible*: optimal taxes are low, or even negative, if talented people create growth theory-type externalities! (Jones '22)
- The market tells us that we want more top programmers, surgeons, managers
  - - So that people accumulate the right human capital, we should let the price signals work
  - - Or if you tax them at rate T, subsidize education at rate T

  - Caveat: In some markets, private rewards may be > social rewards (e.g. hedge funds? Lockwood et al. 2017, Eeckhout et al. 2022), but in many markets (esp. with research, entrepreneurship), they're < social rewards.
    - Some very bad ideas: tax bonuses. Very bad, because it gives an incentives to give fixed rather than variable pay, and banks are less flexibility to cut costs in downturns

Policy

- **On the elasticity of supply of talent:**
  - We don't know the *aggregate* elasticity of talent. So maybe a large, uniform income tax is OK?
  - The cross-sectional elasticity of talent (say, across US states) is pretty high (e.g. Akcigit et al. 2022)
  - So, if you're a country, you want to have lower taxes to attract talent, ceteris paribus (as US, UK)

Policy

Overall, talents markets work well

Two exceptions:

1. *The public sector*

- In Singapore, top public servants are highly educated, highly paid
- Probably underpaid / less qualified elsewhere
- Same for politicians: unimpressive, low quality offerings

2. *The discovery / nurturing of talent* may be suboptimal in many countries

- Countries spend resources fostering top athletes, not so much for other talents

- One could do the same for non-athletic talent: program for gifted children, exposure to innovation etc. (Bell et al. 2019)

Conclusion

- Sherwin Rosen (1981) was prescient
- Superstars economics very important in the past 50 years
  - In part due to rise in firm size, itself due to (i) lower interest rates and risk premium (ii) globalization (iii) IT
- We now have worked out models of superstars economics, including equilibrium wages, incentives, and empirical investigation
- Detailed studies of what CEOs do
- First order bottom line: This very high pay reflects the healthy functioning of talent markets.
- So, help the poor…
- …. But keep nurturing top talents, which are crucial for firm success, innovation, mankind's progress