Job Qualities in the Market for CEOs

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General motivation for this talk

Two measurement problems that relate to policy evaluation.

- Wages do not measure job quality and that some employees will instead have strong preferences for specific job qualities - what we call amenities.

- We rarely have direct measures of individual worker productivity.

We propose a simple method (which relies on simple theory and some assumptions on unobservables) to estimate employee valuations of job quality and employer valuations of employee quality from matched employer-employee data.

We apply this methodology to the market for Danish CEOs.

Plan of the talk

- Job qualities
- Job substitution
- Methods
- Danish market for CEOs
- Results

Job quality: For job type y and worker type x

With the right worker, good job qualities contribute to **productivity**

$$\gamma(x, \underset{+}{y})$$

With the right worker, good job qualities contribute to **worker welfare** (In addition to wages)

$$\alpha(x, \underset{+}{y})$$

Theoretical perspectives on job qualities

TABLE 4.1. DIMENSIONS AND CHARACTERISTICS OF THE QUALITY OF THE WORKING ENVIRONMENT

Dimensions	Job characteristics			
	Job demands		Job resources	
A. Physical and social environment	A.1	Physical risk factors	A.4	Social support at work
	A.2	Physical demands		
	A.3	Intimidation and discrimination at the workplace		
B. Job tasks	B.1	Work intensity	B.3	Task discretion and autonomy
	B.2	Emotional demands		
C. Organisational characteristics			C.1	Organisation participation and
			C.2	workplace voice
			C.3	Good managerial practices
				Task clarity and performance feedback
D. Worktime arrangements	D.1	Unsocial work schedule	D.2	Flexibility of working hours
E. Job prospects	E.1	Perceptions of job insecurity	E.2	Training and learning opportunities.
			E.3	Opportunity for career advancement
F. Intrinsic aspects			F.1	Opportunities for self-realisation
			F.2	Intrinsic rewards

Source: OECD Guidelines on Measuring the Quality of the Working Environment (2017).

Theoretical perspectives on measuring job quality by surveys

Table 6.A.2. Condensed survey module to measure the quality of the working environment.

Survey question	Response scale	Job characteristics
1. I AM EXPOSED AT WORK TO HANDLING OR BEING IN SKIN CONTACT WITH CHEMICAL PRODUCTS OR SUBSTANCES.	Scale B	A.1. Physical risk factors
2. MY JOB INVOLVES CARRYING OR MOVING HEAVY LOADS	Scale B	A.2. Physical demands
3. I AM ASKED TO WORK IN MY FREE TIME TO MEET WORK DEMANDS.	Scale B	D.1. Unsocial work schedule
4. FOR ME ARRANGING TO TAKE AN HOUR OR TWO OFF DURING WORKING HOURS TO TAKE CARE OF PERSONAL MATTERS IS DIFFICULT.	Scale A	D.2. Flexibility of working hours
5. MY JOB INVOLVES WORKING AT VERY HIGH SPEED.	Scale B	B.1. Work intensity
6. MY JOB INVOLVES WORKING TO TIGHT DEADLINES.	Scale B	B.1. Work intensity
7. I AM EXPECTING TO LOSE MY JOB IN THE NEXT 6 MONTHS.	Scale A	E.1. Perceptions of job insecurity
8. I LEARN NEW THINGS IN MY JOB.	Scale A	E.2. Training and learning opportunities
9. I AM ABLE TO CHOOSE OR CHANGE MY METHODS OF WORK.	Scale A	B.3. Task discretion and autonomy
10. MY WORK GIVES ME THE FEELING OF A JOB WELL DONE.	Scale A	F.2. Intrinsic rewards
11. I GET ADEQUATE SUPPORT FROM MY COLLEAGUES IN DIFFICULT SITUATIONS.	Scale A	A.4. Social support at work
12. I CAN INFLUENCE DECISIONS THAT ARE IMPORTANT FOR MY WORK.	Scale A	C.1. Organisational participation and workplace voice
13. CONSIDERING ALL MY EFFORTS AND ACHIEVEMENTS, I RECEIVE THE PRAISE AND RESPECT THAT MY WORK DESERVES. (R.)	Scale A	F.2. Intrinsic rewards

Note: Items denoted with an **R** should be coded in reverse.

SCALE A

(1) Completely disagree
(2) Disagree
(3) Neither disagree nor agree
(4) Agree
(5) Completely agree
(6) Not applicable
(7) Don't know
(8) Refused to answer

SCALE B

(1) Never
(2) Rarely
(3) Sometimes
(4) Often
(5) Always

Source: OECD Guidelines on Measuring the Quality of the Working Environment (2017)

Qualities of the job for a CEO

For a CEO, aspects of the job qualities include the overall characteristics of the firm they are managing:

- Number of employees, Industry, Debt, Exporting/Importing, Net investment, Equity, Fixed assets, etc.

Preview of our findings:

- We will be presenting evidence that CEOs derive a strong positive amenity (gain of job quality) for continued work in the same industry: Gain of legacy mechanism.
- We will also be presenting evidence that CEOs derive a strong negative amenity (loss of job quality) for working in a highly leverage firm: Loss of empowerment mechanism.

Theoretical perspectives on measurement of productivity

To obtain our estimates, we do not need measures of γ. However, we can and do incorporate this information if we have it.

The measurement of γ can be (but is not always) straightforward:

- CEOs: Profits.

- Teachers: Student outcomes

- Coaches: Wins

- Regular employees: Many deliverables are considered in how an employer values an employee's 'performance'.

Theoretical perspectives on measurement of worker welfare

To obtain our estimates, we do not need measures of α. However, we can and do incorporate this information if we have it.

In some cases, we could measure α by a third party.

- A personal psychological assessment by a trained psychologist.
- An assessment by an organizational psychologist with respect to other employees at a work-place or in a profession

However, if we are to have an understanding of the decisions of the individual, it is also important to have information about self assessment and introspection. Survey information on:

- Happiness
- Stress

Survey questions on self-reported happiness and stress

Examples:

1. How satisfied are you generally with your job?

Response scale:

- 0 Not at all satisfied
- ...
- 10 Completely satisfied

2. How often in a typical week do you feel stressed because of your job?

Response scale:

- 0 Never
- ...
- 6 All the time

We have added these questions to the 2023 Q3 Danish labor force survey (Danish LFS).

Former Starbucks CEO Jim Donald photographed in 2004 and 2009.

Read Caption >

(Credit for both photos: Getty Images/Bloomberg)

Some puzzles and questions about the market for CEOs

Do CEOs value non-monetary job amenities?

CEO skills are largely general. Therefore, best CEOs will match to largest firms (Gabaix (2008)). However, there is little mobility of CEOs across industries (Cziraki and Jenter (2022)).

There is strong wage premium for hiring an outsider CEO.

Does reduced corporate oversight enrich a CEO? 'Shareholder view' versus 'Rent extraction view´ of the market for CEOs.

A. The sale of labor is determined by a standard rental market. Like the rental of a car.

B. The sale of labor is subject to search frictions - Like the sale of some assets in OTC markets.

Supply and demand
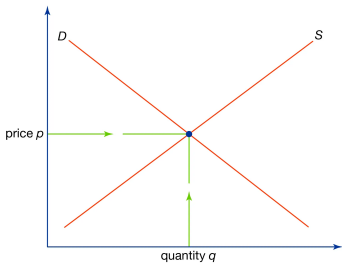
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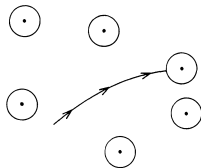

P. HOWITT AND R. P. McAFEE

FIGURE 1
A CONTACT OCCURS WHEN A WORKER'S PATH INTERSECTS A FIRM'S NET

Howitt and McAfee (1987) Costly Search and Recruiting. International Economic Review.

Our model of job subsitution in the market for CEOs

1. Stable matching of CEOs and firms
2. imperfect TU (taxes)
3. CEOs have 'charisma' and firms have 'culture'.
4. Unobserved attributes

Non TU and TU

Table 1: Non-transferable utility model: Solve by DA algorithm

	CEO 1	CEO 2	CEO 3
Firm 1	3,2	2,6	1,1
Firm 2	4,3	7,2	2,4
Firm 3	1,1	2,1	0,0

Table 2: TU model: Solve by surplus maximization

	CEO 1	CEO 2	CEO 3
Firm 1	3+w,2-w	8*	2
Firm 2	7	9	6*
Firm 3	2*	3	0

Imperfect TU: Income taxes and non-monetary job amenities

Table 3: Imperfect transferable utility model

	CEO 1	CEO 2	CEO 3
Firm 1	3+.4*w,2-w	2,6	1,1
Firm 2	4,3	7,2	2,4
Firm 3	1,1	2,1	0,0

Solve by IPFP algorithm.

Imperfect TU is important for accounting for 1) monetary transfers (that are taxed) and 2) non-monetary job amenities that are not taxed.

We allow types to be continuous. Even 'unobserved types'.

What is CEO charisma and firm culture?

In studies of executive pay, the managerial economics literature often account for

1. CEO charisma: The value a CEO brings to any firm if he/she is hired as a manager. (Pushes up CEO wage but does not impact sorting.)

2. Firm culture: The value a firm brings to any position in terms of untaxed job amenities, (Pushes down the CEO wage but does not impact sorting)

Useful to consider data across time to assign values to these important characteristics.

A model of CEO charisma and firm culture

Table 4: CEO 2 has charisma

	CEO 1	CEO 2	CEO 3
Firm 1	3,2	2 + charisma,6	1,1
Firm 2	4,3	7 + charisma,2	2,4
Firm 3	1,1	2 + charisma,1	0,0

Table 5: Firm 2 has culture

	CEO 1	CEO 2	CEO 3
Firm 1	3,2	2,6	1,1
Firm 2	4,3 + culture	7,2 + culture	2,4 + culture
Firm 3	1,1	2,1	0,0

Notes on unobservables

- To estimate CEO 'charisma' and firm 'culture' values, we follow the simple 'half-parametric AKM' procedure of Postel-Vinay and Robin 2006.

- We assume unobservables contribute to match values (See Choo and Siow [2006]).

- We assume CEO performance data is subject to measurement error.

In fitting our matching model to the cross-sectional data, we follow a MLE procedure as in Dupuy and Galichon 2022.

Our Data

We apply the model to a rich dataset that contains the entire population of CEOs in Denmark

- administrative register-based panel data
- CEOs and firms from 2011 market
- accurate and comprehensive measure on pecuniary compensations
- detailed measure on firm performance and balance sheet info
- firms with more than 250 employees
- 295 CEO-firm matches

Plan of the technical part of the talk

Model

The Model: Heterogeneous Firms and CEOs

Assumption 1

There is a continuous distribution of CEOs over $\mathcal{X}$, whose p.d.f. is denoted $f(x)$, and a continuous distribution of firms over $\mathcal{Y}$, whose p.d.f. is denoted $g(y)$.

The market is large so that there is a large number of CEOs of any given observable type x and there is a large number of firms of any given observable type y.

Firms and CEOs are in equal mass which we normalize to 1.

The Model: CEO and Firm Match Values

CEOs' preferences for amenities are additively separable:

$$\underbrace{\alpha\left(x,y\right)}_{\text{Systematic job amenity for a CEO of type x}} + \underbrace{\sigma_1\varepsilon_i\left(y\right)}_{\text{Idiocyncratic amenity of CEO i}}$$

Firms' performance is also additively separable:

$$\underbrace{\gamma\left(x,y\right)}_{\text{Systematic firm performance for a firm of type y}} + \underbrace{\sigma_2\eta_j\left(x\right)}_{\text{Idiocyncratic performance of firm j}}$$

where, σ_1 and σ_2 are scaling factors, indicate the intensity of the unobserved heterogeneity in the equilibrium matching

Assumption 2

Idiosyncratic shocks $\varepsilon_i\left(y\right)$ and $\eta_j\left(x\right)$ follow Gumbel random processes à la Dupuy and Galichon [2014, 2021].

The Model: Transfers subject to taxation

Firm j's profits are given by

$$\gamma(x,y) - \underbrace{w(x,y)}_{\text{gross wages}} + \sigma_2 \eta_j(x),$$

CEO i's utility is given by

$$\alpha(x,y) + \underbrace{T(w(x,y))}_{\text{net (after-tax) earnings}} + \sigma_1 \varepsilon_i(y),$$

Assumption 3

The function $T()$ is continuous, such that $\lim_{w \to -\infty} T(w) = -\infty$.

Assumption 4

The Danish tax system for CEOs is such that the net wage $T(w(x, y))$ reads as

$$T(w(x, y)) = (1 - \tau) w(x, y) + \delta t_1.$$

where τ is the tax rate and δt_1 is a lump sum.

Famously flat! Famously comprehensive! Famously compliant!
Klevin (2014): How can Scandinavians tax so much?

The Model: The CEO and Firm Maximization Problems

Assumption 5

All agents participate, are price takers and utility/profits maximizers.

CEOs know $\alpha(x, y)$, $\gamma(x, y)$, $T()$ and $\sigma_1 \varepsilon_i(y)$, and firms know $\alpha(x, y)$, $\gamma(x, y)$, $T()$ and $\sigma_2 \eta_j(x)$.

Firm j of type $y_j = y$ solves:

$$\max_{x \in \mathcal{X}} \gamma(x, y) - w(x, y) + \sigma_2 \eta_j(x),$$

CEO i of type $x_i = x$ solves:

$$\max_{y \in \mathcal{Y}} \alpha(x, y) + T(w(x, y)) + \sigma_1 \varepsilon_i(y).$$

The Logit Demand of Firms

By the Williams-Daly-Zachary theorem:

The logit demand of firms of type y for CEOs of type x is

$$\mu^F(x|y) := \frac{\mu^F(x,y)}{g(y)} = \exp\left(\frac{\gamma(x,y) - w(x,y) - v(y)}{\sigma_2}\right), \quad (1)$$

where $v(y) = \sigma_2 \log \int_X \exp\left(\frac{\gamma(x',y) - w(x',y)}{\sigma_2}\right) dx'$
$v(y)$ is the expected indirect utility of firms of type y.

The Logit Demand of CEOs

The logit demand of CEOs of type x for firms of type y is

$$\mu^{C}(y|x) := \frac{\mu^{C}(x,y)}{f(x)} = \exp\left(\frac{\alpha(x,y) + T(w(x,y)) - u(x)}{\sigma_1}\right), \tag{2}$$

where $u(x) = \sigma_1 \log \int_Y \exp\left(\frac{\alpha(x,y') + T(w(x,y'))}{\sigma_1}\right) dy'$

$u(x)$ is the expected indirect utility of CEOs of type x.

Equilibrium: Definition

An *equilibrium outcome* (μ, w) consists of an equilibrium matching $\mu(x, y)$, and an equilibrium wage $w(x, y)$.

An outcome (μ, w) is an equilibrium outcome if the gross wage $w(x, y)$ is so that, for all x and y, $\mu^F(x, y) = \mu^C(x, y) = \mu(x, y)$ where $u(x)$ and $v(y)$ are solutions of the system

$$\int_X \mu(x, y)\, dx = g(y),$$
$$\int_Y \mu(x, y)\, dy = f(x).$$

Equilibrium: Existence and Uniqueness

Under our standing assumptions, Theorem 1 in Galichon et al. [2019] applies, so that there exists a unique equilibrium outcome to our problem.

Equilibrium: Implicit Solution

From equations (1) and (2), we obtain an implicit solution for equilibrium matching $\mu(x, y)$:

$$\alpha(x, y) + T(\gamma(x, y) - v(y) - \sigma_2 \log \mu(x, y)) = u(x) + \sigma_1 \log \mu(x, y). \tag{3}$$

Equilibrium: Explicit Solution for Matching and Wage

Equilibrium matching $\mu(x, y)$:

$$\log \mu(x, y) =$$
$$M(u(x), v(y)) \quad : \quad = \frac{\alpha(x, y) - u(x) + (1 - \tau)(\gamma(x, y) - v(y)) + \delta t_1}{\sigma_1 + (1 - \tau)\sigma_2}.$$

Equilibrium wage $w(x, y)$:

$$w(x, y) =$$
$$\frac{\sigma_1}{\sigma_1 + (1 - \tau)\sigma_2}(\gamma(x, y) - v(y)) - \frac{\sigma_2}{\sigma_1 + (1 - \tau)\sigma_2}(\alpha(x, y) - u(x) + \delta t_1).$$

$$(4)$$

Equilibrium: Computation

Given parameters $\alpha(x, y)$, $\gamma(x, y)$, τ, σ_1 and σ_2 and data $f(x)$ and $g(y)$, we use the IPFP algorithm to find equilibrium matching:

(i) Initialization, set a starting value of $\left(v^0(y)\right)_{y \in \mathcal{Y}}$ and $\left(u^1(x)\right)_{x \in \mathcal{X}}$.

(ii) At each iteration, we solve $\left(v^t(y)\right)_{y \in \mathcal{Y}}$ and $\left(u^{t+1}(x)\right)_{x \in \mathcal{X}}$, until $\max_{y \in \mathcal{Y}} \left|v^t(y) - v^{t-1}(y)\right| < \epsilon$ and $\max_{x \in \mathcal{X}} \left|u^{t+1}(x) - u^t(x)\right| < \epsilon$, where ϵ is a tolerance parameter

The IPFP Algorithm

What is lost if no accounting for job quality on worker welfare?

First, the estimates of productivity parameters would be biased.

- The equilibrium matching is increasing in both productivity and amenities (upward bias in productivity)
- The equilibrium wages are increasing in productivity but decreasing in amenities (downward bias in productivity)

Second, comparing productivity estimates across markets with different levels of taxation would be difficult to do since, as taxation increases, equilibrium matching and wages tend to reflect more amenities than productivity, see Dupuy et al. [2020], and hence would tend to increase the bias.

Parametric Specification of Amenity and Productivity

We parameterize the value of job amenities and productivity such that the match value functions of CEOs and firms are linear in parameters:

$$\alpha(x, y; A) = \sum_{l} A_{l,1} y^{(l)} + \sum_{k,l} A_{kl,2} x^{(k)} y^{(l)},$$

and

$$\gamma(x, y; \Gamma) = \sum_{k} \Gamma_{k,1} x^{(k)} + \sum_{k,l} \Gamma_{kl,2} x^{(k)} y^{(l)}.$$

Latent Variable Specification of Wages and Productivity

Let $\hat{w}_i$ be the observed wage for CEO i:

$$\hat{w}_i = w\left(x_i, y_i\right) + \hat{f}_i + \hat{g}_i + \underbrace{e_i^W}_{\text{measurement error}}$$

where $e_i^W \rightsquigarrow N\left(0, s^2\right)$.

Let $\hat{\gamma}_i$ be the observed productivity for firm i:

$$\hat{\gamma}_i = \gamma(x_i, y_i; \Gamma) + \sum_l \gamma_{l,1} y^{(l)} + \underbrace{e_i^P}_{\text{measurement error}}$$

where $e_i^P \rightsquigarrow N\left(0, t^2\right)$.

Estimating CEO and Firm Fixed Effects

Abowd, Kramarz and Margolis's (Econometrica, 1999)? Impossible because CEO market is one-to-one matching market with low mobility.

Solution:
1. Use all top managers (CEO, COO, CFO, CTO, etc.) and firm matched data over 5 years,

2. Apply Postel-Vinay/Robin half-parametric AKM:
Firm Fixed effect: parametric function of (first principal component of) firms' attributes, whose parameters are estimated using the within estimator.
CEO fixed effect: recovered from the de-meaned level wage equation.

Estimation by Maximum Likelihood

Let $\lambda = \left(A, \Gamma, \sigma_1, \sigma_2, s^2, c, t^2\right)$ be the parameters of the model.

It follows that the log-likelihood of observing the data $(\hat{\mu}_{ii}, \hat{w}_i, \hat{\gamma}_i)_{i=1}^{N}$ can be decomposed into 3 terms:

$$\log L\left(\lambda\right) = \log L_1\left(\lambda\right) + \log L_2\left(\lambda\right) + \log L_3\left(\lambda\right)$$

$$= \underbrace{\sum_{i=1}^{N} \log \mu_{ii}}_{\text{the match}} - \underbrace{\sum_{i=1}^{N} \left(\frac{\hat{w}_i - w_{ii}}{2s^2}\right)^2 - \frac{N}{2} \log s^2}_{\text{the transfer}} - \underbrace{\sum_{i=1}^{N} \left(\frac{\hat{\gamma}_i - \gamma_{ii}}{2t^2}\right)^2 - \frac{N}{2} \log t^2}_{\text{the productivity}} .$$

Data

The entire population of CEOs of large firms (> 250 employees) in 2011

Comprehensive and accurate information on CEOs and firms:

1. CEOs' total taxable income, along with demographic, assets and debts holdings, and work history
2. Firms' number of employees, number of branches, shares of female employees, net investment, sector, value of exports, value of imports, equity value, value of fixed assets, ownership structure, Selling, General and Administrative Expenses (SG&A), total salary expenses.

Our sample contains 295 CEO-firm matches, Summary Statistics

Model Specification

1. Which characteristics should be used to distinguish among agents on each side of the market?

2. What is the amount of unobserved heterogeneity necessary to rationalize the data?

Selection of CEO and Firm Attributes

Which characteristics should be used to distinguish between agents on each side of the market?

We select a list of important attributes based on previous literature (Rosen [1982], Gabaix and Landier [2008], Pan [2017], Kaplan et al. [2012], Kaplan and Sorensen [2021], Bertrand and Schoar [2003]) and availability in the data

We apply likelihood-ratio test to select the parametric specification that best describes the data

Selected Parametric Model

CEOs' age, marital status, gender, years of schooling, net wealth, bank debt.

Firms' number of employees, net investment, value of imports, exports, equity value, value of fixed assets.

Interactions: net wealth, bank debt, and marital status from the CEO side to be interacted with number of employees, net investment and value of exports from the firm side, alma mater industry.

Unobserved Heterogeneity

What is the amount of unobserved heterogeneity necessary to rationalize the data?

We use a grid search to find the set of σ parameters that maximize our likelihood function.

$\sigma_1 = 0.5$, $\sigma_2 = 0.25$

We also experiment by using slightly different values of these parameters, our main results remain robust across those specifications.

Table 1. Effect of CEOs' and firms' characteristics on job amenities and productivity (in Millions DKK)

	Main effects	Number of employees	Net investment (in DKK)	Import (in DKK)	Export (in DKK)	Equity (in DKK)	Fixed assets (in DKK)
Productivity (Gamma)							
Main effects		**590.14**	**503.76**	**363.98**	**538.32**	380.40	395.51
		(78.69)	**(94.53)**	**(124.13)**	**(141.40)**	(319.32)	(344.25)
Age (in years)	**3.91**						
	(1.32)						
Age^2	**-3.83**						
	(1.34)						
Years of schooling (in years)	0.25						
	(0.15)						
Net wealth (in DKK)	0.18	-0.13	**-2.63**		**4.74**		
	(0.30)	(0.51)	**(0.74)**		**(0.54)**		
Bank debt (in DKK)	**-2.10**	0.39	0.49		**-14.62**		
	(0.39)	(0.66)	(0.67)		**(1.42)**		
Gender (1 male/0 female)	1.07						
	(0.77)						
Marital status (1 Married)	0.45	0.12	**1.32**		3.43		
	(0.65)	(0.63)	**(0.65)**		(2.04)		
CEO industry experience	0.29						
	(0.31)						
Productivity constant	**812.23**						
	(59.00)						
Salary constant	**14.63**						
	(1.15)						

Notes: This table reports the estimates of the effect of CEO and firm characteristics on job amenities and firm productivity. wages and productivity are measured in millions of Danish kroner. In 2021, 1 DKK = 0.16 USD at the average exchange rate. All covariates, except for CEO industry experience, are standardized to have a standard deviation of 1. Standard errors are in parentheses, calculated from the Hessian of the likelihood. The R-squared on wage is 0.52 whereas the R-squared on productivity is 0.85. The value of the objective function at convergence of this specification is 5544.98. The smaller the value of the objective

Table 1. Effect of CEOs' and firms' characteristics on job amenities and productivity (in Millions DKK)

	Main effects	Number of employees	Net investment (in DKK)	Import (in DKK)	Export (in DKK)	Equity (in DKK)	Fixed assets (in DKK)
Job Amenities (Alpha)							
Main effects		-0.08	**0.40**	-0.09	0.64	**0.66**	**-0.62**
		(0.12)	**(0.15)**	(0.09)	(0.41)	**(0.13)**	**(0.12)**
Age (in years)							
Age^2							
Years of schooling (in years)							
Net wealth (in DKK)		-0.03	**0.57**		**-0.99**		
		(0.09)	**(0.17)**		**(0.12)**		
Bank debt (in DKK)		-0.10	-0.15		**3.24**		
		(0.14)	(0.17)		**(0.32)**		
Gender (1 male/0 female)							
Marital status (1 Married)		-0.06	**-0.66**		-0.18		
		(0.15)	**(0.16)**		(0.40)		
CEO industry experience	**1.56**						
	(0.08)						

Notes: This table reports the estimates of the effect of CEO and firm characteristics on job amenities and firm productivity. wages and productivity are measured in millions of Danish kroner. In 2021, 1 DKK = 0.16 USD at the average exchange rate. All covariates, except for CEO industry experience, are standardized to have a standard deviation of 1. Standard errors are in parentheses, calculated from the Hessian of the likelihood. The R-squared on wage is 0.52 whereas the R-squared on productivity is 0.85. The value of the objective function at convergence of this specification is 5544.98. The smaller the value of the objective function, the higher the likelihood, the better the fit of the model.

Amenities matter in the market for CEOs!

In particular:

CEOs have preferences for **building legacy** and **gaining empowerment**

- The *legacy* amenity explains why there is low mobility in the CEO market and why outsider CEOs earn a wage premium over insider CEOs.

- The *empowerment* amenity explains why CEOs are willing to sacrifice significant pecuniary income to manage high equity firms.

Why Should You Care?

It's important for corporate strategies.

It's important for corporate governance regulations.

It's important for policymakers: top end inequality, subjective well-being of CEOs.

Counterfactual Experiments

1. Equalizing (part of) job amenities across firms
2. Changing firm's equity value
3. Industrial policy: Sectoral shift from construction to ICT
4. Trade policy: trade war

Table 1A: Eliminate CEO's alma-mater industries AM = 0

Changes in CEO assignments	Percentage of CEOs who switched firms	
All firms	54.53%	
Low productivity firms	54.34%	
High productivity firms	54.72%	

Changes in CEO wages	Counterfactual sample	Main sample
Variance of CEO wages	2.45	2.48
Mean of CEO wages (millions DKK)	1331.3	838.02

Changes in CEO amenities	Counterfactual sample	Main sample
Number of CEOs in their own industry	0.00	230.34

Notes: This Table reports results from a counterfactual experiment where we shut down the legacy amenity (CEOs can no longer derive amenity from working in his own industry, or any other industry). We show how (1) CEO assignment, (2) the variation of CEO wages and (3) mean of CEO wages were to change under this counterfactual scenario. This table also reports the number of CEOs who work in their own industries before and after the experiment. Low productivity firms are those whose gross profits are below the median, whereas high productivity firms refer to those whose gross profits are above the median.

Table 1A: Weaken oversight

Changes in CEO assignments	Percentage of CEOs who switched firms	
All firms	0.00%	
Low productivity firms	0.00%	
High productivity firms	0.00%	

Changes in CEO wages	Counterfactual sample	Main sample
Variance of CEO wages	6.24	2.48
Mean of CEO wages (millions DKK)	557.79	838.02

Changes in CEO amenities	Counterfactual sample	Main sample
Number of CEOs in their Alma Mater industry	230.34	230.34

Notes: This Table reports results from a counterfactual experiment where we decrease firms' oversight over CEOs by increasing the equity value of all firms to the 95th percentile of firm's equity value. We show how (1) CEO assignment, (2) the variation of CEO wages and (3) mean of CEO wages were to change under this counterfactual scenario. This table also reports the number of CEOs who work in their own industries before and after the experiment. Low productivity firms are those whose gross profits are below the median, whereas high productivity firms refer to those whose gross profits are above the median.

Table 1: Replacing one-to-one construction firms by a random draw of ICT firms

Changes in CEO assignments	Percentage of CEOs who switched firms	
All firms	9.62%	
Low productivity firms	9.18%	
High productivity firms	10.06%	
Changes in CEO wages	Counterfactual sample	Main sample
Variance of CEO wages	2.81	2.48
Mean of CEO wages (millions DKK)	863.75	838.02
Changes in CEO amenities	Counterfactual sample	Main sample
Number of CEOs in their own industry	217.66	230.34

Notes: This Table reports results from a counterfactual policy experiment where we replace each construction firm in our sample with a random draw of firm from the ICT industry. We show how (1) CEO assignment, (2) the variation of CEO wages and (3) mean of CEO wages were to change under this counterfactual scenario. This table also reports the number of CEOs who work in their own industries before and after the experiment. Low productivity firms are those whose gross profits are below the median, whereas high productivity firms refer to those whose gross profits are above the median.

Table 1: Trade war - exports are reduced by 50% for all firms

Changes in CEO assignments	Percentage of CEOs who switched firms	
All firms	1.39%	
Low productivity firms	1.40%	
High productivity firms	1.38%	
Changes in CEO wages	Counterfactual sample	Main sample
Variance of CEO wages	1.96	2.48
Mean of CEO wages (millions DKK)	773.87	838.02
Changes in CEO amenities	Counterfactual sample	Main sample
Number of CEOs in their own industry	230.36	230.34

Notes: This Table reports results from a counterfactual policy experiment where we simulate a trade war and replace the export value of all firms in our data with half of its actual value. We show how (1) CEO assignment, (2) the variation of CEO wages and (3) mean of CEO wages were to change under this counterfactual scenario. This table also reports the number of CEOs who work in their own industries before and after the experiment. Low productivity firms are those whose gross profits are below the median, whereas high productivity firms refer to those whose gross profits are above the median.

We provide structural estimates on important job amenities in the market for CEOs.

We identify how amenities affect equilibrium matching and wage.

Our finding contribute to several policy relevant discussions:

- Corporate governance (CEO monitoring)
- Top end inequality
- CEO stress, happiness, life expectancy

The model assumes agents are risk-neutral and does not model explicitly incentives as derived from the principal-agent problem

Instead, we provide flexible reduced-form answers to these issues: A key asset of our model is that it allows us to consider multidimensional attributes on both sides of the market which affect amenities and productivity. So the incentive mechanisms that are explicitly modelled in Edmans and Gabaix [2011] can essentially be captured in our estimates of amenities.

The observation of singles allows one to identify the reservation utilities.

We only observe matched population, so the matching *surplus* will not be identified.

The observation of singles does NOT change the identification of amenities and productivity and the joint utility.

- This is a consequence of the independence of irrelevant alternatives (IIA) of the logit model: the incentive for remaining single does not affect the odd ratios of the choices of the partners types. As a result, the distributions of matched CEO and firm $f(x)$ and $g(y)$ may be treated as exogenous.

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Table 6: Summary statistics of CEOs' and firms' characteristics - main sample

	Mean	Std
CEOs:		
Age (in years)	51.57	8.81
Years of schooling (in years)	15.74	2.47
Net wealth	3.29E+06	1.08E+07
Bank debt	1.41E+06	4.33E+06
Gender (1 male/0 female)	0.94	0.23
Marital status (1 Married)	0.87	0.34
Salary	2.64E+06	2.88E+06
Firms:		
Number of employees	991.84	2468.97
Net investment	6.43E+07	1.77E+08
Import	3.86E+08	1.07E+09
Export	6.83E+08	2.63E+09
Equity	8.58E+08	3.05E+09
Fixed assets	9.81E+08	3.09E+09
gross profit	8.95E+08	2.50E+09
N = 295		

A list of CEO and firm characteristics we considered

CEOs' age, education, gender, marital status, number of children, age of each child, net wealth, bank debt, tax value of property, bank deposit, financial investments in stocks, market value of bonds, investments in foreign financial markets, previous industry experience, payout in private pension schemes

Firms' number of employees, number of branches, shares of female employees, net investment, sector, value of exports, value of imports, equity value, value of fixed assets, ownership structure, Selling, General and Administrative Expenses (SG&A).

Equilibrium: Computation Algorithm

1. Initialization: $t = 1$, let $u^{t-1}(x) = 0$ for all $x \in \mathcal{X}$.

2. At each iteration t, solve

$$\int_x M\left(u^t(x), v(y)\right) dx = g(y)$$

for $v(y)$ for all y given $(u^t(x))_{x \in \mathcal{X}}$. Call this solution $v^t(y)$.
Then solve

$$\int_y M\left(u(x), v^t(y)\right) dy = f(x)$$

for $u(x)$ for all $x \neq x_0$ given $(v^t(y))_{y \in \mathcal{Y}}$ and call this solution
$u^{t+1}(x)$.

3. Set $t = t + 1$ and go back to 2, unless
   $\max_{y \in \mathcal{Y}} \left| v^t(y) - v^{t-1}(y) \right| < \epsilon$ and
   $\max_{x \in \mathcal{X}} \left| u^{t+1}(x) - u^t(x) \right| < \epsilon$, where ϵ is a tolerance
   parameter, in which case stop.

4. Compute the equilibrium wages using the solution for the
   potentials $(u(x), v(y))$ into equation (11) to obtain
   $w(x, y) =$
   $$\frac{\sigma_1}{\sigma_1 + (1 - \tau)\sigma_2} (\gamma(x, y) - v(y)) - \frac{\sigma_2}{\sigma_1 + (1 - \tau)\sigma_2} (\alpha(x, y) - u(x)) + \tilde{c} \tag{5}$$

   where $u(x)$ and $v(y)$ are derived from the IPFP above, and

   $$\tilde{c} = c - \frac{\sigma_2}{\sigma_1 + (1 - \tau)\sigma_2} \delta t_1$$

   where c is a constant reflecting the normalization $\tilde{u}(x_0) = 0$.

Structure of Available Data

1. a list of CEOs whose identity is indexed by $i = 1, ..., N$,
2. a list of firms' whose identity is indexed by $j = 1, ..., N$,
3. Matched CEO-firm data, a matching $(\hat{\mu}_{ij})_{i,j}$ where $\hat{\mu}_{ij} = 1$ if CEO i is matched with firm j and 0 otherwise
4. for each CEO i, a vector of (observable) attributes $x_i \in X$, and his/her gross wage $\hat{w}_{ii}$
5. for each firm j, a vector of (observable) attributes $y_j \in Y$, and firms' performance denoted $\hat{\Gamma}_j$
6. the tax system, top income tax rate τ, threshold t_1

Identification

Rewrite equations (9) and (8) gives

$$\alpha(x,y) = u(x) - T(w(x,y)) + \sigma_1 \log \mu(x,y) \qquad (6)$$

$$\gamma(x,y) = v(y) + w(x,y) + \sigma_2 \log \mu(x,y). \qquad (7)$$

Without further assumptions, one can easily show that data on $(\hat{\mu}_{ij})_{i,j}$, $(\hat{w}_{ii})_i$, t_1 and τ identify the systematic amenity $\alpha(x,y)$ up to a function of x and a scaling parameter σ_1, whereas data on $\mu(x,y)$ and $w(x,y)$ identify firm performance $\gamma(x,y)$ up to a function of y and a scaling parameter σ_2.

Equilibrium: Implicit Solution

Rearranging equations (1) and (2) at equilibrium, one obtains

$$\alpha(x, y) + T(w(x, y)) = u(x) + \sigma_1 \log \mu(x, y) \qquad (8)$$
$$\gamma(x, y) - w(x, y) = v(y) + \sigma_2 \log \mu(x, y) \qquad (9)$$

where $u(x) = u(x) - \sigma_1 \log f(x)$ and $v(y) = v(y) - \sigma_2 \log g(y)$.

Solving equation (9) for $w(x, y)$ and plugging the solution into equation (8) gives

$$\alpha(x, y) + T(\gamma(x, y) - v(y) - \sigma_2 \log \mu(x, y)) = u(x) + \sigma_1 \log \mu(x, y).$$
$$(10)$$

Equilibrium: Explicit Solution for Matching

Let $\mu(x, y)$ be the equilibrium matching under $T(w(x, y)) = (1 - \tau) w(x, y) + \delta t_1$. Plugging this expression into equation (10) gives

$$\alpha(x, y) + (1 - \tau)(\gamma(x, y) - v(y) - \sigma_2 \log \mu(x, y)) + \delta t_1 =$$

$$u(x) + \sigma_1 \log \mu(x, y)$$

which solves for $\mu(x, y)$ as

$$\log \mu(x, y) =$$
$$M(u(x), v(y)) \quad : \quad = \frac{\alpha(x, y) - u(x) + (1 - \tau)(\gamma(x, y) - v(y)) + \delta t_1}{\sigma_1 + (1 - \tau)\sigma_2}.$$

Equilibrium: Explicit Solution for Wage

Plugging $\log \mu(x, y)$ into equation (9):

$$\gamma(x, y) - w(x, y) = v(y) + \sigma_2 \log \mu(x, y) \quad (9)$$

and solving for the equilibrium gross wage $w(x, y)$ as a function of the potentials $(u(x), v(y))$ gives

$w(x, y) =$

$$\frac{\sigma_1}{\sigma_1 + (1 - \tau)\sigma_2} (\gamma(x, y) - v(y)) - \frac{\sigma_2}{\sigma_1 + (1 - \tau)\sigma_2} (\alpha(x, y) - u(x) + \delta t_1).$$
$$(11)$$

Parametric Specification of Amenity and Productivity

We parameterize the value of job amenities and productivity such that the match value functions of CEOs and firms are linear in parameters:

$$\alpha(x, y; A) = \sum_{k=1}^{K} A_k \times \varphi_k(x, y),$$

and

$$\gamma(x, y; \Gamma) = \sum_{k=1}^{K} \Gamma_k \times \varphi_k(x, y),$$

where $\varphi_k(x, y)$ are basis functions.

In particular, defining the basis functions as (bi)linear in x and y gives,

$$\alpha(x, y; A) = \sum_{l} A_{l,1} y^{(l)} + \sum_{k,l} A_{kl,2} x^{(k)} y^{(l)},$$

and

$$\gamma(x, y; \Gamma) = \sum_{k} \Gamma_{k,1} x^{(k)} + \sum_{k,l} \Gamma_{kl,2} x^{(k)} y^{(l)}.$$

Former Starbucks CEO Jim Donald photographed in 2004 and 2009.

(Credit for both photos: Getty Images/Bloomberg)

Table 1: Effect of CEOs' and firms' characteristics on job amenities and productivity (in Millions DKK)

	Main effects	Number of employees	Net investment (in DKK)	Import (in DKK)	Export (in DKK)	Equity (in DKK)	Fixed assets (in DKK)
Job Amenities (Alpha)							
Main effects		0.00 (0.17)	0.26 (0.20)	**-0.28 (0.13)**	0.57 (0.95)	**1.06 (0.29)**	**-0.86 (0.22)**
Age (in years)							
Age²							
Years of schooling (in years)							
Net wealth (in DKK)		0.03 (0.28)	0.08 (0.25)		**-0.74 (0.18)**		
Bank debt (in DKK)		-0.40 (0.24)	-0.33 (0.26)		**3.97 (0.47)**		
Gender (1 male/0 female)							
Marital status (1 Married)		-0.30 (0.22)	**-0.61 (0.20)**		-0.05 (0.92)		
Alma Mater	**1.65 (0.16)**						

Notes: This table reports the estimates of the effect of CEO and firm characteristics on job amenities and firm productivity. wages and productivities are measured in millions of Danish kroner. In 2021, 1 DKK = 0.16 USD at the average exchange rate. All covariates, except for alma mater, are standardized to have a standard deviation of 1. Standard errors are in parentheses. The R-squared on wage is 0.5149 whereas the R-squared on productivity is 0.85.

Table 1: Effect of CEOs' and firms' characteristics on job amenities and productivity (in Millions DKK)

	Main effects	Number of employees	Net investment (in DKK)	Import (in DKK)	Export (in DKK)	Equity (in DKK)	Fixed assets (in DKK)
Productivity (Gamma)							
Main effects		**579.36**	**495.30**	**363.73**	**551.63**	371.65	370.71
		(76.46)	**(93.38)**	**(122.46)**	**(135.58)**	(309.79)	(327.38)
Age (in years)	**6.18**						
	(2.07)						
Age$\hat{2}$	**-6.49**						
	(2.12)						
Years of schooling (in years)	0.35						
	(0.24)						
Net wealth (in DKK)	**1.34**	-0.52	-0.43		**3.67**		
	(0.42)	(1.23)	(1.11)		**(0.79)**		
Bank debt (in DKK)	**-1.26**	1.74	1.27		**-17.91**		
	(0.55)	(1.07)	(1.12)		**(2.13)**		
Gender (1 male/0 female)	1.81						
	(1.10)						
Marital status (1 Married)	1.04	1.06	1.12		3.03		
	(1.03)	(0.97)	(0.88)		(4.04)		
Alma Mater	0.72						
	(0.62)						
Productivity constant	**820.06**						
	(57.82)						
Salary constant	**16.49**						
	(0.37)						

Notes: This table reports the estimates of the effect of CEO and firm characteristics on job amenities and firm productivity. wages and productivities are measured in millions of Danish kroner. In 2021, 1 DKK = 0.16 USD at the average exchange rate. All covariates, except for alma mater, are standardized to have a standard deviation of 1. Standard errors are in parentheses. The R-squared on wage is 0.5149 whereas the R-squared on productivity is 0.85.