Estimating the Value of CEOs in Privately Held Businesses

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Acknowledgements

Motivation

What is the marginal product of a CEO?

We know
- Management matters. Consulting (India: Bloom et al. 2013), large-scale training (Italy: Giorcelli 2019, US: Bianchi and Giorcelli 2022, Giorcelli 2023)
- Managers matter. Event studies around CEO changes (US: Bertrand and Schoar 2003, Schoar and Zuo 2016, Metcalfe et al. 2023, Italy: Sauvagnat and Schivardi 2024, Denmark: Bennedsen et al 2020)

But
- Most studies focus on public firms in rich countries.

What about privately held firms?

1. Limited data on compensation, decisions, financials
2. Owners often have oversized control roles
3. Data on small firms more noisy

This paper

1. Model CEO effects in presence of owner-chosen inputs
2. Collect data on 1m+ firms, 1m+ CEOs in Hungary 1992–2022
3. Design a placebo-controlled event study to measure true CEO effects

Preview of Results

- Standard approach: 22.5% performance gap between "good" and "bad" CEOs
- Our placebo test: 17% is noise
- **True CEO effect: 5.5%**

Roadmap

Theoretical Framework

Production Structure

Firms combine fixed and variable inputs:

$$Q_{imt} = \Omega_{it} A_i Z_m K_{it}^{\alpha} L_{imt}^{\beta} M_{imt}^{\gamma}$$

- A_i: Organizational capital (owner-chosen)
- Z_m: Manager skill ($\rightarrow$ TFP)
- K_{it}: Physical capital (owner-chosen)
- L_{imt}, M_{imt}: Labor, materials (manager-chosen)

Division of Control

- Concentrated ownership limits managerial discretion (Fama & Jensen, 1983; Jensen & Meckling, 1976)
- Family firms retain control rights (Burkart et al., 2003)
- Plant managers have even more limited control over investments (Bloom et al., 2012, 2019)

Owners Control
Physical capital investment, intellectual property, industry and location, CEO hiring/firing

Managers Control
Labor hiring, input purchasing, operations, day-to-day decisions

Evidence on Manager Control Rights

Table 1: Plant Manager Autonomy in Family-Controlled Firms

	(1) Investment	(2) Investment	(3) Marketing	(4) Product	(5) Hiring
Family ownership	-0.369**	-0.200**	-0.344**	-0.299**	0.086
	(0.161)	(0.100)	(0.153)	(0.151)	(0.068)
Observations	2,915	2,379	3,133	3,114	3,138
Country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

Data source: Bloom, Sadun, and Van Reenen (2012). Sample restricted to private (non-publicly traded) firm

Investment autonomy measured as maximum capital investment plant manager can approve (USD).

Other autonomy dimensions are binary indicators for full autonomy (score = 5 on 1-5 scale).

PPML = Poisson Pseudo-Maximum Likelihood. Standard errors clustered at firm level.

All specifications include country and 2-digit SIC industry fixed effects.

Optimization Problem

Manager maximizes profit given fixed inputs:

$$\max_{L,M} P_{st} Q_{imt} - W_{st} L_{imt} - \varrho_{st} M_{imt}$$

First-order conditions pin down optimal scale

$$R_{imst} = (P_{st} \Omega_{it} A_i Z_m)^{1/\chi} K_{it}^{\alpha/\chi} W_{st}^{-\beta/\chi} \varrho_{st}^{-\gamma/\chi} (1-\chi)^{(1-\chi)/\chi}. \qquad (1)$$

Surplus = Rent to Fixed Factors

Surplus to fixed factors:

$$S_{imst} = R_{imst} - W_{st}L_{imst} - \varrho_{st}M_{imst} = \chi \cdot R_{imst}$$

where $\chi = 1 - \beta - \gamma$

$$S_{imst} = \chi(P_{st}\Omega_{it}A_iZ_m)^{1/\chi}K_{it}^{\alpha/\chi}W_{st}^{-\beta/\chi}\varrho_{st}^{-\gamma/\chi}(1 - \chi)^{(1-\chi)/\chi}. \qquad (2)$$

Owner controls A_i and K_{it}

Manager controls Z_m

Estimable Equation

Taking logs and substituting out invariant terms,

$$r_{imst} = \frac{\alpha}{\chi} k_{it} + \frac{1}{\chi} z_m + \lambda_i + \mu_{st} + \tilde{\omega}_{it} \tag{3}$$

Assumptions

1 All firms with the sector face the same prices

2 Residual TFP uncorrelated with owner and manager choices

■ Timing can be checked in event study.

3 Owner and manager choices can be arbitrarily correlated

Estimate with Two-Way Fixed Effects

Data

The Hungarian Context

Why Hungary?
- Complete administrative data
  - All incorporated businesses
  - Mandatory CEO registration
- 30+ years of coverage

Economic Background
- Transition economy 1990s
- EU accession 2004
- Mix of domestic and foreign firms

Data Sources

Firm Registry (Cégjegyzék LTS)
- CEO appointments and terminations
- Ownership structure
- Complete since 1992

Balance Sheet Data (Mérleg LTS)
- All firms filing financial statements
- Revenue, costs, employment, assets
- 1980-2022 coverage
- 10.2 million firm-years

Data Cleaning

What is a firm?
Fairly good numeric identifier by Tax Authority (NAV). We follow one-to-one business transitions to match with commercial registry.
One firm = one legal entity (but we can see ultimate owners)

Who is a CEO?
Owners, directors, accountants are all recorded.
1. No numerical identifier before 2013 (but name, home address, mother's name 1999+, birth date 2010+) $\rightarrow$ entity resolution
2. Time spells not always closed or contiguous
3. CEO ("Managing Director") title is not always recorded $\rightarrow$ impute from past and present

Sample Construction

Exclude firms that:

- ever have more than 2 CEOs in a year
- have more than 6 CEOs during their lifetime
- are in their first year (often incomplete)
- were ever state owned
- operate in mining and finance
- never reach 5 employees

CEO Characteristics

Characteristic	Share
Hungarian name	95%
Male (among HU)	73%
Founder	69%
Multiple firms	18%
Connected component	26,476 managers

Industry Distribution

Table 3: Industry Breakdown

Industry (NACE)	Obs.	Firms	CEOs	Surplus share (%)
Agriculture, Forestry, Fishing (A)	322,292	26,972	55,535	7.9
Manufacturing (C)	1,026,905	93,550	179,205	13.7
Wholesale, Retail, Transportation (G,H)	2,906,622	312,641	550,110	6.4
Telecom, Business Services (J,M)	1,978,832	193,905	345,304	18.7
Construction (F)	972,135	120,840	183,144	11.4
Nontradable Services (Other)	2,790,951	290,554	527,661	13.5
Mining, Quarrying (B)*	13,490	1,194	2,922	23.7
Finance, Insurance, Real Estate (K,L)*	202,893	23,516	48,153	48.0

Notes: This table presents industry-level summary statistics using the TEAOR08 classification system. Column (1) shows the industry name and corresponding NACE sector codes. Column (2) shows the total number of firm-year observations in the balance sheet data (1992-2022). Column (3) shows the number of distinct firms with balance sheet data. Column (4) shows the number of distinct managers (CEOs) from the firm registry data. Column (5) shows the average EBITDA surplus. Sectors for...

Temporal Patterns

Table 4: Sample Over Time

Year	Total firms	Sample firms	CEOs	Connected component	
				Firms	CEOs
1992	98,780	28,293	34,103	1,870	2,204
1995	171,759	48,375	56,065	3,390	3,801
2000	280,386	76,095	85,772	5,909	6,223
2005	326,905	93,857	105,703	7,632	7,789
2010	384,570	105,126	117,633	8,898	8,494
2015	433,371	118,128	126,119	9,980	8,960
2020	424,501	117,727	124,936	9,408	8,235
2022	454,106	115,373	123,183	8,994	7,863
Total	1,063,172	222,866	345,852	17,448	26,476

Notes: This table presents the evolution of the sample from 1992 to 2022. Column (1) shows the total number of distinct firms with balance sheet data. Column (2) shows the

CEO Turnover Patterns

CEOs	Firm-Year	Firm
1	80%	63%
2	17%	24%
3	2%	8%
4+	1%	5%
Total	9,627,484	1,012,113

Length (Years)	Actual Spells	Placebo Spells
1	22%	27%
2	15%	19%
3	11%	14%
4+	51%	40%
Total	102,418	14,183

Estimation

Estimation steps

1. Estimate χ as $1-$ revenue share of labor and material
2. Estimate revenue function with rich fixed effects to recover coefficients of fixed factors
3. Estimate firm and manager fixed effects with TWFE on **largest connected component**
4. Check dynamics of effects via event study

Surplus Share (1)

Follow Halpern et al. (2015), Gandhi et al. (2020)

$$\hat{\chi}_s := 1 - \frac{\sum_{i \in s}(W_{st}L_{it} + \varrho_{st}M_{it})}{\sum_{i \in s} R_{it}}$$

Revenue Function (2)

$$r_{imst} = \frac{\alpha}{\chi} k_{it} + \frac{1}{\chi} z_m + \lambda_i + \mu_{st} + \tilde{\omega}_{it}$$

Assumptions

1. All firms with the sector face the same prices
2. Residual TFP uncorrelated with owner and manager choices
   - Timing can be checked in event study.
3. Owner and manager choices can be arbitrarily correlated

Recovering Firm and Manager Fixed Effects (3)

$$\tilde{r}_{imst} := \hat{\chi} r_{imst} - \hat{\alpha} k_{it} - \hat{\mu}_{st} = z_m + \lambda_i + \omega_{it}$$

Remove firm fixed effect by subtracting firm average,

$$\Delta \tilde{r}_{imt} = \Delta z_{m_{it}} + \Delta \omega_{it}$$

with

$$\Delta x_{it} := x_{it} - \frac{1}{N_i} \sum_{\tau} x_{i\tau}$$

Identification Challenges

1. Residual TFP trends may be correlated with manager change (reverse causality)

- We don't need *random mobility*.
- Usual solution: exogenous removal of CEO (hospitalization: Bennedsen et al 2020, death: Sauvagnat and Schivardi 2024)

2. Firm and manager effects can only be interpreted against a baseline group in connected component

- We use *largest connected component* (Abowd et al. 2002)

3. Fixed effects estimated with small-sample noise

- IV designs can even exacerbate small-sample problem

A Two-Manager Example

Manager effect

1	2	3	4	5	6
z_1	z_1	z_1	z_2	z_2	z_2
ω_1	ω_2	ω_3	ω_4	ω_5	ω_6

$$\hat{z}_1 := z_1 + \frac{1}{3}(\omega_1 + \omega_2 + \omega_3)$$

$$\hat{z}_2 := z_2 + \frac{1}{3}(\omega_4 + \omega_5 + \omega_6)$$

Our Solution: Placebo Control

When CEO doesn't change

$$\Delta \tilde{r}_{imt} = \Delta \omega_{it}.$$

By doing the exact same estimation procedure around "non-changes," we can filter out the noise.

Constructing Placebos

1. Estimate time-variante hazard of CEO change ($\approx 20\%$/year)
2. Pick firms with long CEO tenures (7+ years)
3. Randomly assign placebo changes with the estimated hazard

Placebo Spells are Similar to Actual Ones

Length (Years)	Actual Spells	Placebo Spells
1	22%	27%
2	15%	19%
3	11%	14%
4+	51%	40%
Total	102,418	14,183

Event Study (4)

Treatment: CEO changes at time g.

Control: Placebo change at time g.

$$\tilde{r}_{imt} = \lambda_i + \gamma_{t-g} + \omega_{it}$$

with γ estimated with 2-treatment version of Callaway–Sant'Anna (2020), `xt2treatments` (Koren 2025) for different groups of managers.

Results

Surplus Share by Industry (1)

Table 6: Industry Breakdown

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Revenue Function Estimation (2)

Table 7: Surplus Function Estimation Results

	(1) Revenue	(2) EBITDA	(3) Wagebill	(4) Materials	(5) Revenue	(6) Revenue
Fixed assets (log)	0.309***	0.312***	0.278***	0.357***	0.294***	0.299***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.005)
Has intangible assets	0.221***	0.135***	0.226***	0.254***	0.208***	0.269***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.013)
Foreign owned	0.024**	0.002	0.060***	0.019	0.024**	0.022
	(0.012)	(0.013)	(0.012)	(0.014)	(0.012)	(0.031)
Observations	2900201	2251376	2845619	2955946	2893099	230208

Standard errors in parentheses

All models include firm-CEO-spell fixed effects and industry-year fixed effects. Outcome variables are

log-transformed. Models (5) and (6) include quadratic controls for firm age and CEO tenure.
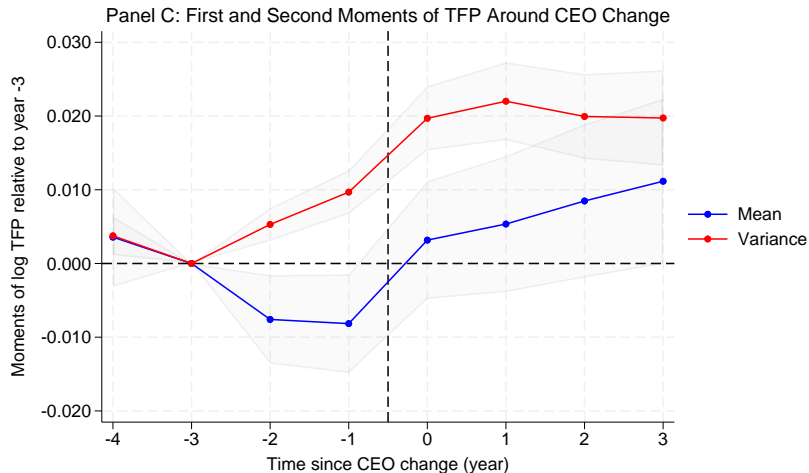
Manager Fixed Effects in the Giant Component (3)

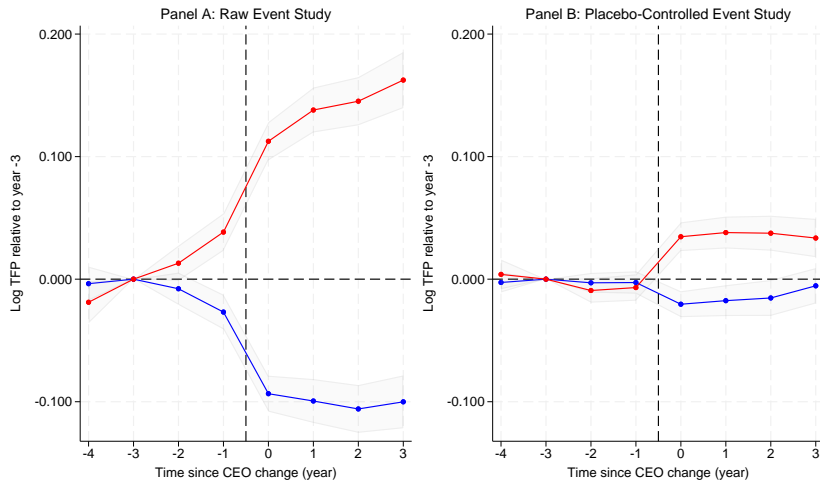

Panel B: Connected Component Manager Skill Distribution
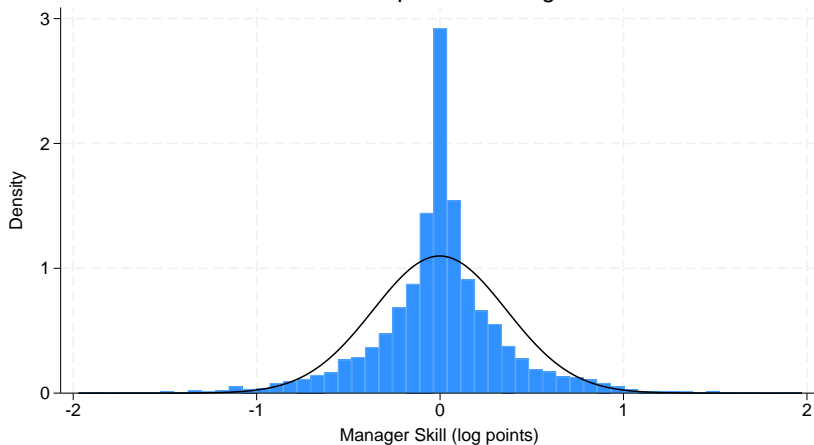
P25-P75 difference: 24.6% productivity

Event Study (4)

Panel C: First and Second Moments of TFP Around CEO Change

Dip in average TFP before CEO change. Elevated variance, stabilizing after CEO change.

Split by "Good" and "Bad" CEOs ($\pm$ 1%)

Actual vs Placebo Effects

Transition	Actual	Placebo	Difference
Bad → Good			3.9**
Good → Bad			-1.2**
Gap	22.1***	17.1***	5.0***

Treatment Effects and Correlations with Outcomes

	(1) Fixed assets (log)	(2) Has intangible assets	(3) Foreign owned	(4) Sales (log)	(5) Employment (log)	(6) Materials (log)
Better CEO	0.018	0.046***	0.027***	0.314***	0.079**	0.345***
	(0.052)	(0.014)	(0.008)	(0.046)	(0.031)	(0.048)
Observations	84169	84169	84169	84169	84169	84169

Guidance For Empirical Research

Don't Use Raw Manager FE
- 75% noise → severe attenuation bias
- Correlations misleading

Better Practices
1. Include observable characteristics
- education and work experience (De Pirro, Koren and Laki 2025)
- foreign name (Koren and Telegdy 2025)
- selectiveness of entry cohort (Koren and Orbán 2025)
2. Manager quality on LHS only (never RHS due to attenuation)
3. Implement placebo checks

Conclusion

What We Did

1. **Modeled** CEO value in private firms
2. **Measured** using universe of Hungarian firms
3. **Developed** placebo-controlled method
4. **Found** 75% of "effects" are spurious. Better managers expand the firm, slowly receive more resources to do so.