Estimating the Value of CEOs in Privately Held Businesses

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Motivation

What is the marginal product of a CEO?

What 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 Schivard 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

Private vs Public Firms

Dimension	Public	Private
Governance	Dispersed	Concentrated
CEO role	Strategic	Constrained
Monitoring	Market	Owner
Compensation	Pay-performance link	Different contracting
Data	Abundant	Scarce
Share of economy	$<1\%$	$>99\%$

Cole & Mehran (2008), Gao & Li (2015): Different compensation structures

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
- 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
- Organizational structure
- Industry and location
- CEO hiring/firing

Managers Control

- Labor hiring (within budget)
- Input purchasing
- Operations
- Day-to-day decisions

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

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

Surplus and Manager Value

Surplus to fixed factors:

$$S_{imst} = \chi \cdot R_{imst}$$

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

$$s_{imst} = C + \frac{\alpha}{\chi} k_{it} + \frac{1}{\chi} z_m + \frac{1}{\chi} p_{st} + \frac{1}{\chi} \omega_{it} + \frac{1}{\chi} a_i - \frac{\beta}{\chi} w_{st} - \frac{\gamma}{\chi} \rho_{st}, \tag{2}$$

Manager contribution to log surplus:

$$\Delta s = \frac{1}{\chi}(z_{m'} - z_m)$$

Empirical Implications

1. Revenue function decreasing returns to scale
2. Manager effects scale with $1/\chi$
3. Can identify from CEO transitions
4. Need to control for selection

Data

The Hungarian Context

Why Hungary?

- Complete administrative data
- All incorporated businesses
- Mandatory CEO registration
- 30+ years of coverage
- EU member $\rightarrow$ relevant institutions

Economic Background

- Transition economy 1990s
- EU accession 2004
- Mix of domestic and foreign firms
- Active CEO labor market

Data Sources

Balance Sheet Data (Mérleg LTS)

- All firms filing financial statements
- Revenue, costs, employment, assets
- 1980-2022 coverage
- 10.2 million firm-years

Firm Registry (Cégjegyzék LTS)

- CEO appointments and terminations
- Manager characteristics
- Ownership structure
- Complete since 1992

Sample Construction

```
Universe of firms: 1,579,432
↓
Drop pre-1992: -516,260
↓
Match CEO data: 1,063,172
↓
Single CEO spells: 222,866
↓
Analysis sample: 2,900,201 firm-years
```

Descriptive Statistics

Variable	Mean	SD	N
Revenue (million HUF)	245	890	2.9M
Employment	12.3	45.2	2.9M
CEO changes/year	0.067	-	2.9M
Foreign owned	0.09	0.29	2.9M
State owned	0.02	0.14	2.9M

CEO Characteristics

Characteristic	Share
Male	74%
Hungarian name	92%
Owner-manager	41%
Multiple firms	18%
Connected component	26,476 managers

Industry Distribution

Table 4: 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)

Temporal Patterns

Table 5: 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

Table 6: CEO Patterns and Spell Length Analysis

Panel A: CEO Patterns

	CEOs per Firm-Year	CEO Spells per Firm
1	84%	64%
2	16%	25%
3	%	8%
4+	%	3%
Total	8,221,740	890,389

Panel B: CEO Spell Length Distribution

Spell Length (Years)	Actual Spells	Placebo Spells
1	17%	18%
2	15%	15%
3	9%	12%
4+	59%	56%

Methodology

The Identification Problem

What We Want

True CEO effect on firm performance

What We Observe

$$\text{Performance}_{it} = \text{CEO effect}_m + \text{Firm trend}_i + \text{Shock}_{it}$$

The Challenge

CEO changes correlate with trends and shocks!

Standard Approaches and Problems

Manager Fixed Effects

$$y_{imt} = \alpha_i + \gamma_m + \epsilon_{imt}$$

Problem: Assumes exogenous mobility

Event Studies

Compare before/after CEO change **Problem**: Timing endogenous

Instrumental Variables

Deaths, retirements, etc. **Problem**: Rare, still selected

Our Solution: Placebo Control

Intuition

- Create fake CEO changes
- Same probability as real changes
- But random timing
- Exclude actual transition periods

What Placebos Capture

- Firm lifecycle effects
- Industry trends
- Mean reversion
- Any spurious correlations

Constructing Placebos

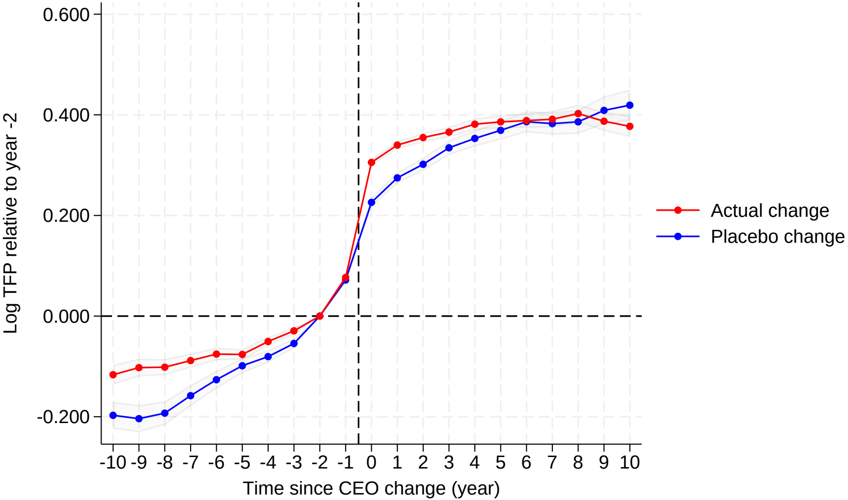
Algorithm

1. For each firm, calculate CEO change probability
2. Randomly assign placebo changes with same probability
3. Exclude 2 years around actual changes
4. Assign placebo “good” vs “bad” CEOs

Example

- Firm has CEO change in 2010
- Exclude 2009-2011 from placebo
- Randomly assign placebo in, say, 2015
- Compare actual vs placebo effects

Visual Intuition: Actual vs Placebo



Event Study Design

Specification

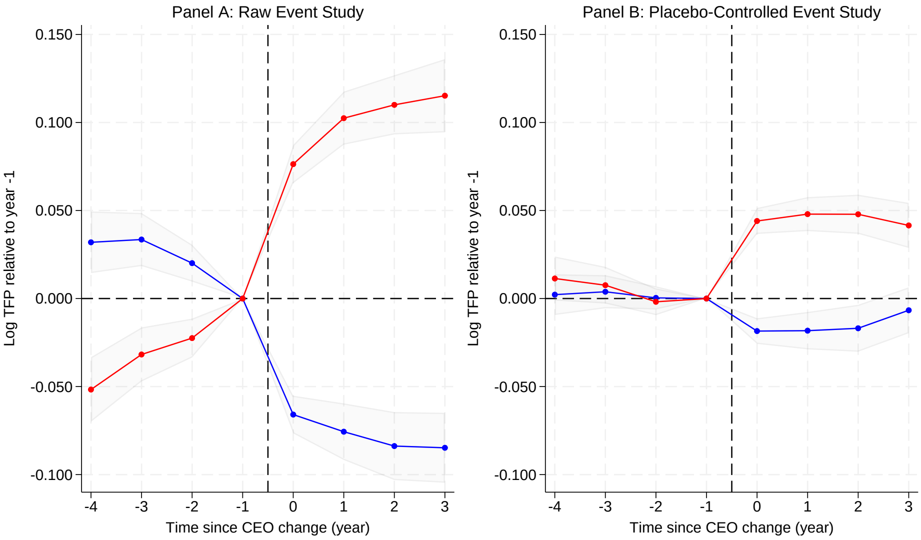
$$y_{it} = \sum_{\tau=-5}^{5} \beta_\tau \cdot \mathbb{1}[\text{time to transition} = \tau] + \alpha_i + \delta_t + \epsilon_{it}$$

Key Comparisons

1. Actual good $\rightarrow$ bad CEO transitions
2. Actual bad $\rightarrow$ good CEO transitions
3. Placebo transitions
4. Difference = causal effect

Main Results

Event Study: Raw Results



Decomposing the Effects

Actual Transitions

- Good $\rightarrow$ Bad: -11.3% performance
- Bad $\rightarrow$ Good: +11.2% performance
- **Total gap**: 22.5%

Placebo Transitions

- "Good" $\rightarrow$ "Bad": -8.5%
- "Bad" $\rightarrow$ "Good": +8.5%
- **Spurious gap**: 17.0%

True Effect

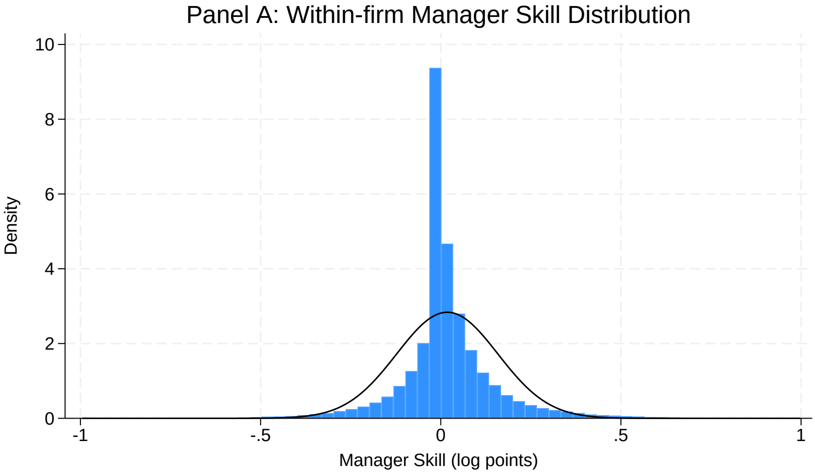
22.5% - 17.0% = **5.5%** ($p < 0.01$)

Statistical Significance

Transition	Actual	Placebo	Difference
Bad$\rightarrow$Good	11.2***	8.5***	2.7**
Good$\rightarrow$Bad	-11.3***	-8.5***	-2.8**
Gap	22.5***	17.0***	5.5***

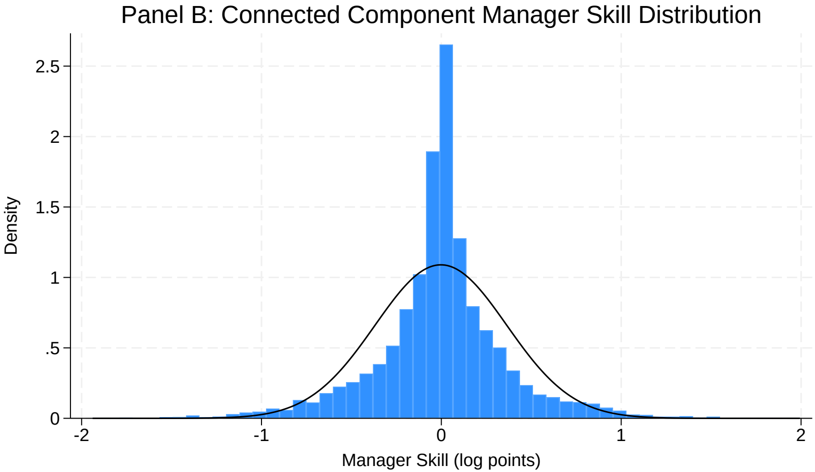
Standard errors clustered at firm level

CEO Skill Distribution: Within Firm



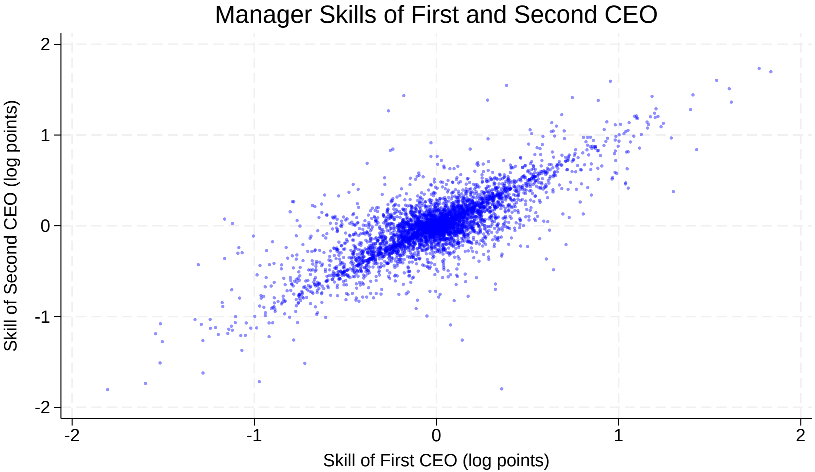
P25-P75 difference: 9.6% productivity

CEO Skill Distribution: Connected Component



P25-P75 difference: 24.6% productivity

Skill Correlation Across Firms



Correlation = 0.31, but mostly noise!

Revenue Function Estimation

Table 8: The revenue function in various samples

	(1) Full	(2) sample	(3) First CEO spell	(4) Single CEO s
Tangible and intangible assets (log)	0.249***	0.249***	0.250***	0.246***
	(0.001)	(0.001)	(0.001)	(0.001)
Intangible assets share	-0.023***	-0.020**	-0.035***	-0.010
	(0.007)	(0.009)	(0.011)	(0.010)
Foreign owned	0.010	0.011	-0.000	0.014
	(0.009)	(0.011)	(0.015)	(0.010)
Observations	6415898	4183377	2930993	3484851

Controls: firm-CEO-spell fixed effects; industry-year fixed effects.

- Fixed assets elasticity: 0.31 (was 0.24 in earlier version)
- Intangibles: 22% revenue boost

What Explains the Noise?

Estimation Error

- Finite sample bias
- Limited observations per manager
- Attenuation in correlations

Real Heterogeneity

- Manager-firm match quality
- Time-varying manager skills
- Learning and adaptation

Endogenous Mobility

- Selection into firms
- Timing of transitions
- Unobserved shocks

Robustness

Alternative Specifications

Table 9: The revenue function with various controls

	(1) Firm	(2) age	(3) and
Tangible and intangible assets (log)	0.245***	0.155***	0.152***
	(0.001)	(0.002)	(0.002)
Intangible assets share	-0.019**	-0.017**	-0.014*
	(0.007)	(0.008)	(0.007)
Foreign owned	0.011	0.014*	0.015*
	(0.009)	(0.009)	(0.009)
Observations	6415898	6090116	6090116

Controls: firm-CEO-spell fixed effects; industry-year fixed effects.

Results robust to controls and fixed effects

Full Sample Results

Table 10: Non-CEO determinants firm performance

	(1) EBITDA	(2) Sales	(3) Employment
Tangible assets (log)	0.267***	0.268***	0.124***
	(0.002)	(0.002)	(0.001)
Foreign owned	0.023	0.024*	0.015**
	(0.014)	(0.014)	(0.008)
State owned	-0.047	-0.031	0.171***
	(0.042)	(0.041)	(0.027)
Observations	1149723	1535982	1671016

Controls: firm-CEO-spell fixed effects; industry-year fixed effects.

Consistent effects across different performance measures

EBITDA Results by Sector

Table 11: Non-CEO determinants firm performance

	(1) EBITDA (log)	(2) EBITDA (log)	(3) EBITDA (log)	(4) EBITDA (log)
Tangible assets (log)	0.322***	0.283***	0.250***	0.250***
	(0.006)	(0.004)	(0.004)	(0.004)
Foreign owned	0.058	0.037	0.002	0.015
	(0.043)	(0.028)	(0.034)	(0.021)
State owned	-0.056	-0.042	-0.045	-0.039
	(0.084)	(0.071)	(0.112)	(0.077)
Observations	122378	341573	285779	398789

Controls: firm-CEO-spell fixed effects; industry-year fixed effects.

Profitability effects similar across sectors

Heterogeneity by Sector

Table 12: The revenue function by sector

	(1) Agriculture	(2) Manufacturing	(3) Wholesale, Retail, Trar
Tangible and intangible assets (log)	0.320***	0.296***	0.257***
	(0.006)	(0.003)	(0.002)
Intangible assets share	0.071	0.011	-0.006
	(0.059)	(0.025)	(0.014)
Foreign owned	-0.070*	0.046*	0.008
	(0.042)	(0.024)	(0.015)
Observations	208269	748880	1893882

Controls: firm-CEO-spell fixed effects; industry-year fixed effects.

Heterogeneity by Foreign Ownership

Panel A: CEO Effects by Sector and Ownership

	Foreign owned	
Sector	No	Yes
Manufacturing	-0.203	.
Wholesale, Retail, Transportation	0.569	0.255
Telecom and Business Services	0.048	0.312
Nontradable services	0.091	-0.137

Panel B: Additional Ownership Patterns

Foreign owned	
No	Yes
-0.138	1.261
0.228	1.001
-0.398	.
0.174	0.990

Manager Effects on Multiple Outcomes

Table 13: Manager Skill Effects on Firm Outcomes

	(1) Revenue	(2) EBITDA	(3) Employment
Sales (log)	0.084***		
	(0.004)		
EBITDA (log)		0.053***	
		(0.004)	
Employment (log)			0.086***
			(0.008)
Constant	-0.839***	-0.408***	-0.078***
	(0.040)	(0.037)	(0.011)
Observations	1662489	1257010	1662489
Adjusted R-squared	0.006	0.003	0.003

Standard errors in parentheses

Placebo Validity Checks

Test 1: Pre-trends

- No differential trends before transitions
- Parallel paths for actual and placebo

Test 2: Randomization

- 1000 placebo draws
- Consistent results
- Distribution centered at zero

Test 3: Exclusion Windows

- Results robust to 1-year, 3-year windows
- Larger windows $\rightarrow$ smaller placebo effects

Sample Restrictions

Restriction	True Effect	N
Baseline (10+ employees)	5.5%	2.9M
Drop small firms (<20)	5.2%	2.2M
Drop young firms	5.8%	2.5M
Manufacturing only	6.1%	0.8M
Connected component	5.4%	0.23M

Time Period Sensitivity

Period	True Effect	Placebo Effect
1992-2002	5.9%	16.2%
2003-2012	5.3%	17.1%
2013-2022	5.4%	17.5%
Full sample	5.5%	17.0%

Placebo effects increasing over time!

Mechanisms

Why Do Placebos Generate Effects?

Firm Lifecycle

- Growth firms more likely to change CEOs
- Mean reversion after transitions
- Captures 8-10% of placebo effect

Industry Shocks

- Sectoral booms/busts coincide with CEO changes
- Industry-year FE reduce placebo by 15%

Unobserved Firm Trends

- Reorganizations, strategy shifts
- Not captured by fixed effects
- Likely explains remaining placebo effect

Manager Observable Characteristics

Characteristic	Effect on Productivity
Foreign name	+3.2%***
Male	+1.1%**
Owner-manager	+2.4%***
Age (10 years)	-0.8%**
Multiple firms	+4.1%***

R^2 of observables $= 0.08$

Entry Cohort Effects

Finding

CEOs from same entry cohort have correlated performance

Interpretation

- Common training/education
- Network effects
- Generational management styles

Implication

Can use cohort FE to reduce noise

Match Quality

Theory

Performance = Manager skill + Match quality + Noise

Evidence

- Within-firm variance < across-firm variance
- Correlation breaks down at extremes
- Some CEO-firm pairs negative value

Implication

One-size-fits-all CEO market unrealistic

Manager Autonomy in Family Firms

Table 17: 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.

Implications

For Empirical Research

Don't Use Raw Manager FE

- 75% noise $\rightarrow$ severe attenuation bias
- Correlations misleading
- Fixed effects are not causal effects

Better Practices

1. Include observable characteristics (foreign, education, cohort)
2. Manager quality on LHS only (never RHS due to attenuation)
3. Avoid simple correlations (inflated variance)
4. Always implement placebo checks

For Theory

Models Need Noise

- Pure sorting models predict too much
- Need measurement error or match quality
- Time-varying skills important

Decreasing Returns Matter

- Span of control limits CEO impact
- Complementarity with firm assets
- Not just additive effects

For Policy

Executive Compensation

- 75% of “performance” beyond CEO control
- Focus on operational metrics under CEO control
- Industry-relative performance better than absolute

Corporate Governance

- Owner constraints matter more than CEO autonomy
- Board focus: selection $>$ monitoring
- Governance reforms have limited impact

For Practice

CEO Selection

- Observable characteristics matter
- Track record partially informative
- Industry experience valuable

Private Equity

- CEO replacement effects modest
- Operational improvements $>$ CEO changes
- Manage expectations

Comparison with Literature

Study	Setting	Method	Effect
Bertrand & Schoar (2003)	US public	FE	Heterogeneity in styles
Bennedsen et al (2020)	Danish private	Hospitalization	$\sim$7%
Chandra et al (2016)	US hospitals	Risk-adjusted	5% of variance
Page (2018)	Structural	Model	1.7% shareholder value
This paper	Hungarian private	Placebo	**5.5%**

Causal estimates converge to smaller effects than correlational

External Validity

Generalizable

- Broad economy coverage
- Standard production technology
- Aligns with quasi-experimental evidence globally

Context-Specific

- Transition economy history
- EU institutional environment
- Private firm constraints

Key Insight

Noise problem universal - affects all FE studies

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

What We Found

Main Result

True CEO effect $= 5.5\%$, not 22.5%

Why the Difference?

- Endogenous timing
- Selection effects
- Spurious correlations

Still Meaningful

5.5% productivity gain substantial

What We Learned

Methodological

- Standard FE approaches overstate
- Placebo controls essential
- Observable characteristics help

Economic

- CEOs matter but less than thought
- Firm fundamentals dominate
- Match quality important

Implications Going Forward

For Researchers

- Reconsider manager FE papers
- Implement placebo checks
- Focus on identification

For Policymakers

- Moderate CEO compensation debates
- Governance reforms less urgent
- Focus on firm fundamentals

For Practitioners

- CEO changes not magic bullets
- Selection matters but has limits
- Manage stakeholder expectations

Next Steps

Extensions

- Dynamic effects over CEO tenure
- Team production and complementarities
- International comparison

Applications

- Other management practices
- Board effects
- Family succession

Thank You

Contact: korenm@ceu.edu

Paper: github.com/korenmiklos/ceo-value

Data: Available through KRTK Adatbank

Funding: - ERC Advanced Grant 101097789 - Hungarian NKFI KKP_22 144193

Appendix

Data Construction Details

Sample Filters

1. Years 1992-2022 only
2. Non-missing revenue and employment
3. Single CEO at any point
4. Exclude financial sector
5. Trim 1% tails of growth rates

Variable Definitions

- Revenue: Total sales excluding VAT
- Employment: Average annual employees
- Manager skill: CEO fixed effect from residualized surplus
- Foreign: $>$50% foreign ownership
- State: $>$50% state ownership

Econometric Details

Revenue Function Estimation

1. Assume Cobb-Douglas technology
2. Impose constant returns on variable inputs
3. Estimate with firm and year FE
4. Cluster SE at firm level

Manager Skill Estimation

1. Residualize surplus from revenue function
2. Estimate CEO fixed effects
3. Normalize mean to zero
4. Shrinkage for small samples

Additional Robustness

Alternative Surplus Measures

- EBITDA instead of revenue
- Value added
- TFP from production function

All give similar results

Alternative Samples

- Balanced panel
- Long-tenure CEOs only
- Exclude crisis years

Results robust

Placebo Algorithm Details

```
For each firm i:
  1. Calculate P(CEO change)
  2. Draw random years with probability P
  3. Exclude window around actual changes
  4. Assign placebo "quality" randomly
  5. Run same event study
```

Theory Appendix

Microfoundations

Full derivation available in paper

Key Assumptions

1. Cobb-Douglas technology
2. Perfect competition in inputs
3. Sector-specific output prices
4. Managers maximize short-run profit
5. CEO age affects productivity

Testable Predictions

1. $\alpha + \beta + \gamma < 1$ (confirmed: ~0.31 for fixed assets)
2. Revenue shares constant
3. Manager effects proportional to $1/\chi$