

# Estimating the Value of CEOs in Privately Held Businesses

Miklós Koren (CEU, HUN-REN KRTK, CEPR and CESifo)   Krisztina Orbán  
(Monash)   Bálint Szilágyi (HUN-REN KRTK)   Álmos Telegdy (Corvinus)  
András Vereckei (HUN-REN KRTK)

REFLEX Workshop, September 2, 2025

# Acknowledgements



**Funded by  
the European Union**



**European Research Council**  
Established by the European Commission



NEMZETI  
KUTATÁSI, FEJLESZTÉSI  
ÉS INNOVÁCIÓS HIVATAL

This research was funded by the European Research Council (ERC Advanced Grant agreement number 101097789) and by the National Research, Development and Innovation Office (Forefront Research Excellence Program contract number 144193). The views expressed in this project are those of the authors and do not necessarily reflect the official view of the European Union, the European Research Council, or the National Research, Development and Innovation Office.

# 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

- 1 Theoretical Framework
- 2 Data: The Hungarian Commercial Registry
- 3 Estimation Methodology
- 4 Results
- 5 Conclusion and Future Work



# 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)
- $\Omega_{it}$ : *Residual* productivity

# 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

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

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

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

Owner controls  $A_i$  and  $K_{it}$

Manager controls  $Z_m$

## Estimable Equation

Taking logs and substituting out invariant terms,

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

### 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+) → entity resolution
- 2 Time spells not always closed or contiguous
- 3 CEO ("Managing Director") title is not always recorded → 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

## Temporal Patterns

Table 2: Sample Over Time

Year	Total firms	Sample firms	CEOs	Connected component	
				Firms	CEOs
1992	98,780	25,833	31,746	1,423	1,713
1995	171,759	45,828	53,704	2,659	3,028
2000	280,386	73,837	83,862	4,783	5,100
2005	326,905	92,242	104,380	6,283	6,474
2010	384,570	103,892	116,680	7,405	7,084
2015	433,371	116,543	124,960	8,332	7,488
2020	424,501	115,755	123,504	7,789	6,841
2022	454,106	113,387	121,730	7,419	6,509
Total	1,063,172	217,737	339,993	14,416	22,001

*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	107,957	14,978

# Estimation

# Estimation steps

- 1 Estimate  $\chi$  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
$z_1$	$z_1$	$z_1$	$z_2$	$z_2$	$z_2$
$\omega_1$	$\omega_2$	$\omega_3$	$\omega_4$	$\omega_5$	$\omega_6$

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

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

# 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-variant 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

## Event Study (4)

Treatment: CEO changes at time  $g$ .

Control: Placebo change at time  $g$ .

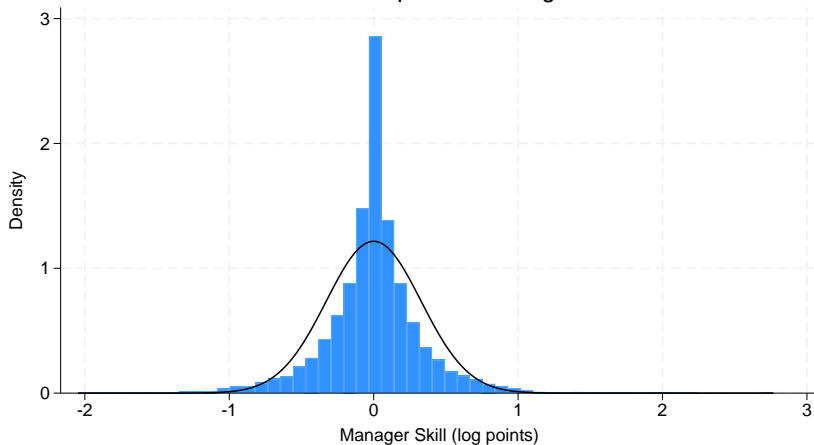
$$\tilde{r}_{imt} = \lambda_i + \gamma_{t-g} + \omega_{it}$$

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

## Results

## Manager Fixed Effects in the Giant Component (3)

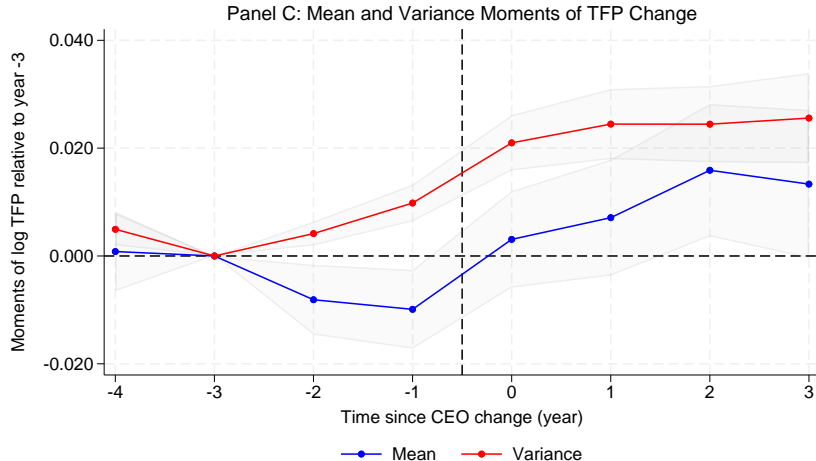
Panel B: Connected Component Manager Skill Distribution



P25-P75 difference: 24.6% productivity

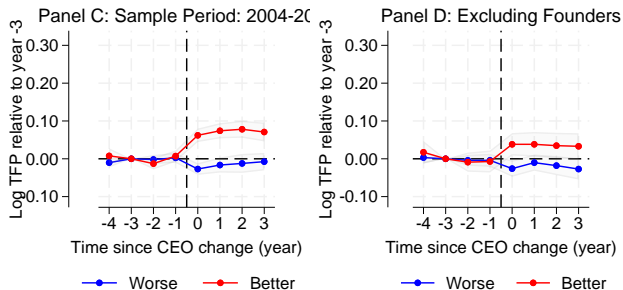
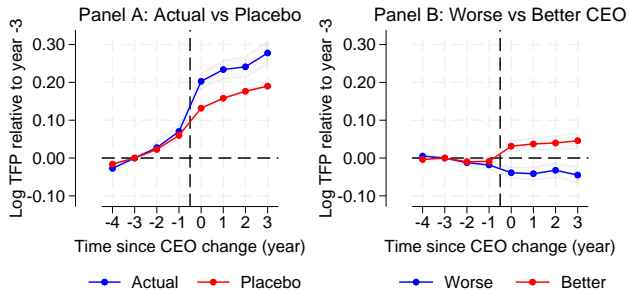


## Event Study (4)



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)

	(1)	(2)	(3)
	Sales (log)	Wagebill (log)	Materials (log)
Better CEO	0.254*** (0.047)	0.154*** (0.047)	0.269*** (0.051)
Observations	92299	92299	92299

## Treatment Effects and Correlations with Outcomes (2)

	(1)	(2)	(3)
	Fixed assets (log)	Has intangible assets	Foreign owned
Better CEO	-0.028 (0.058)	0.050*** (0.015)	0.053*** (0.009)
Observations	92299	92299	92299

## Good Managers Gradually Receive/Build Intangible Assets

But They Immediately Purchase More Material

# Guidance For Empirical Research

## Don't Use Raw Manager FE

- 75% noise  $\rightarrow$  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.

# Appendix

# 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 5: Plant Manager Autonomy in Family-Controlled Firms

	(1) Investment	(2) Investment	(3) Marketing	(4) Product	(5) Hiring
Family ownership	-0.369** (0.161)	-0.200** (0.100)	-0.344** (0.153)	-0.299** (0.151)	0.086 (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) firms

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.

## Surplus Share by Industry (1)

Table 6: Industry Breakdown

Industry (NACE)	Obs.	Firms	CEOs	Surplus share (%)
Agriculture, Forestry, Fishing (A)	320,485	25,951	55,535	7.9
Manufacturing (C)	1,022,252	90,035	179,205	13.7
Wholesale, Retail, Transportation (G,H)	2,887,229	296,237	550,110	6.4
Telecom, Business Services (J,M)	1,968,969	186,013	345,304	18.8
Construction (F)	962,938	112,633	183,144	11.4
Nontradable Services (Other)	2,775,169	277,749	527,661	13.5
Mining, Quarrying (B)*	13,428	1,151	2,922	23.8
Finance, Insurance, Real Estate (K,L)*	201,527	22,344	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-year data. Column (5) shows the surplus share of each industry. *Source:* EBITDA

## 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)	0.336*** (0.001)	0.340*** (0.001)	0.304*** (0.001)	0.386*** (0.002)	0.294*** (0.001)	0.298*** (0.004)
Has intangible assets	0.280*** (0.003)	0.173*** (0.003)	0.281*** (0.003)	0.327*** (0.004)	0.209*** (0.003)	0.259*** (0.010)
Foreign owned	0.023* (0.012)	0.019 (0.012)	0.061*** (0.013)	0.008 (0.015)	0.025** (0.011)	0.035 (0.025)
Founding owner	-0.097*** (0.005)	-0.064*** (0.005)	-0.039*** (0.005)	-0.115*** (0.006)	-0.016*** (0.003)	-0.021** (0.008)
Non-founding owner	-0.008 (0.007)	-0.008 (0.006)	-0.012* (0.007)	-0.013 (0.009)	-0.011*** (0.004)	-0.018* (0.010)

## 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	107,957	14,978