The Macroeconomics of Managers: Supply, Selection and Competition

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Introduction

We know that...

Management matters

- Firms with better management practices are more productive (Bloom et al 2010).
- Management can be improved by intensive training (Bloom et al 2013, Giorcelli 2019).

Managers matter

- Managers are important for firm performance (Bertrand and Schoar 2003, Bennedsen et al 2007).
- Top CEOs are paid a lot (Gabaix and Landier 2008, Frydman et al 2010).

What we don't know

1. What policy interventions can improve management for an entire country?
2. How to quantify the macro effects of these policies?

Why micro $\neq$ macro

Suppose the government subsidizes management trainings.

Supply

How many people will take up this training and become managers?

Selection

Who will become managers? How will the quality of managers change?

Competition

How will the training affect the existing managers? How will the existing managers affect the incentives to take up the training?

This paper

1. Assemble a dataset on the universe of managers in the Hungarian economy (1985 – 2019) + firm balance sheet info + some manager biographies.
2. Examine a large liberalization episode in Hungary in which the demand for management skills increased 20-fold.
3. Build a dynamic equilibrium model of managers with heterogeneous manager skills to capture:
   - schooling choice and career choice based on innate skills and expected benefits from training
   - competition between managers with different skills and different cohorts
4. Calibrate the model to data on managers, firms, and education.
5. Study counterfactual policies:
   - corporate liberalization
   - business education reform

Outline

1. Setup and data
2. An OLG model of managers
3. A numerical example for policy analysis
4. Facts about Hungarian corporations and their CEOs, 1988-2019

Setup and Data

Setup and Data

Large increase in demand for management skills:

- Pre: very small number of firms, small demand for management
- Post: the number of firms and managers explode

Manager Data 1985-2019

Manager

Top officer of corporation (CEO).
Who is the CEO of each corporation? 1m corporations, 1.3m CEOs.
No socioeconomic or demographic information, only identifiers. Sometimes age, can infer gender and nationality (not today).

Financials

- Annual panel of balance sheets and earning statements of corporations with double-entry bookkeeping. 936k firms, 8.4m observations.
- Use sales inflated to 2019, employment, and 2-digit NACE sector.

Schooling data

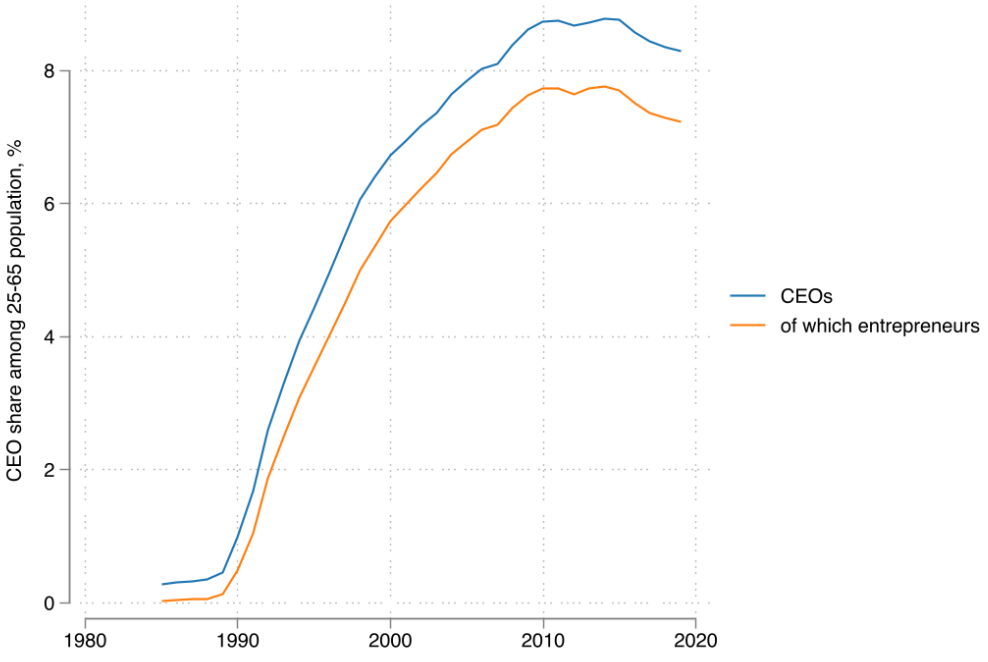
Hübner's Who is Who

Full biographies (school, work experience, etc.) for 63k people in 2013. 30k matched to CEO panel.

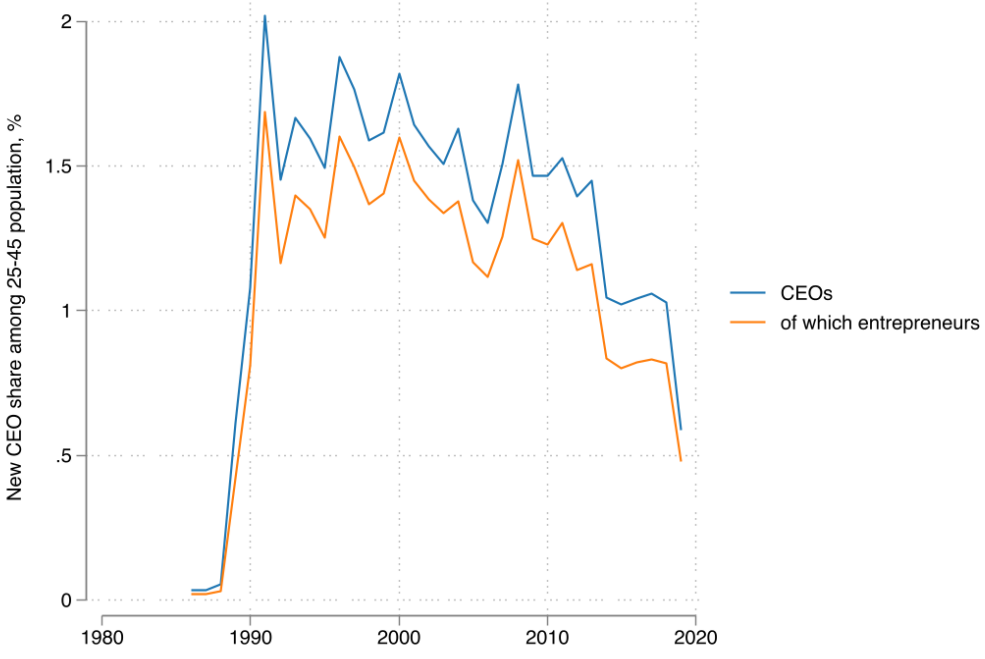
College graduates

Number of gradues by degree and year

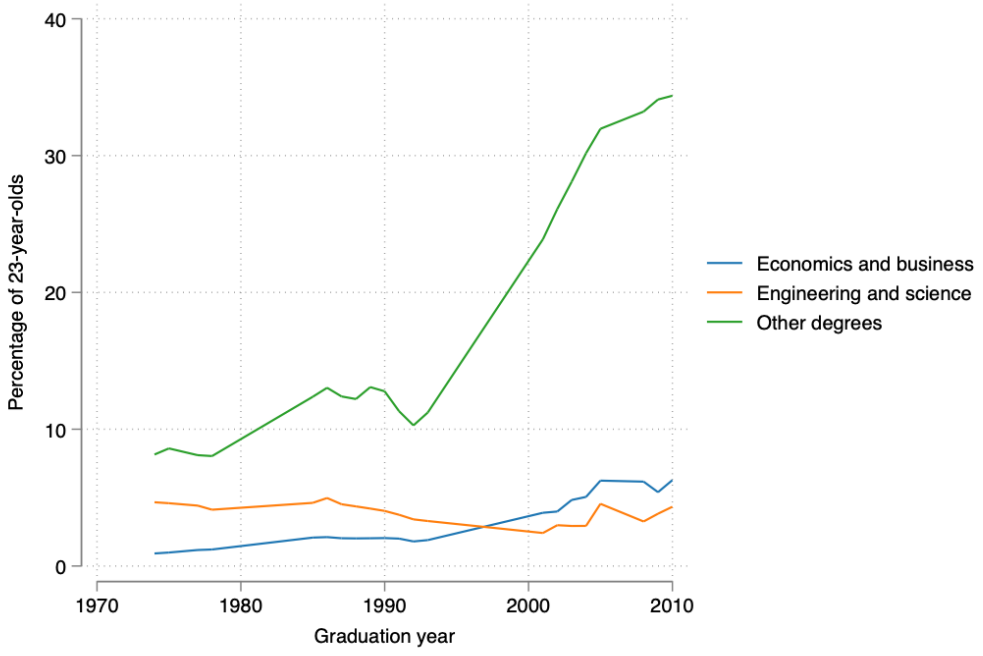
The Stock of Managers Increased Sharply Relative to 35-60 Age Group



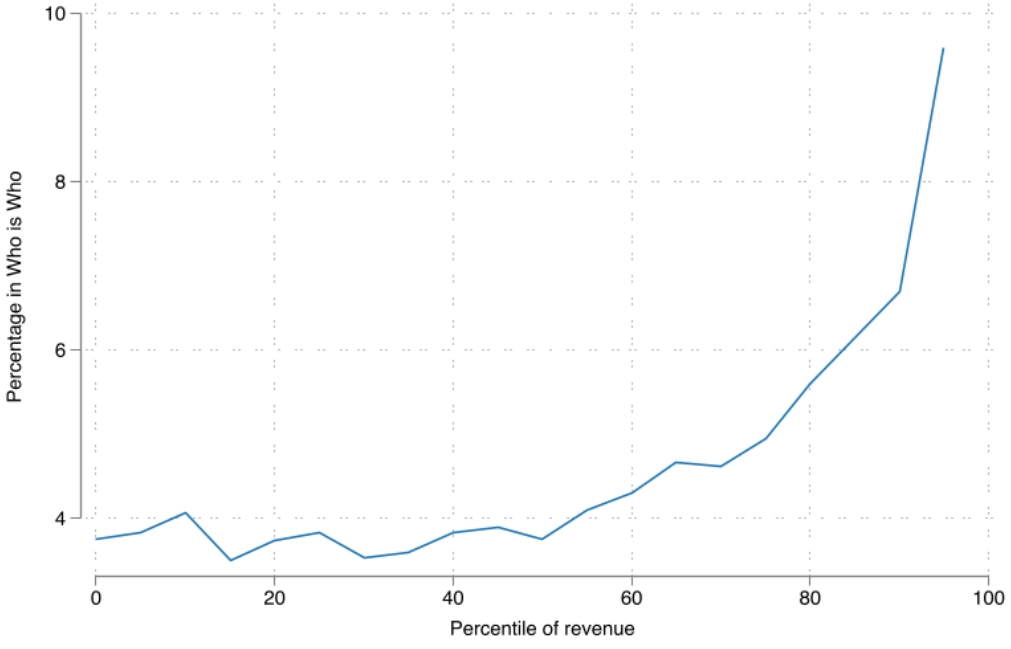
The Inflow of Managers Jumped Suddenly



Business Degrees Became More Prominent



Large Firms are Overrepresented in Hübner



An OLG Model of Managers

An OLG Model of Managers

An overlapping generations model with heterogeneous manager skill, limited span of control and career choice.

Key decisions

school choice: business, engineering or other
career choice: manager or worker

Key equilibrium feedback

competition within and across cohorts

Key friction

school and career choice are irreversible

Outline

1. Static problem: production function, input prices, competition
2. Manager schooling and career choice
3. Demographics: evolution of cohorts

Static Problem

Production Function

Managers differ in their innate skill level. A manager with skill z can hire h workers to produce output with the production function

$$q = z^{\nu} h^{1-\nu}$$

$\nu > 0$ captures span of control (Lucas 1978): hard to run a large firm.

Firm Revenue

$$r(z) = q(z) = zw^{1-1/\nu}(1-\nu)^{1/\nu-1}$$

Employment, production wage bill, revenue, and manager wages are all linear in z.

Real wage (w) is endogenous, determined in competition with other managers.

Labor Market Clearing

$$L^p = Nw^{-1/\nu}(1-\nu)^{1/\nu}\int zdG(z)$$

With $Z := N\int zdG(z)$ denoting the sum of all manager skills, labor market clearing becomes

$$w = (1-\nu)\left(\frac{L^p}{Z}\right)^{-\nu}$$

Aggregate GDP:

$$Y = Z^{\nu}L^{p1-\nu}$$

Manager Wages in Equilibrium

In equilibrium, firms make zero profit. Manager wages capture all quasi-rents.

$$\omega(z) = \nu z \left(\frac{L^p}{Z} \right)^{1-\nu}$$

This is increasing in z but decreasing in Z. Better managers make more, but competition from other managers reduces the wages available to each individual manager.

Education and Career Choice

Education and Career Choice

1. Choose school i
2. Draw innate manager skill z
3. Get trained in school: $z \to \lambda_i z$
4. Choose whether manager or worker

We solve the model backwards.

Distribution of Manager Skills

We assume that z is distributed Pareto, depending on schooling

$$1 - F_i(x) = \Pr(z > x | \text{school} = i) = \left(\frac{x}{\lambda_i z_0} \right)^{-\theta}$$

for $\theta > 1$ (so that the distribution has a finite mean).

Career Choice After Graduation

Potential managers choose to enter if net value exceeds the opportunity cost,

$$(1-\tau)v(t)z > J(t)$$

Selection on manager skill,

$$z > z_{\min}(t) := \frac{J(t)}{(1-\tau)v(t)}.$$

Manager wages may be taxed at rate $\tau \in [0, 1)$.

Entry cutoff $z_{\min}$ independent of school i.

Expected Career When Entering School

Schools affect

1. the probability of becoming a manager
2. expected skills and wages

Probability of becoming a manager

$$\pi_i(t) = z_{\min}(t)^{-\theta}(\lambda_i z_0)^{\theta}$$

Average manager skills

$$\tilde{z}(t) = \frac{\theta}{\theta - 1} z_{\min}(t)$$

Manager Value

Bellman equation for manager value:

$$\rho V(t,z) = \omega[z, Z(t)] - \delta V(t,z) + V_t(t,z)$$

Guess solution:

$$V(t,z) = v(t)z$$

If this is the case, the Bellman can be rewritten as

$$\rho v(t) = \nu p \left[\frac{L^p(t)}{Z(t)}\right]^{1-\nu} - \delta v(t) + v'(t)$$

Expected labor income from a degree

$$E_i(t) = \pi_i(t)(1-\tau)v(t)\tilde{z}(t) + [1-\pi_i(t)]J(t) = J(t)\left[1 + (\lambda_i z_0)^{\theta}(1-\tau)^{\theta}v(t)^{\theta}J(t)^{-\theta}/(\theta-1)\right]$$

Probability of choosing school i

$$x_i = \frac{e^{\alpha_i}\left[1 + (\lambda_i z_0)^\theta (1-\tau)^\theta v(t)^\theta J(t)^{-\theta}/(\theta-1)\right]^{1/\gamma}}{\sum_j e^{\alpha_j}\left[1 + (\lambda_j z_0)^\theta (1-\tau)^\theta v(t)^\theta J(t)^{-\theta}/(\theta-1)\right]^{1/\gamma}}.$$

$1/\gamma$: elasticity of school choice

α_i: attractiveness of school i

Aggregate skill level

$$\Lambda(t) = \left[\sum_i x_i \lambda_i^\theta \right]^{1/\theta}$$

Demographics

Manager and Worker Demographics

Workers and managers die at a constant rate δ.

The stock of population:

$$L := \int_{-\infty}^{t} e^{\delta(s-t)} l ds = l/\delta.$$

The mass of active managers:

$$N(t) := \int_{-\infty}^{t} e^{\delta(s-t)} n(s) ds.$$

The stock of workers:

$$L^p(t) := L - N(t)$$

Competition Between Firms

Potential new managers have a time invariant skill distribution $F(z)$.

Only the best become managers: a time varying truncation of F.

The distribution of skill among the stock of managers, denoted by $G(t, z)$, is a mixture of these truncated distributions.

What can policy do?

1. Lower $\tau \rightarrow$ more managers
2. Increase α_i for high-λ_i schools $\rightarrow$ better composition $\rightarrow$ higher Λ
3. Increase λ_i directly $\rightarrow$ higher Λ (directly and indirectly)

A taxonomy of macro effects

Supply

Higher x_i going to business schools

Selection

Better innate ability of managers, *conditional* on school choice

Competition

Worker and manager wages respond to entry of new managers

Dynamics

Bellman equation of manager wages

$$v'(t) = (\rho + \delta)v(t) - \nu \left[\frac{L^p(t)}{Z(t)}\right]^{1-\nu}$$

The set of managers will be a slowly moving state variable.

$$N'(t) = n(t) - \delta N(t)$$

The change in the overall skill of managers is

$$Z'(t) = n(t)\tilde{z}(t) - \delta Z(t)$$

The change in the discounted PV of worker wages is

$$J'(t) = (\rho + \delta)J(t) - w(t)$$

Dynamic Equilibrium

Ordinary differential equations in Z and N (state) and v and J (co-state):

$$
\begin{aligned}
v'(t) &= (\rho+\delta)v(t) - \nu\left[\frac{L-N(t)}{Z(t)}\right]^{1-\nu} \\
Z'(t) &= \frac{\theta}{\theta-1}\delta L[\Lambda(t)z_0]^{\theta}(1-\tau)^{\theta-1}[v(t)/J(t)]^{\theta-1} - \delta Z(t) \\
N'(t) &= \delta L[\Lambda(t)z_0]^{\theta}(1-\tau)^{\theta}[v(t)/J(t)]^{\theta} - \delta N(t) \\
J'(t) &= (\rho+\delta)J(t) - (1-\nu)\left[\frac{L-N(t)}{Z(t)}\right]^{-\nu}
\end{aligned}
$$

Steady State

The steady state of this economy is when $v'(t) = Z'(t) = N'(t) = J'(t) = 0$.

We have an almost analytical solution.

Steady state is saddle-path stable.

Manager share in the steady state

$$\frac{N_*}{L} = \frac{1}{1 + \frac{1-\nu}{(1-\tau)\nu}\frac{\theta}{\theta-1}}$$

GDP accounting

Value added per worker in the steady state:

$$\frac{Y_*}{L} = \left(\frac{\nu}{1-\nu}\right)^{\nu} (1-\tau)^{\nu} (\Lambda_* z_0)^{\nu} \left(\frac{N_*}{L}\right)^{-\nu/\theta} \left(1 - \frac{N_*}{L}\right)$$

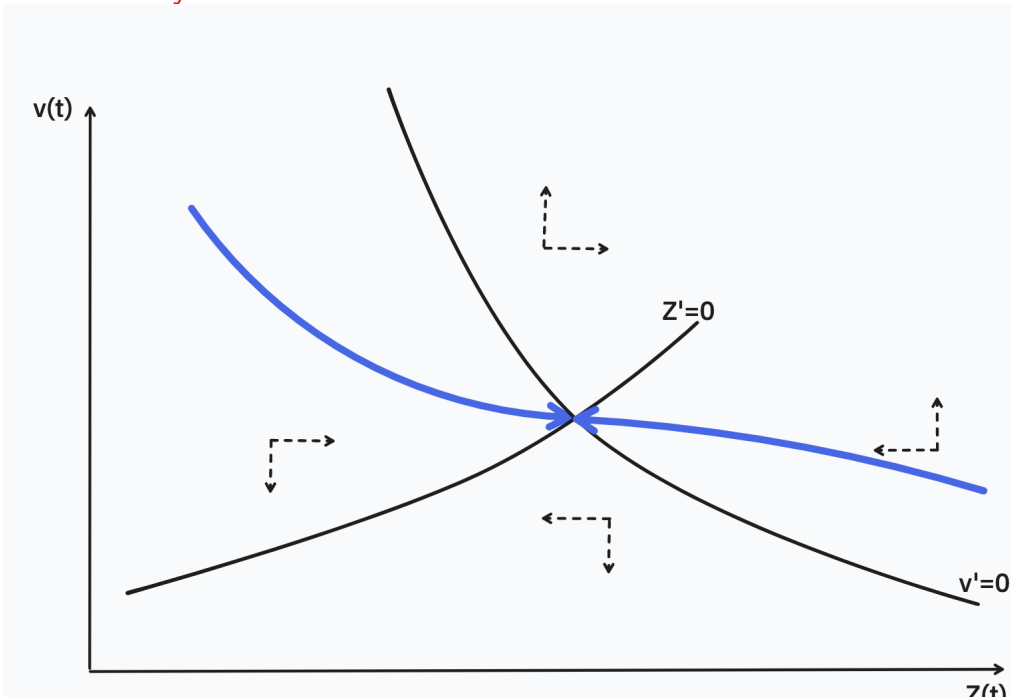
Predictions

GDP per capita is increasing in:

1. Innate manager skill
2. Average manager training

Effect of τ and manager share are ambiguous. There may be too many managers.

Transitional Dynamics



Taking the Model to the Data

Goal

Calibrate model to match two steady states:

1. communism (1985)
2. capitalism (2010)

with only one change, $\tau \to 0$.

Calibration

Table 1: Calibrated parameter values under communism

Parameter	Explanation	Value
ν	Steady-state ratio of managers to workers	0.174
τ	Tax rate	0.929
ρ	Discount rate	0.050
δ	Retirement rate	0.033
θ	Skill distribution, shape	4.380
λ_1	Skill multiplier in business schools	2.197
λ_2	Skill multiplier in engineering	2.185
λ_3	Skill multiplier in other college	1.649
α_1	Relative preference for business schools	-2.23
α_2	Relative preference for engineering	-2.02
α_3	Relative preference for other college	-0.204
γ	Importance of non-pecuniary education benefits	0.059

Measuring manager quality

Log revenue of firm i in year t in industry s, with a mananager having entered in cohort c is

$$\ln R_{icst} = \beta_1 \text{manager\_age}_{ict} + \beta_2 \text{firm\_age}_{ict} + \mu_c + \xi_{st} + \epsilon_{ict}.$$

Degree of Selection

$$\ln \pi_{ic} = \theta \ln \lambda_i - \theta \mu_c + \varepsilon_{ic}.$$

Manager Selection by Degree

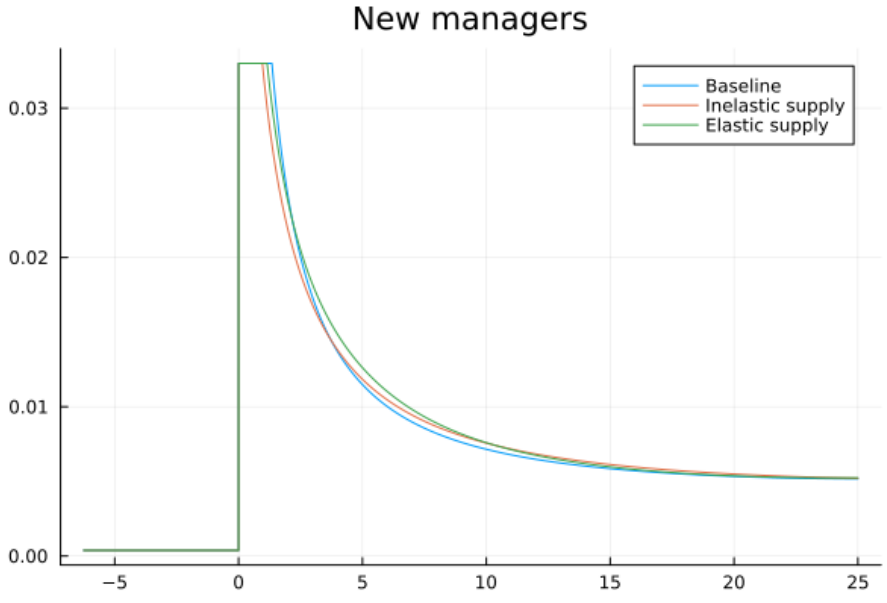
VARIABLES	(1) Share of CEOs, log
Average firm size, log	-4.380***
	(0.736)
Degree = economics	3.447***
	(0.364)
Degree = engineering	3.425***
	(0.362)
Degree = other	2.190***
	(0.371)
Constant	-7.935***
	(0.246)
Observations	82
R^2	0.668

Robust standard errors in parentheses

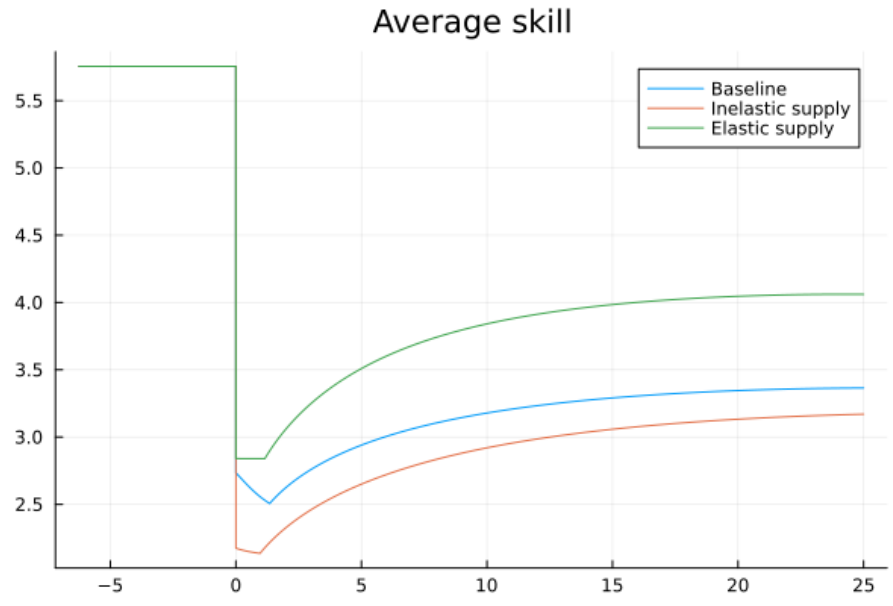
Policy Counterfactuals

1. **Transition**: Reduce τ to 0 suddenly.
2. **Manager tax**: Reduce τ to increase GDP by 5 percent.
3. **School benefit**: Increase α_i to increase GDP by 5 percent.
4. **Curriculum reform**: Increase λ_i to increase GDP by 5 percent.

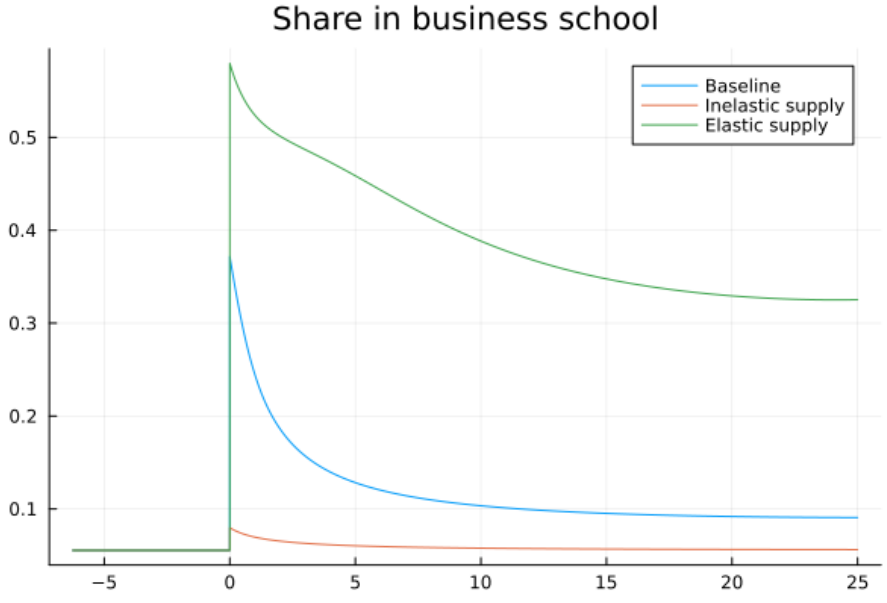
Transition: Manager entry increases suddenly



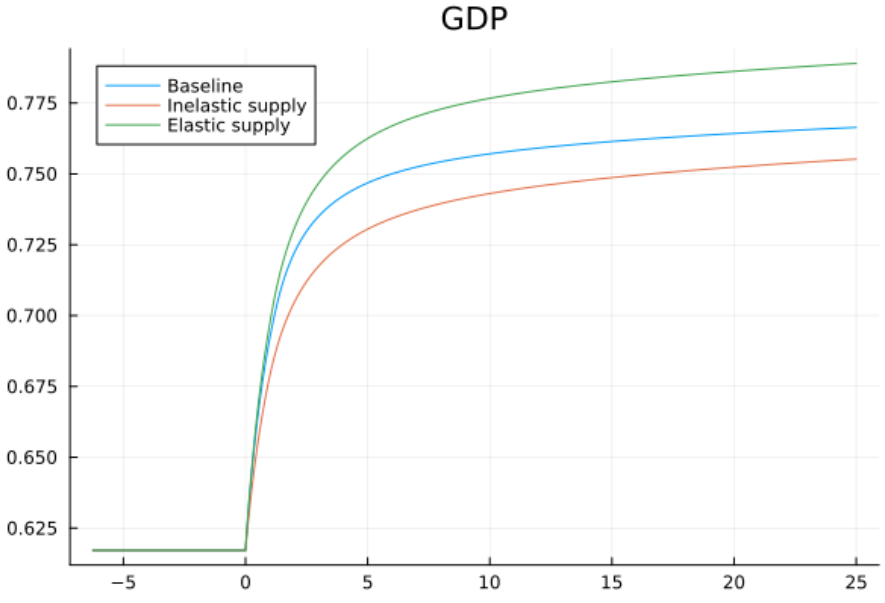
Transition: Entrant skill drops sharply



Transition: Business schools become more popular



Transition: GDP converges to a higher steady state



Policy Counterfactuals

	Transition (τ)	Manager tax	School benefit	Curriculum
Percentage change	-100.0	-3.7	26.7	47.4
Manager entry	58.4	7.1	0.0	0.0
Average education	2.3	0.1	5.0	5.0
Selection	-9.5	-1.5	0.0	0.0
Competition	-13.0	-0.6	0.0	0.0
Total GDP change	27.6	5.0	5.0	5.0
Share in business school	10.8	3.6	61.4	5.5

Discussion

1. Manager entry can increase GDP substantially. But
   - Only if starting from a very low level.
   - There are large pushbacks from selection...
   - ...and competition.
2. Subsidizing business schools has more direct effect on GDP. But
   - Requires implausibly large increase in enrollment.
3. Curriculum reform has the most direct effect on GDP.

Conclusion

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Go Corvinus!