Intangibles, Inequality and Stagnation

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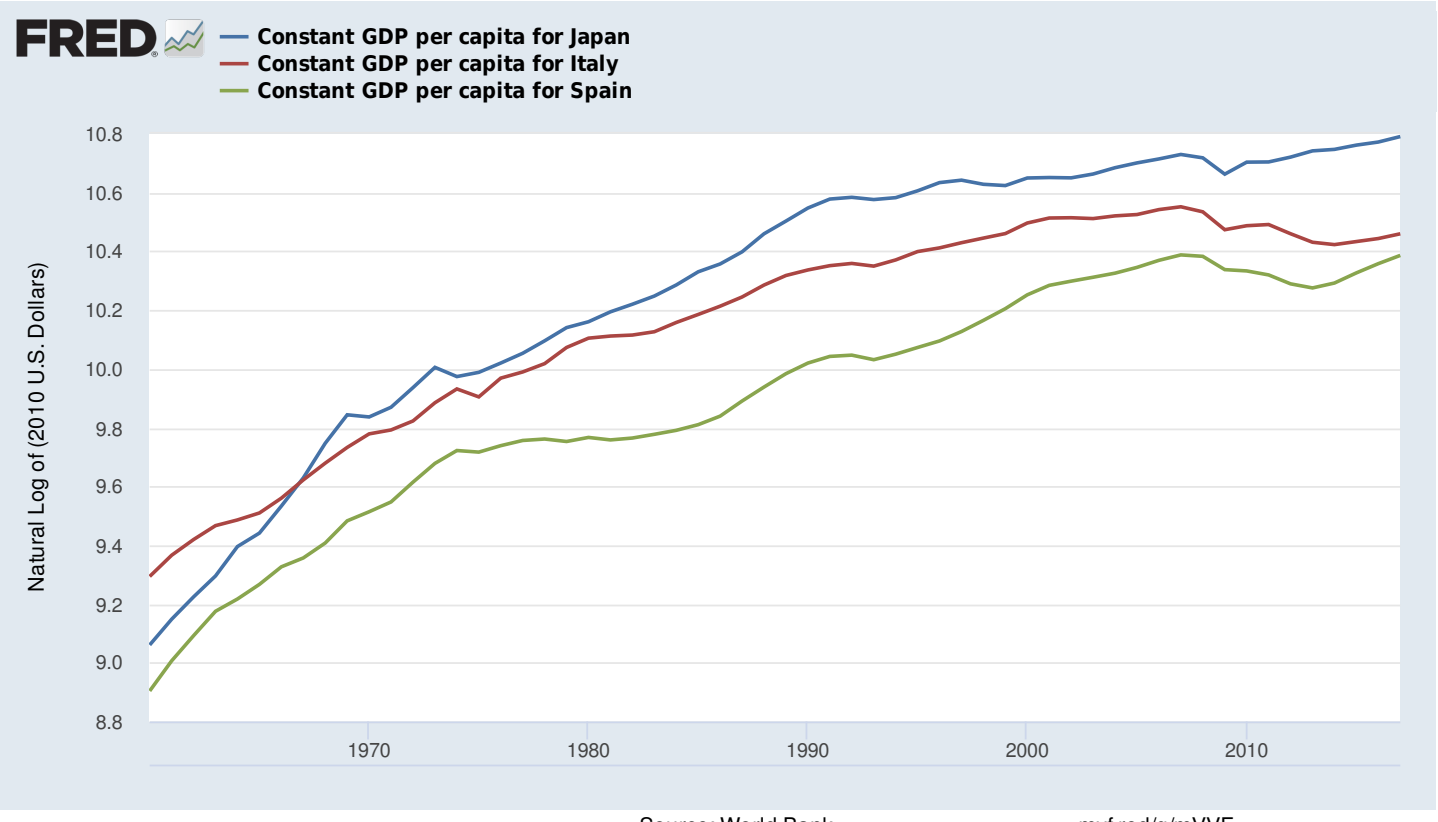

FRED
Constant GDP per capita for Japan
Constant GDP per capita for Italy
Constant GDP per capita for Spain
Natural Log of (2010 U.S. Dollars)
10.8
10.6
10.4
10.2
10.0
9.8
9.6
9.4
9.2
9.0
8.8
1970
1980
1990
2000
2010
Source: World Bank
myf.red/g/mVVF

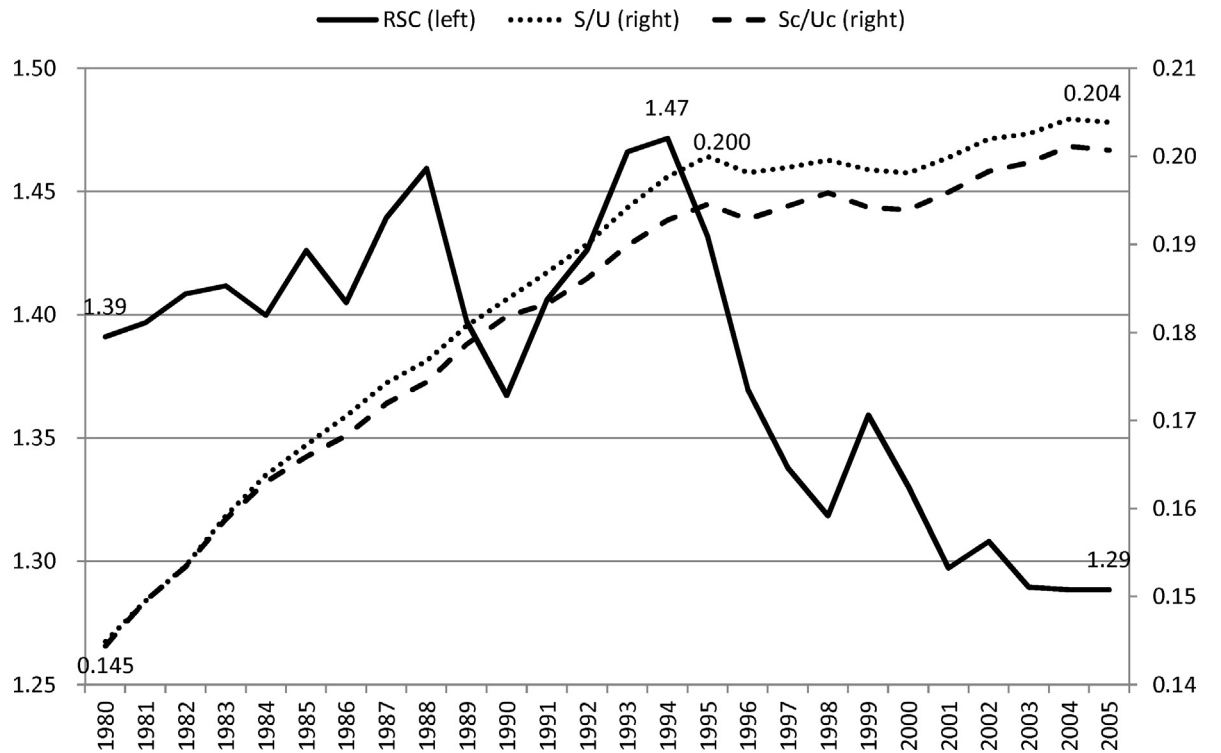


Fig. 1. Relative skill content (RSC) of Japanese trade, 1980–2005.
Source: The author's calculation, based on the JIP database 2009.

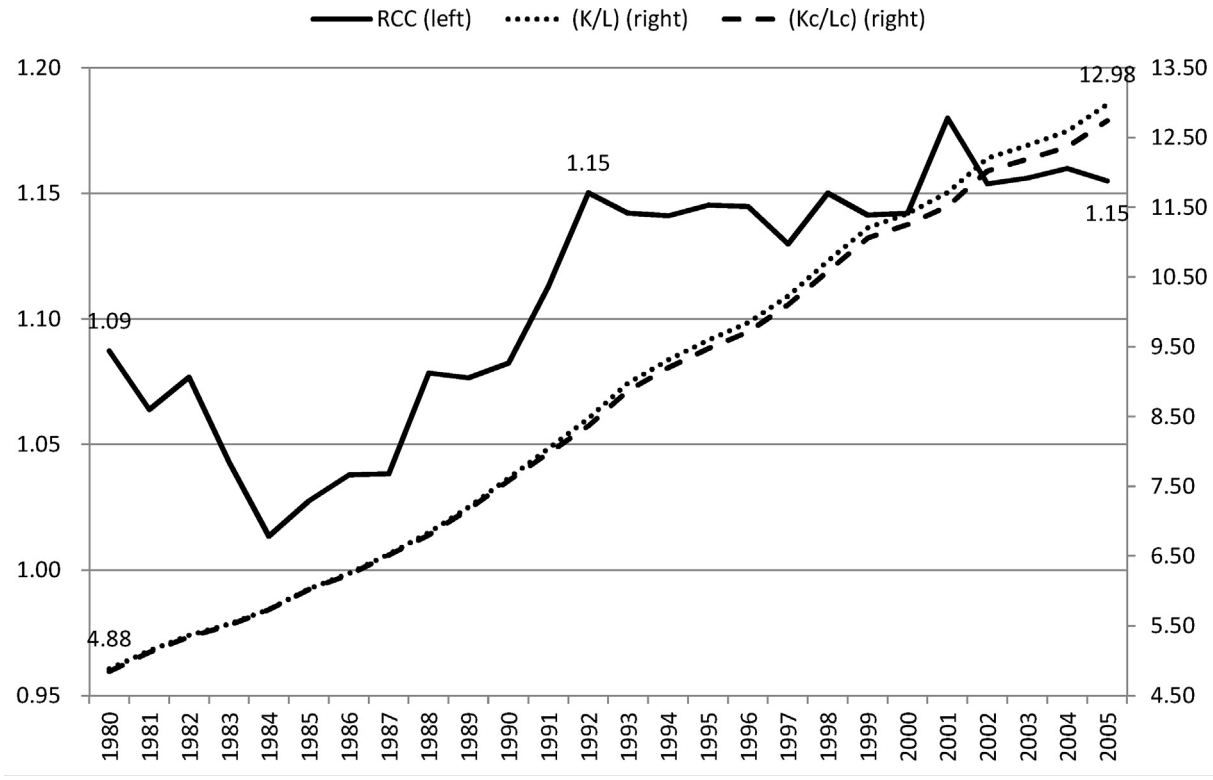
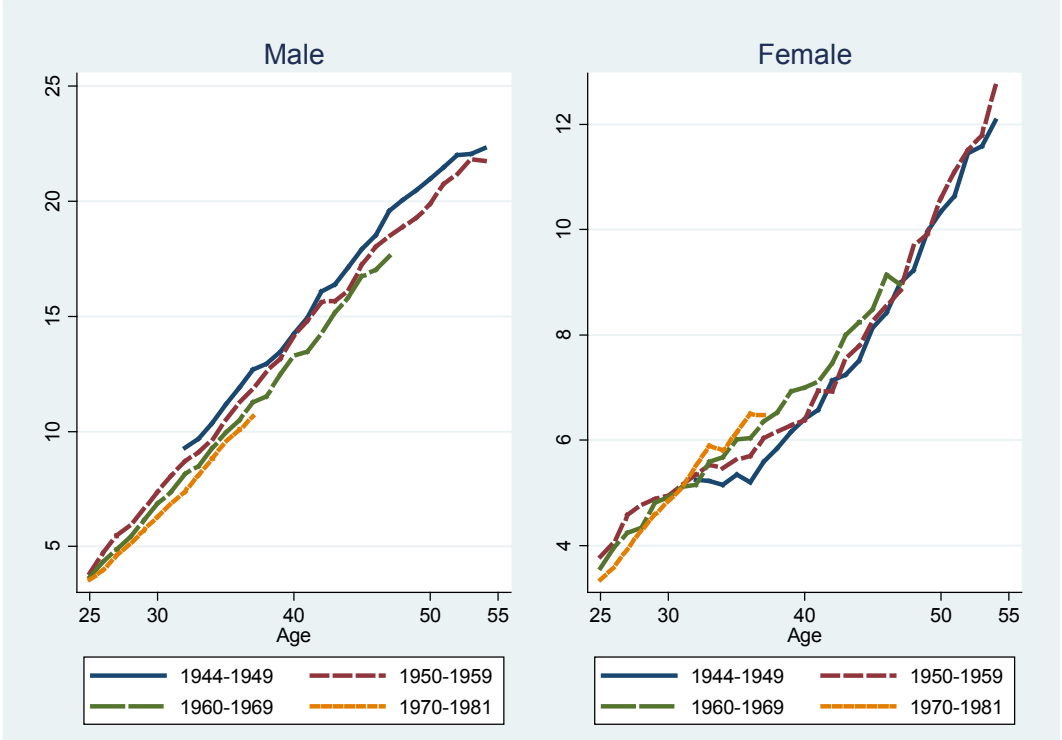


Fig. A1. Relative capital content (RCC) of Japanese trade, 1980–2005.
Source: The author's calculation, based on the JIP database 2009.

Figure 2A: Mean Tenure by birth cohort, Employment Status Survey



Questions

How does managerial skill (intangible capital) accumulate across generations?

How does a negative shock generate a persistent stagnation and a rise in inequality?

How does a small difference in initial condition lead to a large inequality across people?

Approach

Overlapping Generations Model with On-the-Job-Training + Limited Commitment

Skilled managers can train young workers to become future managers

Training is costly: Investment in intangible capital

Outcome of training is subject to idiosyncratic shock

Firm is a coalition of present and future managers and shareholders

Training is partially firm-specific human capital

Young workers are heterogeneous in initial endowment and ability

With full commitment, training only depends upon learning ability, and idiosyncratic shocks are completely insured

$\longrightarrow$ No income inequality, controlling the ability

Under limited commitment, future manager cannot pre-commit to stay in the same firm

$\longrightarrow$ Training received depends upon both endowment and learning ability

Rich young workers receive more intensive training, while poor young workers work as simple workers for life

$\longrightarrow$ Managers absorb some upside idiosyncratic shocks $\longrightarrow$ Large inequality

Decline of endowment or tightening of limited commitment

$\longrightarrow$ intangible investment $\Downarrow$, aggregate production $\Downarrow$, inequality $\Uparrow$ persistently

Model

Overlapping generations: a unit measure of agents are born every period and lives for 2 periods

When young, each agent is endowed with goods e and learning ability κ

$$(e, \kappa) \sim F(e, \kappa) \text{ on } e \in [0, \bar{e}] \text{ and } \kappa \in [0, \bar{\kappa}]$$

Everyone is endowed with unit of time, and work as a worker or a manager

Utility function of agent born at date t is given by

$$U = E[U(c_t^y, c_{t+1}^o)] = \ln c_t^y + \beta E(\ln c_{t+1}^o)$$

Firm is a dynamic coalition of managers and shareholders

Present managers can allocate K^w total skill (intangible capital) for production and hire L labor to produce output

$$y = A(K^w)^{\alpha} L^{1-\alpha}$$

When present managers allocate $\tilde{k}$ intangible and a young with κ learning ability allocates $h \in [0, 1]$ time for training, the expected intangible of the next period is

$$k^+ = \frac{1}{b}\tilde{k}^{\eta}(h\kappa)^{1-\eta}$$

Outcome of individual training depends upon idiosyncratic shock

$$\begin{aligned} k_z^+ &= zk^+ \\ z &\sim \Phi(z) \text{ on } (0, \infty), \text{ where } E(z) = 1 \end{aligned}$$

Intangible is partially coalition specific: Shrinks from k_z^+ to $(1-\theta)\, k_z^+$ by moving to another coalition

The present managers and shareholders with total intangible K choose K^w, L^w, L^m and $\{n, c^y, h, \tilde{k}, k^+, c_z^o\}(\kappa, e)$ to maximize

$$A_t(K^w)^\alpha(L^w + L^m)^{1-\alpha} - w_t L^w +$$

$$\int \left\{ e \text{ -} c^y(\kappa, e) + q_t \int \left[r_{t+1} z k^+(\kappa, e) - c_z^o(\kappa, e) \right] d\Phi \right\} n(\kappa, e) dF$$

subject to

$$K = K^w + \int \tilde{k}(\kappa, e) n(\kappa, e) dF$$

$$L^m = \int [1 - h(\kappa, e)] n(\kappa, e) dF$$

$$\ln c^y(\kappa, e) + \beta \int \ln c_z^o(\kappa, e) d\Phi(z) \geq V(\kappa, e)$$

$$c_z^o(\kappa, e) \geq (1 - \theta) r_{t+1} z k^+(\kappa, e)$$

Equilibrium is K_t^w, L_t^w, L_t^m, $\{n, c^y, h, \tilde{k}, k^+, c_z^o, V\}(\kappa, e), r_t$, q_t, w_t as functions of state $(L_t^o,\ K_t, A_t,\ \theta_t, F_t)$ such that

a) Firms' policy functions solve their problem;

b) Labor and financial markets clear;

$$\begin{aligned} w_t &= (1-\alpha)A_t[K_t^w/(L_t^w + L^m)]^\alpha \\ L_t^w &= L_t^o + L_{t+1}^o \end{aligned}$$

$$\begin{aligned} \int e dF + w_t &= \int_{\Theta_t} \left[w_t h_t(\kappa, e) + r_t \tilde{k}_t(\kappa, e)\right] dF + \int c_t^y(\kappa, e) dF \\ \Theta_t &= \{(\kappa, e) : n_t(\kappa, e) > 0\} \end{aligned}$$

c) K_{t+1} and L_{t+1}^o follow law of motion;

$$L_{t+1}^o = \int [1 - n_t(\kappa, e)] dF_t(\kappa, e)$$

$$K_{t+1} = \int_{\Theta_t} \int z k_t^+(e, \kappa) n_t(\kappa, e) d\Phi(z) dF_t(\kappa, e)$$

Claim: With full commitment $\theta = 1$,

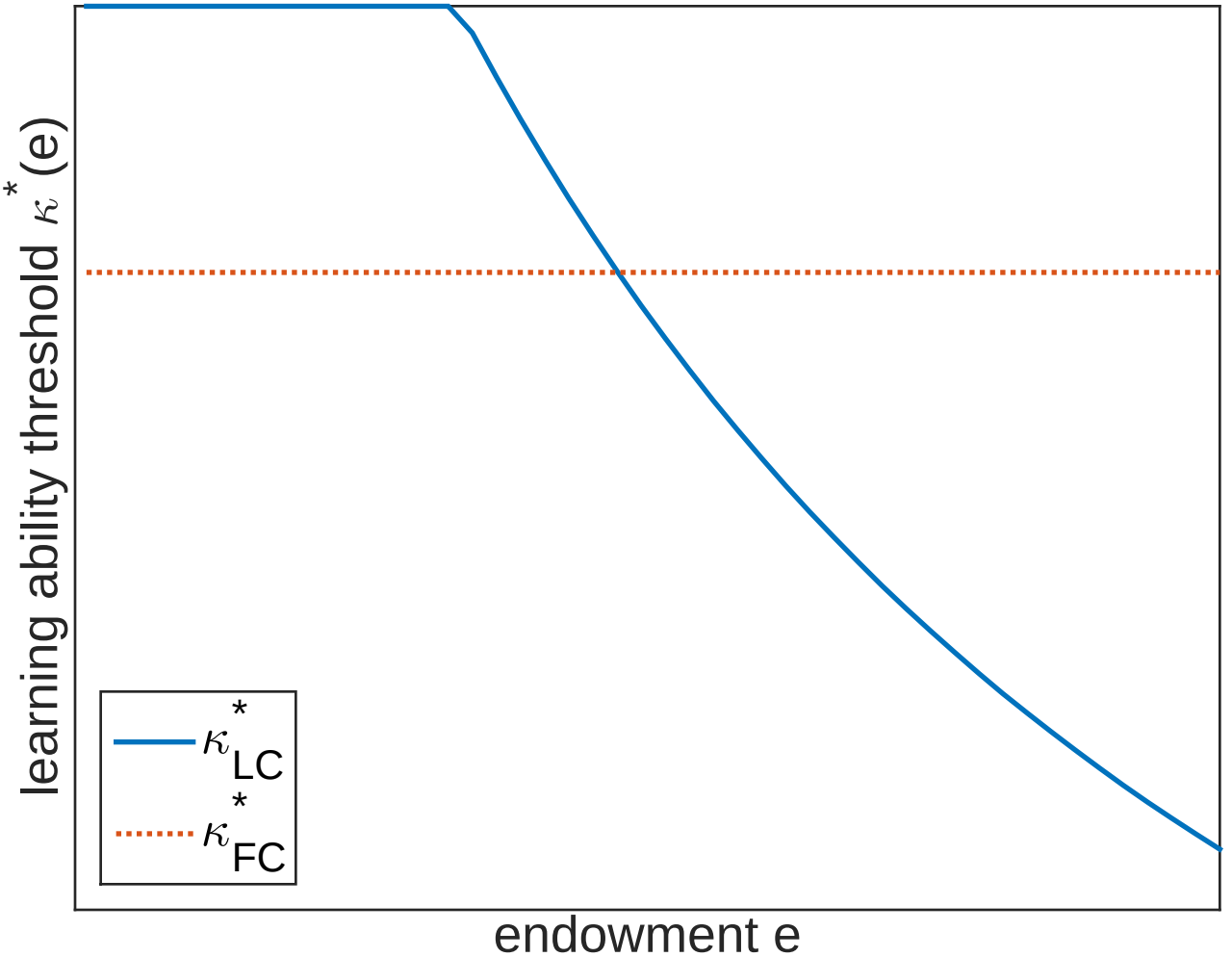
a) Only young agents with $\kappa \geq \kappa_t^*$ are trained

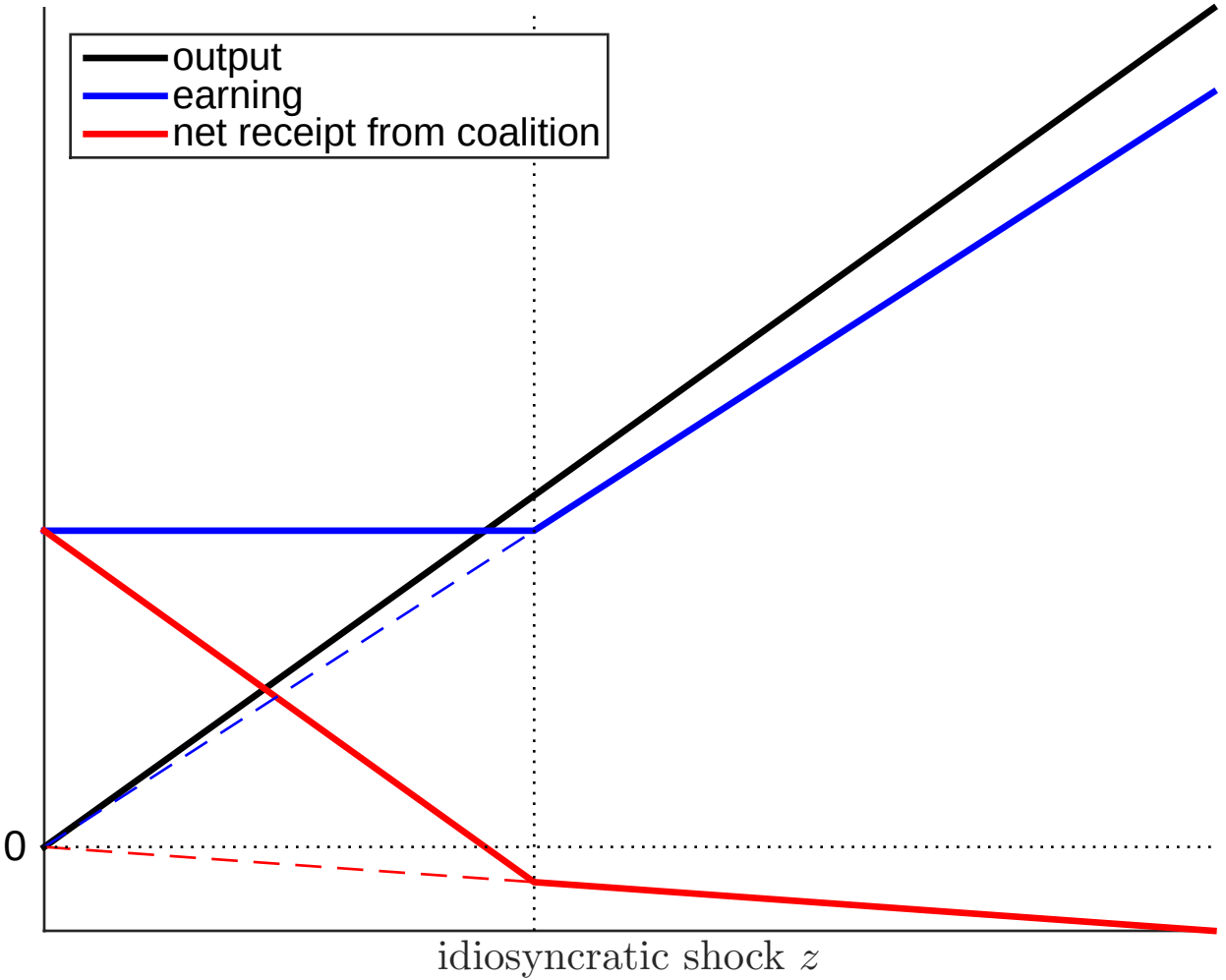
b) Among the trainees, young agent with higher learning ability receives more intensive training to become a more productive manager

$$k_{z,t+1} = z\underset{(+),(0)}{k_t^+(\kappa, e)} = za_t^* \cdot \kappa$$

c) All idiosyncratic shocks are insured among managers of the same type

$$c_{z,t+1}^o(\kappa, e) = c_{t+1}^o(\kappa, e) \text{ for } \forall z$$


learning ability threshold κ^* (e)
endowment e
κ^*_{LC}
κ^*_{FC}

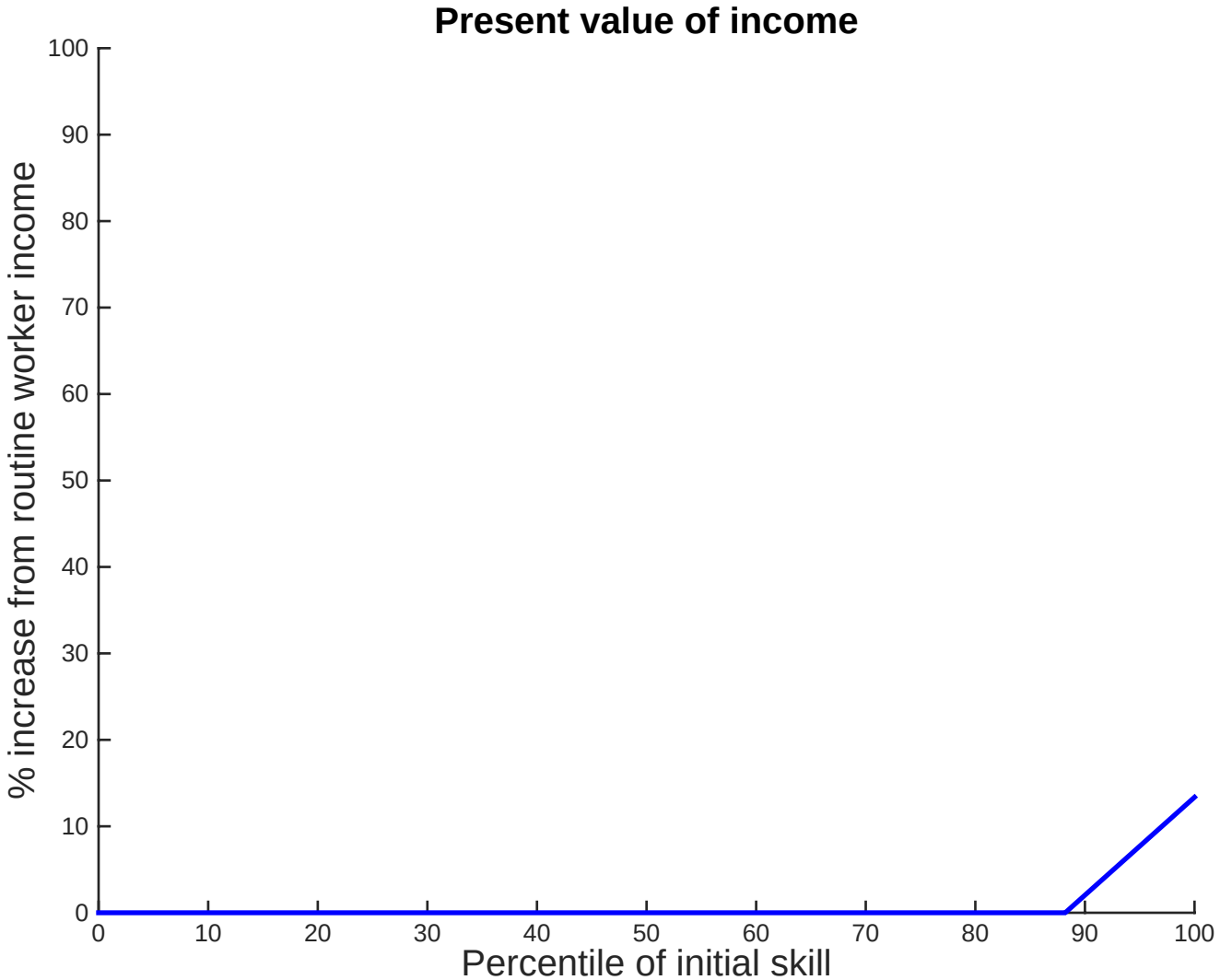

output
earning
net receipt from coalition
0
idiosyncratic shock z

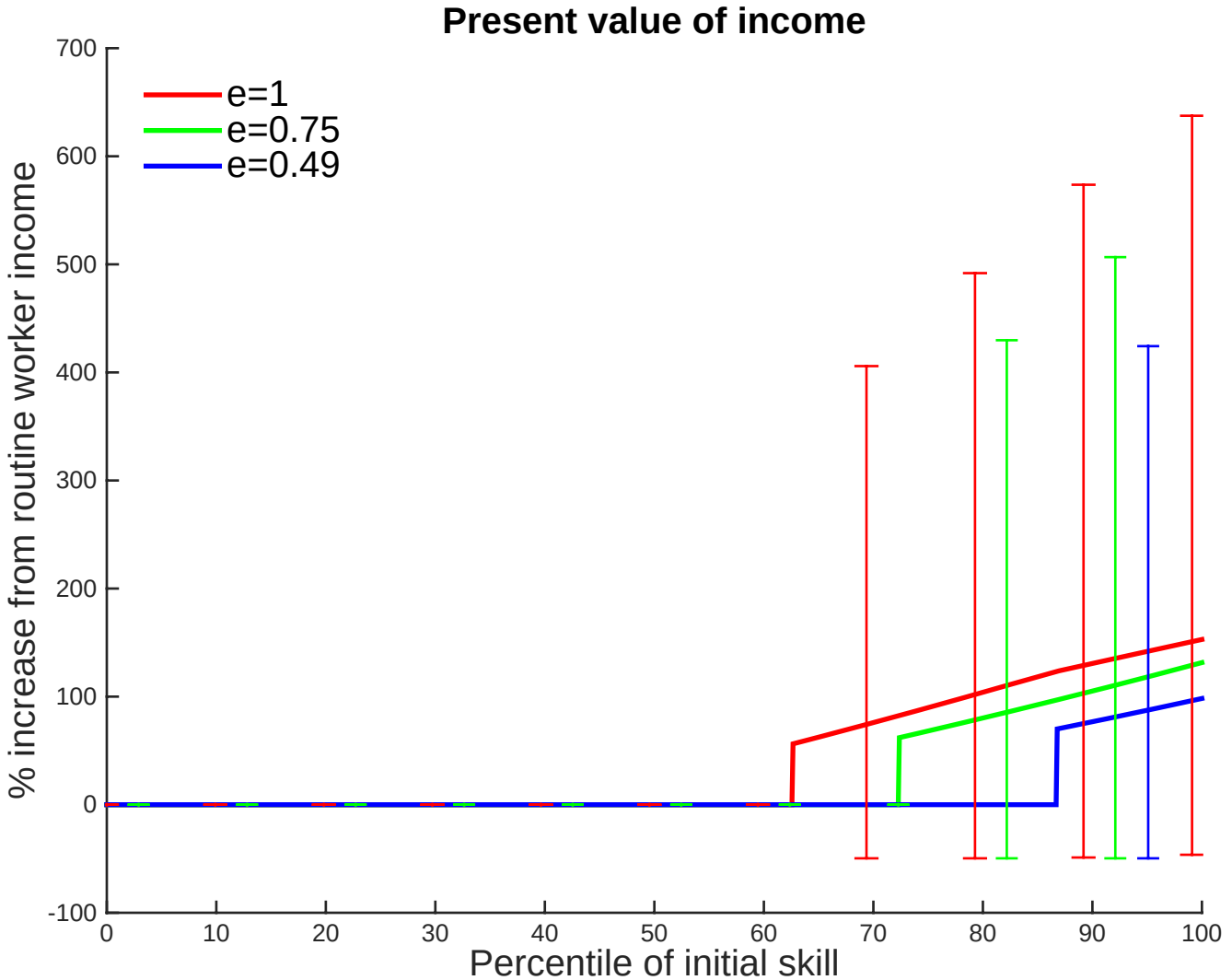
Numerical Example

Distribution of endowment and learning skill is independent and

$$G_t(e) = 1 - \omega_t + \omega_t \frac{e}{\bar{e}_t}, \text{ for } e \in [0, \bar{e}_t], \; H(\kappa)$$

fraction of positive endowment ω	0.8
upper bound of endowment $\bar{e}$	1
learning ability distribution	$U[0, 1]$
share of intangibles α	0.3
share of manager's skill η in training	0.3
utility discount β	0.75
specificity of intangible capital θ	0.1
standard dev. of idiosyncratic shock z	1


Present value of income
% increase from routine worker income
Percentile of initial skill
0
10
20
30
40
50
60
70
80
90
100


Present value of income
e=1
e=0.75
e=0.49
% increase from routine worker income
700
600
500
400
300
200
100
0
-100
0
10
20
30
40
50
60
70
80
90
100
Percentile of initial skill

Adding Match-Specific Shocks

The realized intangible depends upon match-specific and common idiosyncratic shocks ζ and z

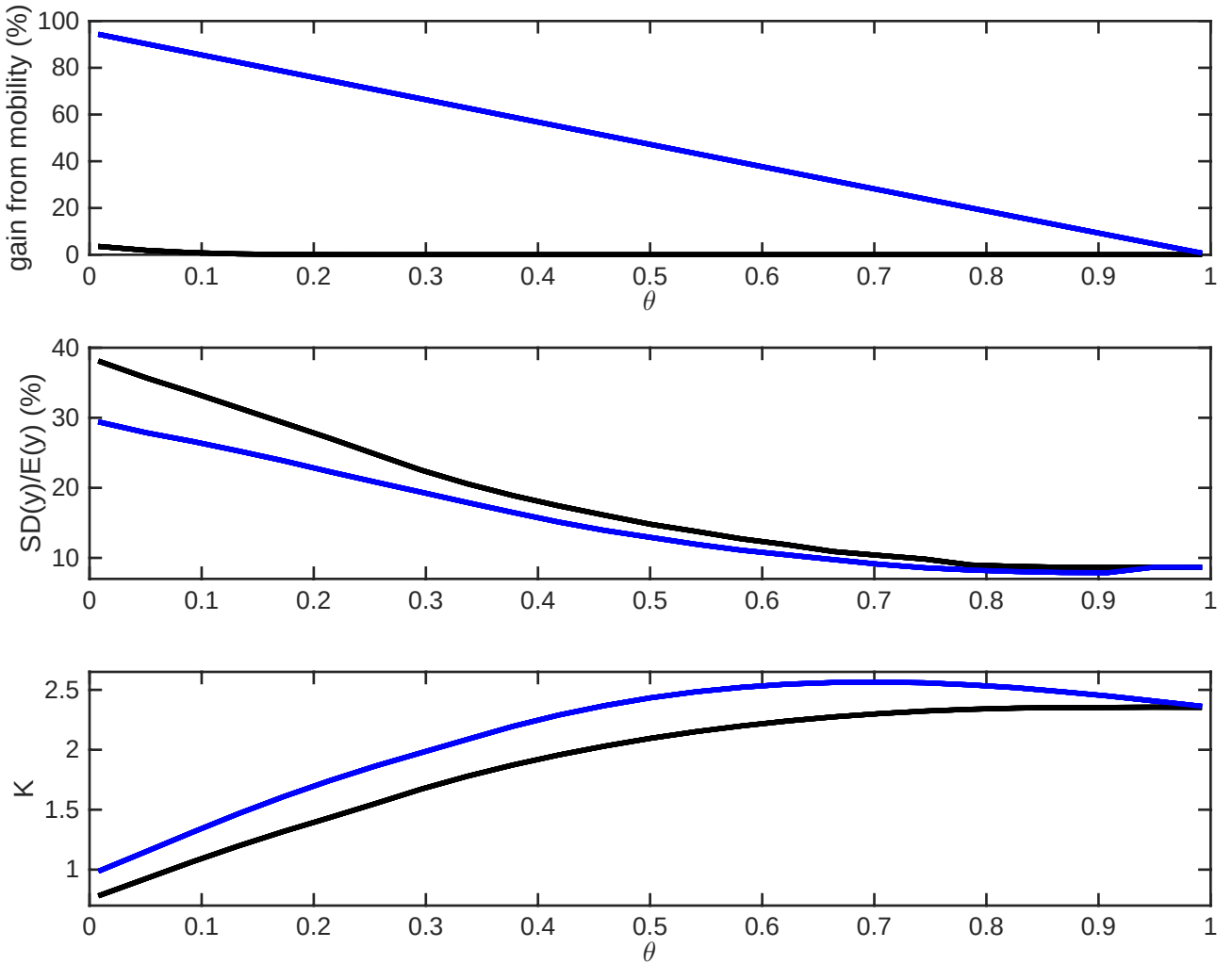
$$k^+_{\zeta,z} = \zeta \cdot z \cdot k^+$$

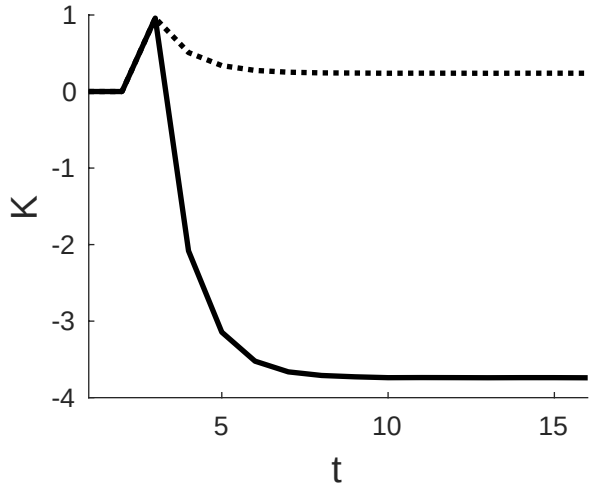
When old, manager can move to a new firm to draw a new ζ. Because ζ is insurable, manager moves to a new firm iff

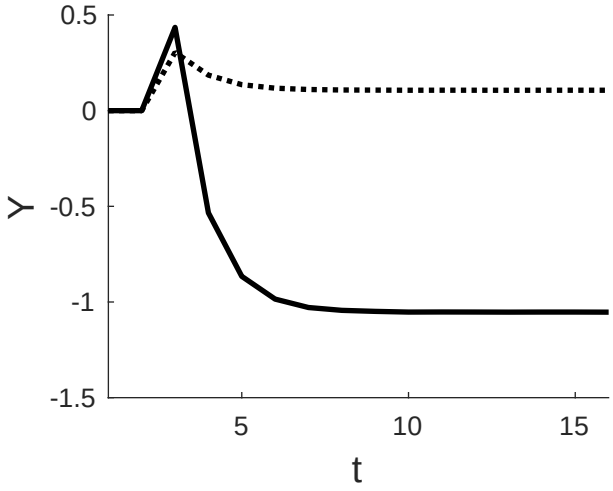
$$\zeta < (1-\theta)E(\zeta) = 1-\theta$$

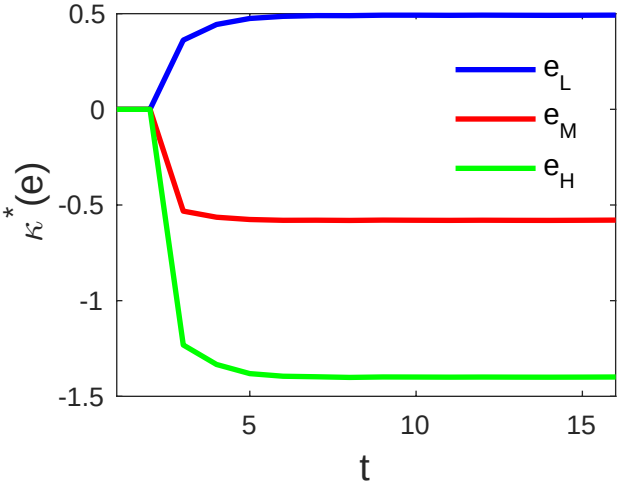
The incentive constraint becomes

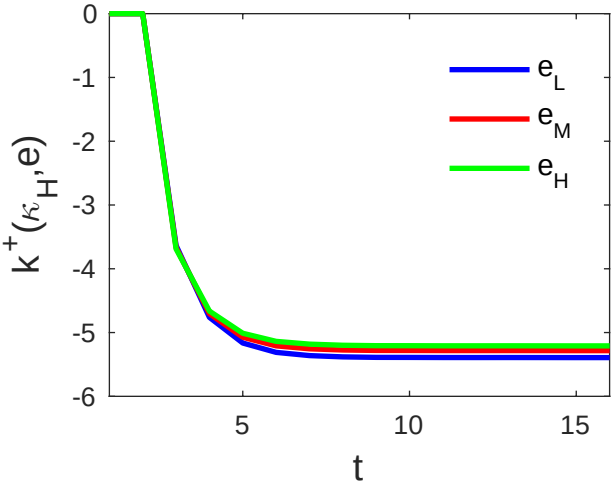
$$c^o_z(\kappa, e) \geq r(1-\theta)zk^+(\kappa, e)$$

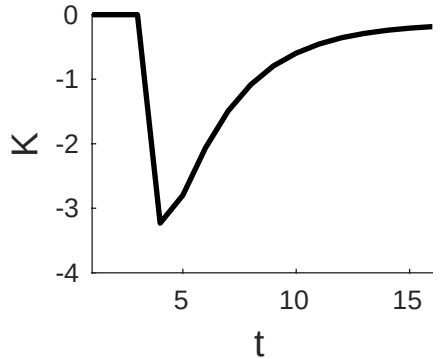

gain from mobility (%)
100
80
60
40
20
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
θ
SD(y)/E(y) (%)
40
30
20
10
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
K
2.5
2
1.5
1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
θ

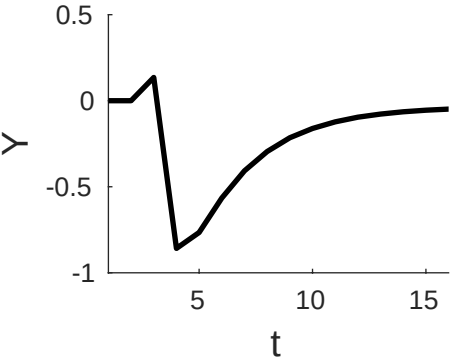

K
t
1
0
-1
-2
-3
-4
5
10
15

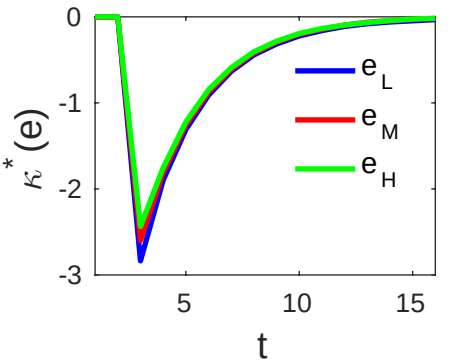

Y
t
0.5
0
-0.5
-1
-1.5
5
10
15

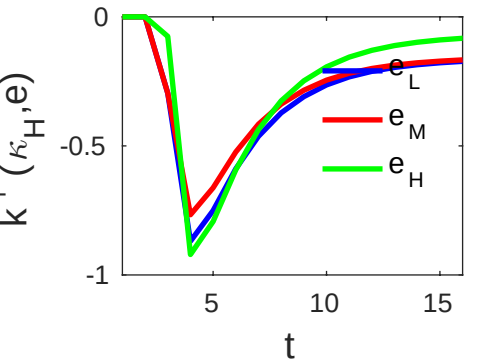

$\kappa^*(e)$
t
0.5
0
-0.5
-1
-1.5
5
10
15
e_L
e_M
e_H


$k^+(\kappa_H,e)$
t
0
-1
-2
-3
-4
-5
-6
5
10
15
e_L
e_M
e_H


0
-1
-2
-3
-4
K
5
10
15
t


0.5
0
-0.5
-1
Y
5
10
15
t


0
-1
-2
-3
κ* (e)
e L
e M
e H
5
10
15
t


0
-0.5
-1
k+ (κH,e)
e L
e M
e H
5
10
15
t

Conclusion

With limited commitment, ability and endowment of individual affects

- occupation at extensive margin
- investment in intangible at intensive margin
- insurance against idiosyncratic risk

At the aggregate, limited commitment leads to

- inequality in permanent and realized income and consumption
- persistent aggregate effects from permanent or temporary shock to commitment and endowment

Literature

Dynamic coalition and intangibles

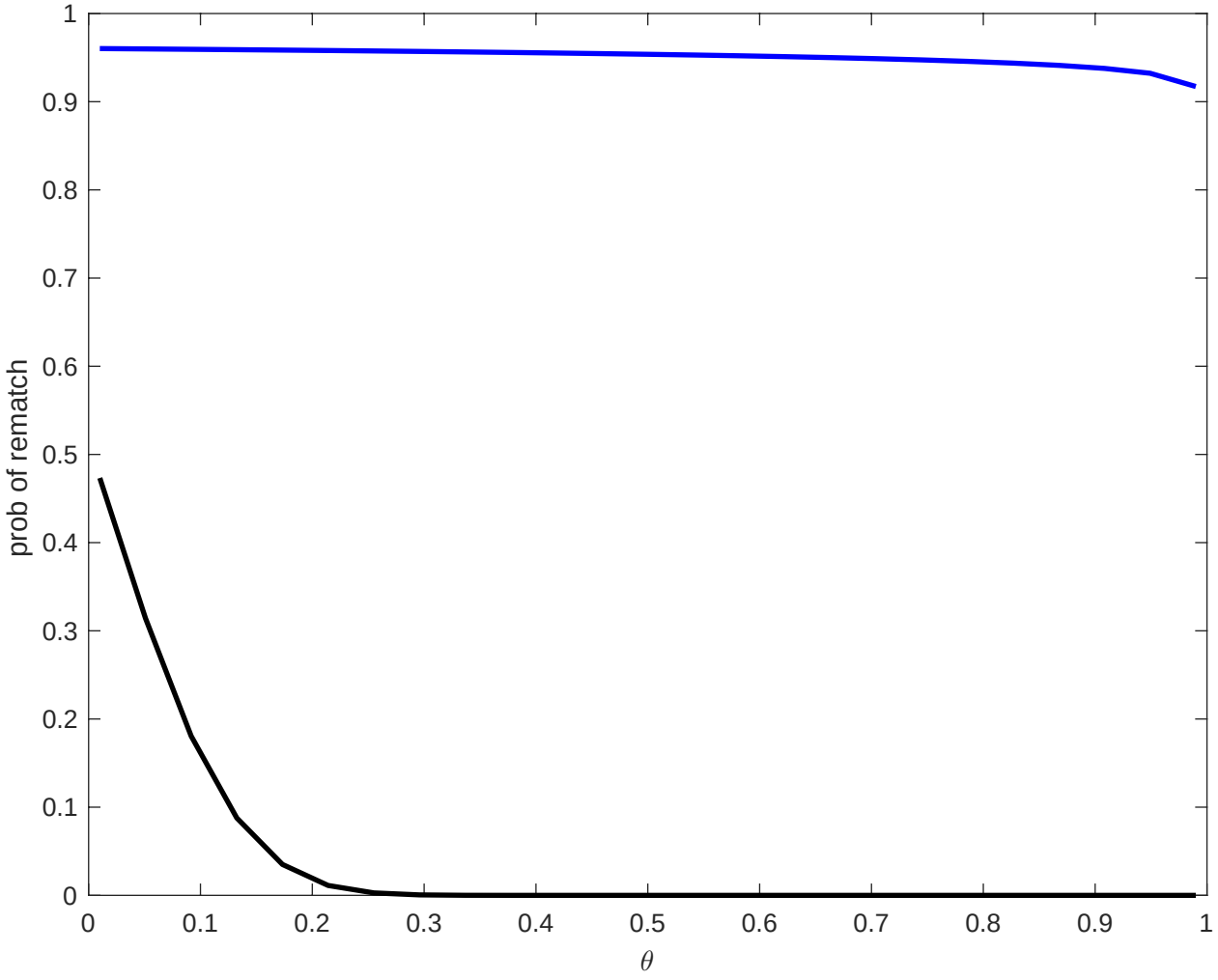
Boyd-Prescott (1987), Chari-Hopenhyn (1991), Kim (2006)

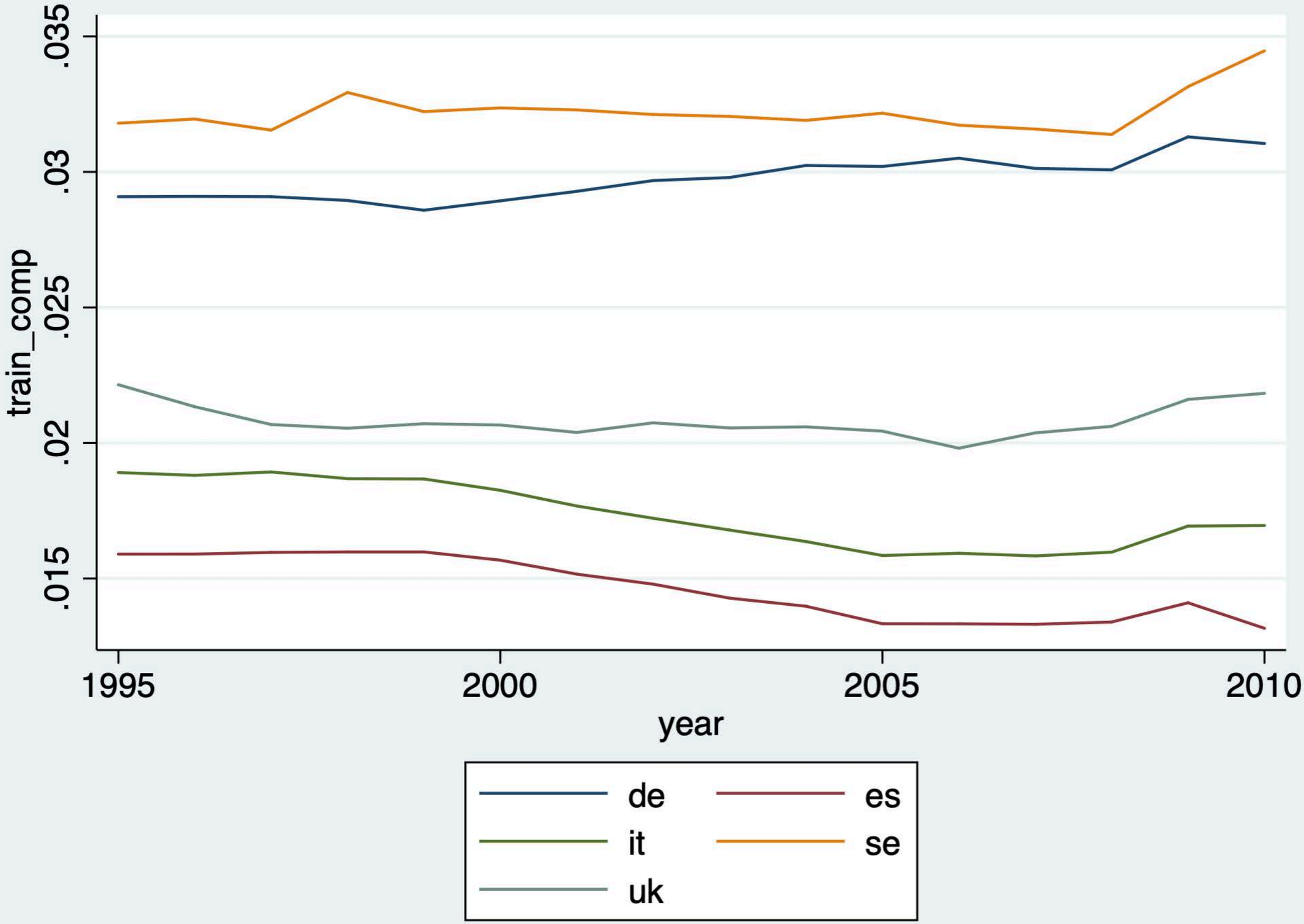
Financial friction, human capital and inequality

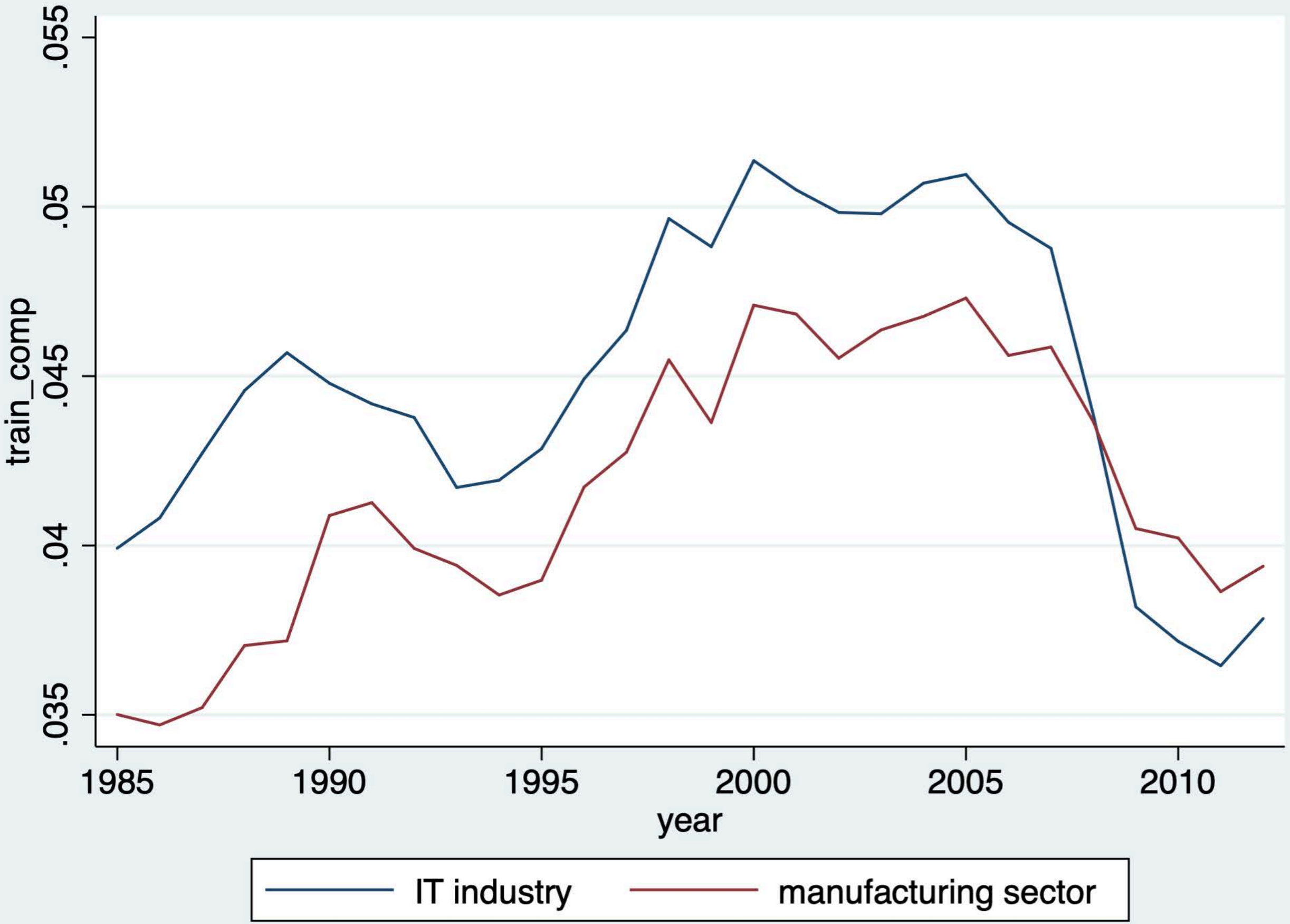
Galor-Zeira (1993), Banerjee-Newman (1993), Benabou (2002), Carneiro-Heckman (2002), Banerjee-Duflo (2005), Lochner-Monge -Naranjo (2011)

Financial friction and misallocation of capital

Kiyotaki (1998), Buera (2009), Buera-Shin (2013), Moll (2014)


prob of rematch
θ
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


train_comp
.015
.02
.025
.03
.035
1995
2000
2005
2010
year
de
es
it
se
uk


train_comp
.035
.04
.045
.05
.055
1985
1990
1995
2000
2005
2010
year
IT industry
manufacturing sector