PhD Topics in Macroeconomics

Lecture 12: misallocation, part four

Chris Edmond

2nd Semester 2014

This lecture

Buera/Shin (2013) model of financial frictions, misallocation and the transitional dynamics of growth miracles

1- motivating facts on transitional dynamics of growth miracles (focus on features inconsistent with neoclassical growth model)

2- model of entrepreneurship, credit frictions and misallocation

3- quantitative experiments, response to reduction in misallocation

Motivation

(1) Growth miracles followed large-scale, economy-wide reforms

(Japan 1949, Taiwan 1959, Korea 1961, Singapore 1967, Malaysia 1968, Thailand 1983, China 1992)

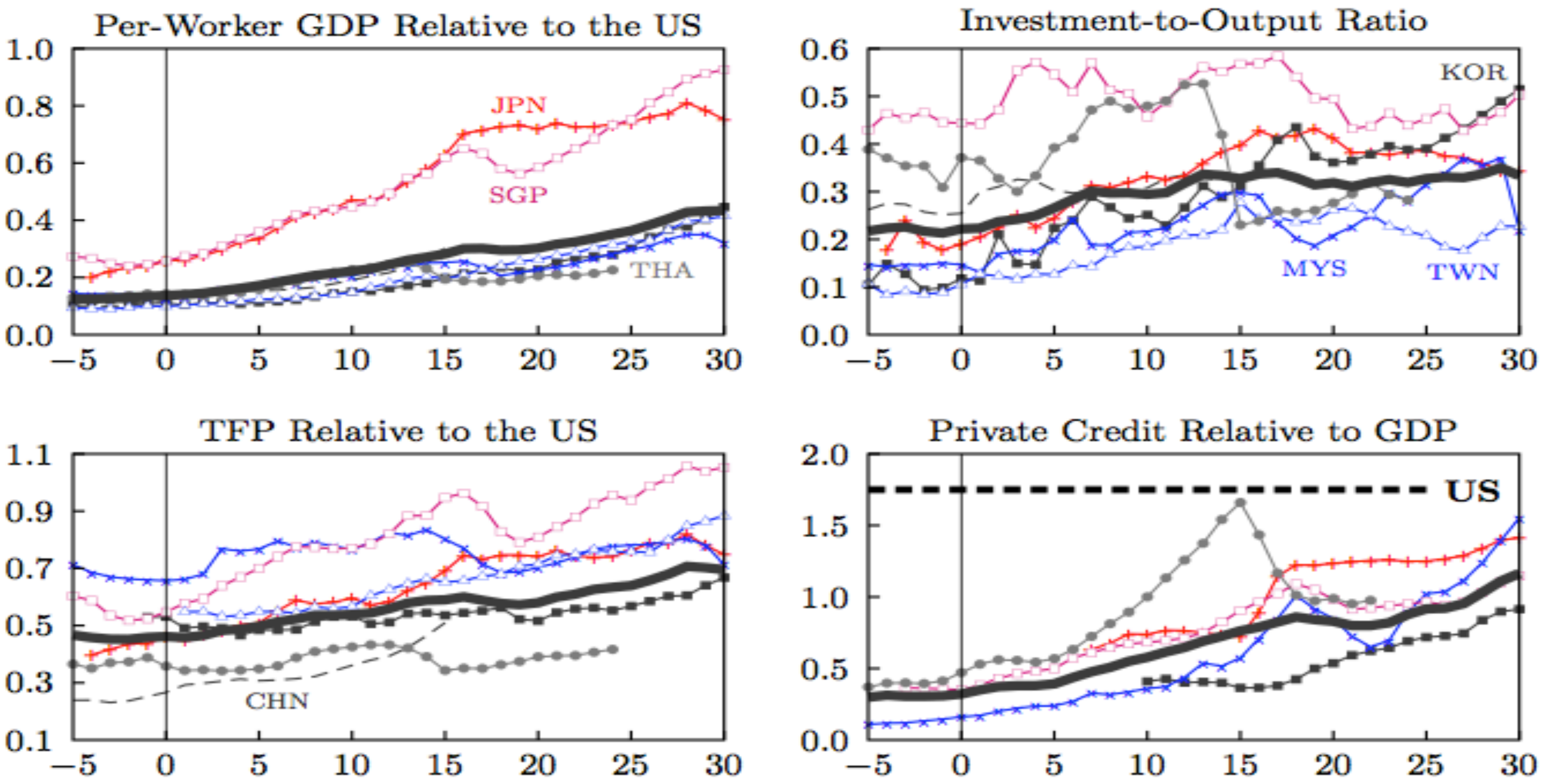
(2) Even these growth miracles were drawn out, the catch-up to richest countries took several decades

(3) Large fraction of catch-up explained by sustained growth in TFP

(4) Investment-to-GDP ratios roughly 'hump-shaped', not the monotone dynamics implied by a neoclassical growth model

(5) Financial markets remained underdeveloped through early stages of transition

Transitional dynamics of growth miracles



Transitions following reforms (year zero). Sustained growth, but slow relative to neoclassical growth model. Such a model also predicts a monotone decreasing investment-to-GDP ratio. Low levels of external finance throughout early stages of transition.

Transitional dynamics of growth miracles

- Neoclassical growth model with standard calibration implies half-life of convergence ≈ 6 years
  - but for these growth miracles, half-life at least 15 years
- Neoclassical model implies investment rate jumps at beginning of 'reform' then decreases monotonically back to long-run value
  - but for these growth miracles, investment rate responds slowly, builds to peak and only then begins to fall back
- Buera and Shin build a model with misallocation and financial market frictions that can explain these transitional dynamics

Model: overview

- Discrete time $t = 0, 1, \ldots$
- Individuals heterogeneous in wealth w and ability a
- *Occupational choice*: each period, individuals choose either (i) work for wage or (ii) be entrepreneur and run own firm
- *Collateral constraint*: entrepreneur's ability to hire productive capital is limited by wealth

Heterogeneity

- Individuals have wealth w and ability a

- Ability a *exogenous*. With probability ψ retain current a, with probability $1-\psi$ draw new ability a' from Pareto distribution

  Let $F(a' \,|\, a)$ denote CDF for a' conditional on current ability a

  Let $\mu(a)$ denote the associated stationary CDF for a

- Wealth w *endogenous* through consumption/savings decisions

  Let $G_t(w, a)$ denote joint CDF of (w, a) in period t

  Let $G_t(w \,|\, a)$ denote CDF for w conditional on ability a in period t

Technology

- Any individual can work for wage or operate own technology

- Technology uses ability (fixed factor) and variable capital and labor

$$y = af(k, l), \qquad f(k, l) := (k^{\alpha} l^{1-\alpha})^{1-\nu}, \qquad 0 < \alpha, \nu < 1$$

  with span of control parameter $1 - \nu$

- No 'market for ability'.

Financial frictions

- Physical capital is only asset

- Capital rental k limited by entrepreneur's wealth w

$$k \leq \lambda w, \qquad \lambda \geq 1$$

- Exogenous parameter λ controls severity of financial frictions

  - $\lambda = 1$: financial autarky, all capital self-financed

  - $\lambda = \infty$: perfect financial markets

- Potential profits from entrepreneurial technology

$$\pi_t(w,a) = \max_{l,\, k \leq \lambda w} \left[af(k,l) - \omega_t l - (r_t + \delta)k \right]$$

- Let $l_t(w,a)$ denote demand for labor given factor prices ω_t, r_t

- Let $k_t(w,a)$ denote demand for capital given factor prices ω_t, r_t

Dynamic programming

- Let $V_t(w, a)$ denote value function of individual with state (w, a)

- This value function solves the Bellman equation

$$V_t(w, a) = \max_{w' \geq 0} \left[U(c) + \beta \int_1^\infty V_{t+1}(w', a') \, dF(a' \mid a) \right]$$

subject to budget constraint

$$c + w' \leq \max \left[\omega_t \, , \, \pi_t(w, a) \right] + (1 + r_t) w$$

- Let $w' = h_t(w, a)$ denote the associated policy function

Occupational choice

- Threshold wealth $w_t^*(a)$ for each ability type, solves

$$\pi_t(w^*, a) = \omega_t$$

- Type-a individuals with wealth $w \geq w_t^*(a)$ become entrepreneurs

- Type-a individuals with wealth $w < w_t^*(a)$ do not have enough wealth to operate technology at profitable scale (given a)

  Put differently, individuals with given wealth w only become entrepreneurs if their ability a is high enough

- With perfect financial markets ($\lambda = +\infty$), occupational choice depends only on ability a, not on wealth w

Market clearing

- *Labor market*:

$$\int_1^\infty \int_{w_t^*(a)}^\infty l_t(w,a)\, dG_t(w \,|\, a)\, d\mu(a) = \int_1^\infty G_t(w_t^*(a) \,|\, a)\, d\mu(a)$$

(demand from entrepreneurs equals supply by non-entrepreneurs)

- *Capital rental market*:

$$\int_1^\infty \int_{w_t^*(a)}^\infty k_t(w,a)\, dG_t(w \,|\, a)\, d\mu(a) = \int_1^\infty \int_0^\infty w\, dG_t(w \,|\, a)\, d\mu(a)$$

(demand from entrepreneurs equals supply from all; physical capital is only asset)

Distributional dynamics

- Conditional distribution $G_t(w \,|\, a)$ evolves according to

$$G_{t+1}(w \,|\, a) = \psi \int_{u \leq w} \int_{h_t(v,a)=u} dG_t(v \,|\, a)\, du$$

$$+ (1-\psi) \int_1^{\infty} \int_{u \leq w} \int_{h_t(v,a)=u} dG_t(v \,|\, a)\, du\, d\mu(a)$$

given the policy function $w' = h_t(w, a)$ that solves the individual dynamic programming problem

Calibration: invariant parameters

- *Standard part.*

  - period utility CRRA with risk aversion $\sigma = 1.5$
  - depreciation rate $\delta = 0.06$ annual
  - capital's share of variable factor payments $\alpha = 0.33$

- *Non-standard part.* Still need to assign β, ν, ψ and Pareto shape η. US as frictionless ($\lambda = \infty$) benchmark, choose parameters to match

ν, η employment share of top 10% establishments by size ($= 0.67$)
earnings share of top 20% population ($= 0.3$)

ψ exit rate for establishments ($= 0.1$ annual)
β real interest rate ($= 0.045$ annual)

Gives parameters $\beta = 0.90$, $\nu = 0.21$, $\psi = 0.89$ and $\eta = 4.15$

Idiosyncratic distortions and financial frictions

- Initial condition will be that of an economy with idiosyncratic distortions $\tau_i \in (-1, 1)$ that act as an output tax/subsidy

- Consider entrepreneur i with state (w_i, a_i) and profits

$$\pi_{it}(w_i, a_i) = \max_{l,\, k \leq \lambda w_i} \Big[(1-\tau_i)\, a_i\, f(k,l) - \omega_t l - (r_t + \delta)k \Big]$$

- Financial friction λ is common to all (not indexed by i)

- Distortions will affect both static allocation of resources and occupational choice. Interaction with financial friction

Parameterization of distortions τ_i

- Binary outcomes $\tau_i \in \{\tau_-, \tau_+\}$ with $\tau_- \leq 0 \leq \tau_+$ and

$$\text{Prob}[\tau_i = \tau_+ \,|\, a] = 1 - \exp(-qa), \qquad q > 0$$

  note that probability of 'tax' increasing in ability a

- Entrepreneurs draw new τ_i whenever their a_i state changes (i.e., probability ψ keep τ_i, a_i; probability $1-\psi$ draw new τ_i, a_i)

- Now need to assign values to three additional parameters, τ_-, τ_+, q.

Calibration of distortions τ_i

- *Main idea*:

  – choose τ_-, τ_+ and q so that model matches *magnitude of long-run* changes in TFP and capital intensity

  – then evaluate model in terms of implications for *speed and shape of transitional dynamics*

- *Details*: choose parameters so that, 20 years after reforms,

  – measured TFP relative to the US increases by one-third
  – capital/ouput ratio increases by about 40%

  – and balanced budget for distortions, i.e., 'tax reveneues' = 'subsidy expenditures'

Gives parameters $\tau_+ = 0.5$, $\tau_- = -0.15$ and $q = 1.55$.

Calibration of financial friction λ

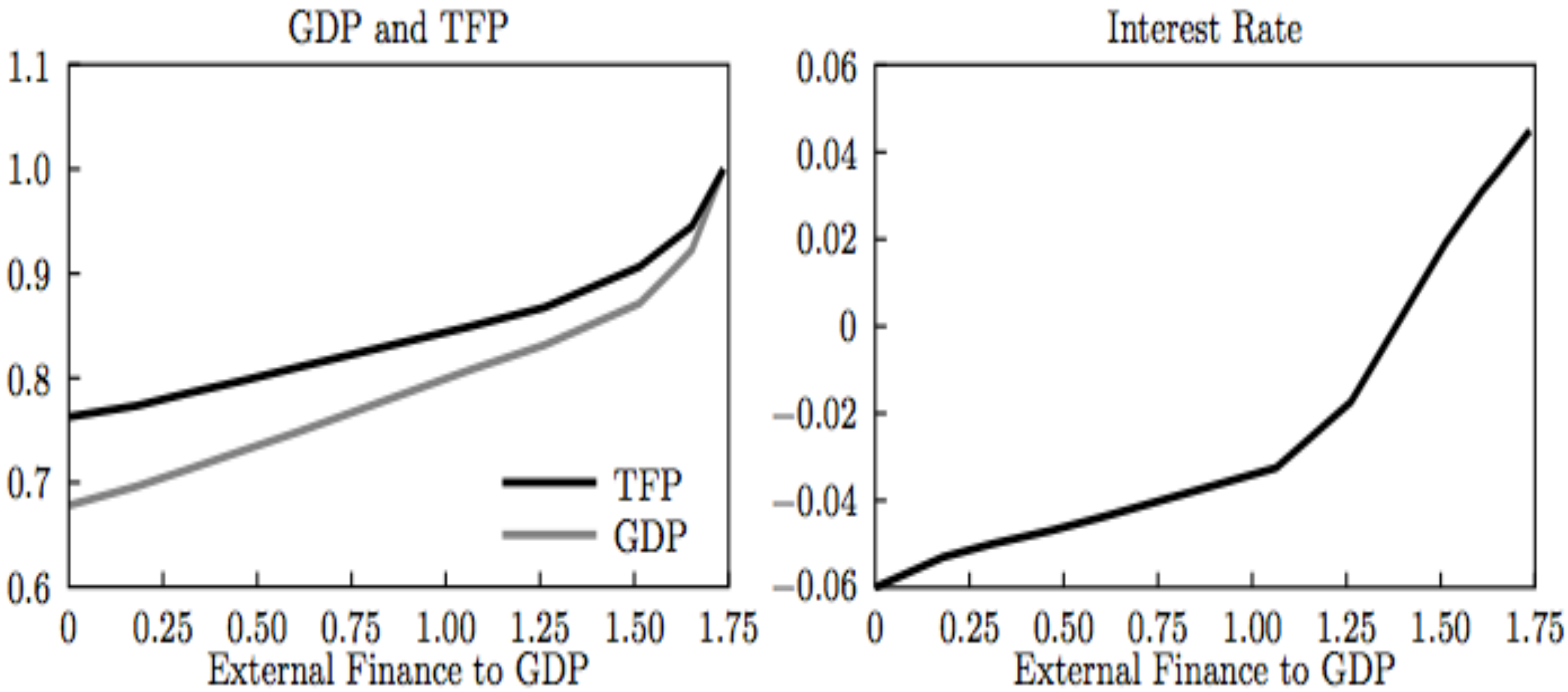
- Still need to assign financial friction λ. By varying λ, model implies different degrees of financial development

- Empirical range of external finance-to-GDP ratio is from 0.1 (least developed countries) to about 1.75 (the US)

- Buera/Shin choose λ so that model produces external finance-to-GDP ratio of 0.6 in absence of distortions

- Again, idea is to match long-run change. Gives $\lambda = 1.35$

Long run effects of financial frictions λ



Left panel shows GDP and TFP relative to perfect financial markets benchmark ($\lambda = \infty$). Financial frictions can significantly reduce both GDP and TFP (by distorting both allocation of capital and entry/exit decisions). Right panel shows low interest rates in economies with tighter financial frictions (low λ) both because of lower demand for capital and because more saving for self-financing.

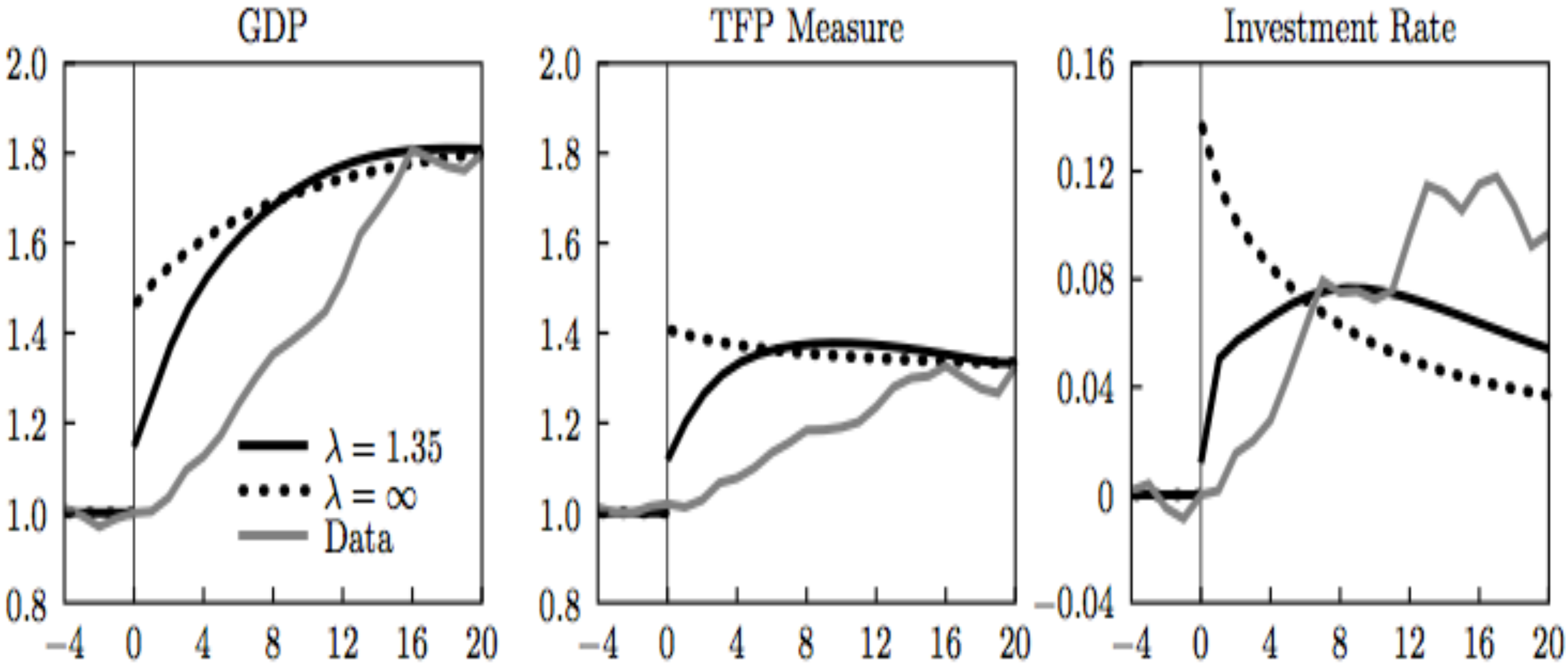
Benchmark transition experiment

- Start in initial equilibrium with idiosyncratic distortions τ_i and financial friction λ

- Unexpected once-and-for-all elimination of idiosyncratic distortions τ_i ('reform'), but no change in λ

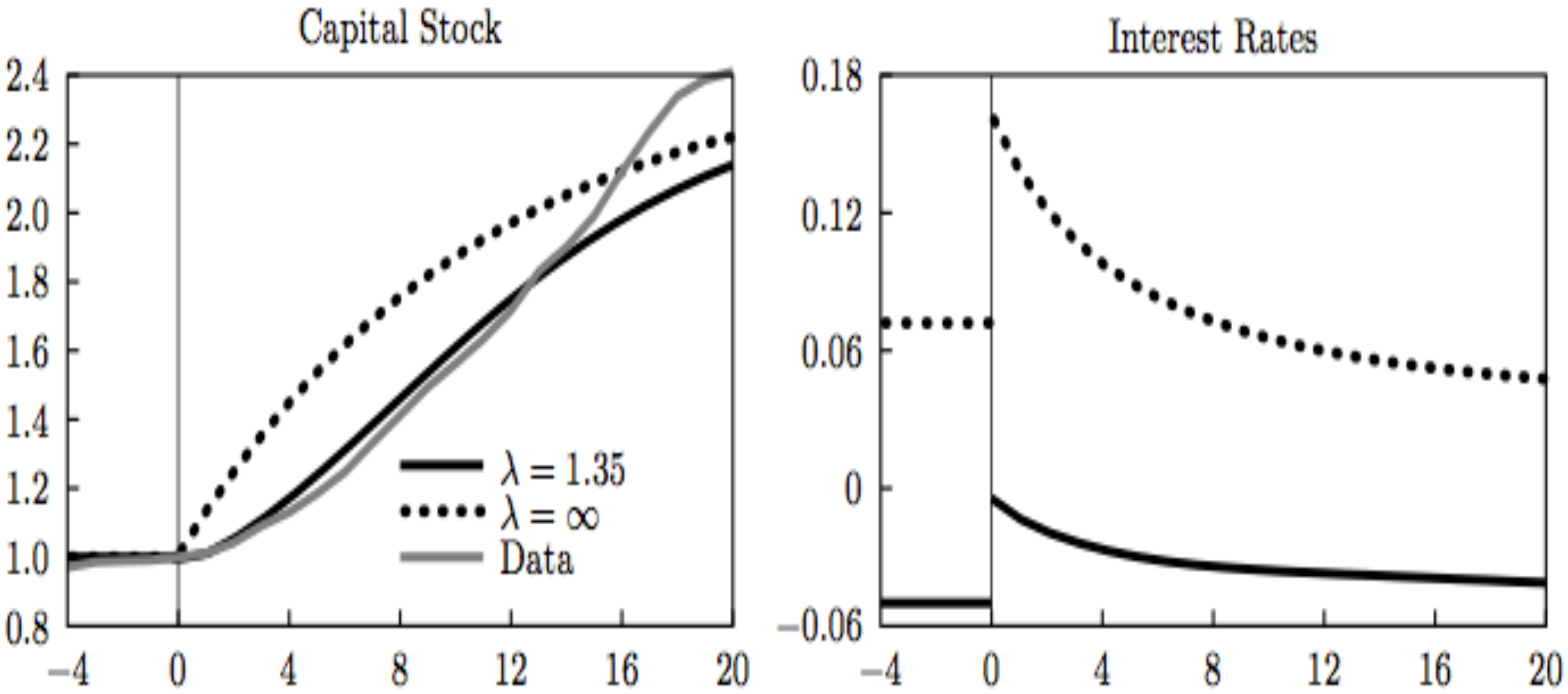
- All dynamics therefore endogenous, no additional dynamics induced by gradual change etc

Benchmark transition experiment

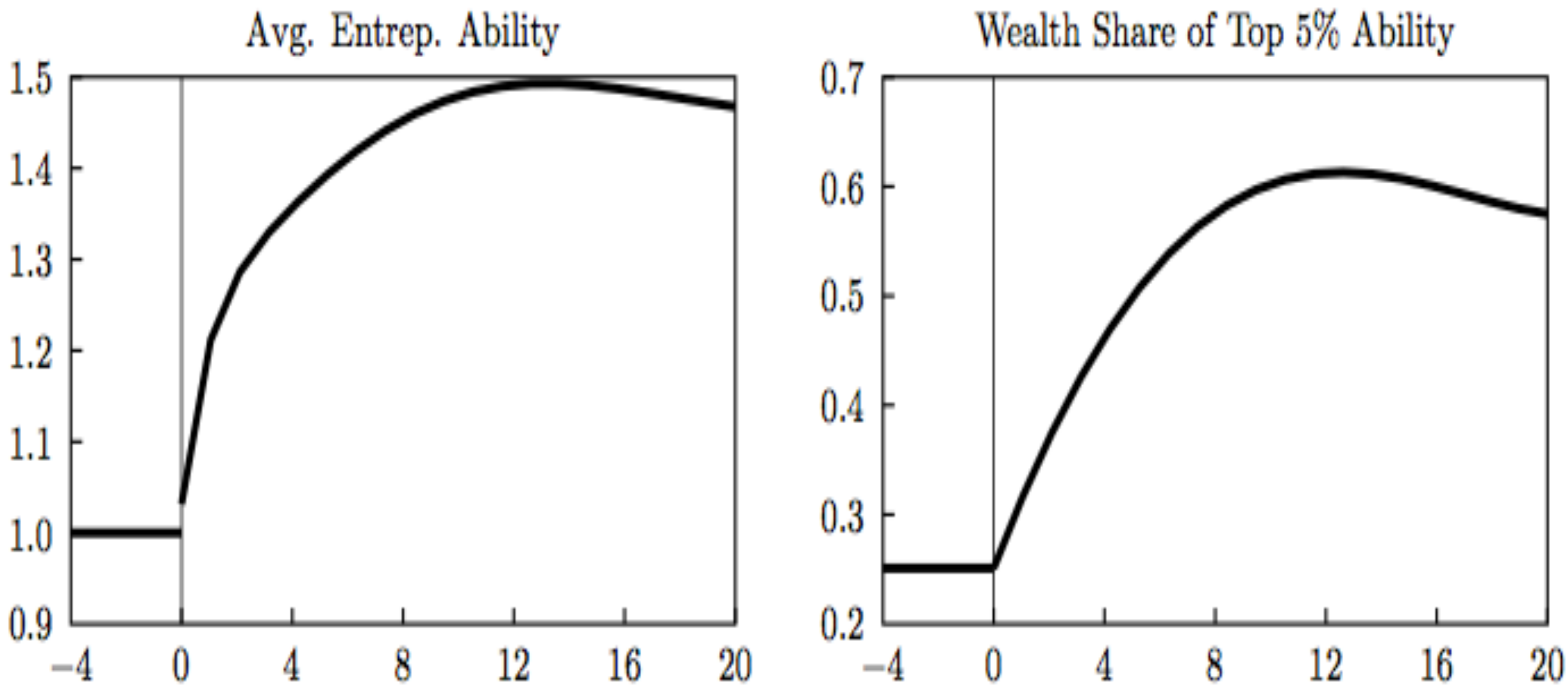


GDP and TFP normalized by pre-reform values; investment/GDP ratio as deviation from pre-reform value. Transition is slow compared to perfect financial markets benchmark. Endogenous TFP dynamics as *gradual* reallocation to more productive entrepreneurs (both through more efficient scale and entry/exit). Hump-shaped investment rate, not sudden spike.

Benchmark transition experiment

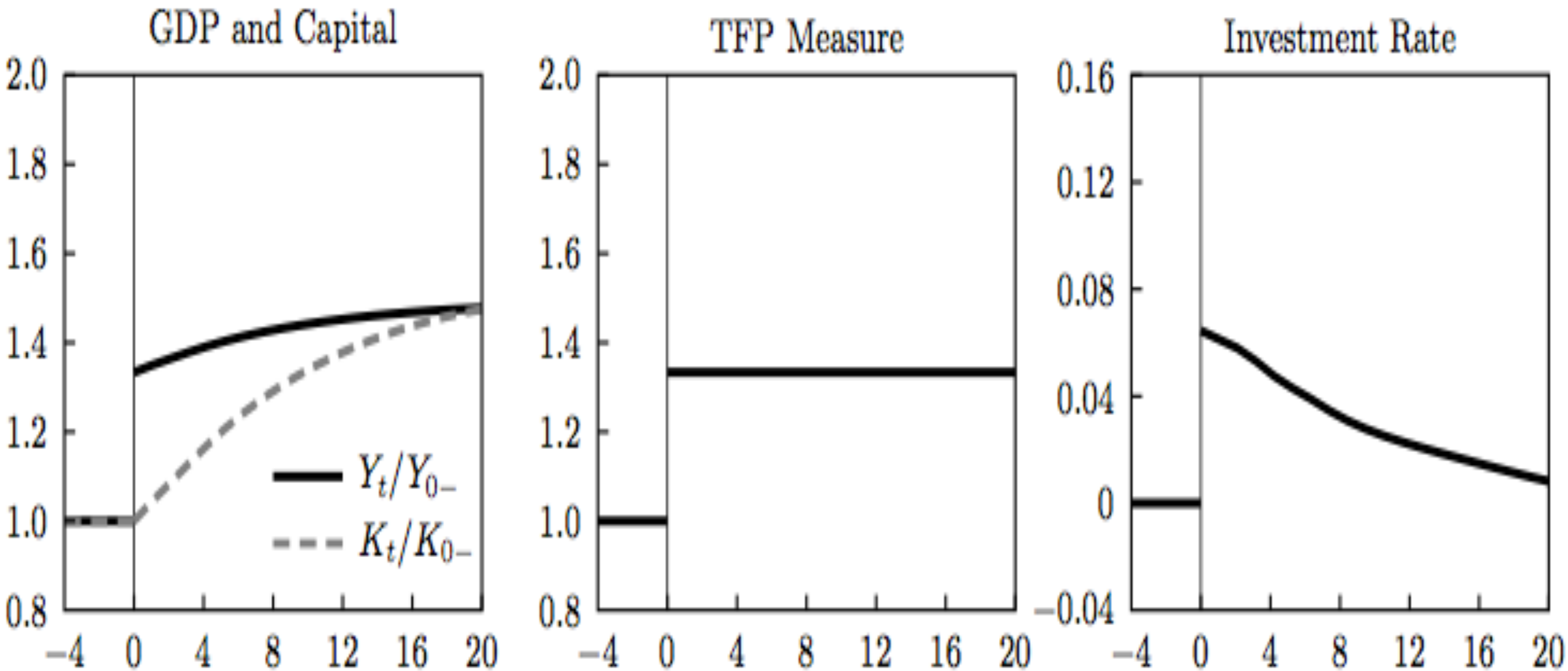


Micro implications of transition



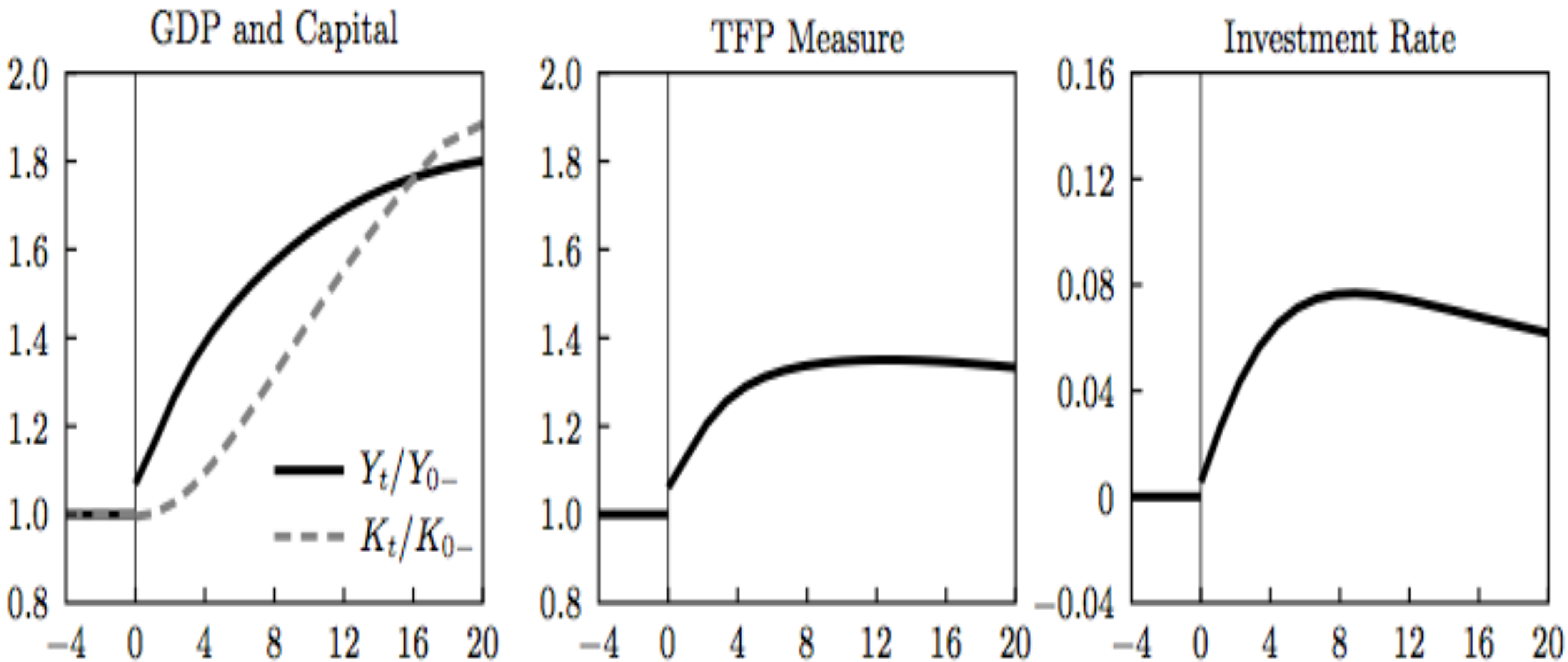
Average entrepreneurial ability normalized by pre-reform value. Average ability increases, exit by low-a individuals who lose subsidies and entry by high-a individuals kept out by taxes. Not instantaneous because high w allows some low-a individuals to linger while low w means some high-a individuals need to save. High-a have increased incentive to save to overcome λ, increases their share of

No initial misallocation



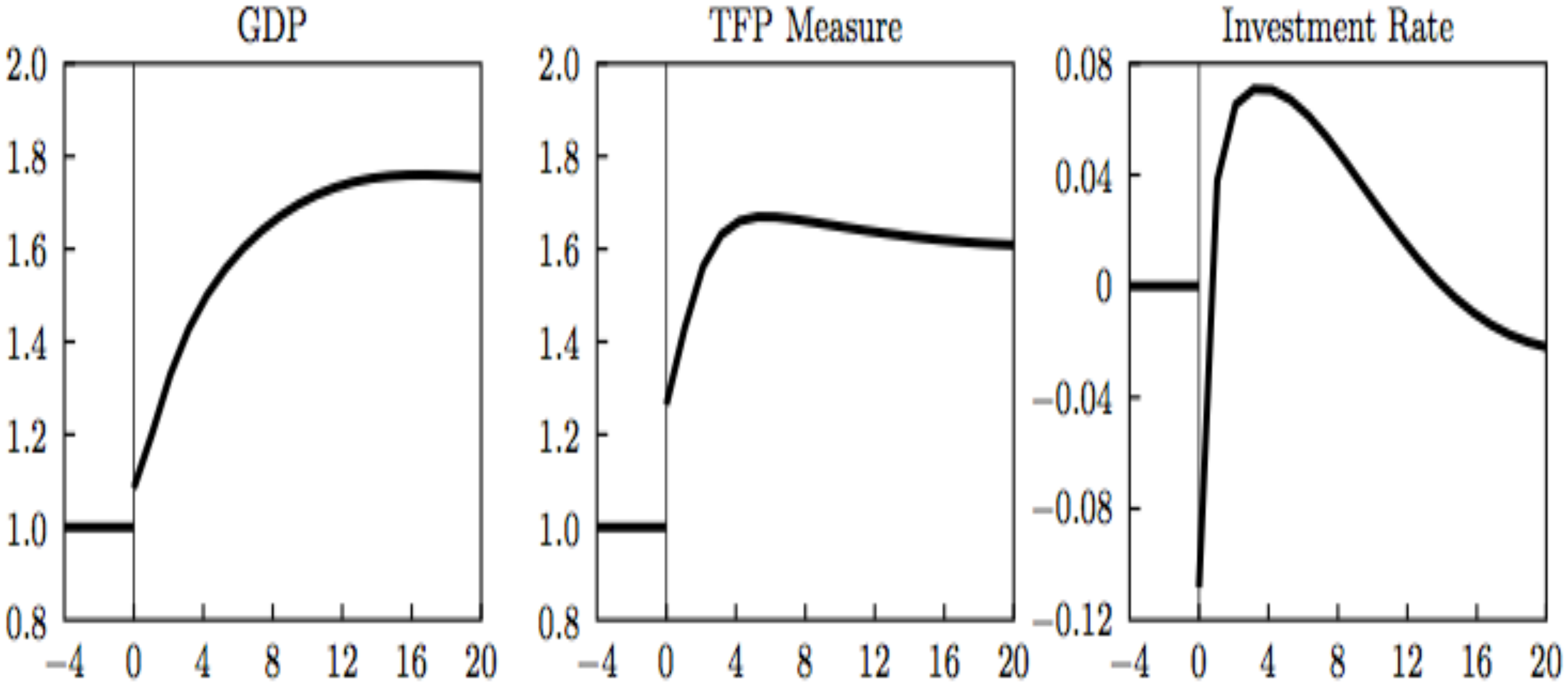
Initial misallocation is necessary for the model's rich transitional dynamics. With financial friction alone, model implies standard neoclassical dynamics (i.e., the rich dynamics come from the interaction of misallocation and financial frictions).

Transition with gradual financial development



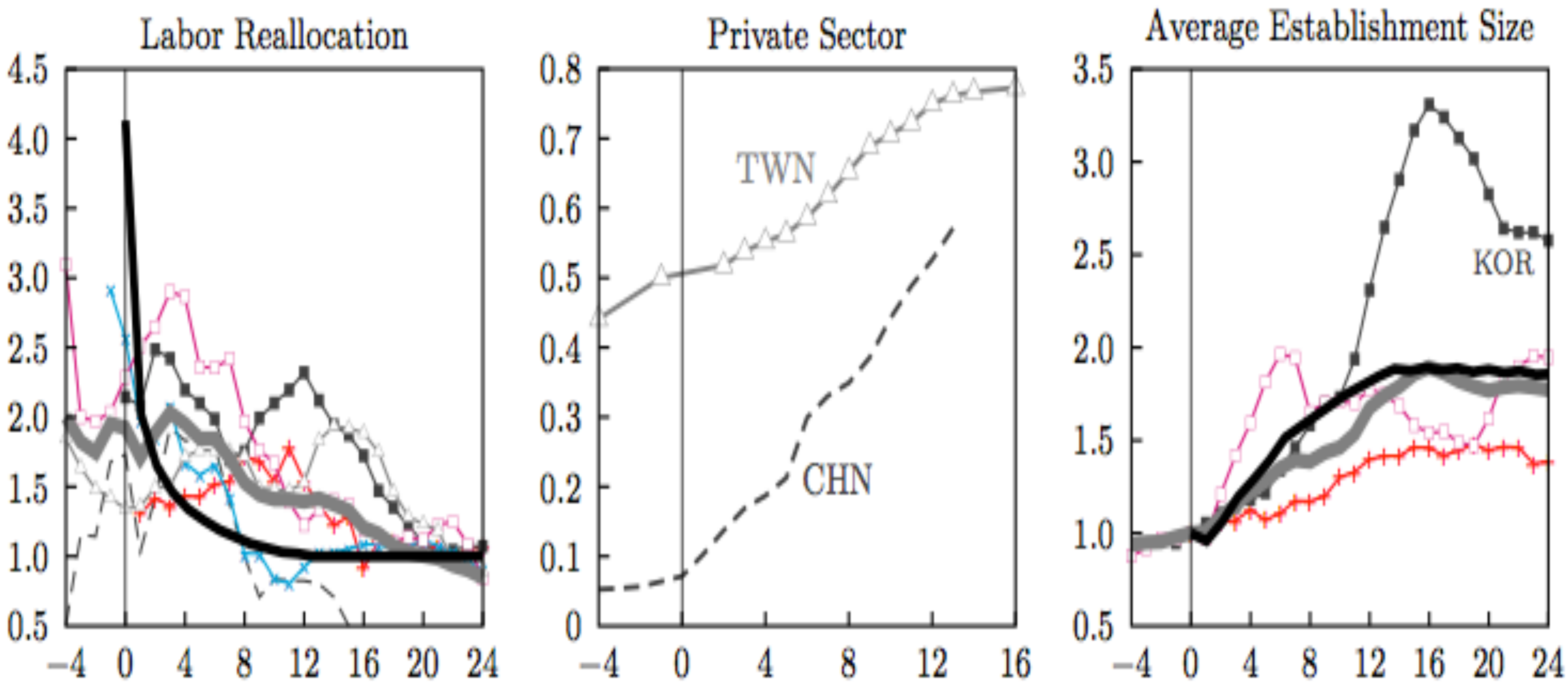
Linear increase from pre-reform $\lambda = 1.13$ to $\lambda = 1.55$ over 20 years, implies external finance-to-GDP ratio increases from 0.3 to 0.86. Financial frictions are most severe when misallocation is greatest. Slower transition relative to benchmark exercise.

Transition for small open economy



Pre-reform, misallocation and closed economy. Reform eliminates misallocation and opens economy. Capital outflow since world interest rate (= 4.5%) is higher than domestic. Higher interest rates increase exit by marginal entrepreneurs and increase rate at which entrepreneurs save to self-finance, both speed up reallocation. TFP grows faster and is higher in long run.

Micro evidence from growth miracles



Middle panel shows private sector shares of production (TWN) and employment (CHN). Left panel shows model labor reallocation rate (in black) against 2-digit manufacturing labor reallocation (grey line is sample average, all normalized by long-run levels). Right panel shows manufacturing establishment size in model and data, all normalized by pre-reform levels.

Summary

- Model generates large but slow-building increase in TFP following removal of idiosyncratic distortions, non-monotone investment rate

- Main mechanism is interaction of financial market frictions and idiosyncratic distortions

- Financial frictions give the idiosyncratic distortions lingering effects, "*the persistence of history*," takes considerable time for

  - (high talent, low wealth) entrepreneurs to expand to efficient scale

  - (high wealth, low talent) entrepreneurs to exit

In short, gradual process of reallocation with slow-building TFP

Next

- Heterogeneous firms and international trade, part one

- Background on monopolistic competition and trade

  - ◇ Krugman (1980): Scale economies, product differentiation, and the pattern of trade, *American Economic Review*.