Chinese Growth in the Face of a Demographic Transition (in progress)

Zheng Song (Chicago Booth) Kjetil Storesletten (Fed. Reserve)
Yikai Wang (Univ. Zurich) Fabrizio Zilibotti (Univ. Zurich)

CIGS - Tokyo

09.08.11

Introduction

The Growth of China: Present and Future

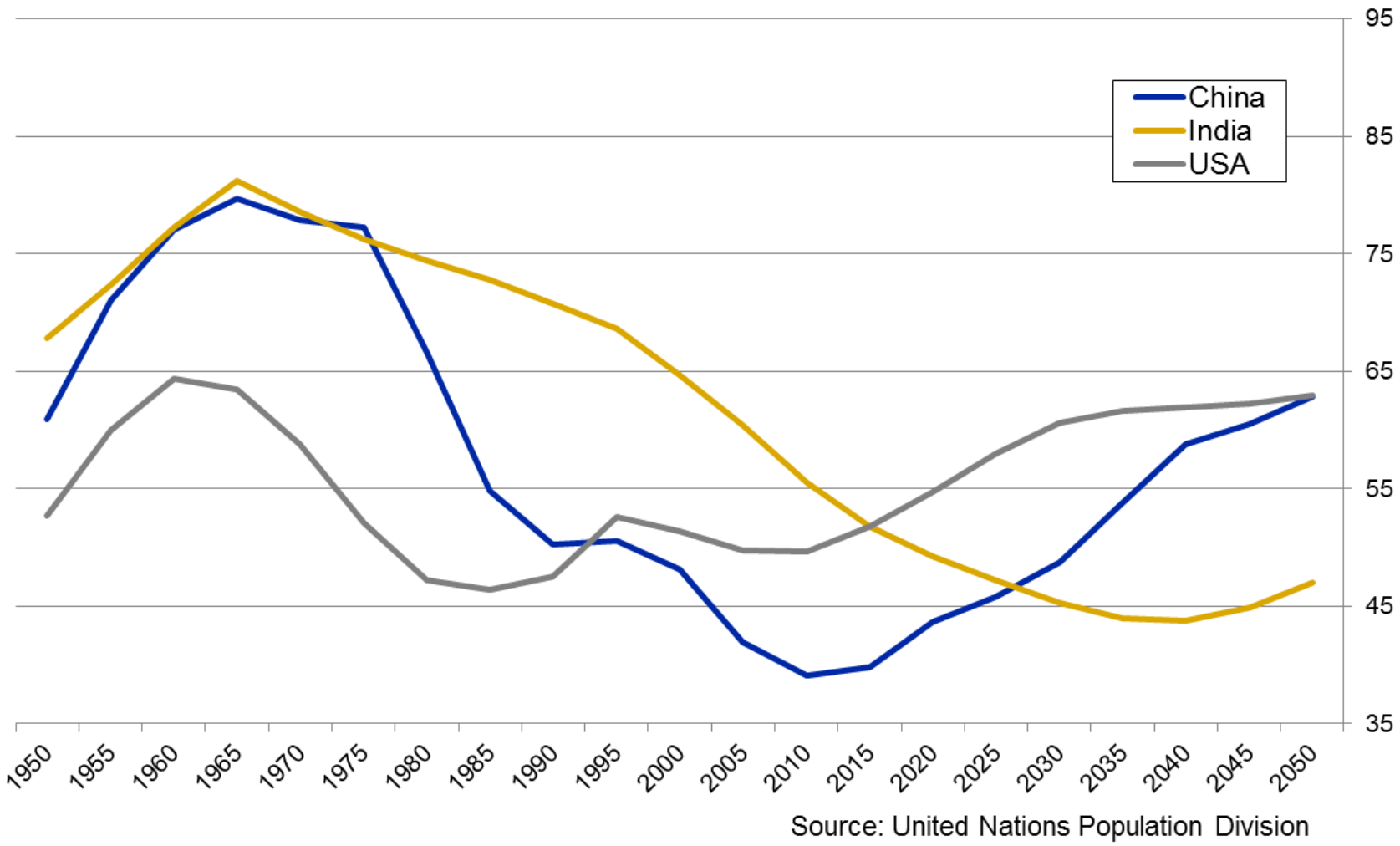
- China GDPpc has grown by a 4.2-to-5.8-fold over the last 20 years (btw. 7.4% and 9.2% annual growth, source PWT)
- China is set to become the largest economy worldwide in the current decade
- ... though its GDPpc is still 20-to-25% of the US
- Will China continue to catch up at a stellar rate? Will its pace decline? If so, when and how fast?
- What institutional arrangements can sustain growth? What arrangements can diffuse welfare among its citizens?

- The sources of Chinese growth till 2011
  - high investment rates with no reduction in the RoR to capital;
  - resource reallocation (urban-rural and state-private);
  - technological convergence (TFP growth);
  - human capital accumulation (quantity and quality);
  - favorable demographics (!!).

- The BIG question mark:
  - sharp demographic transition ahead;
  - an ageing society.
- The Economist: the "elephant" is set to outpace the "dragon".

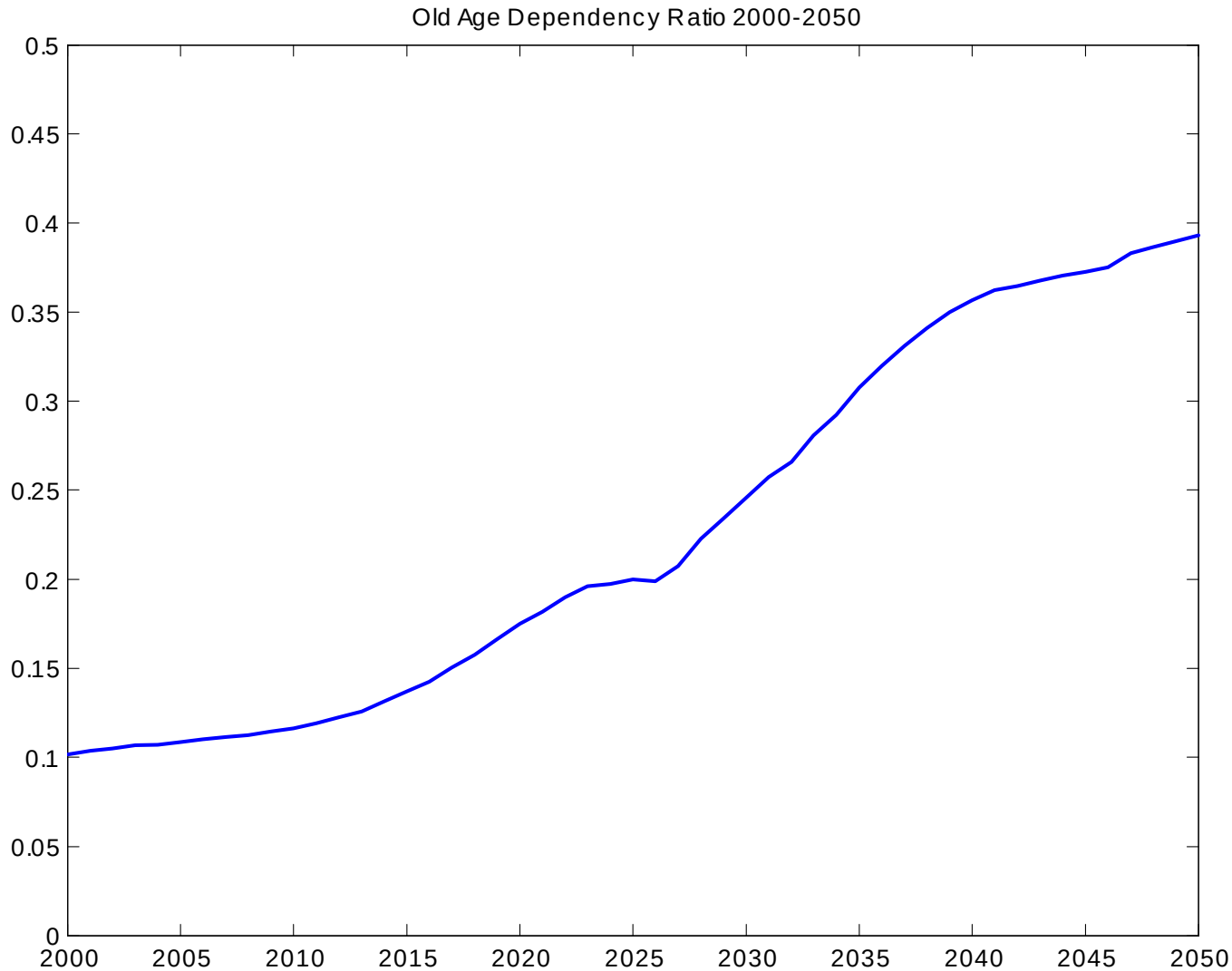
Introduction

Total Dependency Ratio in China, India, US



Introduction

Ageing Society



Introduction

Effects on Economic Performance

- Consequences of higher dependency ratios:
  - Fewer workers$\longrightarrow$ lower GDP pc for given GDP pw
  - Less innovative and forward-looking society
  - Lower savings [hardly a problem...]
  - Pension system under strain (more taxes, etc...)
- Eventually, lower growth?

Introduction

Fertility: One-Child Policy

- First introduced in 1978 (applied to newborn in 1979). Reformed in 2001. Urban families can have only one child.
- In rural areas a second child is allowed if the first child is female. Restrictions are looser for ethnic minorities.
  In some areas, couples are allowed to have a second child if both parents are themselves single children.
- The strict one-child policy is applied to 38% of the total population. 53% have been allowed to have a second child in the event the first born was a daughter. 5.5% can have a second child regardless of the gender of their first child. 3.7% of the total population can have three or more children.

Introduction

Fertility Outlook: One-Child Policy

- In 2008, the government announced that the policy will remain in place for at least another decade.
- Yet, some relaxation ahead?
  A plausible scenario (Zeng Yi 2007): *all* couples in which at least one party is an only child and all rural couples whose first child is a girl will be allowed to have two children
- We assume such a scenario for 2012-2050.
  This yields a TFR of 1.98 in rural and of 1.8 in urban area.
  Higher than today (1.63) but below the "replacement rate".
- Till 2011, we use the data. After 2050, smooth convergence to TFR=2.08. Population level converges to 1.2 billion.

Introduction

A Multidimensional Transition

- Aggregate demographic dynamics conceal other important aspects of population dynamics:

1. reallocation of workers from rural to urban (2.3% yearly migration rate in 2000-07)

   source of productivity growth

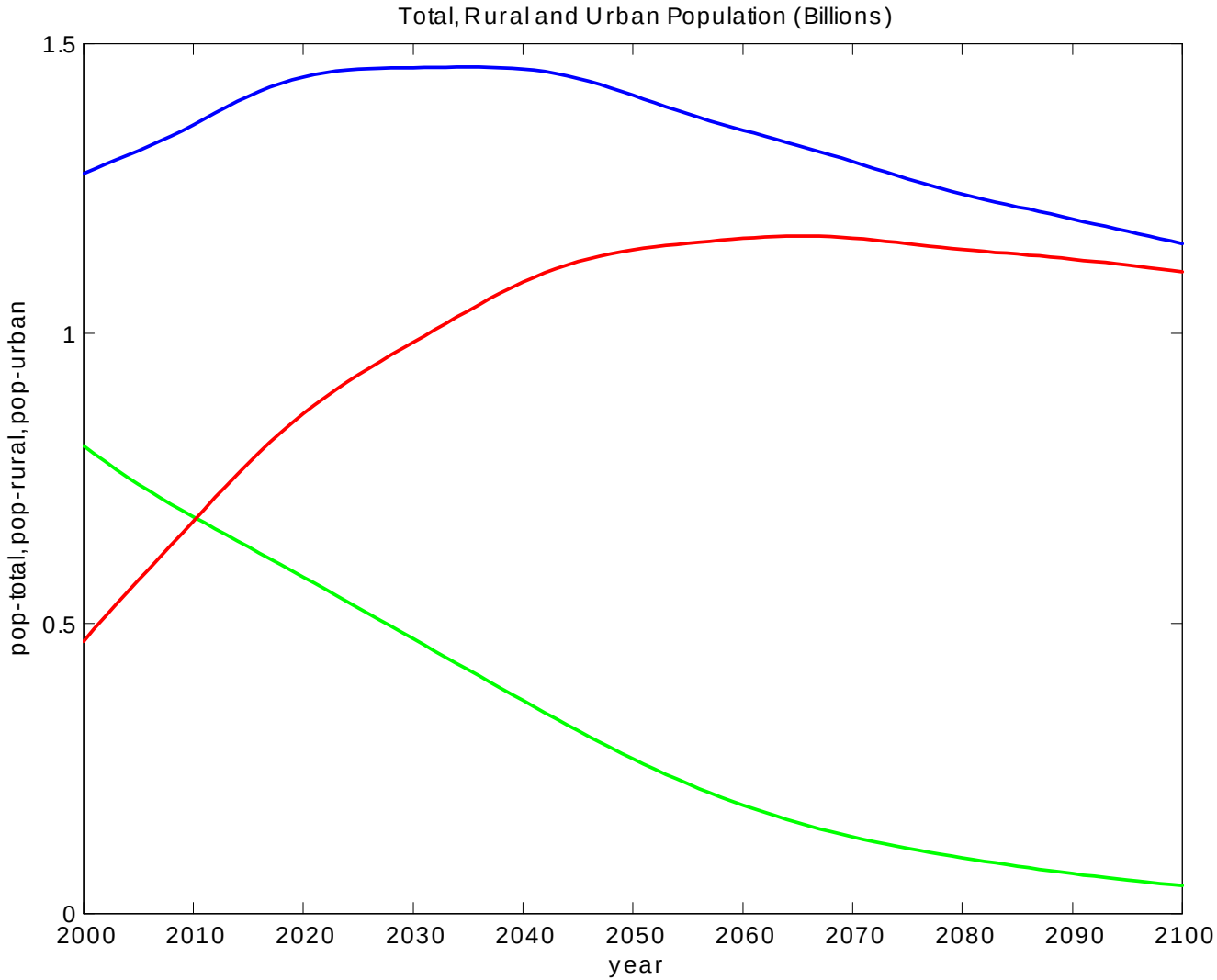
   source of relief for the urban pension system

2. reallocation of workers within urban sector

   source of productivity growth

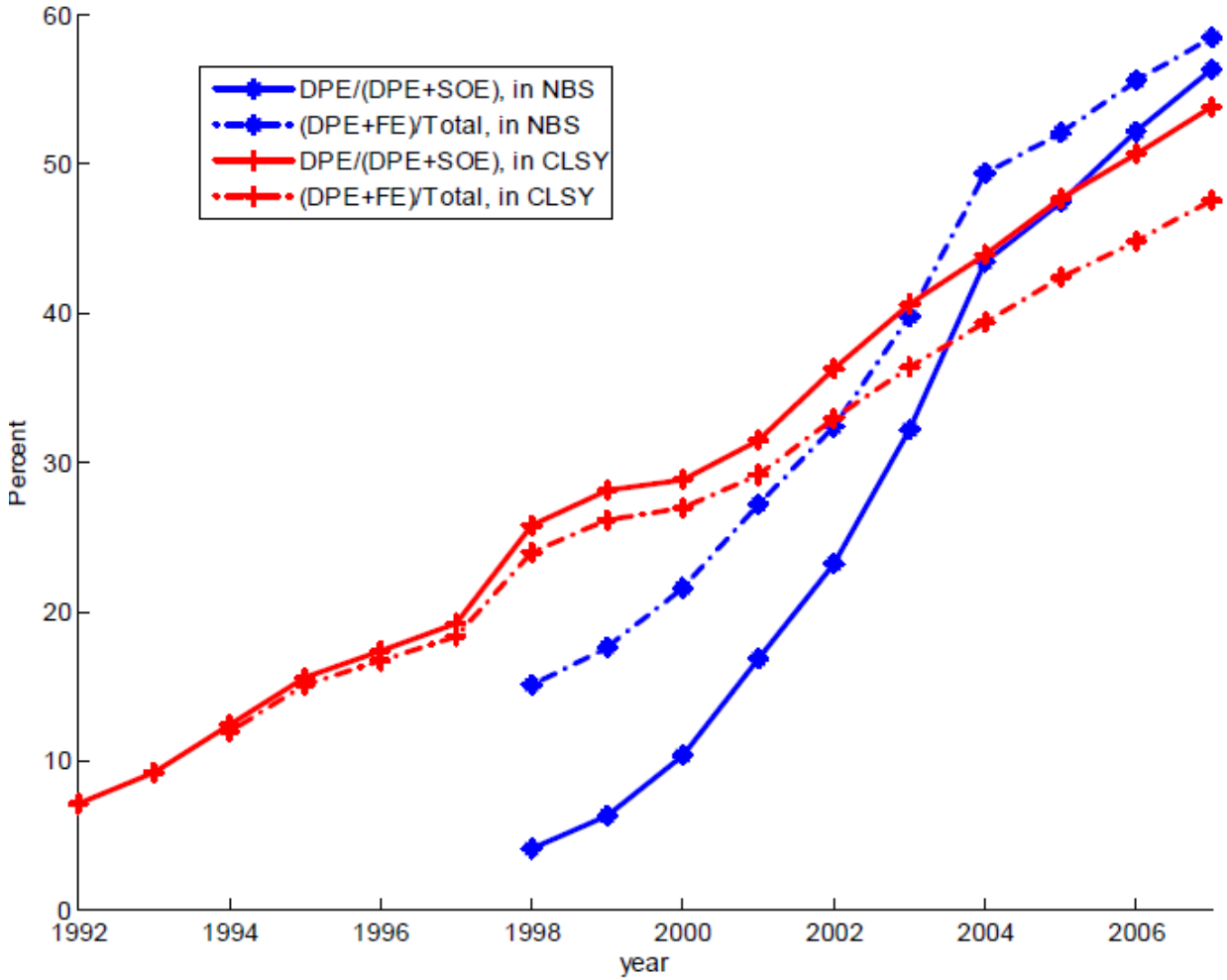
Introduction

Urban and rural population (preview, more on methodology later)



Introduction

Structural Change from State-Owned Enterprises (SOE) to Private Enterprises



Introduction

The Pension Dilemma

- Concern: Current pension system is unsustainable due to the large baby-bust problem.
- True, but...
  - The pension system covers only (a share of) urban workers:
    - ... so dependency ratio hinges on "urban population" growth
    - ... and the migration flow is still very strong
  - Current GDP growth is high while interest rate is low:
    - ... so future cost of fixing pension system could be low (implicit debt could be deflated by fast medium-term growth)

Introduction

Must look beyond the standard neoclassical model

- Standard tool for quantitative evaluation of pension reform:
  Auerbach-Kotlikoff economy, i.e.,
  neoclassical calibrated multi-period overlapping generation model
- But Chinese transition has non-standard features
  $\Rightarrow$ Cannot use an off-the-shelf Auerbach-Kotlikoff economy.

Introduction

Notable features of the Chinese transition, 1992-2010

- Rate of return on **savings** in bank deposits is low (1.8%)...
- ... in spite of high RoR on **capital** (Bai, Hsieh and Qian, 2005).
- No tendency for the rate of return to capital to fall despite a very high investment rate.
- Wage growth significantly below productivity growth...
- ... but higher than interest rate on bank deposits.
- High saving rates (total 50%, household 30%).
- SAVINGS>>INVESTMENTS: Growing foreign surplus.

Introduction

Plan of talk

1. Outline (sketch) a model with financial imperfections that accounts for the non-standard macroeconomic trends in China (following Song, Storesletten and Zilibotti, AER 2011).
2. Add demographic model and a pension system.
3. Calibrate model to study effects of demographic transition and alternative pension reforms on
   - economic growth,
   - macroeconomic variables,
   - welfare of current/future generations.

"Growing Like China": Sketch

Building Blocks

- **Key Assumptions**:
  1. Different rates of return across firms
     - Evidence: private firms have higher return than SOE.
  2. *Asymmetric* financial market imperfections
     - Evidence: limited access of private firms to external financing.
     - SOE have 2.6 times higher capital-labor ratios than DPE.
- **Main Predictions**:
  1. *Gradual* labor and capital reallocation within manufacturing (decline of SOE and expansion of private firms)
  2. Non-decreasing returns to investments
  3. Accumulation of a foreign surplus

"Growing Like China": Sketch

Production Sectors

- Two type of firms, E-firms (*entrepreneurial*) and F-firms (*financially integrated*).
- E-firms have higher TFP:

$$\begin{aligned} y_{Et} &= (k_{Et})^{\alpha} (\chi A_t n_{Et})^{1-\alpha} \\ y_{Ft} &= (k_{Ft})^{\alpha} (A_t n_{Ft})^{1-\alpha} \end{aligned}$$

  - where $A_{t+1} = (1+z) A_t$ (exogenous technical progress).
- ... but are at disadvantage in financial markets:
  - F-firms have deep pockets (e.g., owned by the intermediaries);
  - E-firms *can only* pledge a fraction η of their profit cash-flow.
- Exogenous (urban) population growth.

"Growing Like China": Sketch

Households

- OLG of agents who work in the first part of their lives and live off savings in the second
- Young workers earn a wage (w) and invest their savings in bank deposits paying return r
- Young entrepreneurs earn a "managerial" compensation (m) and (optimally) invest savings in their *own* business
- When old, they turn into firm-owning entrepreneurs

"Growing Like China": Sketch

Banks

- Competitive banks collect deposits and hold portfolios of loans to domestic firms and foreign bonds (B)
- Rate of return on deposits is pinned down by the world interest rate, r.

"Growing Like China": Sketch

F-firms (modeled as neoclassical firms)

- Investments entirely financed by external (bank) loans
- Profit maximization implies a constant capital per effective unit of labor:

$$\kappa_F = \left(\frac{\alpha}{r + \delta} \right)^{\frac{1}{1-\alpha}}$$

- Wages equal the marginal product of labor: $w_t / A_t = (1 - \alpha) \kappa_F^{\alpha}$

"Growing Like China": Sketch

E-firms (i)

- E-firms are owned by old entrepreneurs
  and run by young *managers*
- Young managers appropriate a share ψ
  of the cash flow due to informational rents
- Managers invest their savings in the own business.
- E-firms are credit constrained:
  investments and growth hinge on the savings of young managers

"Growing Like China": Sketch

E-firms (ii)

- Suppose [to fix ideas] that firms can get no external credit ($\eta = 0$). Profit max yields:

$$\Xi_t(k_{Et}) = \max_{n_{Et}, m_t} \left\{ (k_{Et})^{\alpha} (\chi A_t n_{Et})^{1-\alpha} - w_t n_{Et} - m_t \right\}$$

  subject to IC constraint: $m_t \geq \psi (k_{Et})^{\alpha} (\chi A_t n_{Et})^{1-\alpha}$
- Key: w_t / A_t is "locked" during transition.
- In equilibrium, capital per effective unit of labor is constant:

$$\kappa_E = (1-\psi)^{-\frac{1}{\alpha}} \chi^{-\frac{1-\alpha}{\alpha}} \left(\frac{\alpha}{r+\delta} \right)^{\frac{1}{1-\alpha}}$$

- ... and so is the rate of return to capital

$$\Xi_t(k_{Et}) = \underbrace{(1-\psi)^{\frac{1}{\alpha}} (\chi)^{\frac{1-\alpha}{\alpha}} (r+\delta)}_{\text{constant RoR}} \times k_{Et}$$

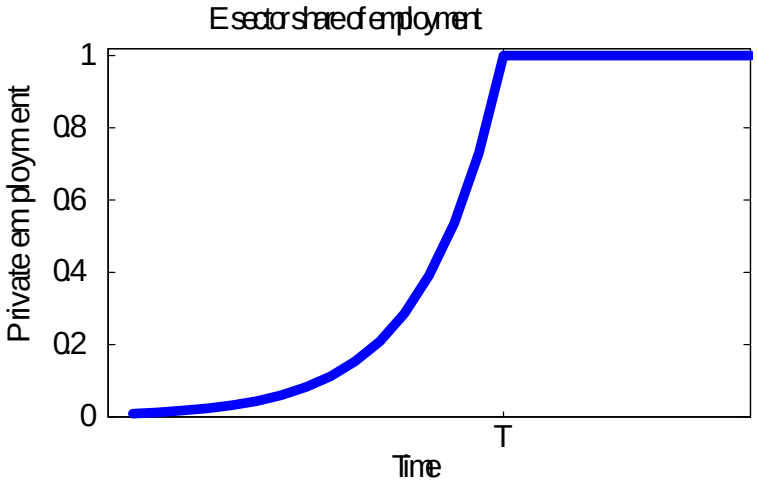
"Growing Like China": Sketch

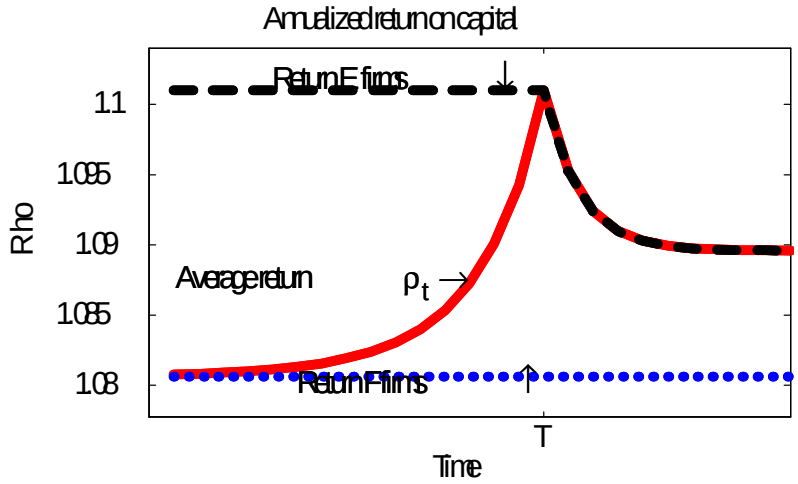
Mechanism

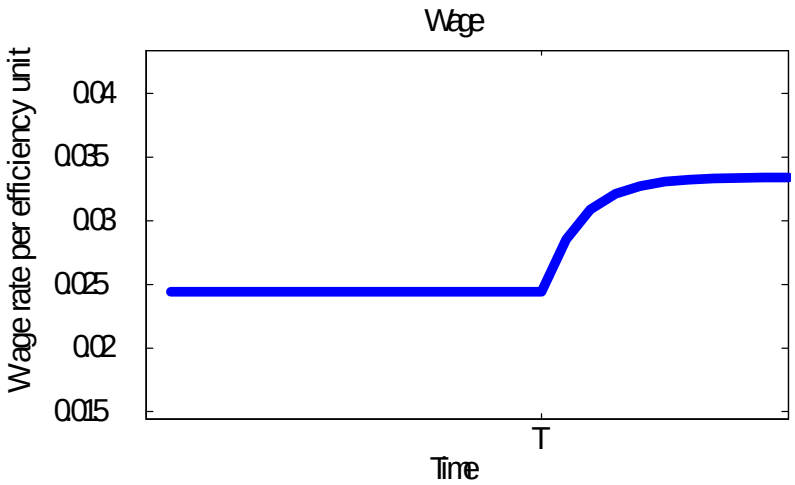
- As entrepreneurs grow richer,
  E-firms hire more and more workers.
- TFP grows since E-firms are more productive.
- Transition is gradual because entrepreneurial investment is constrained by internal savings.
- Low wage growth till transition ends.
  Then, capital deppening and faster wage growth.

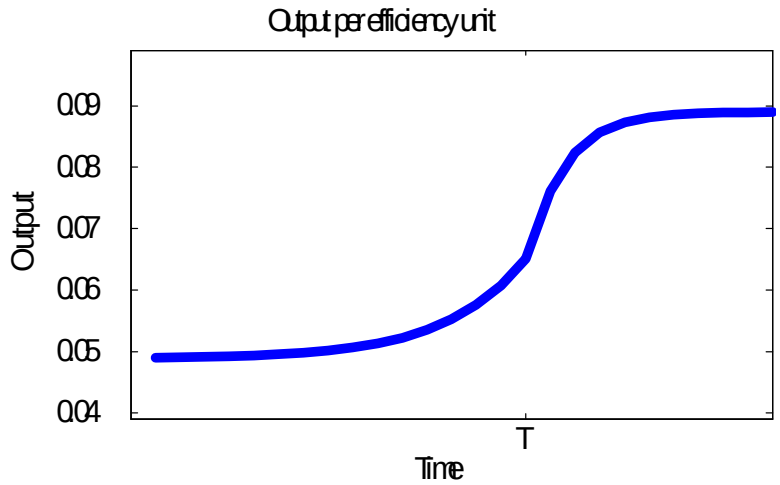
"Growing Like China": Sketch

Equilibrium Dynamics During the Transition









"Growing Like China": Sketch

Foreign Asset Position (suppose E-firms cannot borrow)

- The difference between worker's savings and the investments of F sector determines the foreign balance
- From the balance sheets of the bank sector,

$$\underbrace{K_F + B}_{\text{ASSETS}} = \underbrace{WEALTH_{\text{workers}}}_{\text{LIABILITIES (DEPOSITS)}}$$

- As E-sector grows, $K_F \downarrow$, while $WEALTH_{\text{workers}} \uparrow$. Thus, $B \uparrow$. The economy accumulates a surplus
- The result carries over to the general case with a less drastic credit constraint.

"Growing Like China": Sketch

The Transition, 1992-2007

- Focus the transition 1992-2007.
- Good quantitative fit to the data in terms of
  - GDP and TFP growth
  - savings/investment dynamics
  - foreign surplus
  - wage growth

"GLC with Pensions": Preview

Extended Model

- Next step: enrich this model to incorporate
  - pension system
  - demographic transition
- Use this framework to analyze pension reforms

"GLC with Pensions": Preview

Why "this" model to analyze demographic transition?

- We exploit the following specific features of GLC model
  - SOE-DPE transition implies high "TFP" growth;
  - "Delayed" wage growth, due to SOE-DPE transition (but high wage growth thereafter!);
  - Workers earn low returns on their savings in spite of the high RoR to capital;
  - Workers' savings are "detached" from capital accumulation.

"GLC with Pensions": Environment

Preferences and budget constraints

- Preferences at birth of an agent born at t=1:

$$U_t^1 = \sum_{t=1}^{T} s_t \beta^t \frac{\left(c_t^{\phi} \left(1 - h_t\right)^{1-\phi} \right)^{1-\theta}}{1-\theta}$$

- Workers retire at age J. Their budget constraint is:

$$\sum_{t=1}^{T} \frac{s_t}{R^t} c_t = \sum_{t=1}^{J-1} \frac{s_t}{R^t} \left(1 - \tau_t\right) w_t h_t + \sum_{t=J}^{T} \frac{s_t}{R^t} b_{t,J}$$

"GLC with Pensions": Environment

Population projections (based on Yi (2007), Census 2000 and Survey 2005)

- Fertility
  - 2000-2011: Fertility and mortality constant at 2005 levels;
  - 2012-2050: "Two-children for only-child couples";
  - 2050-2100: Gradual transition to "reproduction rate";
  - Current sex-imbalance is assumed to persist.
- Mortality:
  - gradual increase in longevity from 71.4 to 82 in 2080.

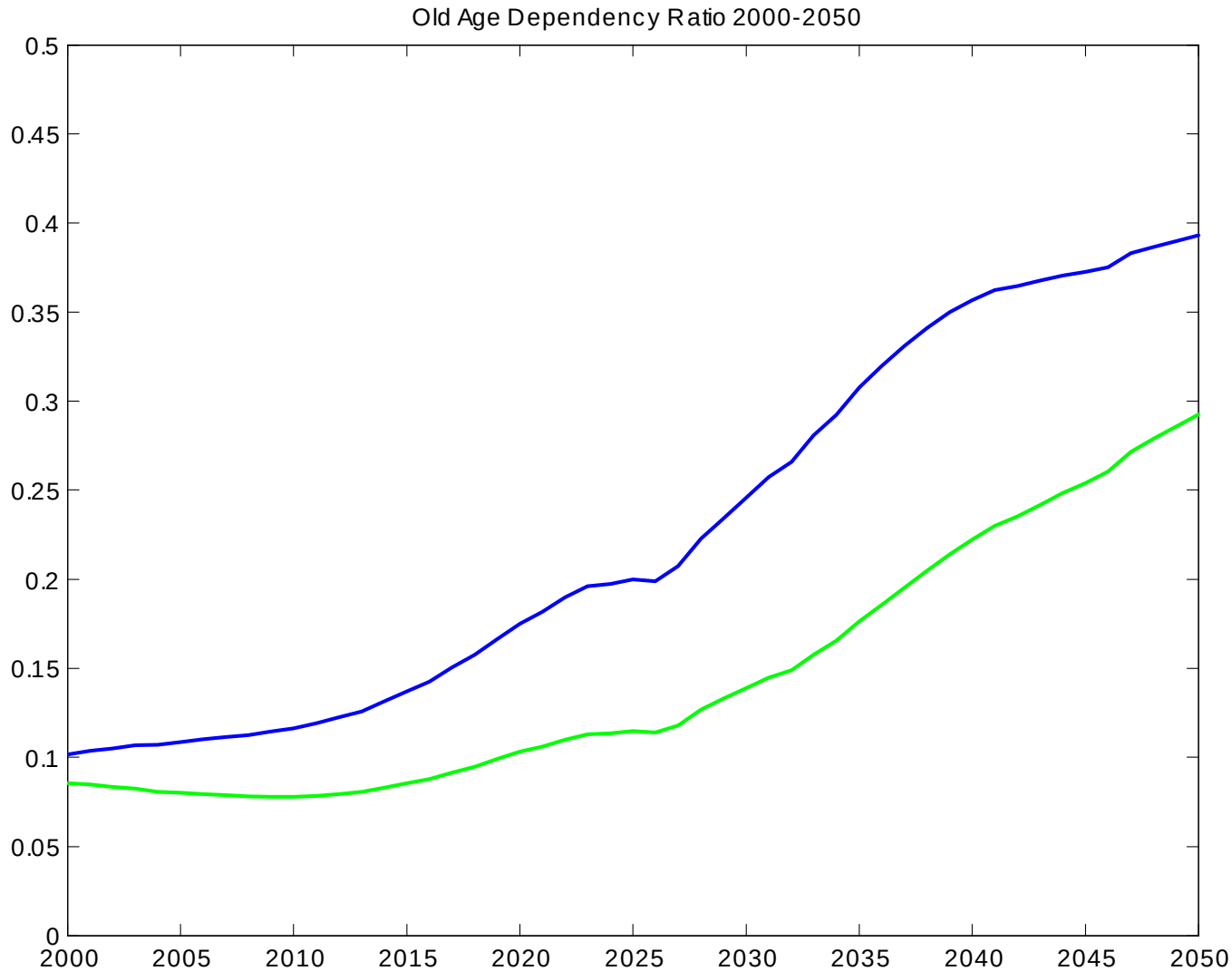
"GLC with Pensions": Environment

Population projections: rural-urban migration

- Age-specific migration rate (ASMR), data 2000-2005
- Assume ASMR will stay the same in future
- Result: 400 milion people move between 2000-2050!
  - Keep track of the age distribution in urban and rural areas
  - Population in cities significantly younger since migrants are young
- Migration yields old age dependency ratio of 29% in 2050.
  - without migration the dependency ratio would be 39%

"GLC with Pensions": Environment

Projections of old age dependency ratios



"GLC with Pensions": Calibration

Parameters Set Exogenously

- Agents live up to 100 years old.
- Workers enter workforce at 22 and retire at age 60.
- Intertemporal elasticity of substitution $= 2$.
- Capital share in 2000, $\alpha = 0.5$.
- Depreciation rate $\delta = 10\%$.
- Interest rate 2.5%. TFP growth (long-run growth) 2%.

"GLC with Pensions": Calibration

Parameters Set Endogenously to match facts 2000-2007

- $\beta = 1.018 \rightarrow$ match 2000-2007 average total savings rate
- Set χ and ψ to match two key moments for firms:
  - the RoR gap $\rho_E - \rho_F = 9\%$
  - relative capital-output ratio $\frac{K_F}{Y_F} = 2.65 \times \frac{K_E}{Y_E}$
    $\Rightarrow$ implies $\chi = 4.8$ and $\psi = 0.45$
- Entrepreneurs finance 11% of investments externally in 2000
  Target: data on external financing of DPE
- Initial conditions for $K_{E,0} \rightarrow$
  match the average DPE employment share 2000-2007.

"GLC with Pensions": Environment

Government pension system

- Contribution rate roughly constant at $\tau = 20\%$ in 2000-10.
- Tax labor income at rate τ_t, pay period-t pension benefits b_{tj} to agents who retired in period j. Replacement rate q_j

$$b_{tj} = q_j \cdot (0.6 \cdot w_t + 0.4 \cdot w_j)$$

- Retirees who retired before 1997: get 78% replacement rate
- "Transition generation" (retired 1997-2011): get 60% replacement rate (Sin 2005).

"GLC with Pensions": Environment

Government pension system

- Government's long-run budget constraint:

$$0 = \sum_{t=0}^{\infty} R^{-t} \left(N_t^W \cdot \tau_t w_t H_t - \sum_j N_{tj}^R \cdot b_{tj} \right)$$

  where N_t^W = #participating workers, H_t is aggr. labor supply, and $N_{t,j}^{RET}$ =#surviving retirees in t who retired in year j

- Assume 60% coverage rate (to be done: account for increasing coverage).

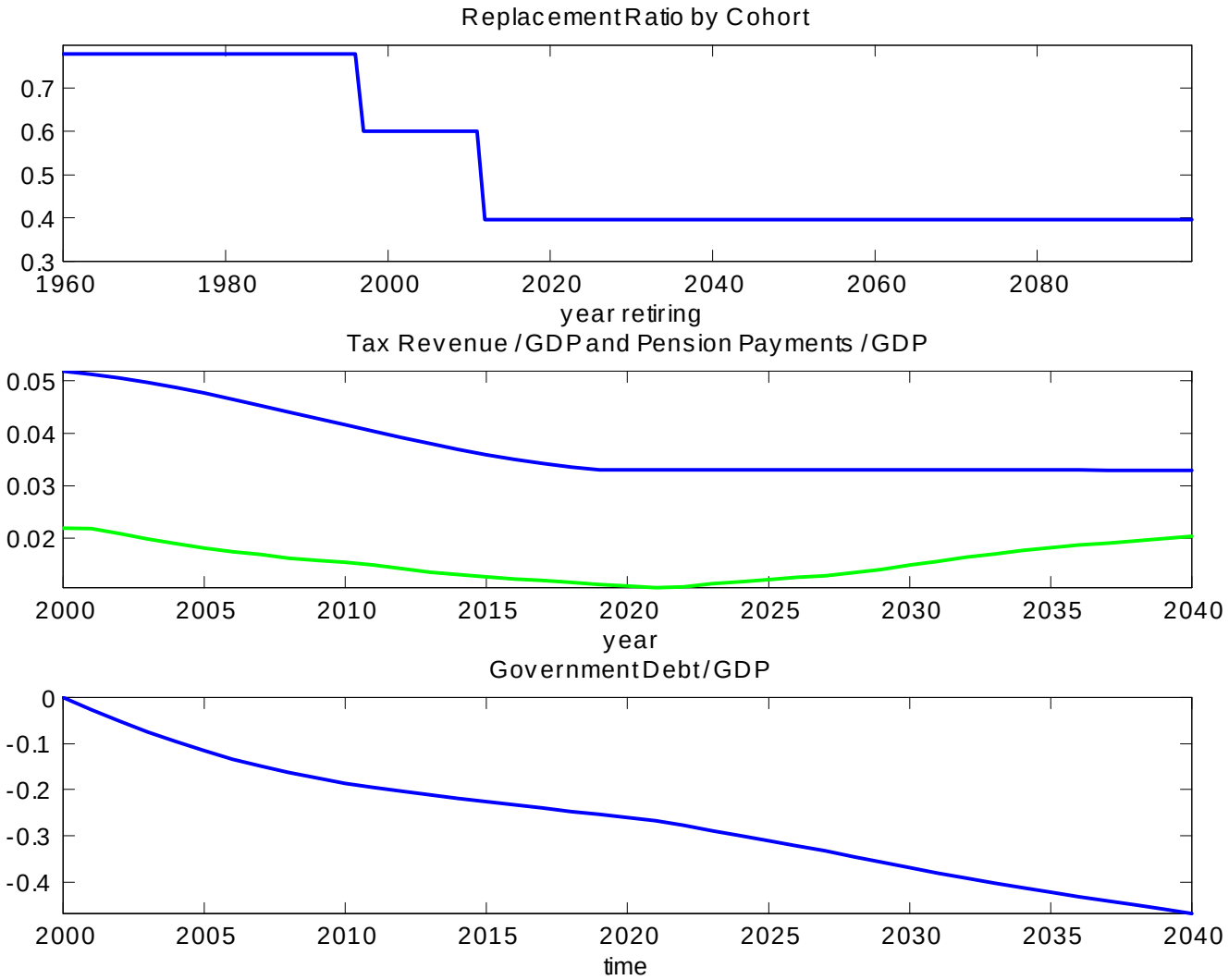
"GLC with Pensions": Calibration

Benchmark Pension System: Sustainable reform

- Benchmark Experiment: Assume sustainable reform in 2012
  - τ_t and q_t take empirical values 2000-2011
  - After 2007: taxes kept constant at $\tau_t = 20\%$
  - Choose a constant replacement rate $\bar{q}$ after 2007 so that the long-run government budget is balanced
  - $\Rightarrow$ implies $\bar{q} = 39.6\%$ (down from $q_{2011} = 60\%$!)
  - Implies large build-up of government funds until 2100

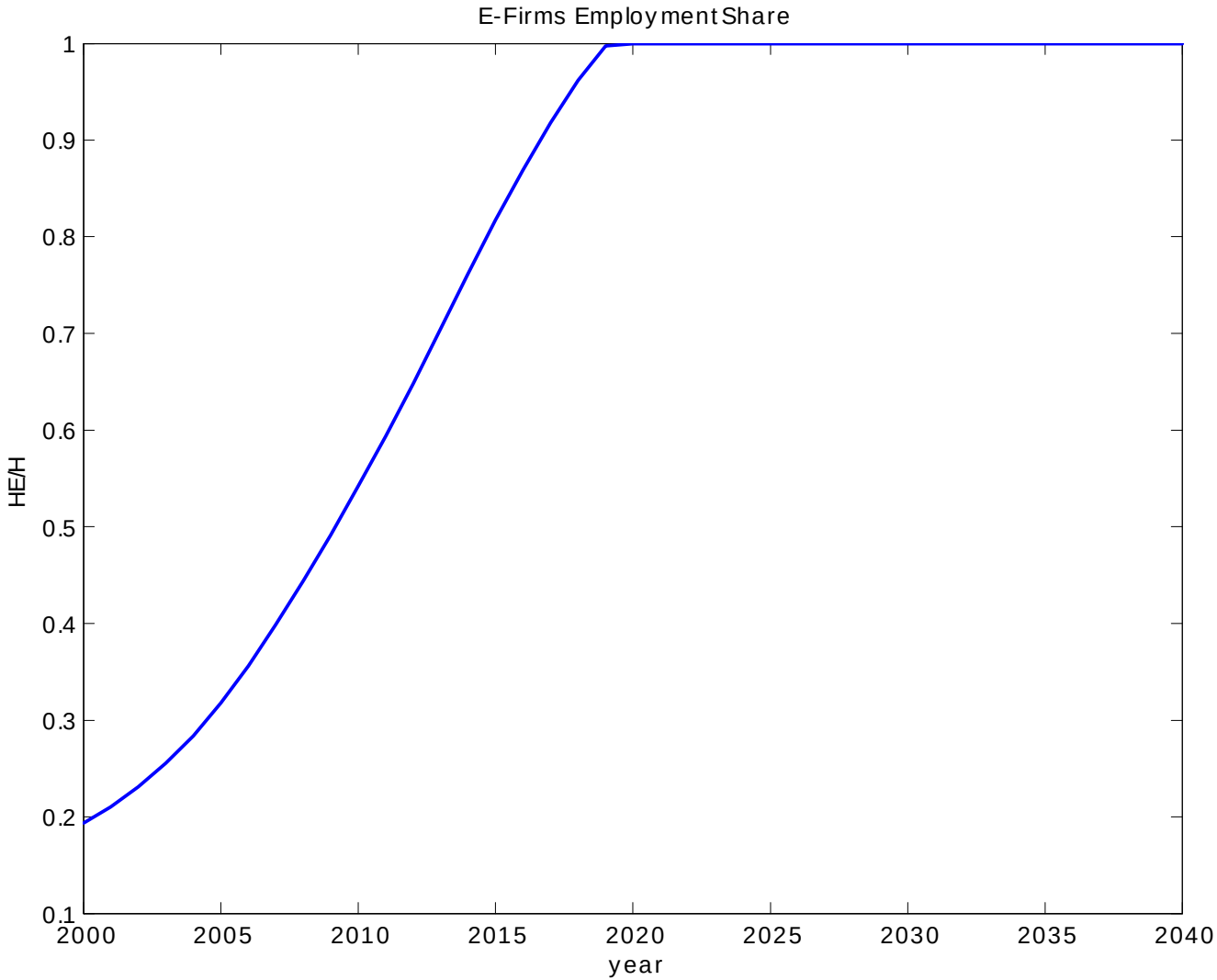
"GLC with Pensions": Benchmark Reform

Projections of pension dynamics



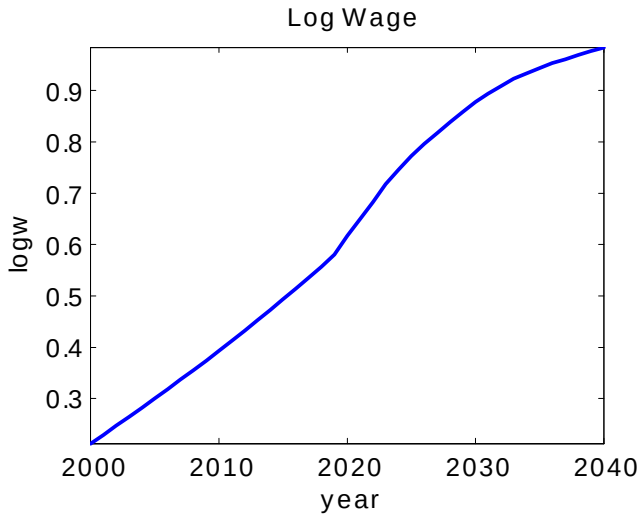
"GLC with Pensions": Results

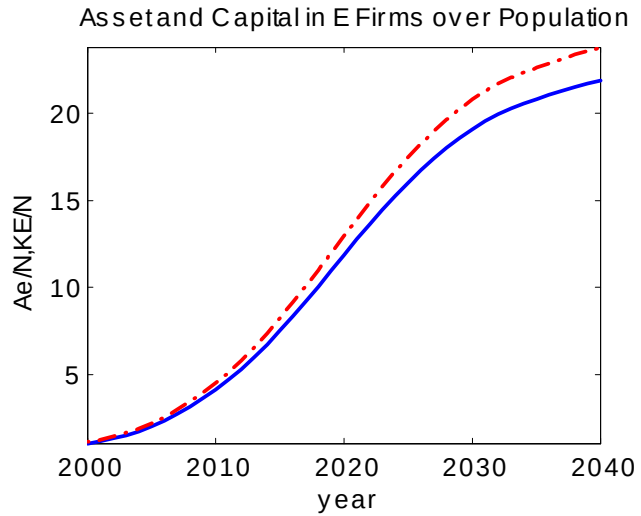
Macroeconomic outcomes: SOE-DPE Transition

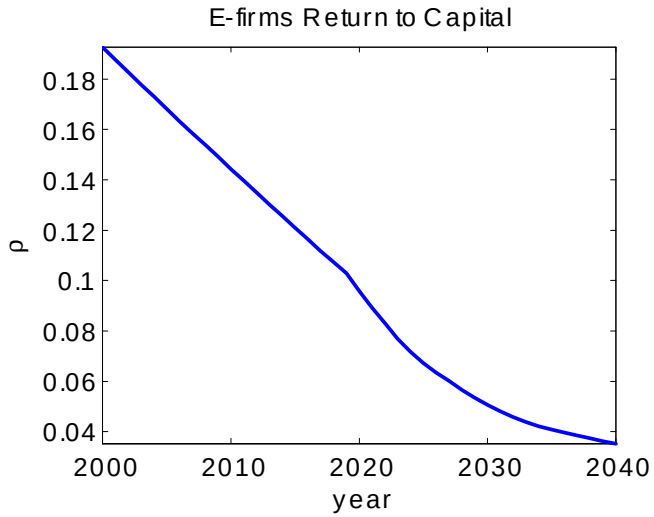


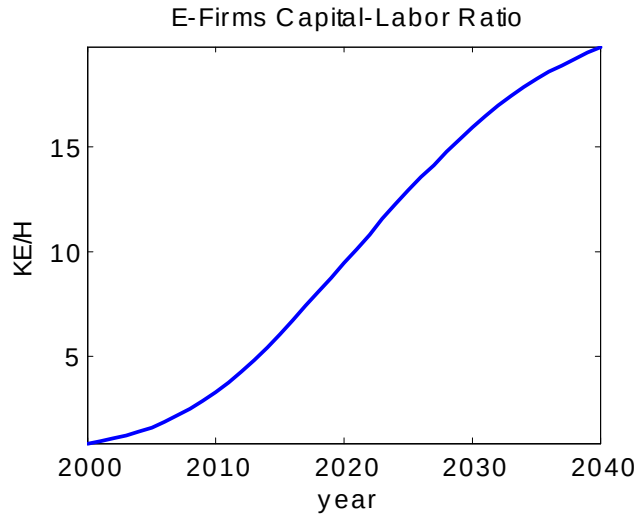
"GLC with Pensions": Results

Macroeconomic outcomes: Wages and RoR to Capital



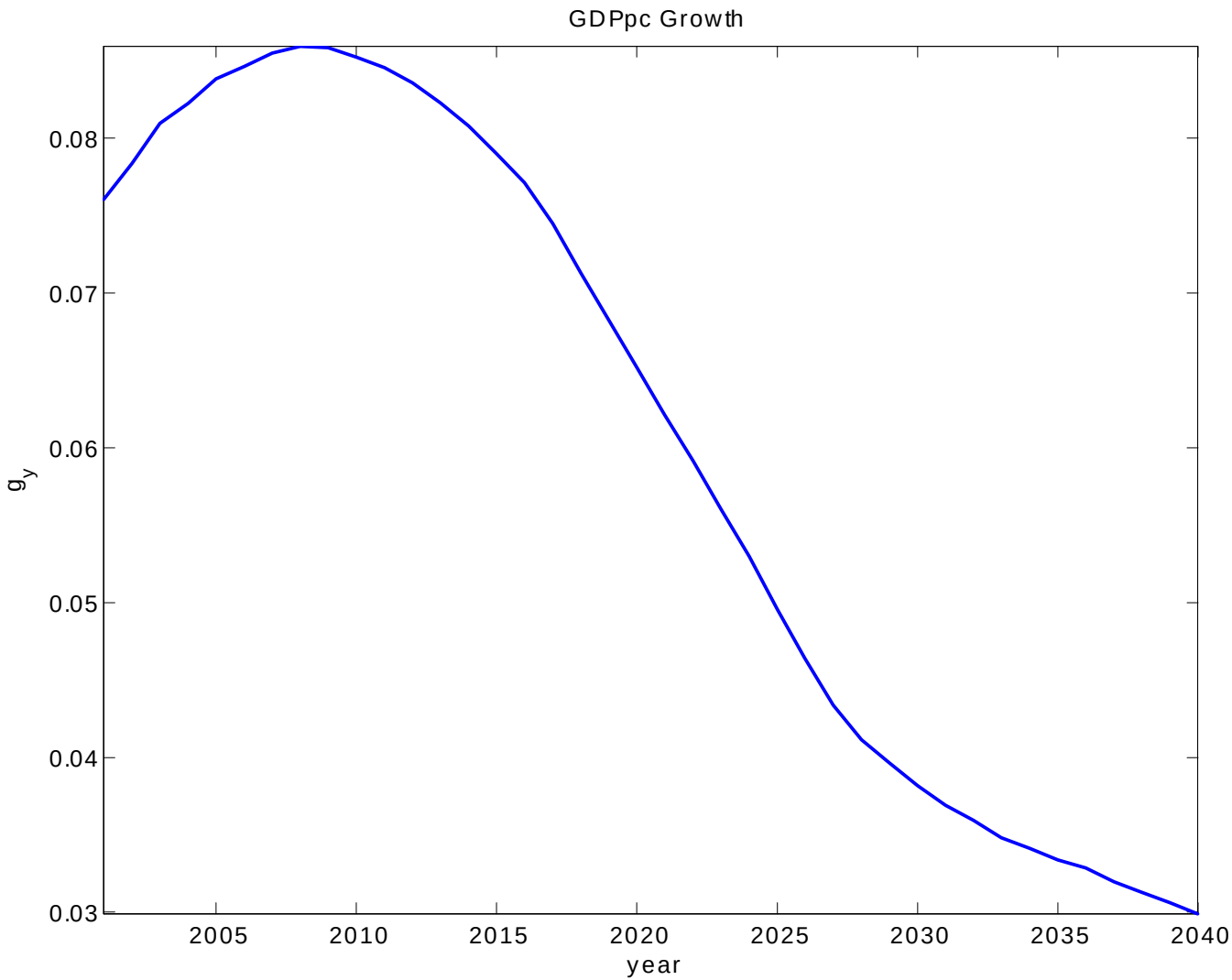






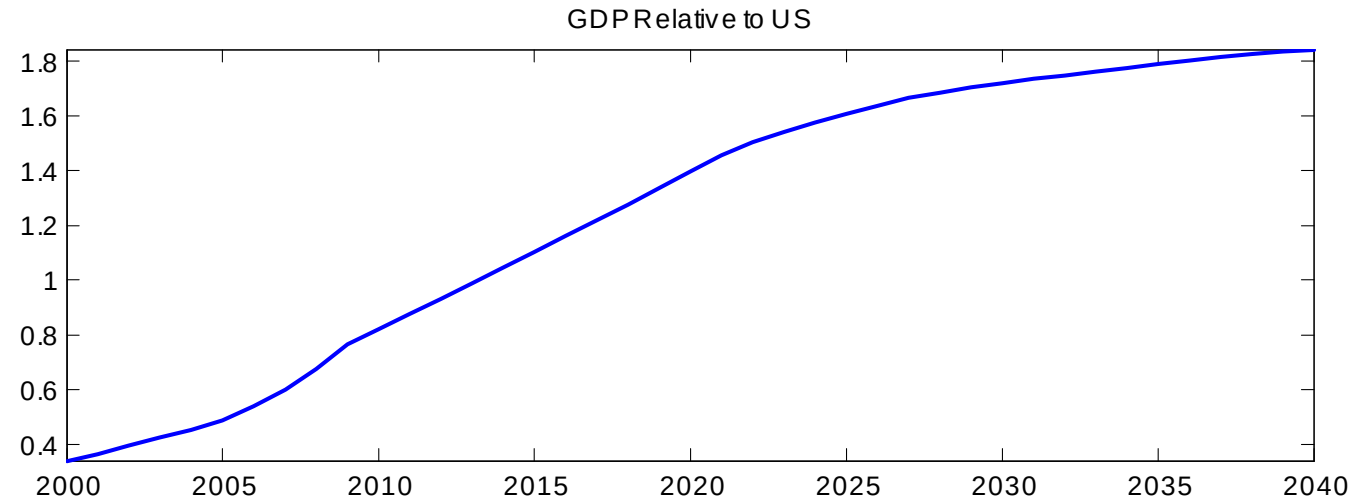
"GLC with Pensions": Results

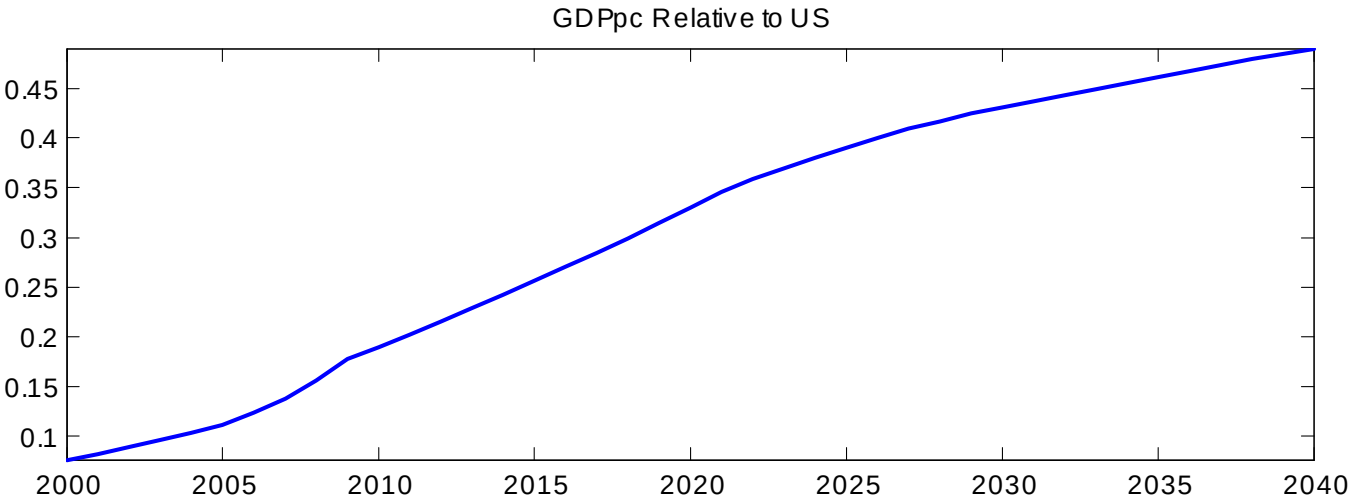
Macroeconomic outcomes: GDPpc Growth 2000-2040



"GLC with Pensions": Results

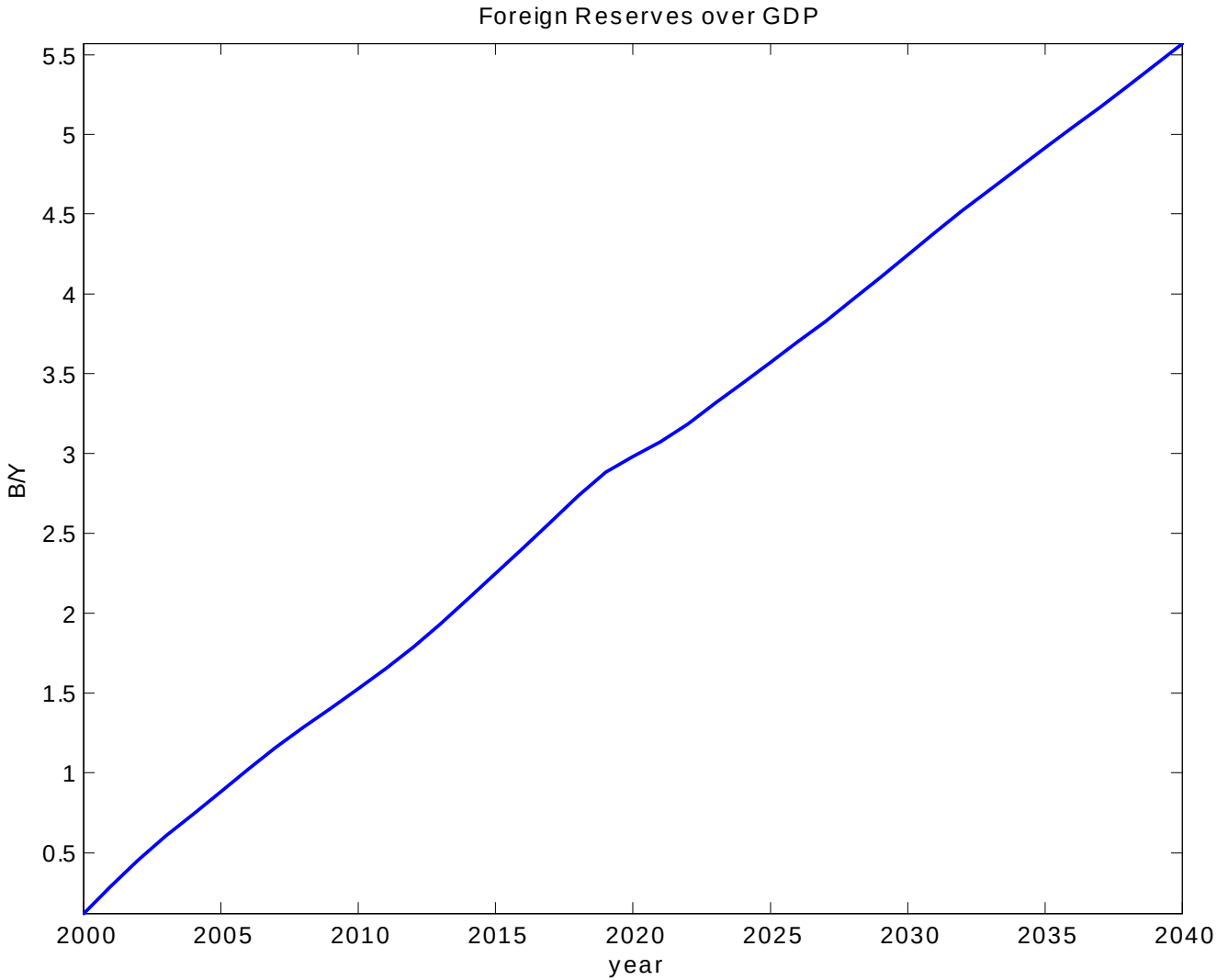
Macroeconomic outcomes: GDP and GDPpc relative to the US





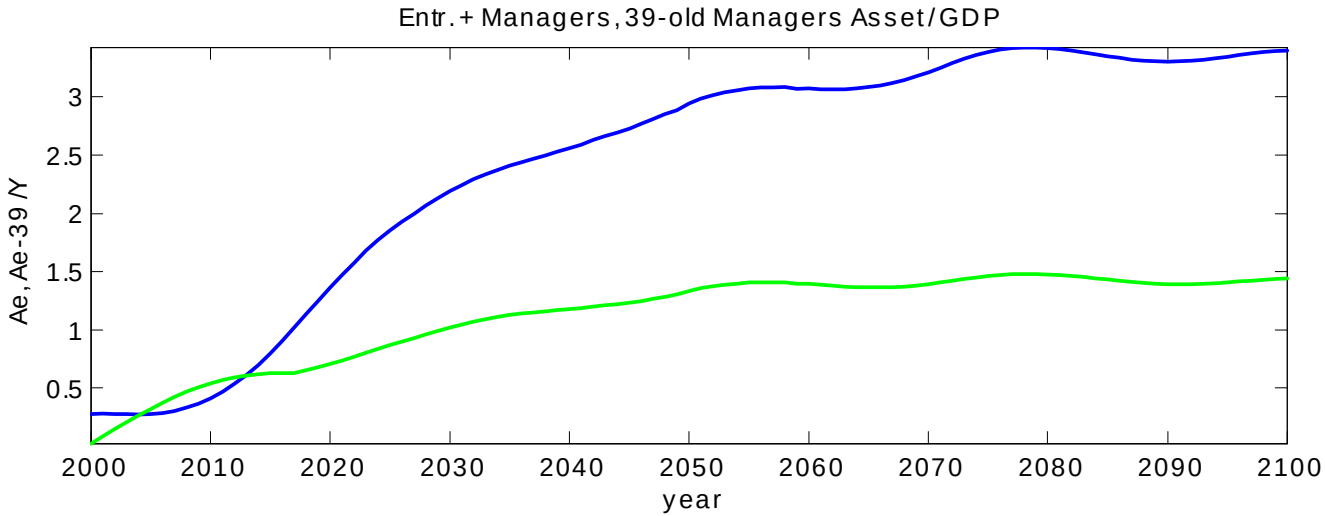
"GLC with Pensions": Results

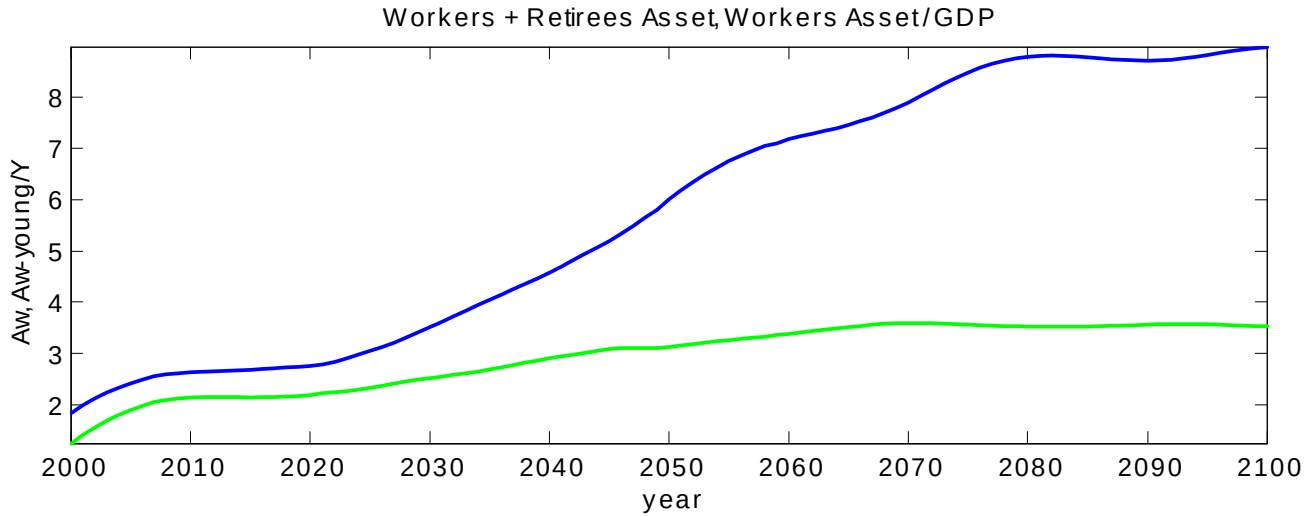
Macroeconomic outcomes: Foreign Reserves over GDP



"GLC with Pensions": Results

Macroeconomic outcomes: Wealth Dynamics





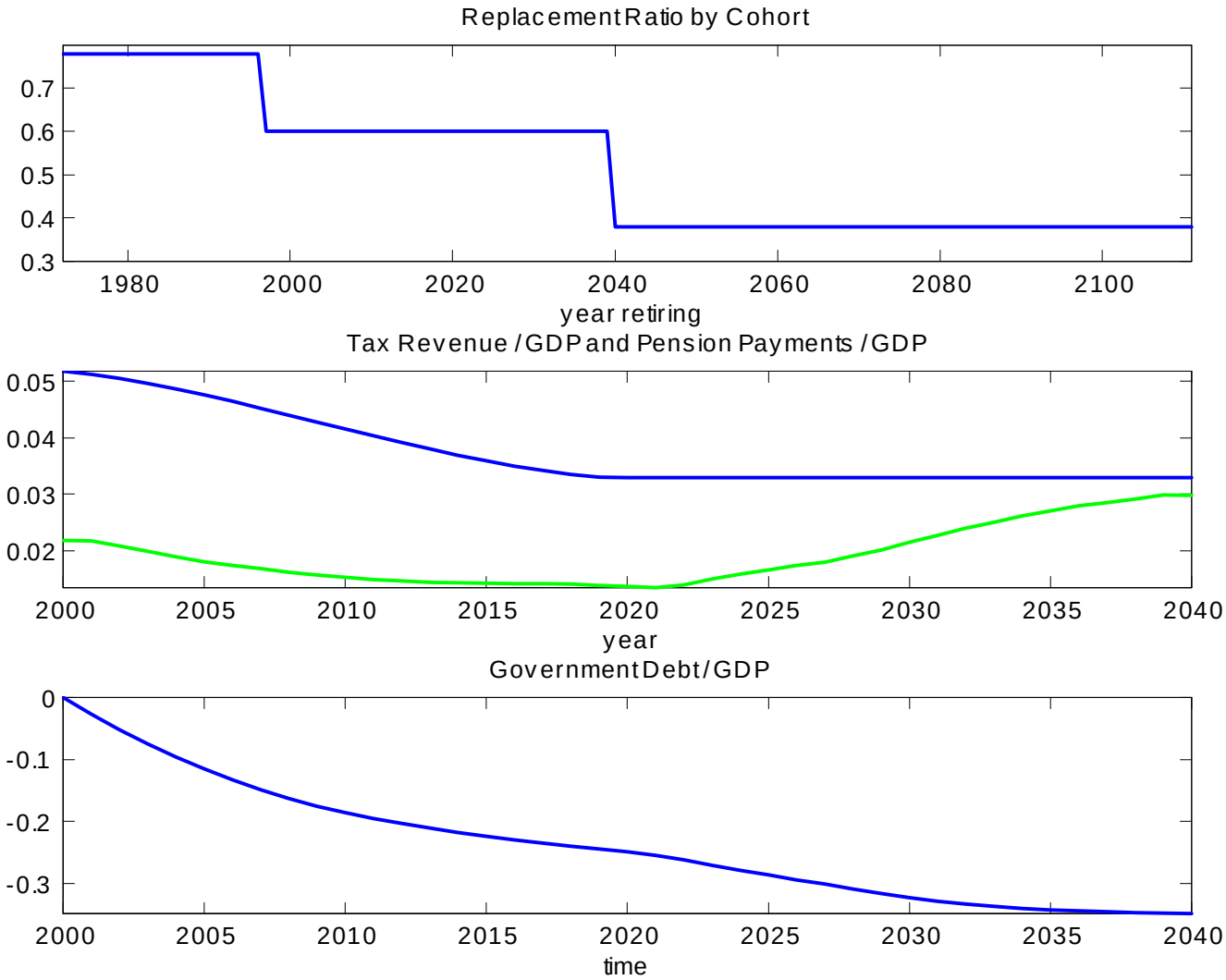
"GLC with Pensions": Alternative Reforms

Two scenarios

1. Delayed reform
   - Keep taxes and replacement rate
     at the current level till 2040
   - Repl. rate must be cut to 37.9% starting 2041
2. Switch to a fully funded system (in 2000)
   - No default on existing claims:
     all living agents get present value of future benefits
     MINUS present value of future expected contributions
   - These entitlements are converted into govt. bonds
   - Taxes adjusted to service new government debt
   - No transfers in future

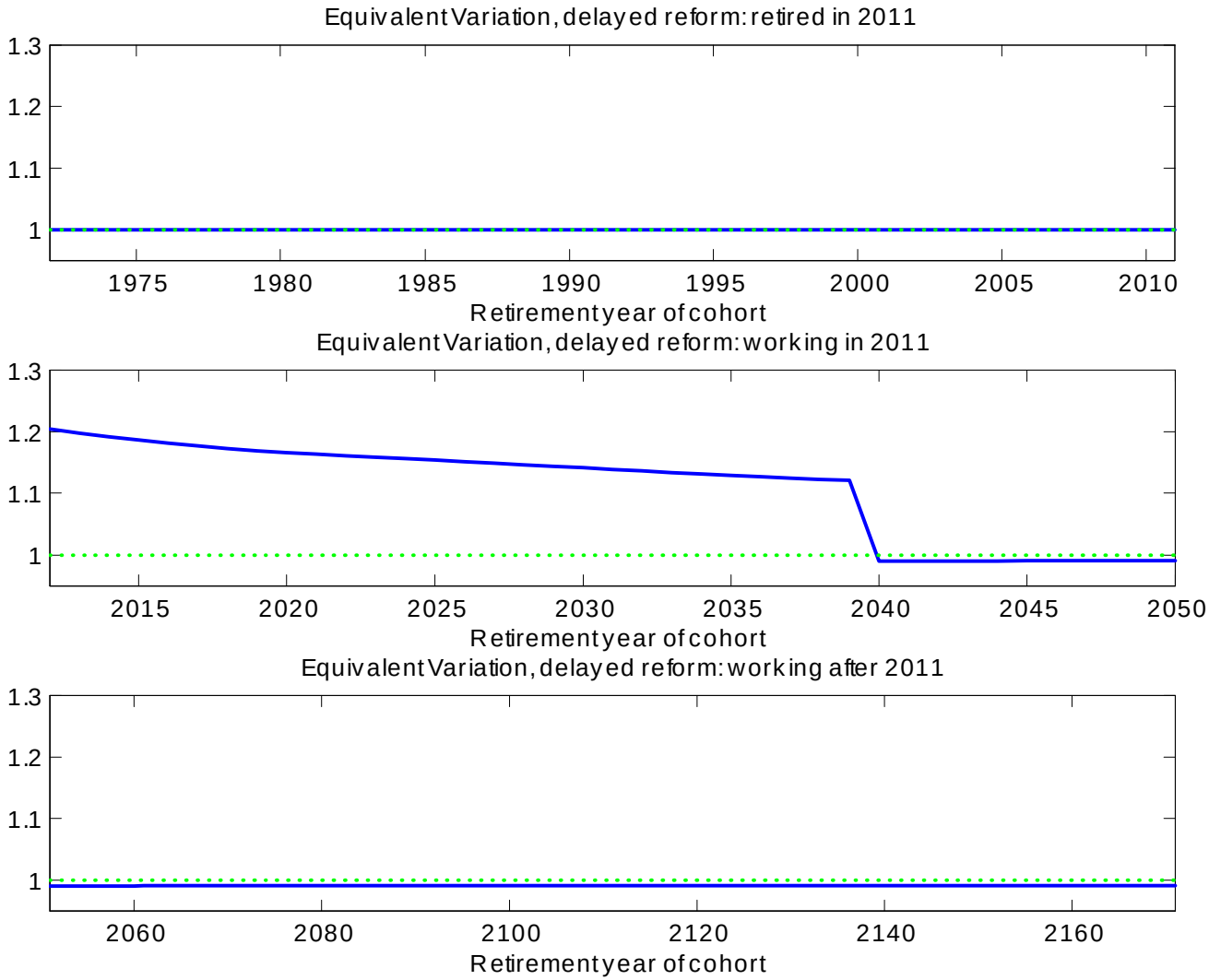
"GLC with Pensions": Delayed Reform

Projections of pension dynamics



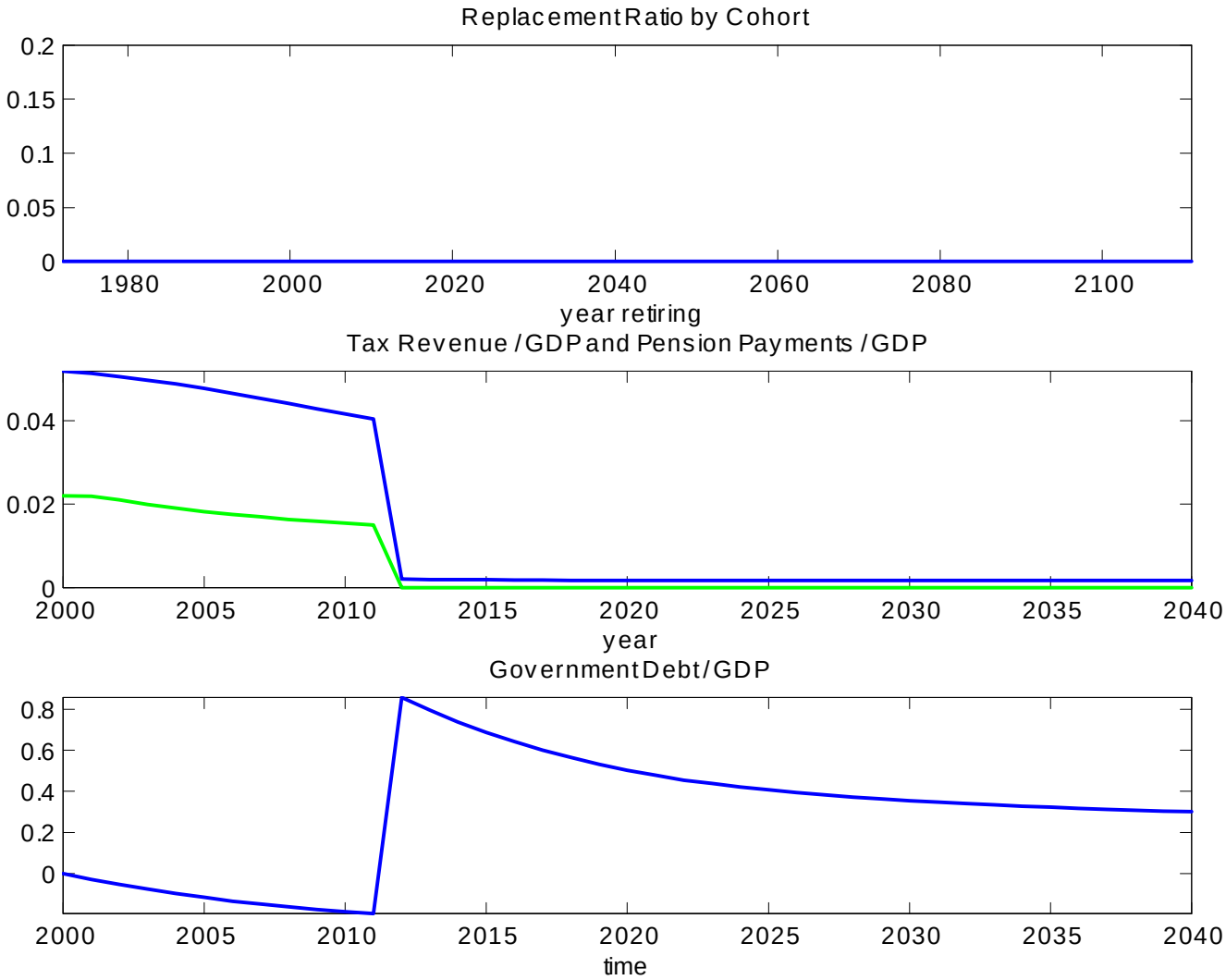
"GLC with Pensions": Delayed Reform

Welfare Effect of Delayed Reform



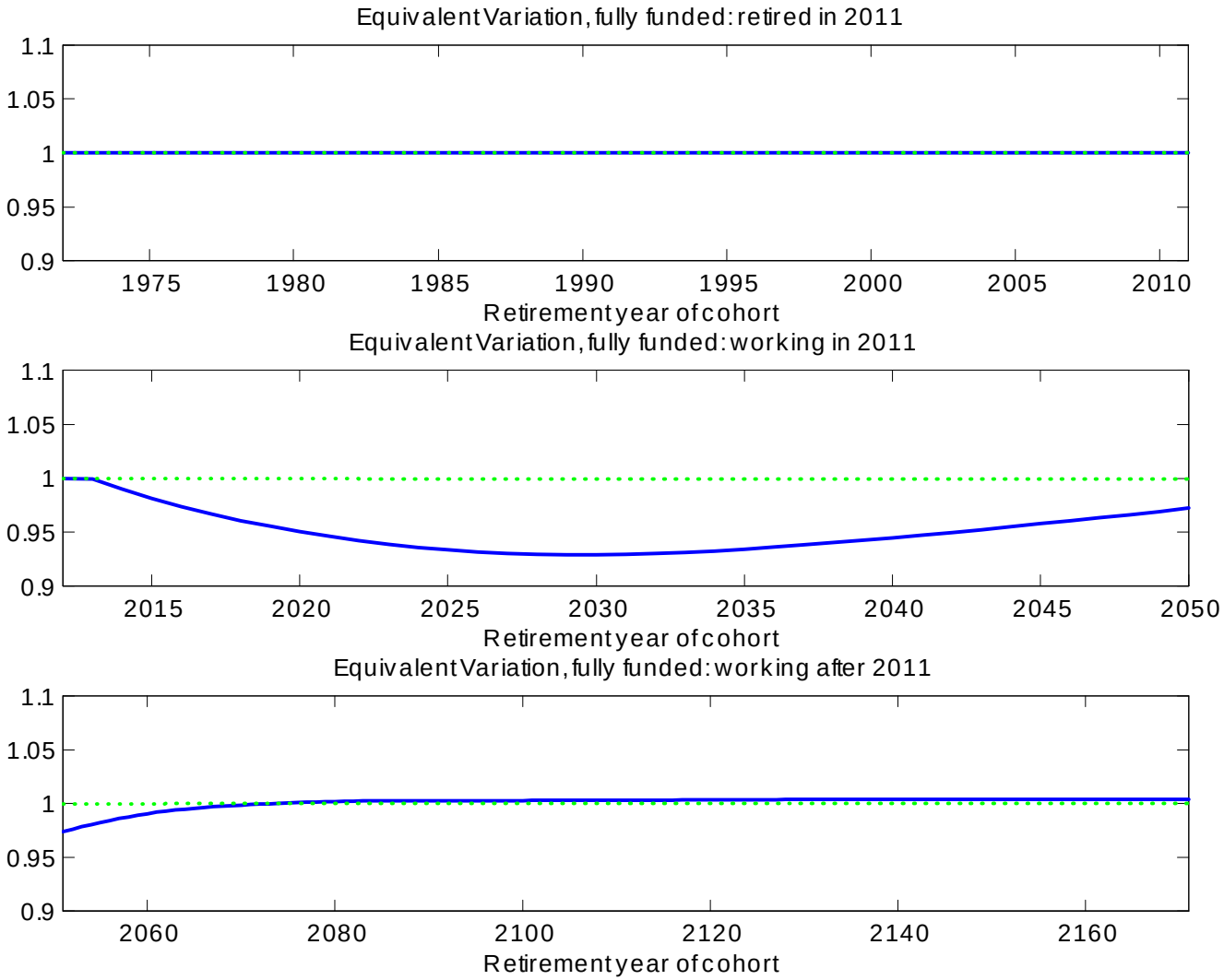
"GLC with Pensions": Fully Funded

Projections of pension dynamics



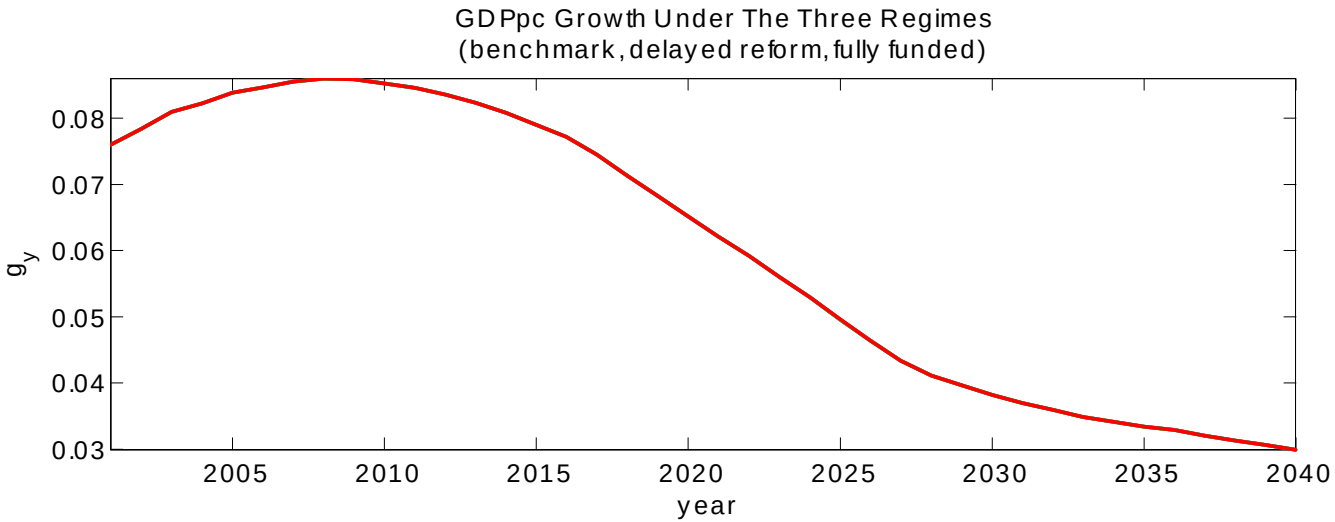
"GLC with Pensions": Fully Funded

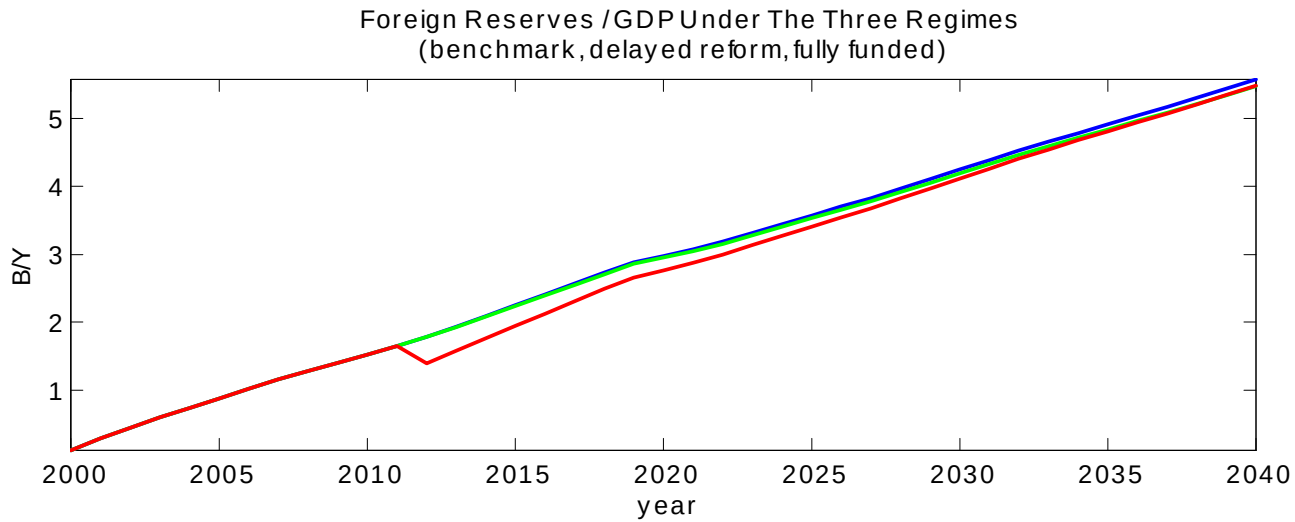
Welfare Effect of Delayed Reform



"GLC with Pensions": Comparison

Macroeconomic outcomes: GDPpc Growth and Foreign Surplus





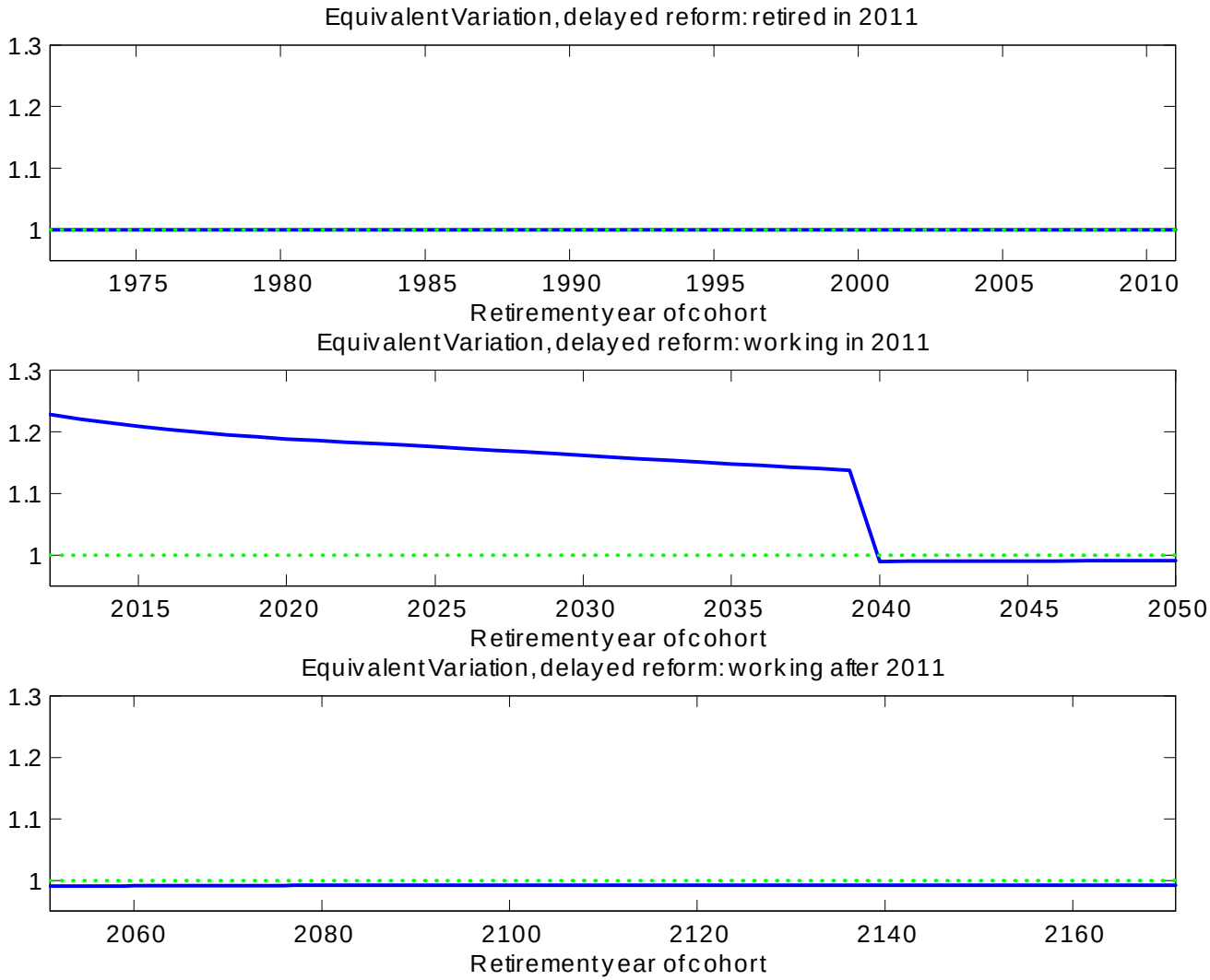
"GLC with Pensions": Elastic Labor Supply

Effect of elastic labor supply

- Funded system reduces taxation which can distort labor supply
- In contrast, delayed reforms imposes higher future distortion
- Recalibrate the model
- Results: very little change

"GLC with Pensions": Delayed Reform

Welfare Effect of Delayed Reform (elastic labor supply)



"GLC with Pensions": Fully Funded

Welfare Effect of Delayed Reform (elastic labor supply)

YIKAI: THREE PANEL GRAPH (2000-2040)

"GLC with Pensions": Human Capital Accumulation

Human Capital

- Large increase in educational attainment
- ... for instance...

"GLC with Pensions": Human Capital Accumulation

Human Capital

YIKAI: ONE PANEL GRAPH WITH THE NUMBER OF YEARS OF SCHOOLING BY COHORT (1980-2040)

"GLC with Pensions": Human Capital Accumulation

Human Capital

YIKAI: TWO PANEL GRAPH WITH THE NUMBER OF YEARS OF SCHOOLING BY COHORT (1980-2040)

- GDPpc GROWTH UNDER THE THREE REGIMES (benchmark, delayed reform, fully funded)
- GDPpc relative to US UNDER THE THREE REGIMES (benchmark, delayed reform, fully funded)

"GLC with Pensions": Delayed Reform

Welfare Effect of Delayed Reform (human capital)

YIKAI: THREE PANEL GRAPH (2000-2040)

"GLC with Pensions": Fully Funded

Welfare Effect of Delayed Reform (human capital)

YIKAI: THREE PANEL GRAPH (2000-2040)

More Scenarios

What if? [TO BE DONE]

- The pension system is extended to rural workers
- Financial development (more workers' savings can be used to finance domestic investments)
- Alternative assumptions about technical change (TFP convergence)

Conclusions

Growth Perspectives

- GLC: Transition explains an important share of the economic growth of China
- If so, we expect a declining growth rate in the years to come
- Yet, growth remains high in the 20 years to come
- By 2040, China is a mature economy, with European standards of living
- Our analysis ignores technological convergence:
  - lower bound to growth and development

Conclusions

Pension System

- Important elements of the Chinese system:
  - pension system is *urban*
  - migration increases the return on the urban PAYG
  - so, high migration from rural areas mitigates urgency of reform
- Fully funded (FF) is often praised because PAYG reduces savings and capital accumulation. However:
  - China does not need to increase workers's savings
  - The rate of return to workers' savings is NOT the rate of return to capital. In fact, it is much lower.

Conclusions

Pension System

- FF reform is likely to increase external imbalance (foreign surplus)
- To the opposite, China can afford delaying the reform, at the "cost" of reducing its foreign surplus
- Since the calibrated economy is not dynamically inefficient, there is usual trade off between welfare of current and future generations
  - (Poorer) current generations gain from delaying reform
  - (Richer) future generations gain from FF reform
- But:
  - During a fairly long transition the PAYG can guarantee a high rate of return
  - Delaying is not very costly
  - It can increase consumption and avoid a further increase in the foreign surplus