The Welfare Cost of Banking Regulation

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Motivation

- Introduction of Basel II Accord
- Worldwide regulatory framework
- Capital adequacy requirements
  - Given proportion of risky loans in form of equities
  - Ends up by being a constraint on bank's portfolio

Literature

- Fair amount of work on
  - Effectiveness of capital requirements on banking system stability (see, e.g., Kim and Santomero (1988), Dewatripont and Tirole (1994), Barth et al. (2004),...)
  - Efficiency of capital requirements in an endowment economy (Hellman, Murdock, and Stiglitz (2001), Allen and Gale (2003, 2004))

Goal of the Paper

- Welfare assessment with endowment economies ignores the effect of this requirement on growth
- Goal of this paper is to assess the trade-off, between ensuring financial stability and fostering growth

Main Idea

- Build a model of banking regulation in a standard overlapping generation framework with individuals, banks and firms
- Young individuals are entrepreneurs, old are lenders
- Banks serve as financial intermediaries
- Crisis is modeled as the outcome of a productivity shock
- Regulation is modeled as a constraint on bank's portfolio
- Calibrate this model to obtain quantitative results

Outline

- Model
- Growth Effect of Regulation
  - Unregulated Economy
  - Regulated Economy
- Stabilization Effect of Regulation
- Welfare Assessment
- Conclusion

Individuals – Consumers

- Young individuals are entrepreneurs, old are lenders
- Entrepreneur is endowed with two types of technology
  - Risky technology: $y_{1t} = z_t k_{1t}^{\alpha}$
  - Safe technology: $y_{2t} = k_{2t}^{\alpha}$
- z_t is a two-state i.i.d. random variable with $Prob(z_t = z_h) = \pi; Prob(z_t = z_l) = 1 - \pi; \overline{z} > 1$
- Individual of generation t has preferences over consumption streams given by $U(c_t^y, c_{t+1}^o) = E[u(c_t^y) + \beta u(c_{t+1}^o)]$
- with $u(c) = \frac{c^{1-\rho}-1}{1-\rho}$

Final Good Firms

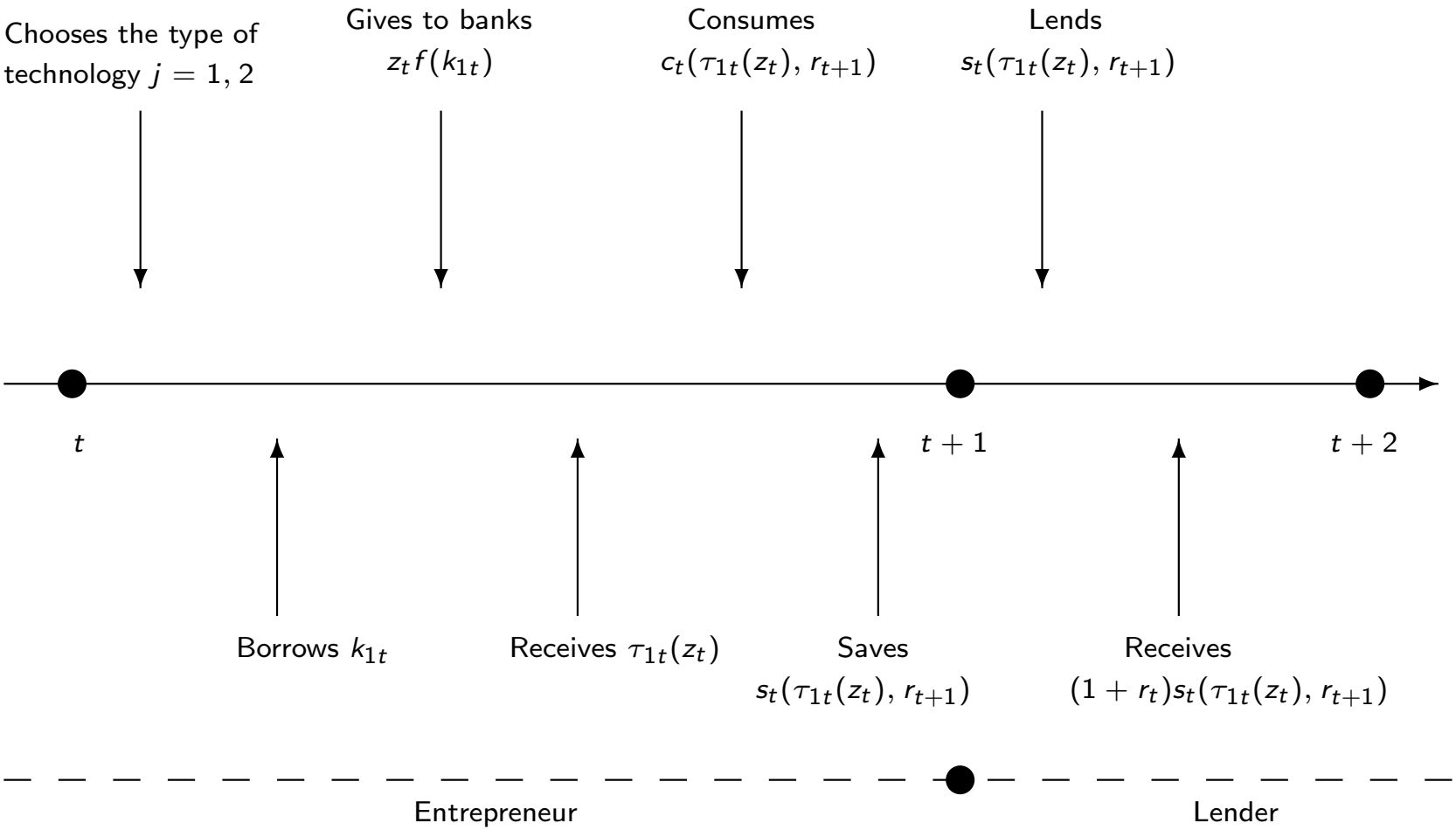
Large number of competitive firms, which produce final goods with intermediate inputs using a CES technology

$$Y_t = [\gamma Y_{1t}^{\sigma} + (1-\gamma) Y_{2t}^{\sigma}]^{\frac{1}{\sigma}}$$

Banks

- Banks collect savings from the old cohort and lend to entrepreneurs
- Banking sector is competitive
  - Banks specialize either in the risky sector or the safe sector
- Lending contracts are set conditional on the type of technology
  - $(k_{1t}, \tau_{1t}(z_t))$
  - (k_{2t}, τ_{2t})

Timing of Events



Saving Problem

- Saving is obtained as follows

$$s(\tau_t, r_{t+1}) = \arg\max_{s} \{u[\tau_t - s] + \beta E_t\ u[(1 + r_{t+1})s]\}$$

- Derive the indirect utility function by

$$v(\tau_t, r_{t+1}) = u[\tau_t - s(\tau_t, r_{t+1})] + \beta E_t\ u[(1 + r_{t+1})s(\tau_t, r_{t+1})]$$

Optimal Contract Without Regulation

- Optimal contract of risky banks solves the problem

$$\max_{(k_{1t},\tau_{1t}(z_t))} E_t\left[v(\tau_{1t}(z_t), r_{t+1})\right]$$

- subject to the budget constraint

$$\pi\tau_{1t}(z_h) + (1-\pi)\tau_{1t}(z_l) + r_t k_{1t} \leq p_{1t}\left[\pi y_{1t}(z_h) + (1-\pi)y_{1t}(z_l)\right]$$

Entrepreneur's Choice of Occupation

Chooses the risky technology if the expected utility deriving from it is greater than the one deriving from the risk-free technology. i.e.

$$\mathrm{E}_t\left[v(\tau_{1t}(z_t), r_{t+1})\right] \geq \mathrm{v}(\tau_{2t}, r_{t+1})$$

Definition – Competitive Equilibrium

- Given k_0, *a sequential market equilibrium is*
  - Individuals' *consumptions*: c_0^o, $\left\{c_{1t}^y, c_{1t+1}^o\right\}_{t=0}^{\infty}$, $\left\{c_{2t}^y, c_{2t+1}^o\right\}_{t=0}^{\infty}$
  - Aggregate capital $\left\{k_{t+1}\right\}_{t=0}^{\infty}$
  - Proportion of entrepreneurs in the risky sector $\left\{n_t\right\}_{t=0}^{\infty}$
  - Banks' *contracts* : $\left\{\left(k_{1t}, \tau_{1t}(z_t)\right)\right\}_{t=0}^{\infty}$, $\left\{\left(k_{2t}, \tau_{2t}\right)\right\}_{t=0}^{\infty}$
  - Firms' allocation $\left\{Y_t, Y_{1t}, Y_{2t}\right\}_{t=0}^{\infty}$
  - Prices $\left\{r_t, p_{1t}, p_{2t}\right\}_{t=0}^{\infty}$

Definition – Competitive Equilibrium (Cont.)

1. Consumers optimize
2. Contracts are optimal, i.e., they solve banks' problem
3. Ex-ante, entrepreneurs are indifferent between technologies'type

i.e., $E\left[v(\tau_{1t}(z_t), r_{t+1})\right] = v(\tau_{2t}, r_{t+1})$

4. Firms optimize, i.e., $\{Y_t, Y_{1t}, Y_{2t}\}_{t=0}^{\infty}$ solve firms' problem
5. Aggregate capital stock equals supply
6. Market from risky input clears
7. Market from risk-free input clears

Characterization

- Concavity of the instantaneous utility function drives banks to provide contracts that provide full insurance
- Equilibrium in any period t,
  - $k_{1t} = k_{2t}$
  - n^* is positive, strictly less than one, and is an increasing function of $\overline{z}$
- Banking system provides contract to risk-free projects
- Economy behaves exactly like the standard one sector OLG model of capital accumulation

Banks' Problem with Regulation

- Bank problem is

$$\max_{(\widehat{k}_{1t},\widehat{\tau}_{1t},\widehat{k}_{2t},\widehat{\tau}_{2t})} v(\widehat{\tau}_{1t}, r_{t+1})$$

- subject to,

$$\widehat{n}_t\widehat{\tau}_{1t} + (1-\widehat{n}_t)\widehat{\tau}_{2t} + r_t k_{1t} \leq \widehat{n}_t p_{1_t}\widehat{y}_{1t} + (1-\widehat{n}_t)p_{2_t}\widehat{y}_{2t}$$

$$v(\widehat{\tau}_{2t}, r_{t+1}) \geq v(\tau_{2t}, r_{t+1})$$

$$\frac{\widehat{n}_t\widehat{k}_{1t}}{k_{1t}} \leq \theta$$

- with

$$k_{1t} = \widehat{n}_t\widehat{k}_{1t} + (1-\widehat{n}_t)\widehat{k}_{2t}$$

Definition – Regulated Competitive Equilibrium

- Given k_0, *a sequential market equilibrium is*
  - Individuals' *consumptions* : $c_0^o, \left\{\widehat{c}_{1t}^y, \widehat{c}_{1t+1}^o\right\}_{t=0}^{\infty}$, $\left\{\widehat{c}_{2t}^y, \widehat{c}_{2t+1}^o\right\}_{t=0}^{\infty}, \left\{c_{2t}^y, c_{2t+1}^o\right\}_{t=0}^{\infty}$
  - Proportion of entrepreneurs : $\left\{\widehat{n}_t\right\}_{t=0}^{\infty}, \left\{m_t\right\}_{t=0}^{\infty}$
  - Banks' *contracts* : $\left\{\left(\widehat{k}_{1t}, \widehat{\tau}_{1t}(z_t)\right)\right\}_{t=0}^{\infty}, \left\{\left(\widehat{k}_{2t}, \widehat{\tau}_{2t}\right)\right\}_{t=0}^{\infty}$, $\left\{\left(k_{2t}, \tau_{2t}\right)\right\}_{t=0}^{\infty}$
- Ex-ante, entrepreneurs implementing the risk-free technology are indifferent between banks' type
- Ex-ante, entrepreneurs in the risky banks are indifferent between technologies' type

Characterization

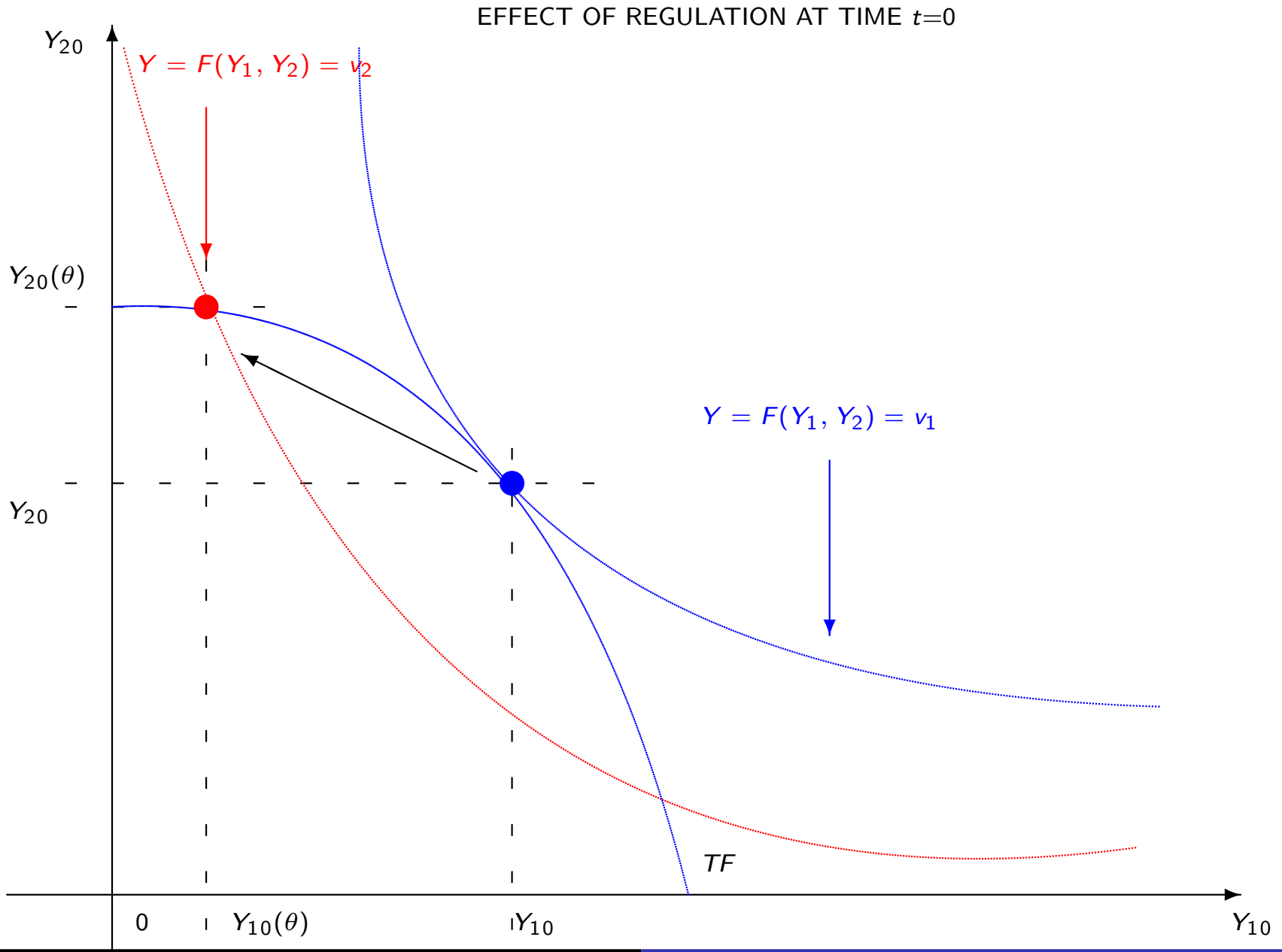
Case where $\theta \in (n^*, 1)$

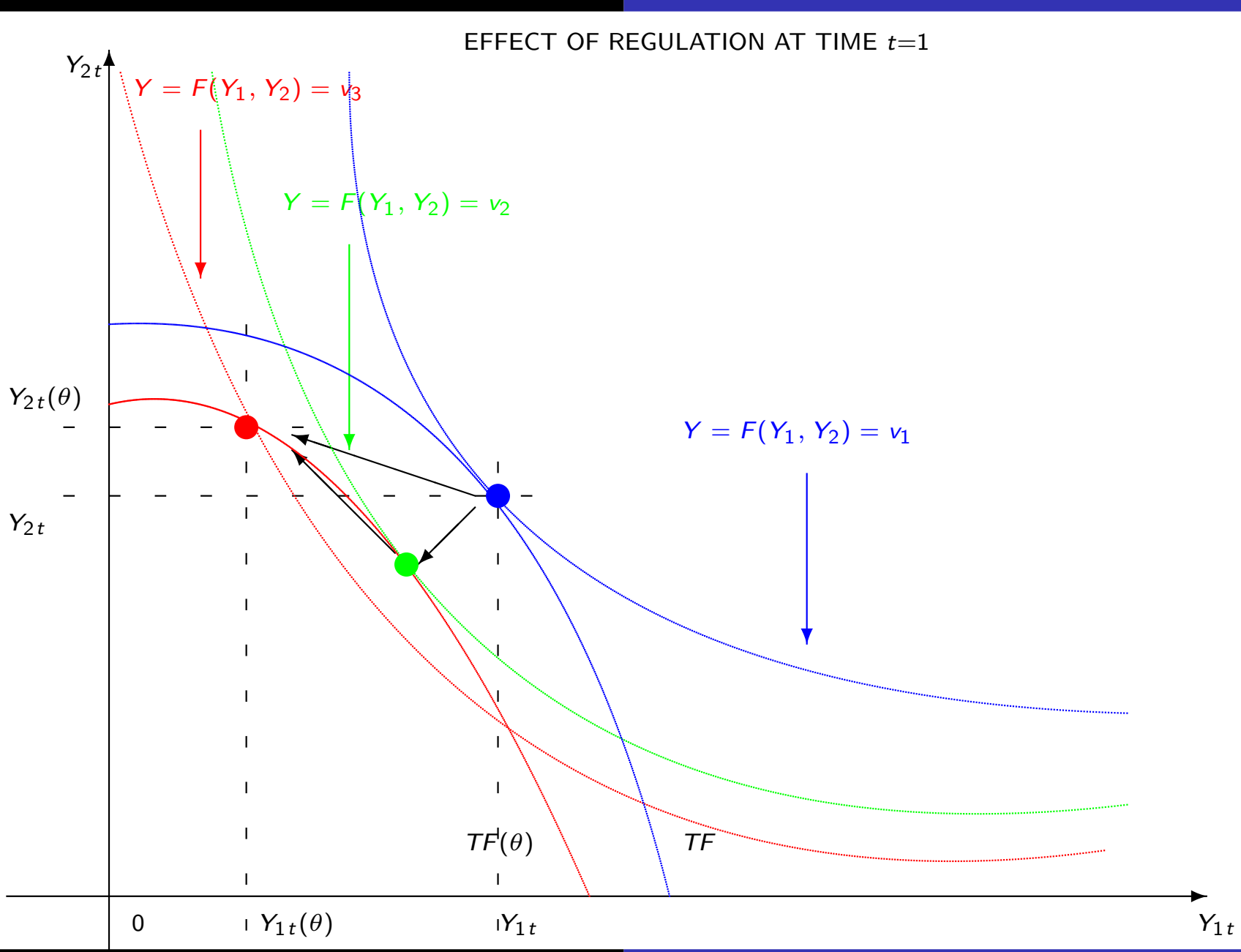
- Regulation has no effect on growth
  - Entrepreneurs move from risk-free banks to risky banks, until the transfer in risky banks equalized the one of the risk-free

Characterization (Cont.)

Case where $\theta \in (0, n^*)$

- Regulation is effective
- Regulation has a positive effect on Y_{2t}, but a negative on Y_{1t}
- Explanation for the risk-free input
  - Demand remains unchanged, because it depends only on technology parameters
  - Supply increases with regulation
  - Result : greater production of risk-free inputs


EFFECT OF REGULATION AT TIME t=0
Y_{20}
$Y = F(Y_1, Y_2) = v_2$
$Y_{20}(\theta)$
Y_{20}
$Y = F(Y_1, Y_2) = v_1$
TF
0
$Y_{10}(\theta)$
Y_{10}
Y_{10}


EFFECT OF REGULATION AT TIME t=1
Y_{2t}
$Y = F(Y_1, Y_2) = v_3$
$Y = F(Y_1, Y_2) = v_2$
$Y = F(Y_1, Y_2) = v_1$
$Y_{2t}(\theta)$
Y_{2t}
$TF(\theta)$
TF
0
$Y_{1t}(\theta)$
Y_{1t}
Y_{1t}

Banking Crisis

- Assume that
  - Aggregate unanticipated productivity shock can occur in the risky sector i.e. now $\overline{z}_t \in \{z_w, \overline{z}\}$
  - Banks are required to meet their promise to pay at least $\underline{\tau}$ to entrepreneurs
- $\overline{z}_t = \overline{z}$, the economy continues to work as usual
- $\overline{z}_t = z_w$, bank may go bankrupt if available resources are insufficient

Banking Crisis (Cont.)

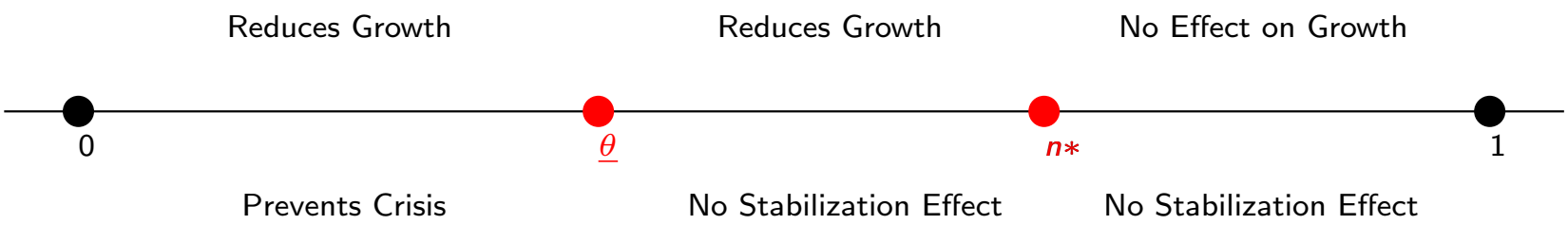
- For any $\underline{\tau}$ positive, there will exist a number $\underline{z}$ such that if $z_w < \underline{z}$, risky banks will go bankrupt
- Assume that $z_w < \underline{z}$, therefore banks always go bankrupt in the unregulated economy when the unexpected state occurs
- Bankruptcy rule asks to provide first, the minimum transfer to entrepreneurs and share the remaining assets to lenders

Effect of Regulation on Banking Crisis

- Regulation can prevent bankruptcies if θ is set at an appropriate level $\theta \leq \underline{\theta}$
- Intuitively,
  - $\theta \leq \underline{\theta}$, the number of people choosing the risky technology is low and the effect of the productivity shock is dampened
  - In case of crisis, regulated risky banks have enough resources to pay
    - Lenders
    - Risk-free entrepreneurs
    - At least the minimum transfer to the risky entrepreneurs

Summary

- Overall effects of regulation



Qualitative Welfare Measure

- Realized welfare of generation t is given by

$$W_t(c(z_t), c(z_{t+1})) =$$

$$n_t v^r(\tau_{1t}(z_t), r_{t+1}(z_{t+1})) + (1 - n_t)v^r(\tau_{2t}(z_t), r_{t+1}(z_{t+1}))$$

- Realized overall social welfare measure is given by

$$W(c(z^t)) = \sum_{t=0}^{\infty} \delta^t W_t(c(z_t), c(z_{t+1}))$$

- Regulation affects the welfare through
  - Weight, the proportion of risky-entrepreneurs
  - Transfer, (type 1 and type 2 transfers)
  - Interest rate

Quantitative Welfare Measure

Relative welfare-gain of the regulation, Ω is defined by

$$W((1+\Omega)c(z^t)) = W(\widehat{c}(z^t))$$

Calibration

- Calibrate the model to match the US economy
  - Proportion of the risky sector is approximated by the proportion of high-tech product in exports
  - Productivity in the risky sector is approximated by the ratio of the stock market long-run return over the real interest rate
  - Lower productivity is approximated by the observed productivity in major crisis periods
  - Minimum transfer is approximated by the share of revenue received by entrepreneurs in case of bank failure
  - Intergenerational discount factor is calibrated to match the interest rate

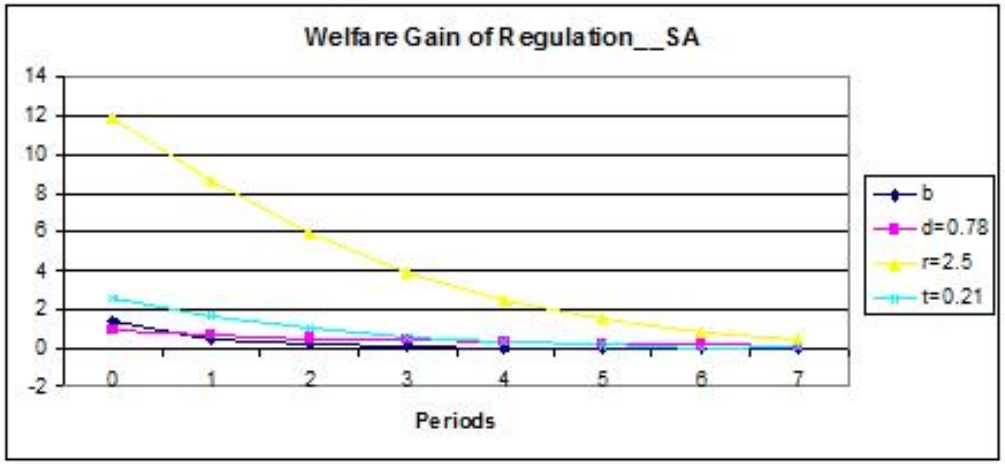
Relative Welfare Gain

Relative Welfare Gain – Function of Crisis-Time

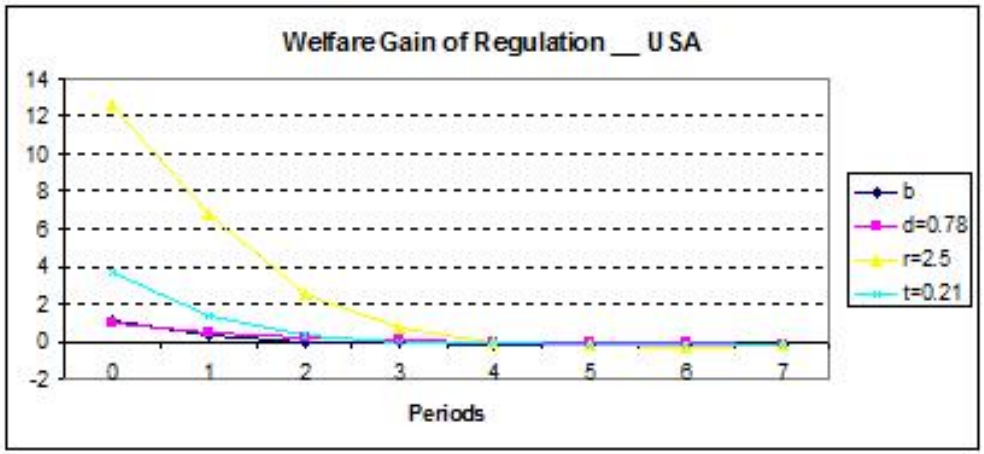
	T	0	1	2	3	4	5
ρ							
1.1		3.1	2.7	1.9	0.8	−0.05	−0.12
1.5		4.5	3.2	2.8	1.5	0.04	−0.06
2		7.5	5.2	3.8	2.2	0.95	0.22
2.5		9.4	6.5	4.5	3.0	1.03	0.59

- Relative welfare-gain is
  - Time decreasing
  - Increases with risk-aversion coefficient

Relative Welfare Gain (Cont.)



Relative Welfare Gain (Cont.)



Conclusion

- Built a model showing that regulation can prevent crisis, but at a cost in terms of growth
- Showed in a calibration exercise that regulation is welfare enhancing when the economy is hit by large shocks given that individuals are sufficiently risk averse

Table 2. Benchmark Parameter Values

Symbol	USA	SA	Description
Preferences			
β	0.30	0.61	individuals' discount factor
δ	0.30	0.61	social discount factor
ρ	1.50	1.50	coefficient of relative risk aversion
Technology			
α	0.34	0.34	capital's share of income
γ	0.30	0.21	distribution parameter
σ	0.70	0.70	substitution parameter
$\overline{z}$	2.50	2.80	anticipated productivity shock
z_w	0.80	0.92	unanticipated productivity shock
Bankruptcy rules			
$\underline{\tau}$	0.25	0.25	minimum transfer to entrepreneurs
Period			

Table 1. Data, average (1960-2000)

Country	Life expectancy (years)	Interest rate (%)	High-Tech (%) of Exp. (%)
USA	74	4.1	32.5
SA	54	3.2	6.3

Source: WDI (2002)