Inefficient Borrowing in Production Economies

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Ente Einaudi, Rome, 2010

Motivation

- Crisis associated with financial market imperfections cause significant economic dislocation ("Sudden Stop",Calvo (1998) and recent 2007-2009 crisis).
- An important question is whether the likelihood and the severity of these crises are affected by excessive borrowing in normal times (i.e. overborrowing).

Motivation

- Policy debate has emphasized the role of macro-prudential policies (ex-ante policies)
- Policy debate:
  1. Korinek (2009), Bianchi (2009), Jeanne and Korinek (2010), Bianchi and Mendoza (2010): various specification (endowment, production, relative price, asset price) $\Rightarrow$ overborrowing and stress the role of ex-ante policies (i.e. tax on debt)
  2. Benigno et al. (2009,2010), Caballero (2010), Nikolov (2009) $\Rightarrow$ stress the role of ex-post policies.
- Logic of policy prescriptions:
  1. If there is overborrowing, policy should focus on ex ante prevention.
  2. If there is no overborrowing, policy should focus on ex post intervention.

Contribution

- Examine inefficient borrowing in multi–sector production economies.
- Main results:
  1. Production economies might display underborrowing.
  2. Welfare gains from possible policy actions in crisis times are higher than in normal times (~more scope for ex-post rather than ex-ante policies).
- $\Rightarrow$ no clear cut rationale to prefer prevention over intervention policies

Outline

- Model and its properties
- Mechanisms behind inefficient borrowing
- Quantitative analysis
- Welfare analysis and Conclusions

How do we model sudden stop?

- Following Mendoza (2002, 2010):

1. Two Sector (Traded and Nontraded) Small Open Economy with Flexible prices
2. Occasionally binding borrowing constraint
3. Crisis is endogenous and nested in regular cycles
4. The model can describe both bad and good times (match many of the quantitative features of emerging market business cycles, inside and outside sudden stop periods)

Scope for policy intervention:

- General idea (Arnott, Greenwald and Stiglitz, 1994): *with financial frictions* agents take actions that makes sense from an individual point of view but do not take into account the impact of their actions in the aggregate.
- Scope for policy arises because of the presence of this externality (pecuniary externality or systemic externality)
- In general the presence of the externality creates scope for policy action even during normal times.
- In the context of our model scope for policy emerges in the two-sector economy: agents do not internalize the effects of their choices on relative prices.

Model: Preferences

- Households maximize:

$$U^j \equiv E_0 \sum_{t=0}^{\infty} \left\{ \beta^t \frac{1}{1-\rho} \left(C_{j,t} - \frac{H_{j,t}^{\delta}}{\delta} \right)^{1-\rho} \right\},$$

- Consumption basket C is a composite of tradable and non-tradables goods:

$$C_t \equiv \left[\omega^{\frac{1}{\kappa}} \left(C_t^T \right)^{\frac{\kappa-1}{\kappa}} + (1-\omega)^{\frac{1}{\kappa}} \left(C_t^N \right)^{\frac{\kappa-1}{\kappa}} \right]^{\frac{\kappa}{\kappa-1}}.$$

- Aggregate price index increasing in relative price of non-tradables

$$P_t = \left[\omega + (1-\omega) \left(P_t^N \right)^{1-\kappa} \right]^{\frac{1}{1-\kappa}};$$

Model: Budget and Credit Constraint

- Access to international capital markets is not only incomplete:

$$C_t^T + P_t^N C_t^N = \pi_t + W_t H_t - B_{t+1} + (1+i) B_t,$$

- But also imperfect:

$$B_{t+1} \geqslant -\frac{1-\phi}{\phi} \left[\pi_t + W_t H_t\right]$$

- The constraint limits B to a fraction of current income.
- Constraint binds only occasionally.

Model: Household FOCs

- Marginal utility of current consumption is higher when constraint is binding (time profile of relative price affects time profile of consumption)

$$B_{t+1} : \mu_t = \lambda_t + \beta (1 + i) E_t \left[\mu_{t+1} \right]$$

- Labor supply higher if constraint is binding:

$$H_t : \left(C_{j,t} - \frac{H_{j,t}^{\delta}}{\delta} \right)^{-\rho} \left(H_{j,t}^{\delta - 1} \right) = \mu_t W_t + \frac{1 - \phi}{\phi} W_t \lambda_t,$$

- Non-tradable consumption choice:

$$C_N : \left(C_{j,t} - \frac{H_{j,t}^{\delta}}{\delta} \right)^{-\rho} (1 - \omega)^{\frac{1}{\kappa}} \left(C_t^N \right)^{-\frac{1}{\kappa}} C^{\frac{1}{\kappa}} = \mu_t P_t^N,$$

- Marginal utility of tradable consumption determines multiplier

$$C_T : \left(C_{j,t} - \frac{H_{j,t}^{\delta}}{\delta} \right)^{-\rho} \omega^{\frac{1}{\kappa}} \left(C_t^T \right)^{-\frac{1}{\kappa}} C^{\frac{1}{\kappa}} = \mu_t.$$

Model: Firms

- Traded and Nontraded goods are produced with variable labor input:

$$Y_t^N = A_t^N H_t^{1-\alpha^N}, Y_t^T = A_t^T H_t^{1-\alpha^T}$$

- The firm (owned by the consumer) chooses labor to maximize profits:

$$\pi_t = A_t^T \left(H_t^T\right)^{1-\alpha^T} + P_t^N A_t^N \left(H_t^N\right)^{1-\alpha^N} - W_t H_t.$$

- Labor demand schedules:

$$W_t = \left(1-\alpha^N\right) P_t^N A_t^N \left(H_t^N\right)^{-\alpha^N},$$

:

$$W_t = \left(1-\alpha^T\right) A_t^T \left(H_t^T\right)^{-\alpha^T}.$$

Model: Interaction between Credit Friction and Consumption Choices in CE

- Role of credit constraint in the non-binding region
- If the constraint might bind in the next period we have

$$\mu_t = \beta (1+i) E_t \left[\lambda_{t+1} + \beta (1+i) E_t \left[\mu_{t+2} \right] \right]$$

- Intratemporal equilibrium condition

$$\frac{(1-\omega)^{\frac{1}{\kappa}} \left(C_t^N\right)^{-\frac{1}{\kappa}}}{\omega^{\frac{1}{\kappa}} \left(C_t^T\right)^{-\frac{1}{\kappa}}} = P_t^N$$

- Precautionary saving motive determines a decline in relative price.

Model: Interaction between Credit friction and Labor Market/Production Choices Equilibrium in CE

Role of production economy in the non-binding region.

- Household choose intratemporal allocation of consumption

$$P_t^N = \frac{(1-\omega)^{\frac{1}{\kappa}} \left(A_t^N \left(H_t^N \right)^{1-\alpha^N} \right)^{-\frac{1}{\kappa}}}{\omega^{\frac{1}{\kappa}} \left(C_t^T \right)^{-\frac{1}{\kappa}}}$$

- Household choose labor supply

$$\left(H_t^{\delta-1} \right) = \left(1 + \left(\frac{1-\omega}{\omega} \right) \left(P_t^N \right)^{1-\kappa} \right)^{\frac{1}{\kappa-1}} MPL_t^T$$

- Firm technology determines intrasectoral labor allocation:

$$P_t^N = \frac{MPL_t^T}{MPL_t^{NT}}$$

- System of equation determines H_t^T, H_t^N and P_t^N for given borrowing (i.e. C_t^T).
- If $\downarrow C^T \Rightarrow \downarrow P^N \Rightarrow \uparrow H$; intrasectoral allocation will $\uparrow H^T$ and $\downarrow H^N$ so that $\downarrow C^N$ and $\Rightarrow$ amplify further decline in C^T.

Model: Interaction between Credit friction and Labor Market Equilibrium in CE

- To what extent this mechanism is robust?
  1. wealth effects determined by the fact that in multisector economy with GHH relative price will affect household labor supply choice.This effect will arise also in one sector economy without GHH preferences
  2. this mechanism is independent from the way the collateral constraint is specified (i.e. in terms of relative price of non-tradables or asset prices)
  3. this mechanism operates also when there is a working capital constraint.

Model: Constraints of the Social Planner Problem

- Resource constraint on tradables

$$C_t^T = Y_t^T - B_{t+1} + (1+i)\, B_t.$$

- Resource:constraint on nontradable goods

$$C^N = Y^N = A_t^N \left(H_t^N\right)^{1-\alpha^N}$$

- Credit constraint from a country perspective:

$$B_{t+1} \geq -\frac{1-\phi}{\phi}\left[Y^T + P_t^N Y^N\right],$$

- Pricing rule as in the CE (Kehoe and Levine, 1993):

$$P_t^N = \frac{(1-\omega)^{\frac{1}{\kappa}} \left(A_t^N \left(H_t^N\right)^{1-\alpha^N}\right)^{-\frac{1}{\kappa}}}{\omega^{\frac{1}{\kappa}} \left(C_t^T\right)^{-\frac{1}{\kappa}}}$$

Model: First Order Conditions

- The first order conditions for the planner problem are given by

$$C_T : U_C(C_t) C_{C^T} = \mu_{1,t}^{SP} - \lambda_t \frac{1-\phi}{\phi} \frac{\partial P_t^N}{\partial C_t^T} \left(A_t^N \left(H_t^N \right)^{1-\alpha^N} \right), \tag{1}$$

$$C_N : U_C(C_t) C_{C^N} = \mu_{2,t}^{SP}, \tag{2}$$

$$B_{t+1} : \mu_{1,t}^{SP} = \lambda_t^{SP} + \beta (1+i) E_t \left[\mu_{1,t+1}^{SP} \right] \tag{3}$$

and

$$H_t^T : U_C(C_t) \left(H_t^{\delta-1} \right) = \left(1-\alpha^T \right) \mu_{1,t}^{SP} A_t^T H_t^{-\alpha^T} \left[1 + \frac{1-\phi}{\phi} \frac{\lambda_t^{SP}}{\mu_{1,t}^{SP}} \right] \tag{4}$$

$$H_t^N : U_C(C_t) \left(H_t^{\delta-1} \right) = \left(1-\alpha^N \right) \mu_{2,t}^{SP} A_t \left(H_t^N \right)^{-\alpha^N}$$
$$\left[1 + \frac{1-\phi}{\phi} \frac{\lambda_t^{SP}}{\mu_{2,t}^{SP}} \left(\frac{(1-\omega)\left(C_t^T\right)}{\omega} \right)^{\frac{1}{\kappa}} \frac{\kappa-1}{\kappa} \left(A_t^N \left(H_t^N \right)^{\left(1-\alpha^N\right)} \right)^{-\frac{1}{\kappa}} \right] \tag{5}$$

Comparison between SP and CE: intertemporal effect

- First order condition in the planner problem for intertemporal decision when the constraint is not binding:

$$\mu_{1,t}^{SP} = \beta (1+i) E_t \left[\mu_{1,t+1}^{SP} \right]$$

  where $\mu_{1,t}^{SP}$ is the marginal utility of tradable consumption.
- Now if the constraint might bind in the future:

$$\mu_{1,t}^{SP} = \beta (1+i) E_t \left[\lambda_{t+1}^{SP} + \beta (1+i) \mu_{1,t+2}^{SP} \right],$$

- where $\mu_{1,t+2}^{SP}$ is bigger than competitive multiplier since planner takes into account effect of prices on marginal value of wealth.
- $\mu_{1,t}^{SP} > \mu_t^{CE}$ implies higher marginal utility of tradable consumption in SP compared to CE
- Lower tradable consumption profile in the SP compared to CE implies that agents would be better off by increasing their saving (i.e. there is overborrowing).

Comparison between SP and CE: production effect

- First order condition in the planner problem for labor supply when the constraint is not binding:

$$U_C(C)\left(H_t^{\delta-1}\right) = \mu_{1,t}^{SP} MPL_t^T.$$

  where $\mu_{1,t}^{SP} > \mu_t^{CE}$ is the marginal utility of tradable consumption in the SP allocation.
- The possibility that the constraint might bind in the future $\Rightarrow \uparrow \mu_{1,t}^{SP} > \uparrow \mu_t^{CE}$
- The marginal utility of supplying one unit of labor is also higher for a given MPL_t^T so that in the SP allocation labor supply tends to be higher than in the CE allocation even when the constraint is not binding.
- The relative increase in nontradable production/consumption in the SP allocation compared to the CE one will push for higher C^T in SP reducing the amount agents save in the social planner equilibrium (i.e. this might generate underborrowing in the competitive equilibrium allocation compared to the social planner one).

Comparison between SP and CE: intrasectoral allocation effect

- In the CE, sectoral labor reallocation is determined by P_N. As P_N decreases, there is a shift towards tradable goods production out from non-tradable goods. If goods are complement this decline in the non-tradable production/consumption will lead to a reduction in tradable consumption and an increase in savings.
- In the SP, sectoral labor reallocation is guided by $\frac{\mu_{2,t}^{SP}}{\mu_{1,t}^{SP}}$. Since $\uparrow \mu_{1,t}^{SP}$ and is higher than at the CE, there is a bigger shift towards tradable goods production that would lead to a decline in non-tradable production/consumption and a relative increase in savings compared to the CE allocation.
- The intrasectoral allocation effect will generate overborrowing.

Calibration: key parameter values (quarterly)

- Elast. of sub. (tradable and non-tradable goods) $\kappa = 0.76$
- Weight of tradable and non-tradable goods $\omega = 0.32076$
- Utility curvature $\rho = 2$
- Labor supply elasticity $\delta = 2$
- Labor share in production α^T and $\alpha^N = 0.66$
- Credit constraint parameter $\phi = 0.4607$
- Persistence/volatility shock: $\rho_T = 0.553, \sigma_n = 0.028$
- Home real interest rate $i = 0.099$
- Unconditional probability of sudden stop 1.6% per quarter

Figure 1: Policy functions for Foreign Borrowing

CE and SP

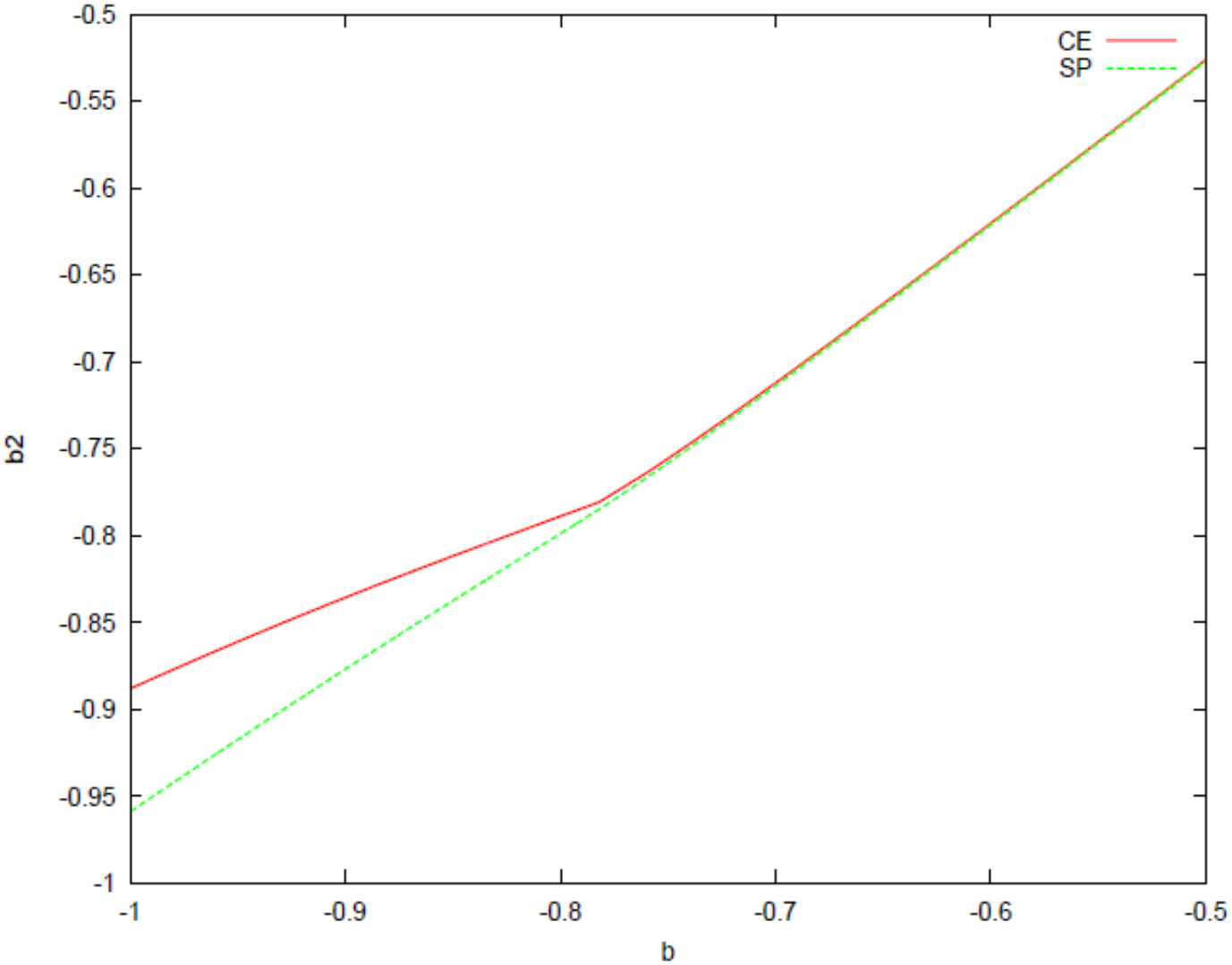


Figure 2: Policy Functions for PN

CE and SP

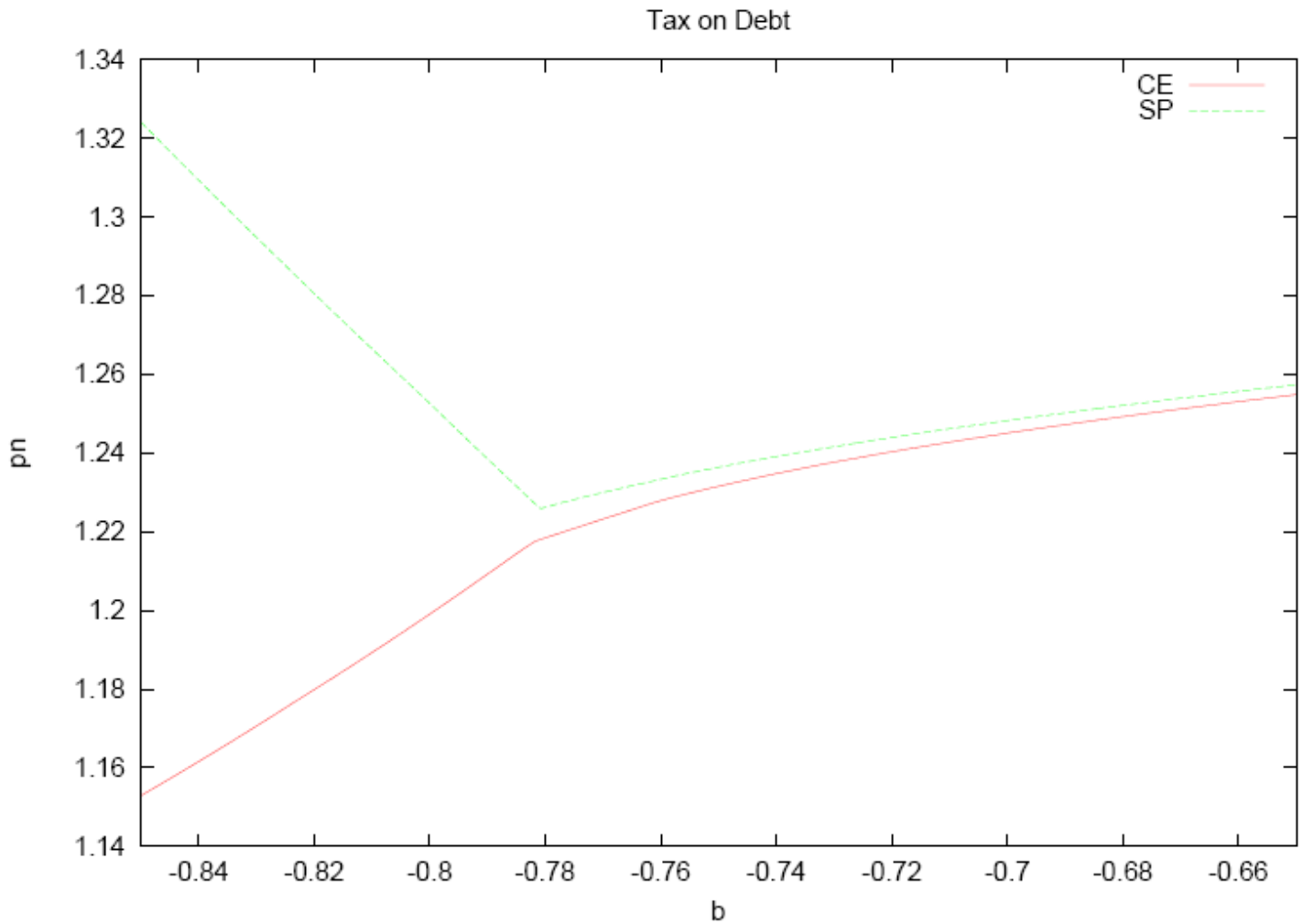
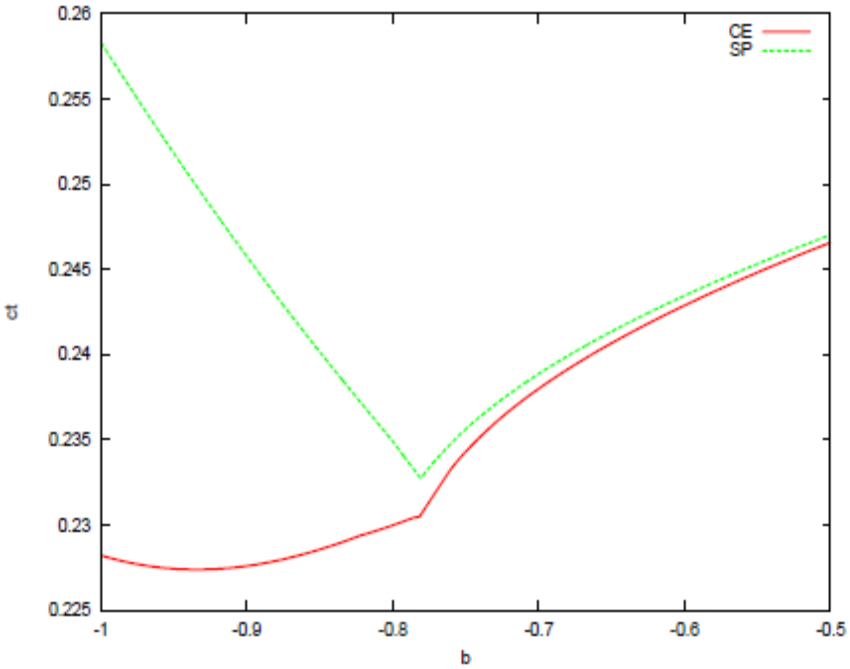


Figure 3a: Policy Functions for CT and CN

CE and SP



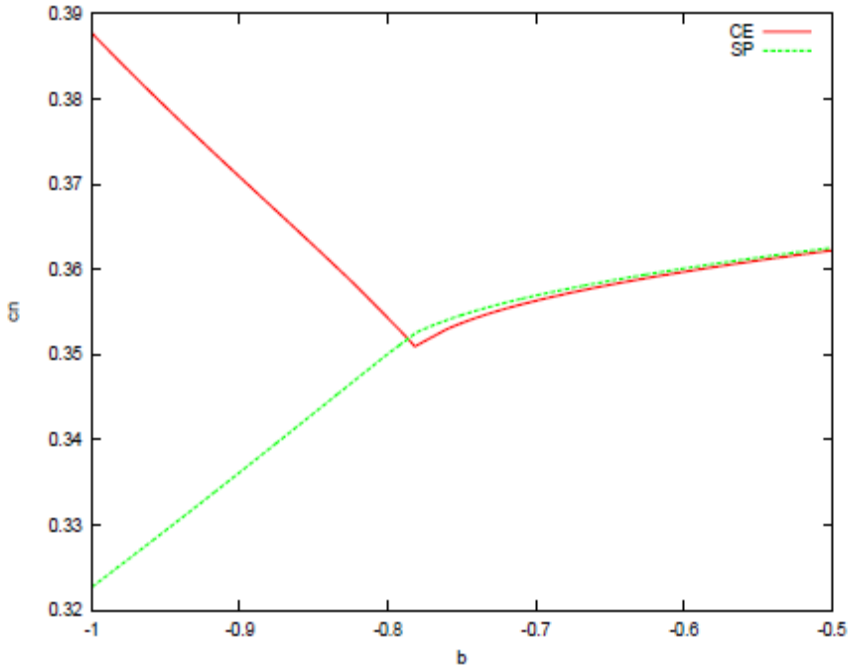
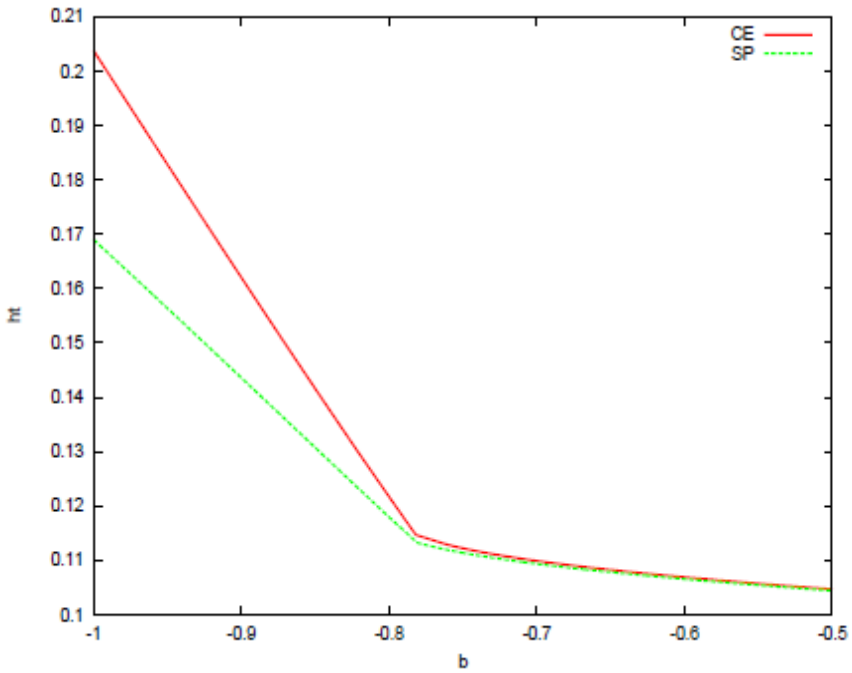


Figure 3b: Policy Functions for HT and HN

CE and SP



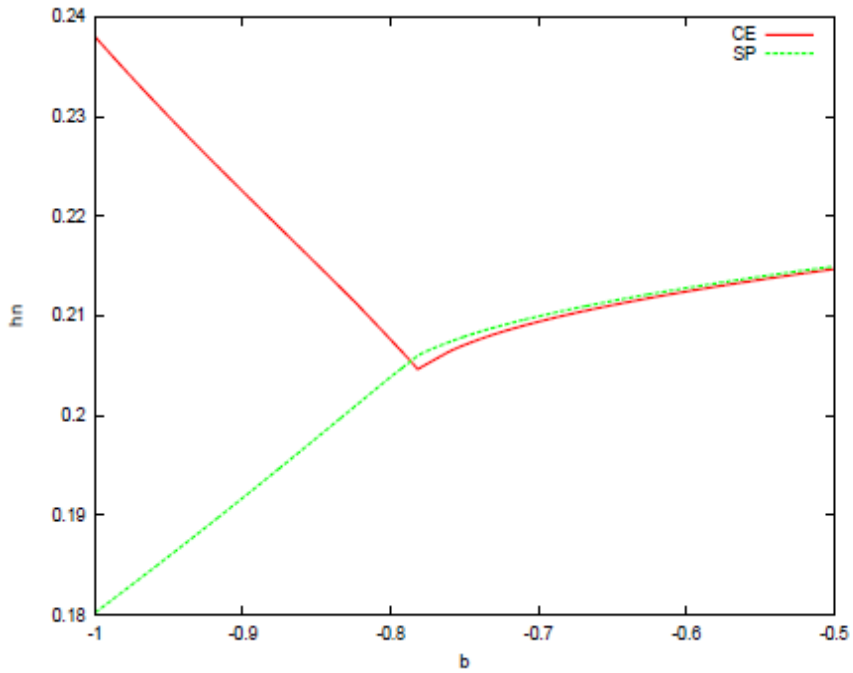
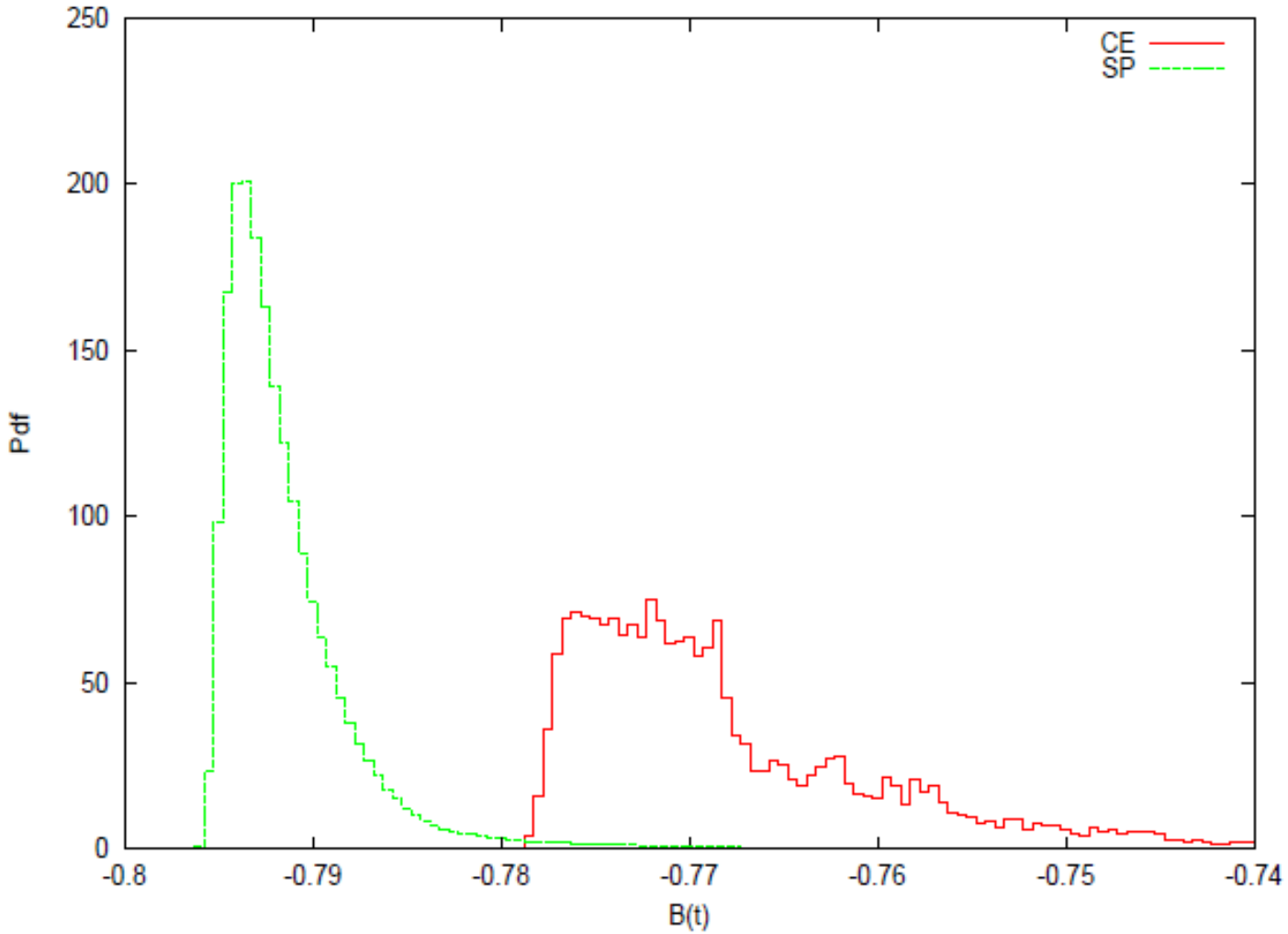


Figure 4: Ergodic distribution for Debt

CE and SP



Welfare implications

Welfare gain of moving from the CE to the SP
(In percent of total consumption at each time and state**)**

	Overall	At the sudden stop
Production, benchmark parameters	0.0276	0.0346

The welfare gains of moving from the CE to SP are calculated as the percent of total consumption that the agents are willing to forego at every date and state to move from one allocation to the other. That is the percent reduction in consumption at all future dates and states in the SP that equates expected utility in the CE with expected utility in the SP. This cost is calculated at each point on the state space. The "overall" welfare cost is calculated by weightng the cost in each state by the unconditional probability of being in that state.

Policy Implications and Conclusions

- Interaction between multisector production economy and credit constraint important for policy prescription
  1. Modest underborrowing $\Rightarrow$ e.g. no clear cut case for Tobin tax or capital controls.
  2. Welfare gain larger at sudden stop $\Rightarrow$ ex-post policies might be more relevant.
- Overborrowing arises in special circumstances (endowment economy and specific calibration, see Benigno et al. 2010)
- Comparison between CE and SP might be misleading in terms of policy design (Benigno et al. (2009)).
- Framework proposed has several limitations: no moral hazard consideration, time-incosistencies (Chari and Kehoe, 2010) and no efficiency consideration (see Nikolov, 2009).
- Work in progress: multisector economy with asset price (robustness analysis with alternative rules).