XXXVI ENCUENTRO DE ECONOMISTAS DEL BANCO CENTRAL DE RESERVA DEL PERÚ

Capital Flows and Bank Risk-Taking

Jorge Pozo

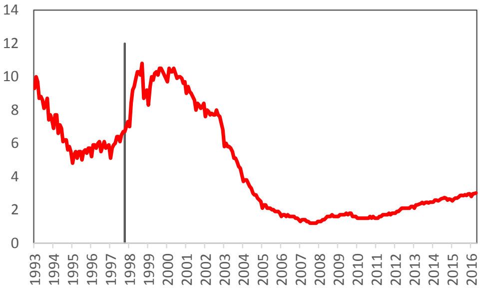
Banco Central de Reserva del Perú

October 31, 2018

Introduction

- 1998 Peruvian sudden stop: After 1998Q3, there is a gradual reduction of the ST NFL to GDP ratio and an almost immediate increase of the morosity ratio of the banking system. The morosity ratio jumped from 6.4 to 10.3 in three quarters.
- I provide a framework to understand the dynamics of the excessive bank risk-taking after an unanticipated sudden stop.
- I simulate the 1998 Peruvian sudden stop.

Figure 1: Morosity rate of the Peruvian banking system (%)

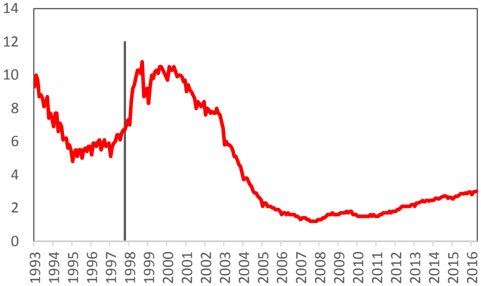


Source: SBS.

Introduction

- 1998 Peruvian sudden stop: After 1998Q3, there is a gradual reduction of the ST NFL to GDP ratio and an almost immediate increase of the morosity ratio of the banking system. The morosity ratio jumped from 6.4 to 10.3 in three quarters.
- I provide a framework to understand the dynamics of the excessive bank risk-taking after an unanticipated sudden stop.
- I simulate the 1998 Peruvian sudden stop.

Figure 1: Morosity rate of the Peruvian banking system (%)

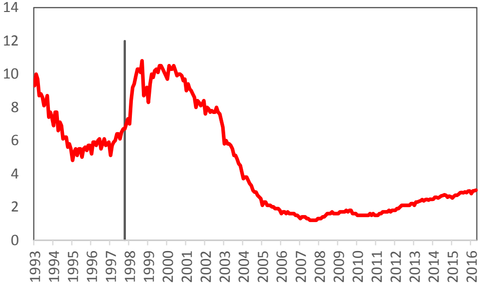


Source: SBS.

Introduction

- 1998 Peruvian sudden stop: After 1998Q3, there is a gradual reduction of the ST NFL to GDP ratio and an almost immediate increase of the morosity ratio of the banking system. The morosity ratio jumped from 6.4 to 10.3 in three quarters.
- I provide a framework to understand the dynamics of the excessive bank risk-taking after an unanticipated sudden stop.
- I simulate the 1998 Peruvian sudden stop.

Figure 1: Morosity rate of the Peruvian banking system (%)



Source: SBS.

Results

- The limited liability + deposit insurance ⇒ Inefficiently high level of loans.
- The intertemporal effect amplifies the inefficiency.
  - The fact that banks have limited liability and deposit insurance not only in the present but also in the future creates incentive to increases even by more the inefficient overvaluation of the marginal benefits of the loans.
  - The default probability of banks is 6 times its value when abstracting from this intertemporal effect.
- Sudden Stop Simulation: I assume a 87% gradual reduction of the foreign borrowing limit to account for the reduction of the ST NFL to GDP (from 7.5% (1998Q3) to 1% in 2010).
- In the long-term:
  - The (quarterly) default probability: From 0.7% to 1.8%.
  - The relative excess loans: From 3.6% to 6.2%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect the short-term responses are (1.1 and 1.1 respectively) and those account for the 8.5% and 6.8% of their long-term movements.

Results

- The limited liability + deposit insurance ⇒ Inefficiently high level of loans.
- The intertemporal effect amplifies the inefficiency.
  - The fact that banks have limited liability and deposit insurance not only in the present but also in the future creates incentive to increases even by more the inefficient overvaluation of the marginal benefits of the loans.
  - The default probability of banks is 6 times its value when abstracting from this intertemporal effect.
- Sudden Stop Simulation: I assume a 87% gradual reduction of the foreign borrowing limit to account for the reduction of the ST NFL to GDP (from 7.5% (1998Q3) to 1% in 2010).
- In the long-term:
  - The (quarterly) default probability: From 0.7% to 1.8%.
  - The relative excess loans: From 3.6% to 6.2%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect the short-term responses are (1.1 and 1.1 respectively) and those account for the 8.5% and 6.8% of their long-term movements.

Results

- The limited liability + deposit insurance ⇒ Inefficiently high level of loans.
- The intertemporal effect amplifies the inefficiency.
  - The fact that banks have limited liability and deposit insurance not only in the present but also in the future creates incentive to increases even by more the inefficient overvaluation of the marginal benefits of the loans.
  - The default probability of banks is 6 times its value when abstracting from this intertemporal effect.
- Sudden Stop Simulation: I assume a 87% gradual reduction of the foreign borrowing limit to account for the reduction of the ST NFL to GDP (from 7.5% (1998Q3) to 1% in 2010).
- In the long-term:
  - The (quarterly) default probability: From 0.7% to 1.8%.
  - The relative excess loans: From 3.6% to 6.2%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect the short-term responses are (1.1 and 1.1 respectively) and those account for the 8.5% and 6.8% of their long-term movements.

Results

- The limited liability + deposit insurance ⇒ Inefficiently high level of loans.
- The intertemporal effect amplifies the inefficiency.
  - The fact that banks have limited liability and deposit insurance not only in the present but also in the future creates incentive to increases even by more the inefficient overvaluation of the marginal benefits of the loans.
  - The default probability of banks is 6 times its value when abstracting from this intertemporal effect.
- Sudden Stop Simulation: I assume a 87% gradual reduction of the foreign borrowing limit to account for the reduction of the ST NFL to GDP (from 7.5% (1998Q3) to 1% in 2010).
- In the long-term:
  - The (quarterly) default probability: From 0.7% to 1.8%.
  - The relative excess loans: From 3.6% to 6.2%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect the short-term responses are (1.1 and 1.1 respectively) and those account for the 8.5% and 6.8% of their long-term movements.

Results

- The limited liability + deposit insurance ⇒ Inefficiently high level of loans.
- The intertemporal effect amplifies the inefficiency.
  - The fact that banks have limited liability and deposit insurance not only in the present but also in the future creates incentive to increases even by more the inefficient overvaluation of the marginal benefits of the loans.
  - The default probability of banks is 6 times its value when abstracting from this intertemporal effect.
- Sudden Stop Simulation: I assume a 87% gradual reduction of the foreign borrowing limit to account for the reduction of the ST NFL to GDP (from 7.5% (1998Q3) to 1% in 2010).
- In the long-term:
  - The (quarterly) default probability: From 0.7% to 1.8%.
  - The relative excess loans: From 3.6% to 6.2%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect the short-term responses are (1.1 and 1.1 respectively) and those account for the 8.5% and 6.8% of their long-term movements.

Results

- The limited liability + deposit insurance ⇒ Inefficiently high level of loans.
- The intertemporal effect amplifies the inefficiency.
  - The fact that banks have limited liability and deposit insurance not only in the present but also in the future creates incentive to increases even by more the inefficient overvaluation of the marginal benefits of the loans.
  - The default probability of banks is 6 times its value when abstracting from this intertemporal effect.
- Sudden Stop Simulation: I assume a 87% gradual reduction of the foreign borrowing limit to account for the reduction of the ST NFL to GDP (from 7.5% (1998Q3) to 1% in 2010).
- In the long-term:
  - The (quarterly) default probability: From 0.7% to 1.8%.
  - The relative excess loans: From 3.6% to 6.2%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect the short-term responses are (1.1 and 1.1 respectively) and those account for the 8.5% and 6.8% of their long-term movements.

Results

- The limited liability + deposit insurance $\Rightarrow$ Inefficiently high level of loans.
- The intertemporal effect amplifies the inefficiency.
  - The fact that banks have limited liability and deposit insurance not only in the present but also in the future creates incentive to increases even by more the inefficient overvaluation of the marginal benefits of the loans.
  - The default probability of banks is 6 times its value when abstracting from this intertemporal effect.
- Sudden Stop Simulation: I assume a 87% gradual reduction of the foreign borrowing limit to account for the reduction of the ST NFL to GDP (from 7.5% (1998Q3) to 1% in 2010).
- In the long-term:
  - The (quarterly) default probability: From 0.7% to 1.8%.
  - The relative excess loans: From 3.6% to 6.2%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect the short-term responses are (1.1 and 1.1 respectively) and those account for the 8.5% and 6.8% of their long-term movements.

Results

- The limited liability + deposit insurance ⇒ Inefficiently high level of loans.
- The intertemporal effect amplifies the inefficiency.
  - The fact that banks have limited liability and deposit insurance not only in the present but also in the future creates incentive to increases even by more the inefficient overvaluation of the marginal benefits of the loans.
  - The default probability of banks is 6 times its value when abstracting from this intertemporal effect.
- Sudden Stop Simulation: I assume a 87% gradual reduction of the foreign borrowing limit to account for the reduction of the ST NFL to GDP (from 7.5% (1998Q3) to 1% in 2010).
- In the long-term:
  - The (quarterly) default probability: From 0.7% to 1.8%.
  - The relative excess loans: From 3.6% to 6.2%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect the short-term responses are (1.1 and 1.1 respectively) and those account for the 8.5% and 6.8% of their long-term movements.

Results

- The limited liability + deposit insurance ⇒ Inefficiently high level of loans.
- The intertemporal effect amplifies the inefficiency.
  - The fact that banks have limited liability and deposit insurance not only in the present but also in the future creates incentive to increases even by more the inefficient overvaluation of the marginal benefits of the loans.
  - The default probability of banks is 6 times its value when abstracting from this intertemporal effect.
- Sudden Stop Simulation: I assume a 87% gradual reduction of the foreign borrowing limit to account for the reduction of the ST NFL to GDP (from 7.5% (1998Q3) to 1% in 2010).
- In the long-term:
  - The (quarterly) default probability: From 0.7% to 1.8%.
  - The relative excess loans: From 3.6% to 6.2%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect the short-term responses are (1.1 and 1.1 respectively) and those account for the 8.5% and 6.8% of their long-term movements.

Results

- The limited liability + deposit insurance $\Rightarrow$ Inefficiently high level of loans.
- The intertemporal effect amplifies the inefficiency.
  - The fact that banks have limited liability and deposit insurance not only in the present but also in the future creates incentive to increases even by more the inefficient overvaluation of the marginal benefits of the loans.
  - The default probability of banks is 6 times its value when abstracting from this intertemporal effect.
- Sudden Stop Simulation: I assume a 87% gradual reduction of the foreign borrowing limit to account for the reduction of the ST NFL to GDP (from 7.5% (1998Q3) to 1% in 2010).
- In the long-term:
  - The (quarterly) default probability: From 0.7% to 1.8%.
  - The relative excess loans: From 3.6% to 6.2%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect the short-term responses are (1.1 and 1.1 respectively) and those account for the 8.5% and 6.8% of their long-term movements.

Results

- The limited liability + deposit insurance ⇒ Inefficiently high level of loans.
- The intertemporal effect amplifies the inefficiency.
  - The fact that banks have limited liability and deposit insurance not only in the present but also in the future creates incentive to increases even by more the inefficient overvaluation of the marginal benefits of the loans.
  - The default probability of banks is 6 times its value when abstracting from this intertemporal effect.
- Sudden Stop Simulation: I assume a 87% gradual reduction of the foreign borrowing limit to account for the reduction of the ST NFL to GDP (from 7.5% (1998Q3) to 1% in 2010).
- In the long-term:
  - The (quarterly) default probability: From 0.7% to 1.8%.
  - The relative excess loans: From 3.6% to 6.2%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect the short-term responses are (1.1 and 1.1 respectively) and those account for the 8.5% and 6.8% of their long-term movements.

Results

- The limited liability + deposit insurance ⇒ Inefficiently high level of loans.
- The intertemporal effect amplifies the inefficiency.
  - The fact that banks have limited liability and deposit insurance not only in the present but also in the future creates incentive to increases even by more the inefficient overvaluation of the marginal benefits of the loans.
  - The default probability of banks is 6 times its value when abstracting from this intertemporal effect.
- Sudden Stop Simulation: I assume a 87% gradual reduction of the foreign borrowing limit to account for the reduction of the ST NFL to GDP (from 7.5% (1998Q3) to 1% in 2010).
- In the long-term:
  - The (quarterly) default probability: From 0.7% to 1.8%.
  - The relative excess loans: From 3.6% to 6.2%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect the short-term responses are (1.1 and 1.1 respectively) and those account for the 8.5% and 6.8% of their long-term movements.

Results

- The limited liability + deposit insurance ⇒ Inefficiently high level of loans.
- The intertemporal effect amplifies the inefficiency.
  - The fact that banks have limited liability and deposit insurance not only in the present but also in the future creates incentive to increases even by more the inefficient overvaluation of the marginal benefits of the loans.
  - The default probability of banks is 6 times its value when abstracting from this intertemporal effect.
- Sudden Stop Simulation: I assume a 87% gradual reduction of the foreign borrowing limit to account for the reduction of the ST NFL to GDP (from 7.5% (1998Q3) to 1% in 2010).
- In the long-term:
  - The (quarterly) default probability: From 0.7% to 1.8%.
  - The relative excess loans: From 3.6% to 6.2%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect the short-term responses are (1.1 and 1.1 respectively) and those account for the 8.5% and 6.8% of their long-term movements.

Model

- Infinity time period small open economy model.
- Domestic households (HHs), banks, foreign investors government. HHs own banks.
- Each period households decide how much to consume and save (only through deposits on banks).
- Banks receive deposits from HHs and foreign investors, and make risky investments.
- Assumptions:
  - Banks face limited liability.
  - Domestic and foreign deposits are insured by the government.
  - Banks have an exogenous binding foreign borrowing limit.
  - An exogenous law of motion of the bank equity.
  - Agents are risk-neutral.
  - Opportunity cost of foreign investor smaller than domestic ones.

Model

- Infinity time period small open economy model.
- Domestic households (HHs), banks, foreign investors government. HHs own banks.
- Each period households decide how much to consume and save (only through deposits on banks).
- Banks receive deposits from HHs and foreign investors, and make risky investments.
- Assumptions:
  - Banks face limited liability.
  - Domestic and foreign deposits are insured by the government.
  - Banks have an exogenous binding foreign borrowing limit.
  - An exogenous law of motion of the bank equity.
  - Agents are risk-neutral.
  - Opportunity cost of foreign investor smaller than domestic ones.

Model

- Infinity time period small open economy model.
- Domestic households (HHs), banks, foreign investors government. HHs own banks.
- Each period households decide how much to consume and save (only through deposits on banks).
- Banks receive deposits from HHs and foreign investors, and make risky investments.
- Assumptions:
  - Banks face limited liability.
  - Domestic and foreign deposits are insured by the government.
  - Banks have an exogenous binding foreign borrowing limit.
  - An exogenous law of motion of the bank equity.
  - Agents are risk-neutral.
  - Opportunity cost of foreign investor smaller than domestic ones.

Model

- Infinity time period small open economy model.
- Domestic households (HHs), banks, foreign investors government. HHs own banks.
- Each period households decide how much to consume and save (only through deposits on banks).
- Banks receive deposits from HHs and foreign investors, and make risky investments.
- Assumptions:
  - Banks face limited liability.
  - Domestic and foreign deposits are insured by the government.
  - Banks have an exogenous binding foreign borrowing limit.
  - An exogenous law of motion of the bank equity.
  - Agents are risk-neutral.
  - Opportunity cost of foreign investor smaller than domestic ones.

Model

- Infinity time period small open economy model.
- Domestic households (HHs), banks, foreign investors government. HHs own banks.
- Each period households decide how much to consume and save (only through deposits on banks).
- Banks receive deposits from HHs and foreign investors, and make risky investments.
- Assumptions:
  - Banks face limited liability.
  - Domestic and foreign deposits are insured by the government.
  - Banks have an exogenous binding foreign borrowing limit.
  - An exogenous law of motion of the bank equity.
  - Agents are risk-neutral.
  - Opportunity cost of foreign investor smaller than domestic ones.

Model

- Infinity time period small open economy model.
- Domestic households (HHs), banks, foreign investors government. HHs own banks.
- Each period households decide how much to consume and save (only through deposits on banks).
- Banks receive deposits from HHs and foreign investors, and make risky investments.
- Assumptions:
  - Banks face limited liability.
  - Domestic and foreign deposits are insured by the government.
  - Banks have an exogenous binding foreign borrowing limit.
  - An exogenous law of motion of the bank equity.
  - Agents are risk-neutral.
  - Opportunity cost of foreign investor smaller than domestic ones.

Model

- Infinity time period small open economy model.
- Domestic households (HHs), banks, foreign investors government. HHs own banks.
- Each period households decide how much to consume and save (only through deposits on banks).
- Banks receive deposits from HHs and foreign investors, and make risky investments.
- Assumptions:
    - Banks face limited liability.
    - Domestic and foreign deposits are insured by the government.
    - Banks have an exogenous binding foreign borrowing limit.
    - An exogenous law of motion of the bank equity.
    - Agents are risk-neutral.
    - Opportunity cost of foreign investor smaller than domestic ones.

Model

- Infinity time period small open economy model.
- Domestic households (HHs), banks, foreign investors government. HHs own banks.
- Each period households decide how much to consume and save (only through deposits on banks).
- Banks receive deposits from HHs and foreign investors, and make risky investments.
- Assumptions:
  - Banks face limited liability.
  - Domestic and foreign deposits are insured by the government.
  - Banks have an exogenous binding foreign borrowing limit.
  - An exogenous law of motion of the bank equity.
  - Agents are risk-neutral.
  - Opportunity cost of foreign investor smaller than domestic ones.

Model

- Infinity time period small open economy model.
- Domestic households (HHs), banks, foreign investors government. HHs own banks.
- Each period households decide how much to consume and save (only through deposits on banks).
- Banks receive deposits from HHs and foreign investors, and make risky investments.
- Assumptions:
  - Banks face limited liability.
  - Domestic and foreign deposits are insured by the government.
  - Banks have an exogenous binding foreign borrowing limit.
  - An exogenous law of motion of the bank equity.
  - Agents are risk-neutral.
  - Opportunity cost of foreign investor smaller than domestic ones.

Model

- Infinity time period small open economy model.
- Domestic households (HHs), banks, foreign investors government. HHs own banks.
- Each period households decide how much to consume and save (only through deposits on banks).
- Banks receive deposits from HHs and foreign investors, and make risky investments.
- Assumptions:
  - Banks face limited liability.
  - Domestic and foreign deposits are insured by the government.
  - Banks have an exogenous binding foreign borrowing limit.
  - An exogenous law of motion of the bank equity.
  - Agents are risk-neutral.
  - Opportunity cost of foreign investor smaller than domestic ones.

Model

- Infinity time period small open economy model.
- Domestic households (HHs), banks, foreign investors government. HHs own banks.
- Each period households decide how much to consume and save (only through deposits on banks).
- Banks receive deposits from HHs and foreign investors, and make risky investments.
- Assumptions:
  - Banks face limited liability.
  - Domestic and foreign deposits are insured by the government.
  - Banks have an exogenous binding foreign borrowing limit.
  - An exogenous law of motion of the bank equity.
  - Agents are risk-neutral.
  - Opportunity cost of foreign investor smaller than domestic ones.

Domestic Households

- Utility of HHs at time t,

$$W_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i C_{t+i} \right\}, \tag{1}$$

- β is the HHs discount factor, C_t is the consumption level at period t.
- The budget constraint at time t is,

$$C_t + D_t = \omega^H + \bar{R}^D_{t-1} D_{t-1} + \Pi_t + T_t, \tag{2}$$

  - ω^H: fixed exogenous income,
  - D_t: one-period deposits held in the bank by domestic households (domestic deposits),
  - $\bar{R}^D_t$: gross return agreed at time t for the domestic deposits held from t to $t+1$,
  - Π_t: banks' dividends. T_t: lump sum government taxes.
- Since I assume deposit insurance domestic depositors will also always receive the agreed gross return.
- HHs maximize (1) subject to (2). The first order condition for D_t requires,

$$1 = \beta \bar{R}^D_t.$$

Domestic Households

- Utility of HHs at time t,

$$W_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i C_{t+i} \right\}, \tag{1}$$

- β is the HHs discount factor, C_t is the consumption level at period t.
- The budget constraint at time t is,

$$C_t + D_t = \omega^H + \bar{R}^D_{t-1} D_{t-1} + \Pi_t + T_t, \tag{2}$$

  - ω^H: fixed exogenous income,
  - D_t: one-period deposits held in the bank by domestic households (domestic deposits),
  - $\bar{R}^D_t$: gross return agreed at time t for the domestic deposits held from t to $t+1$,
  - Π_t: banks' dividends. T_t: lump sum government taxes.
- Since I assume deposit insurance domestic depositors will also always receive the agreed gross return.
- HHs maximize (1) subject to (2). The first order condition for D_t requires,

$$1 = \beta \bar{R}^D_t.$$

Domestic Households

- Utility of HHs at time t,

$$W_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i C_{t+i} \right\}, \tag{1}$$

- β is the HHs discount factor, C_t is the consumption level at period t.
- The budget constraint at time t is,

$$C_t + D_t = \omega^H + \bar{R}^D_{t-1} D_{t-1} + \Pi_t + T_t, \tag{2}$$

  - ω^H: fixed exogenous income,
  - D_t: one-period deposits held in the bank by domestic households (domestic deposits),
  - $\bar{R}^D_t$: gross return agreed at time t for the domestic deposits held from t to $t+1$,
  - Π_t: banks' dividends. T_t: lump sum government taxes.
- Since I assume deposit insurance domestic depositors will also always receive the agreed gross return.
- HHs maximize (1) subject to (2). The first order condition for D_t requires,

$$1 = \beta \bar{R}^D_t.$$

Domestic Households

- Utility of HHs at time t,

$$W_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i C_{t+i} \right\}, \quad (1)$$

- β is the HHs discount factor, C_t is the consumption level at period t.
- The budget constraint at time t is,

$$C_t + D_t = \omega^H + \bar{R}^D_{t-1} D_{t-1} + \Pi_t + T_t, \quad (2)$$

  - ω^H: fixed exogenous income,
  - D_t: one-period deposits held in the bank by domestic households (domestic deposits),
  - $\bar{R}^D_t$: gross return agreed at time t for the domestic deposits held from t to $t+1$,
  - Π_t: banks' dividends. T_t: lump sum government taxes.
- Since I assume deposit insurance domestic depositors will also always receive the agreed gross return.
- HHs maximize (1) subject to (2). The first order condition for D_t requires,

$$1 = \beta \bar{R}^D_t.$$

Domestic Households

- Utility of HHs at time t,

$$W_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i C_{t+i} \right\}, \tag{1}$$

- β is the HHs discount factor, C_t is the consumption level at period t.
- The budget constraint at time t is,

$$C_t + D_t = \omega^H + \bar{R}^D_{t-1} D_{t-1} + \Pi_t + T_t, \tag{2}$$

  - ω^H: fixed exogenous income,
  - D_t: one-period deposits held in the bank by domestic households (domestic deposits),
  - $\bar{R}^D_t$: gross return agreed at time t for the domestic deposits held from t to $t+1$,
  - Π_t: banks' dividends. T_t: lump sum government taxes.

- Since I assume deposit insurance domestic depositors will also always receive the agreed gross return.
- HHs maximize (1) subject to (2). The first order condition for D_t requires,

$$1 = \beta \bar{R}^D_t.$$

Domestic Households

- Utility of HHs at time t,

$$W_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i C_{t+i} \right\}, \tag{1}$$

- β is the HHs discount factor, C_t is the consumption level at period t.
- The budget constraint at time t is,

$$C_t + D_t = \omega^H + \bar{R}^D_{t-1} D_{t-1} + \Pi_t + T_t, \tag{2}$$

  - ω^H: fixed exogenous income,
  - D_t: one-period deposits held in the bank by domestic households (domestic deposits),
  - $\bar{R}^D_t$: gross return agreed at time t for the domestic deposits held from t to $t+1$,
  - Π_t: banks' dividends. T_t: lump sum government taxes.
- Since I assume deposit insurance domestic depositors will also always receive the agreed gross return.
- HHs maximize (1) subject to (2). The first order condition for D_t requires,

$$1 = \beta \bar{R}^D_t.$$

Domestic Households

- Utility of HHs at time t,

$$W_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i C_{t+i} \right\}, \quad (1)$$

- β is the HHs discount factor, C_t is the consumption level at period t.
- The budget constraint at time t is,

$$C_t + D_t = \omega^H + \bar{R}^D_{t-1} D_{t-1} + \Pi_t + T_t, \quad (2)$$

  - ω^H: fixed exogenous income,
  - D_t: one-period deposits held in the bank by domestic households (domestic deposits),
  - $\bar{R}^D_t$: gross return agreed at time t for the domestic deposits held from t to $t+1$,
  - Π_t: banks' dividends. T_t: lump sum government taxes.
- Since I assume deposit insurance domestic depositors will also always receive the agreed gross return.
- HHs maximize (1) subject to (2). The first order condition for D_t requires,

$$1 = \beta \bar{R}^D_t.$$

Domestic Households

- Utility of HHs at time t,

$$W_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i C_{t+i} \right\}, \tag{1}$$

- β is the HHs discount factor, C_t is the consumption level at period t.
- The budget constraint at time t is,

$$C_t + D_t = \omega^H + \bar{R}^D_{t-1} D_{t-1} + \Pi_t + T_t, \tag{2}$$

  - ω^H: fixed exogenous income,
  - D_t: one-period deposits held in the bank by domestic households (domestic deposits),
  - $\bar{R}^D_t$: gross return agreed at time t for the domestic deposits held from t to $t+1$,
  - Π_t: banks' dividends. T_t: lump sum government taxes.

- Since I assume deposit insurance domestic depositors will also always receive the agreed gross return.
- HHs maximize (1) subject to (2). The first order condition for D_t requires,

$$1 = \beta \bar{R}^D_t.$$

Domestic Households

- Utility of HHs at time t,

$$W_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i C_{t+i} \right\}, \tag{1}$$

- β is the HHs discount factor, C_t is the consumption level at period t.
- The budget constraint at time t is,

$$C_t + D_t = \omega^H + \bar{R}^D_{t-1} D_{t-1} + \Pi_t + T_t, \tag{2}$$

  - ω^H: fixed exogenous income,
  - D_t: one-period deposits held in the bank by domestic households (domestic deposits),
  - $\bar{R}^D_t$: gross return agreed at time t for the domestic deposits held from t to $t+1$,
  - Π_t: banks' dividends. T_t: lump sum government taxes.

- Since I assume deposit insurance domestic depositors will also always receive the agreed gross return.
- HHs maximize (1) subject to (2). The first order condition for D_t requires,

$$1 = \beta \bar{R}^D_t.$$

Banks

- The balance sheet equation,

$$K_t = D_t + D_t^F + N_t,$$

  - N_t: Equity at time t.
  - D_t^F: Short-term deposits held by foreign investors (foreign deposits).
- Banks intermediate K_t of capital in period t.
- There is a payoff of $Z_{t+1}K_t^{\alpha}$ in period $t+1$ plus the leftover capital.
- Z_{t+1} is the capital productivity for banks and follows a log-normal AR(1) process.
- The exogenous foreign borrowing limit:

$$D_t^F \leq \phi_t.$$

- It says that foreign depositors have less ability to force banks to honor their obligations.
- The net operating income of the banks is,

$$NOI_{t+1} = (1-\delta)K_t + Z_{t+1}K_t^{\alpha} - \bar{R}_t^D D_t - \bar{R}_t^F D_t^F - N_t,$$

  - $\bar{R}_t^F$: gross return of foreign deposits.
  - δ: capital depreciation rate.

Banks

- The balance sheet equation,

$$K_t = D_t + D_t^F + N_t,$$

  - N_t: Equity at time t.
  - D_t^F: Short-term deposits held by foreign investors (foreign deposits).
- Banks intermediate K_t of capital in period t.
- There is a payoff of $Z_{t+1}K_t^{\alpha}$ in period $t+1$ plus the leftover capital.
- Z_{t+1} is the capital productivity for banks and follows a log-normal AR(1) process.
- The exogenous foreign borrowing limit:

$$D_t^F \leq \phi_t.$$

- It says that foreign depositors have less ability to force banks to honor their obligations.
- The net operating income of the banks is,

$$NOI_{t+1} = (1-\delta)K_t + Z_{t+1}K_t^{\alpha} - \bar{R}_t^D D_t - \bar{R}_t^F D_t^F - N_t,$$

  - $\bar{R}_t^F$: gross return of foreign deposits.
  - δ: capital depreciation rate.

Banks

- The balance sheet equation,

$$K_t = D_t + D_t^F + N_t,$$

  - N_t: Equity at time t.
  - D_t^F: Short-term deposits held by foreign investors (foreign deposits).
- Banks intermediate K_t of capital in period t.
- There is a payoff of $Z_{t+1}K_t^{\alpha}$ in period $t+1$ plus the leftover capital.
- Z_{t+1} is the capital productivity for banks and follows a log-normal AR(1) process.
- The exogenous foreign borrowing limit:

$$D_t^F \leq \phi_t.$$

- It says that foreign depositors have less ability to force banks to honor their obligations.
- The net operating income of the banks is,

$$NOI_{t+1} = (1-\delta)K_t + Z_{t+1}K_t^{\alpha} - \bar{R}_t^D D_t - \bar{R}_t^F D_t^F - N_t,$$

  - $\bar{R}_t^F$: gross return of foreign deposits.
  - δ: capital depreciation rate.

Banks

- The balance sheet equation,
$$K_t = D_t + D_t^F + N_t,$$
  - N_t: Equity at time t.
  - D_t^F: Short-term deposits held by foreign investors (foreign deposits).
- Banks intermediate K_t of capital in period t.
- There is a payoff of $Z_{t+1}K_t^{\alpha}$ in period $t+1$ plus the leftover capital.
- Z_{t+1} is the capital productivity for banks and follows a log-normal AR(1) process.
- The exogenous foreign borrowing limit:
$$D_t^F \leq \phi_t.$$
- It says that foreign depositors have less ability to force banks to honor their obligations.
- The net operating income of the banks is,
$$NOI_{t+1} = (1-\delta)K_t + Z_{t+1}K_t^{\alpha} - \bar{R}_t^D D_t - \bar{R}_t^F D_t^F - N_t,$$
  - $\bar{R}_t^F$: gross return of foreign deposits.
  - δ: capital depreciation rate.

Banks

- The balance sheet equation,

$$K_t = D_t + D_t^F + N_t,$$

  - N_t: Equity at time t.
  - D_t^F: Short-term deposits held by foreign investors (foreign deposits).
- Banks intermediate K_t of capital in period t.
- There is a payoff of $Z_{t+1}K_t^{\alpha}$ in period $t+1$ plus the leftover capital.
- Z_{t+1} is the capital productivity for banks and follows a log-normal AR(1) process.
- The exogenous foreign borrowing limit:

$$D_t^F \leq \phi_t.$$

- It says that foreign depositors have less ability to force banks to honor their obligations.
- The net operating income of the banks is,

$$NOI_{t+1} = (1-\delta)K_t + Z_{t+1}K_t^{\alpha} - \bar{R}_t^D D_t - \bar{R}_t^F D_t^F - N_t,$$

  - $\bar{R}_t^F$: gross return of foreign deposits.
  - δ: capital depreciation rate.

Banks

- The balance sheet equation,

$$K_t = D_t + D_t^F + N_t,$$

  - N_t: Equity at time t.
  - D_t^F: Short-term deposits held by foreign investors (foreign deposits).
- Banks intermediate K_t of capital in period t.
- There is a payoff of $Z_{t+1}K_t^\alpha$ in period $t+1$ plus the leftover capital.
- Z_{t+1} is the capital productivity for banks and follows a log-normal AR(1) process.
- The exogenous foreign borrowing limit:

$$D_t^F \leq \phi_t.$$

- It says that foreign depositors have less ability to force banks to honor their obligations.
- The net operating income of the banks is,

$$NOI_{t+1} = (1-\delta)K_t + Z_{t+1}K_t^\alpha - \bar{R}_t^D D_t - \bar{R}_t^F D_t^F - N_t,$$

  - $\bar{R}_t^F$: gross return of foreign deposits.
  - δ: capital depreciation rate.

Banks

- The balance sheet equation,

$$K_t = D_t + D_t^F + N_t,$$

  - N_t: Equity at time t.
  - D_t^F: Short-term deposits held by foreign investors (foreign deposits).

- Banks intermediate K_t of capital in period t.
- There is a payoff of $Z_{t+1}K_t^\alpha$ in period $t+1$ plus the leftover capital.
- Z_{t+1} is the capital productivity for banks and follows a log-normal AR(1) process.
- The exogenous foreign borrowing limit:

$$D_t^F \leq \phi_t.$$

- It says that foreign depositors have less ability to force banks to honor their obligations.
- The net operating income of the banks is,

$$NOI_{t+1} = (1-\delta)K_t + Z_{t+1}K_t^\alpha - \bar{R}_t^D D_t - \bar{R}_t^F D_t^F - N_t,$$

  - $\bar{R}_t^F$: gross return of foreign deposits.
  - δ: capital depreciation rate.

Banks

- The balance sheet equation,

$$K_t = D_t + D_t^F + N_t,$$

  - N_t: Equity at time t.
  - D_t^F: Short-term deposits held by foreign investors (foreign deposits).
- Banks intermediate K_t of capital in period t.
- There is a payoff of $Z_{t+1}K_t^{\alpha}$ in period $t+1$ plus the leftover capital.
- Z_{t+1} is the capital productivity for banks and follows a log-normal AR(1) process.
- The exogenous foreign borrowing limit:

$$D_t^F \leq \phi_t.$$

- It says that foreign depositors have less ability to force banks to honor their obligations.
- The net operating income of the banks is,

$$NOI_{t+1} = (1-\delta)K_t + Z_{t+1}K_t^{\alpha} - \bar{R}_t^D D_t - \bar{R}_t^F D_t^F - N_t,$$

  - $\bar{R}_t^F$: gross return of foreign deposits.
  - δ: capital depreciation rate.

Banks

- The balance sheet equation,

$$K_t = D_t + D_t^F + N_t,$$

  - N_t: Equity at time t.
  - D_t^F: Short-term deposits held by foreign investors (foreign deposits).
- Banks intermediate K_t of capital in period t.
- There is a payoff of $Z_{t+1}K_t^{\alpha}$ in period $t+1$ plus the leftover capital.
- Z_{t+1} is the capital productivity for banks and follows a log-normal AR(1) process.
- The exogenous foreign borrowing limit:

$$D_t^F \leq \phi_t.$$

- It says that foreign depositors have less ability to force banks to honor their obligations.
- The net operating income of the banks is,

$$NOI_{t+1} = (1-\delta)K_t + Z_{t+1}K_t^{\alpha} - \bar{R}_t^D D_t - \bar{R}_t^F D_t^F - N_t,$$

  - $\bar{R}_t^F$: gross return of foreign deposits.
  - δ: capital depreciation rate.

Banks

- The balance sheet equation,
$$K_t = D_t + D_t^F + N_t,$$
  - N_t: Equity at time t.
  - D_t^F: Short-term deposits held by foreign investors (foreign deposits).
- Banks intermediate K_t of capital in period t.
- There is a payoff of $Z_{t+1}K_t^{\alpha}$ in period $t+1$ plus the leftover capital.
- Z_{t+1} is the capital productivity for banks and follows a log-normal AR(1) process.
- The exogenous foreign borrowing limit:
$$D_t^F \leq \phi_t.$$
- It says that foreign depositors have less ability to force banks to honor their obligations.
- The net operating income of the banks is,
$$NOI_{t+1} = (1-\delta)K_t + Z_{t+1}K_t^{\alpha} - \bar{R}_t^D D_t - \bar{R}_t^F D_t^F - N_t,$$
  - $\bar{R}_t^F$: gross return of foreign deposits.
  - δ: capital depreciation rate.

Banks

- The balance sheet equation,
$$K_t = D_t + D_t^F + N_t,$$
  - N_t: Equity at time t.
  - D_t^F: Short-term deposits held by foreign investors (foreign deposits).
- Banks intermediate K_t of capital in period t.
- There is a payoff of $Z_{t+1}K_t^\alpha$ in period $t+1$ plus the leftover capital.
- Z_{t+1} is the capital productivity for banks and follows a log-normal AR(1) process.
- The exogenous foreign borrowing limit:
$$D_t^F \leq \phi_t.$$
- It says that foreign depositors have less ability to force banks to honor their obligations.
- The net operating income of the banks is,
$$NOI_{t+1} = (1-\delta)K_t + Z_{t+1}K_t^\alpha - \bar{R}_t^D D_t - \bar{R}_t^F D_t^F - N_t,$$
  - $\bar{R}_t^F$: gross return of foreign deposits.
  - δ: capital depreciation rate.

Banks

- The NPV of future dividends (d_t) of bank is,

$$V_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i d_{t+i} \right\}.$$

- Banks default at $t+1$ if the revenues are not enough to cover the agreed obligations, i.e. banks default if,

$$(1-\delta)K_t + Z_{t+1}K_t^{\alpha} \leq \bar{R}_t^D D_t + \bar{R}_t^F \phi_t, \qquad or \qquad NOI_{t+1} + N_t < 0.$$

- I assume:
  - There are not default costs.
  - There are not equity injections.
  - Banks continue operating but with zero equity.
- Hence, if banks default,

$$d_{t+1} = 0, \qquad and \qquad N_{t+1} = 0.$$

- When banks do not default, they allocate a fraction $0 < \gamma < 1$ of, $NOI_{t+1} + N_t$, as dividends.
  - γ: exogenous and constant across time.

Banks

- The NPV of future dividends (d_t) of bank is,

$$V_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i d_{t+i} \right\}.$$

- Banks default at $t+1$ if the revenues are not enough to cover the agreed obligations, i.e. banks default if,

$$(1-\delta)K_t + Z_{t+1}K_t^{\alpha} \leq \bar{R}_t^D D_t + \bar{R}_t^F \phi_t, \qquad or \qquad NOI_{t+1} + N_t < 0.$$

- I assume:
  - There are not default costs.
  - There are not equity injections.
  - Banks continue operating but with zero equity.
- Hence, if banks default,

$$d_{t+1} = 0, \qquad and \qquad N_{t+1} = 0.$$

- When banks do not default, they allocate a fraction $0 < \gamma < 1$ of, $NOI_{t+1} + N_t$, as dividends.
  - γ: exogenous and constant across time.

Banks

- The NPV of future dividends (d_t) of bank is,

$$V_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i d_{t+i} \right\}.$$

- Banks default at $t+1$ if the revenues are not enough to cover the agreed obligations, i.e. banks default if,

$$(1-\delta)K_t + Z_{t+1}K_t^{\alpha} \leq \bar{R}_t^D D_t + \bar{R}_t^F \phi_t, \qquad or \qquad NOI_{t+1} + N_t < 0.$$

- I assume:
  - There are not default costs.
  - There are not equity injections.
  - Banks continue operating but with zero equity.
- Hence, if banks default,

$$d_{t+1} = 0, \qquad and \qquad N_{t+1} = 0.$$

- When banks do not default, they allocate a fraction $0 < \gamma < 1$ of, $NOI_{t+1} + N_t$, as dividends.
  - γ: exogenous and constant across time.

Banks

- The NPV of future dividends (d_t) of bank is,

$$V_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i d_{t+i} \right\}.$$

- Banks default at $t+1$ if the revenues are not enough to cover the agreed obligations, i.e. banks default if,

$$(1-\delta)K_t + Z_{t+1}K_t^{\alpha} \leq \bar{R}_t^D D_t + \bar{R}_t^F \phi_t, \qquad or \qquad NOI_{t+1} + N_t < 0.$$

- I assume:
  - There are not default costs.
  - There are not equity injections.
  - Banks continue operating but with zero equity.
- Hence, if banks default,

$$d_{t+1} = 0, \qquad and \qquad N_{t+1} = 0.$$

- When banks do not default, they allocate a fraction $0 < \gamma < 1$ of, $NOI_{t+1} + N_t$, as dividends.
  - γ: exogenous and constant across time.

Banks

- The NPV of future dividends (d_t) of bank is,

$$V_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i d_{t+i} \right\}.$$

- Banks default at $t+1$ if the revenues are not enough to cover the agreed obligations, i.e. banks default if,

$$(1-\delta)K_t + Z_{t+1}K_t^{\alpha} \leq \bar{R}_t^D D_t + \bar{R}_t^F \phi_t, \qquad or \qquad NOI_{t+1} + N_t < 0.$$

- I assume:
    - There are not default costs.
    - There are not equity injections.
    - Banks continue operating but with zero equity.
- Hence, if banks default,

$$d_{t+1} = 0, \qquad and \qquad N_{t+1} = 0.$$

- When banks do not default, they allocate a fraction $0 < \gamma < 1$ of, $NOI_{t+1} + N_t$, as dividends.
    - γ: exogenous and constant across time.

Banks

- The NPV of future dividends (d_t) of bank is,

$$V_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i d_{t+i} \right\}.$$

- Banks default at $t+1$ if the revenues are not enough to cover the agreed obligations, i.e. banks default if,

$$(1-\delta)K_t + Z_{t+1}K_t^{\alpha} \leq \bar{R}_t^D D_t + \bar{R}_t^F \phi_t, \qquad or \qquad NOI_{t+1} + N_t < 0.$$

- I assume:
  - There are not default costs.
  - There are not equity injections.
  - Banks continue operating but with zero equity.
- Hence, if banks default,

$$d_{t+1} = 0, \qquad and \qquad N_{t+1} = 0.$$

- When banks do not default, they allocate a fraction $0 < \gamma < 1$ of, $NOI_{t+1} + N_t$, as dividends.
  - γ: exogenous and constant across time.

Banks

- The NPV of future dividends (d_t) of bank is,

$$V_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i d_{t+i} \right\}.$$

- Banks default at $t+1$ if the revenues are not enough to cover the agreed obligations, i.e. banks default if,

$$(1-\delta)K_t + Z_{t+1}K_t^{\alpha} \leq \bar{R}_t^D D_t + \bar{R}_t^F \phi_t, \qquad or \qquad NOI_{t+1} + N_t < 0.$$

- I assume:
  - There are not default costs.
  - There are not equity injections.
  - Banks continue operating but with zero equity.
- Hence, if banks default,

$$d_{t+1} = 0, \qquad and \qquad N_{t+1} = 0.$$

- When banks do not default, they allocate a fraction $0 < \gamma < 1$ of, $NOI_{t+1} + N_t$, as dividends.
  - γ: exogenous and constant across time.

Banks

- The NPV of future dividends (d_t) of bank is,

$$V_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i d_{t+i} \right\}.$$

- Banks default at $t+1$ if the revenues are not enough to cover the agreed obligations, i.e. banks default if,

$$(1-\delta)K_t + Z_{t+1}K_t^{\alpha} \leq \bar{R}_t^D D_t + \bar{R}_t^F \phi_t, \qquad or \qquad NOI_{t+1} + N_t < 0.$$

- I assume:
  - There are not default costs.
  - There are not equity injections.
  - Banks continue operating but with zero equity.
- Hence, if banks default,

$$d_{t+1} = 0, \qquad and \qquad N_{t+1} = 0.$$

- When banks do not default, they allocate a fraction $0 < \gamma < 1$ of, $NOI_{t+1} + N_t$, as dividends.
  - γ: exogenous and constant across time.

Banks

- The NPV of future dividends (d_t) of bank is,

$$V_t = \mathbb{E}_t \left\{ \sum_{i=0}^{\infty} \beta^i d_{t+i} \right\}.$$

- Banks default at $t+1$ if the revenues are not enough to cover the agreed obligations, i.e. banks default if,

$$(1-\delta)K_t + Z_{t+1} K_t^{\alpha} \leq \bar{R}_t^D D_t + \bar{R}_t^F \phi_t, \qquad or \qquad NOI_{t+1} + N_t < 0.$$

- I assume:
  - There are not default costs.
  - There are not equity injections.
  - Banks continue operating but with zero equity.
- Hence, if banks default,

$$d_{t+1} = 0, \qquad and \qquad N_{t+1} = 0.$$

- When banks do not default, they allocate a fraction $0 < \gamma < 1$ of, $NOI_{t+1} + N_t$, as dividends.
  - γ: exogenous and constant across time.

Banks

- In general,

$$d_{t+1} = \gamma [NOI_{t+1} + N_t]^+ ,$$
$$N_{t+1} = (1-\gamma) [NOI_{t+1} + N_t]^+ .$$

- which is the law of motion of equity.
- I define $e^{z,*}_{t+1}$:

$$(1-\delta)K_t + Z^*_{t+1}K^{\alpha}_t = \bar{R}^D_t D_t + \bar{R}^F_t D^F_t .$$

  - where $Z^*_{t+1} = exp(\mu_z(1-\rho_z) + \rho_z log(Z_t) + e^{z,*}_{t+1})$.

- If $e^z_{t+1} < e^{z,*}_{t+1}$, banks default. The default probability is,

$$p_t = F(e^{z,*}_{t+1}).$$

- Dividends can be rewritten as,

$$d_t = \frac{\gamma}{1-\gamma} N_t .$$

- Banks seek to maximize V_t subject to balance sheet the law of motion of equity.

Banks

- In general,

$$d_{t+1} = \gamma [NOI_{t+1} + N_t]^+ ,$$
$$N_{t+1} = (1-\gamma) [NOI_{t+1} + N_t]^+ .$$

- which is the law of motion of equity.
- I define $e^{z,*}_{t+1}$:

$$(1-\delta)K_t + Z^*_{t+1} K_t^{\alpha} = \bar{R}^D_t D_t + \bar{R}^F_t D^F_t .$$

  - where $Z^*_{t+1} = exp(\mu_z(1-\rho_z) + \rho_z log(Z_t) + e^{z,*}_{t+1})$.

- If $e^z_{t+1} < e^{z,*}_{t+1}$, banks default. The default probability is,

$$p_t = F(e^{z,*}_{t+1}).$$

- Dividends can be rewritten as,

$$d_t = \frac{\gamma}{1-\gamma} N_t .$$

- Banks seek to maximize V_t subject to balance sheet the law of motion of equity.

Banks

- In general,

$$d_{t+1} = \gamma [NOI_{t+1} + N_t]^+ ,$$
$$N_{t+1} = (1-\gamma)\,[NOI_{t+1} + N_t]^+ .$$

- which is the law of motion of equity.
- I define $e^{z,*}_{t+1}$:

$$(1-\delta)K_t + Z^*_{t+1} K_t^{\alpha} = \bar{R}^D_t D_t + \bar{R}^F_t D^F_t .$$

  - where $Z^*_{t+1} = exp(\mu_z(1-\rho_z) + \rho_z log(Z_t) + e^{z,*}_{t+1})$.
- If $e^{z}_{t+1} < e^{z,*}_{t+1}$, banks default. The default probability is,

$$p_t = F(e^{z,*}_{t+1}).$$

- Dividends can be rewritten as,

$$d_t = \frac{\gamma}{1-\gamma} N_t .$$

- Banks seek to maximize V_t subject to balance sheet the law of motion of equity.

Banks

- In general,

$$d_{t+1} = \gamma [NOI_{t+1} + N_t]^+ ,$$
$$N_{t+1} = (1-\gamma)\,[NOI_{t+1} + N_t]^+ .$$

- which is the law of motion of equity.
- I define $e^{z,*}_{t+1}$:

$$(1-\delta)K_t + Z^*_{t+1}K^\alpha_t = \bar{R}^D_t D_t + \bar{R}^F_t D^F_t .$$

  - where $Z^*_{t+1} = exp(\mu_z(1-\rho_z) + \rho_z log(Z_t) + e^{z,*}_{t+1})$.

- If $e^z_{t+1} < e^{z,*}_{t+1}$, banks default. The default probability is,

$$p_t = F(e^{z,*}_{t+1}).$$

- Dividends can be rewritten as,

$$d_t = \frac{\gamma}{1-\gamma} N_t.$$

- Banks seek to maximize V_t subject to balance sheet the law of motion of equity.

Banks

- In general,

$$d_{t+1} = \gamma [NOI_{t+1} + N_t]^+ ,$$
$$N_{t+1} = (1-\gamma)\,[NOI_{t+1} + N_t]^+ .$$

- which is the law of motion of equity.
- I define $e^{z,*}_{t+1}$:

$$(1-\delta)K_t + Z^*_{t+1} K^{\alpha}_t = \bar{R}^D_t D_t + \bar{R}^F_t D^F_t .$$

  - where $Z^*_{t+1} = exp(\mu_z(1-\rho_z) + \rho_z log(Z_t) + e^{z,*}_{t+1})$.
- If $e^z_{t+1} < e^{z,*}_{t+1}$, banks default. The default probability is,

$$p_t = F(e^{z,*}_{t+1}).$$

- Dividends can be rewritten as,

$$d_t = \frac{\gamma}{1-\gamma} N_t .$$

- Banks seek to maximize V_t subject to balance sheet the law of motion of equity.

Banks

- In general,

$$d_{t+1} = \gamma[NOI_{t+1} + N_t]^+ ,$$
$$N_{t+1} = (1-\gamma)\,[NOI_{t+1} + N_t]^+ .$$

- which is the law of motion of equity.
- I define $e^{z,*}_{t+1}$:

$$(1-\delta)K_t + Z^*_{t+1}K^{\alpha}_t = \bar{R}^D_t D_t + \bar{R}^F_t D^F_t .$$

  - where $Z^*_{t+1} = exp(\mu_z(1-\rho_z) + \rho_z log(Z_t) + e^{z,*}_{t+1})$.
- If $e^z_{t+1} < e^{z,*}_{t+1}$, banks default. The default probability is,

$$p_t = F(e^{z,*}_{t+1}).$$

- Dividends can be rewritten as,

$$d_t = \frac{\gamma}{1-\gamma}N_t.$$

- Banks seek to maximize V_t subject to balance sheet the law of motion of equity.

Banks

- In general,

$$d_{t+1} = \gamma [NOI_{t+1} + N_t]^+ ,$$
$$N_{t+1} = (1-\gamma)\,[NOI_{t+1} + N_t]^+ .$$

- which is the law of motion of equity.
- I define $e^{z,*}_{t+1}$:

$$(1-\delta)K_t + Z^*_{t+1}K^{\alpha}_t = \bar{R}^D_t D_t + \bar{R}^F_t D^F_t .$$

  - where $Z^*_{t+1} = exp(\mu_z(1-\rho_z) + \rho_z log(Z_t) + e^{z,*}_{t+1})$.

- If $e^z_{t+1} < e^{z,*}_{t+1}$, banks default. The default probability is,

$$p_t = F(e^{z,*}_{t+1}).$$

- Dividends can be rewritten as,

$$d_t = \frac{\gamma}{1-\gamma} N_t .$$

- Banks seek to maximize V_t subject to balance sheet the law of motion of equity.

Banks

- The Lagrangian equation is:

$$L_t = \mathbb{E}_t \left\{ \sum_{i=t}^{\infty} \beta^{i-t} \left(\gamma \frac{N_i}{1-\gamma} + \lambda_i \left[\left[(1-\delta) K_{i-1} + Z_i K_{i-1}^{\alpha} - \bar{R}_{i-1}^{D} D_{i-1} - \bar{R}_{i-1}^{F} \phi_{i-1} \right]^{+} (1-\gamma) - N_i \right] \right) \right\},$$

- where λ_t is the LM associated with the law of motion of equity
- λ_t: Shadow value of bank equity. Rewriting L_t,

$$L_t = \frac{\gamma}{1-\gamma} N_t + \lambda_t \left[\left[NOI_t + N_{t-1} \right]^{+} (1-\gamma) - N_t \right] + \mathbb{E}_t \left\{ \frac{\gamma\beta}{1-\gamma} N_{t+1} \right\} +$$

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1} \left[NOI_{t+1} + N_t \right] (1-\gamma) dF(e_{t+1}^{z}) - \mathbb{E}_t \{ \lambda_{t+1} N_{t+1} \} + \mathbb{E}_t \{ L_{t+2} \}.$$

- The FOC for D_t yields:

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1} \left(1 - \delta + Z_{t+1} \alpha K_t^{\alpha-1} - \bar{R}_t^{D} \right) (1-\gamma) dF(e_{t+1}^{z}) +$$

$$\beta \lambda_{t+1} \left((1-\delta) K_t + Z_{t+1} K_t^{\alpha} - \bar{R}_t^{D} D_t - \bar{R}_t^{F} \phi_t \right) (1-\gamma) f(e_{t+1}^{z}) \Big|_{e_{t+1}^{z} = e_{t+1}^{z,*}} \frac{\partial e_{t+1}^{z,*}}{\partial D_t} = 0.$$

Banks

- The Lagrangian equation is:

$$L_t = \mathbb{E}_t \left\{ \sum_{i=t}^{\infty} \beta^{i-t} \left(\gamma \frac{N_i}{1-\gamma} + \lambda_i \left[\left[(1-\delta) K_{i-1} + Z_i K_{i-1}^{\alpha} - \bar{R}_{i-1}^{D} D_{i-1} - \bar{R}_{i-1}^{F} \phi_{i-1} \right]^{+} (1-\gamma) - N_i \right] \right) \right\},$$

- where λ_t is the LM associated with the law of motion of equity

- λ_t: Shadow value of bank equity. Rewriting L_t,

$$L_t = \frac{\gamma}{1-\gamma} N_t + \lambda_t \left[[NOI_t + N_{t-1}]^{+} (1-\gamma) - N_t \right] + \mathbb{E}_t \left\{ \frac{\gamma\beta}{1-\gamma} N_{t+1} \right\} +$$
$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1} \left[NOI_{t+1} + N_t \right] (1-\gamma) dF(e_{t+1}^{z}) - \mathbb{E}_t \{ \lambda_{t+1} N_{t+1} \} + \mathbb{E}_t \{ L_{t+2} \}.$$

- The FOC for D_t yields:

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1} \left(1 - \delta + Z_{t+1} \alpha K_t^{\alpha-1} - \bar{R}_t^{D} \right) (1-\gamma) dF(e_{t+1}^{z}) +$$
$$\beta \lambda_{t+1} \left((1-\delta) K_t + Z_{t+1} K_t^{\alpha} - \bar{R}_t^{D} D_t - \bar{R}_t^{F} \phi_t \right) (1-\gamma) f(e_{t+1}^{z}) \Big|_{e_{t+1}^{z} = e_{t+1}^{z,*}} \frac{\partial e_{t+1}^{z,*}}{\partial D_t} = 0.$$

Banks

- The Lagrangian equation is:

$$L_t = \mathbb{E}_t \left\{ \sum_{i=t}^{\infty} \beta^{i-t} \left(\gamma \frac{N_i}{1-\gamma} + \lambda_i \left[\left[(1-\delta)K_{i-1} + Z_i K_{i-1}^{\alpha} - \bar{R}_{i-1}^{D} D_{i-1} - \bar{R}_{i-1}^{F} \phi_{i-1} \right]^{+} (1-\gamma) - N_i \right] \right) \right\},$$

- where λ_t is the LM associated with the law of motion of equity

- λ_t: Shadow value of bank equity. Rewriting L_t,

$$L_t = \frac{\gamma}{1-\gamma} N_t + \lambda_t \left[\left[NOI_t + N_{t-1} \right]^{+} (1-\gamma) - N_t \right] + \mathbb{E}_t \left\{ \frac{\gamma\beta}{1-\gamma} N_{t+1} \right\} +$$

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1} \left[NOI_{t+1} + N_t \right] (1-\gamma) dF(e_{t+1}^{z}) - \mathbb{E}_t \{ \lambda_{t+1} N_{t+1} \} + \mathbb{E}_t \{ L_{t+2} \}.$$

- The FOC for D_t yields:

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1} \left(1 - \delta + Z_{t+1} \alpha K_t^{\alpha-1} - \bar{R}_t^{D} \right) (1-\gamma) dF(e_{t+1}^{z}) +$$

$$\beta \lambda_{t+1} \left((1-\delta) K_t + Z_{t+1} K_t^{\alpha} - \bar{R}_t^{D} D_t - \bar{R}_t^{F} \phi_t \right) (1-\gamma) f(e_{t+1}^{z}) \Big|_{e_{t+1}^{z} = e_{t+1}^{z,*}} \frac{\partial e_{t+1}^{z,*}}{\partial D_t} = 0.$$

Banks

- The Lagrangian equation is:

$$L_t = \mathbb{E}_t \left\{ \sum_{i=t}^{\infty} \beta^{i-t} \left(\gamma \frac{N_i}{1-\gamma} + \lambda_i \left[\left[(1-\delta) K_{i-1} + Z_i K_{i-1}^{\alpha} - \bar{R}_{i-1}^{D} D_{i-1} - \bar{R}_{i-1}^{F} \phi_{i-1} \right]^{+} (1-\gamma) - N_i \right] \right) \right\},$$

- where λ_t is the LM associated with the law of motion of equity

- λ_t: Shadow value of bank equity. Rewriting L_t,

$$L_t = \frac{\gamma}{1-\gamma} N_t + \lambda_t \left[\left[NOI_t + N_{t-1} \right]^{+} (1-\gamma) - N_t \right] + \mathbb{E}_t \left\{ \frac{\gamma\beta}{1-\gamma} N_{t+1} \right\} +$$

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1} \left[NOI_{t+1} + N_t \right] (1-\gamma) dF(e_{t+1}^{z}) - \mathbb{E}_t \{ \lambda_{t+1} N_{t+1} \} + \mathbb{E}_t \{ L_{t+2} \}.$$

- The FOC for D_t yields:

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1} \left(1 - \delta + Z_{t+1} \alpha K_t^{\alpha-1} - \bar{R}_t^{D} \right) (1-\gamma) dF(e_{t+1}^{z}) +$$

$$\beta \lambda_{t+1} \left((1-\delta) K_t + Z_{t+1} K_t^{\alpha} - \bar{R}_t^{D} D_t - \bar{R}_t^{F} \phi_t \right) (1-\gamma) f(e_{t+1}^{z}) \Big|_{e_{t+1}^{z} = e_{t+1}^{z,*}} \frac{\partial e_{t+1}^{z,*}}{\partial D_t} = 0.$$

Banks

- The FOC for D_t yields,

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1}-\bar{R}_t^D)(1-\gamma)dF(e_{t+1}^z)=0.$$

- The FOC for N_t yields,

$$\frac{\gamma}{1-\gamma}-\lambda_t+\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1})(1-\gamma)dF(e_{t+1}^z)=0.$$

- The shadow value of equity, λ_{t+1}, affects the marginal (net) benefits of the loans.
- λ_{t+1} captures the intertemporal effects.
- If λ_{t+1} is independent of e_{t+1}^z: two-period model.
- Market clearing condition:

$$C_t=\omega^H+(1-\delta)K_{t-1}+Z_tK_{t-1}^{\alpha}-K_t+\phi_t-\bar{R}_t^F\phi_{t-1},$$

- $NFL_t=\phi_t$.
- $Y_t=\omega^H+Z_tK_{t-1}^{\alpha}$. $GDP_t=G_t+Y_t$.
- $NFA_t-NFA_{t-1}=CA_t=Y_t-C_t-I_t-D_{t-1}^F(\bar{R}_{t-1}^F-1)$.

Banks

- The FOC for D_t yields,

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1}-\bar{R}_t^D)(1-\gamma)dF(e_{t+1}^z)=0.$$

- The FOC for N_t yields,

$$\frac{\gamma}{1-\gamma}-\lambda_t+\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1})(1-\gamma)dF(e_{t+1}^z)=0.$$

- The shadow value of equity, λ_{t+1}, affects the marginal (net) benefits of the loans.
- λ_{t+1} captures the intertemporal effects.
- If λ_{t+1} is independent of e_{t+1}^z: two-period model.
- Market clearing condition:

$$C_t=\omega^H+(1-\delta)K_{t-1}+Z_tK_{t-1}^{\alpha}-K_t+\phi_t-\bar{R}_t^F\phi_{t-1},$$

- $NFL_t=\phi_t$.
- $Y_t=\omega^H+Z_tK_{t-1}^{\alpha}$. $GDP_t=G_t+Y_t$.
- $NFA_t-NFA_{t-1}=CA_t=Y_t-C_t-I_t-D_{t-1}^F(\bar{R}_{t-1}^F-1)$.

Banks

- The FOC for D_t yields,

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1}-\bar{R}_t^D)(1-\gamma)dF(e_{t+1}^z)=0.$$

- The FOC for N_t yields,

$$\frac{\gamma}{1-\gamma}-\lambda_t+\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1})(1-\gamma)dF(e_{t+1}^z)=0.$$

- The shadow value of equity, λ_{t+1}, affects the marginal (net) benefits of the loans.
- λ_{t+1} captures the intertemporal effects.
- If λ_{t+1} is independent of e_{t+1}^z: two-period model.
- Market clearing condition:

$$C_t=\omega^H+(1-\delta)K_{t-1}+Z_tK_{t-1}^{\alpha}-K_t+\phi_t-\bar{R}_t^F\phi_{t-1},$$

- $NFL_t=\phi_t$.
- $Y_t=\omega^H+Z_tK_{t-1}^{\alpha}$. $GDP_t=G_t+Y_t$.
- $NFA_t-NFA_{t-1}=CA_t=Y_t-C_t-I_t-D_{t-1}^F(\bar{R}_{t-1}^F-1)$.

Banks

- The FOC for D_t yields,

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1}-\bar{R}_t^D)(1-\gamma)dF(e_{t+1}^z)=0.$$

- The FOC for N_t yields,

$$\frac{\gamma}{1-\gamma}-\lambda_t+\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1})(1-\gamma)dF(e_{t+1}^z)=0.$$

- The shadow value of equity, λ_{t+1}, affects the marginal (net) benefits of the loans.
- λ_{t+1} captures the intertemporal effects.
- If λ_{t+1} is independent of e_{t+1}^z: two-period model.
- Market clearing condition:

$$C_t=\omega^H+(1-\delta)K_{t-1}+Z_tK_{t-1}^{\alpha}-K_t+\phi_t-\bar{R}_t^F\phi_{t-1},$$

- $NFL_t=\phi_t$.
- $Y_t=\omega^H+Z_tK_{t-1}^{\alpha}$. $GDP_t=G_t+Y_t$.
- $NFA_t-NFA_{t-1}=CA_t=Y_t-C_t-I_t-D_{t-1}^F(\bar{R}_{t-1}^F-1)$.

Banks

- The FOC for D_t yields,

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1}-\bar{R}_t^D)(1-\gamma)dF(e_{t+1}^z)=0.$$

- The FOC for N_t yields,

$$\frac{\gamma}{1-\gamma}-\lambda_t+\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1})(1-\gamma)dF(e_{t+1}^z)=0.$$

- The shadow value of equity, λ_{t+1}, affects the marginal (net) benefits of the loans.
- λ_{t+1} captures the intertemporal effects.
- If λ_{t+1} is independent of e_{t+1}^z: two-period model.
- Market clearing condition:

$$C_t=\omega^H+(1-\delta)K_{t-1}+Z_tK_{t-1}^{\alpha}-K_t+\phi_t-\bar{R}_t^F\phi_{t-1},$$

- $NFL_t=\phi_t$.
- $Y_t=\omega^H+Z_tK_{t-1}^{\alpha}$. $GDP_t=G_t+Y_t$.
- $NFA_t-NFA_{t-1}=CA_t=Y_t-C_t-I_t-D_{t-1}^F(\bar{R}_{t-1}^F-1)$.

Banks

- The FOC for D_t yields,

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1}-\bar{R}_t^D)(1-\gamma)dF(e_{t+1}^z)=0.$$

- The FOC for N_t yields,

$$\frac{\gamma}{1-\gamma}-\lambda_t+\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1})(1-\gamma)dF(e_{t+1}^z)=0.$$

- The shadow value of equity, λ_{t+1}, affects the marginal (net) benefits of the loans.
- λ_{t+1} captures the intertemporal effects.
- If λ_{t+1} is independent of e_{t+1}^z: two-period model.
- Market clearing condition:

$$C_t=\omega^H+(1-\delta)K_{t-1}+Z_tK_{t-1}^{\alpha}-K_t+\phi_t-\bar{R}_t^F\phi_{t-1},$$

- $NFL_t=\phi_t$.
- $Y_t=\omega^H+Z_tK_{t-1}^{\alpha}$. $GDP_t=G_t+Y_t$.
- $NFA_t-NFA_{t-1}=CA_t=Y_t-C_t-I_t-D_{t-1}^F(\bar{R}_{t-1}^F-1)$.

Banks

- The FOC for D_t yields,

$$\beta \int_{e^{z,*}_{t+1}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1}-\bar{R}^D_t)(1-\gamma)dF(e^z_{t+1})=0.$$

- The FOC for N_t yields,

$$\frac{\gamma}{1-\gamma}-\lambda_t+\beta \int_{e^{z,*}_{t+1}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1})(1-\gamma)dF(e^z_{t+1})=0.$$

- The shadow value of equity, λ_{t+1}, affects the marginal (net) benefits of the loans.
- λ_{t+1} captures the intertemporal effects.
- If λ_{t+1} is independent of e^z_{t+1}: two-period model.
- Market clearing condition:

$$C_t=\omega^H+(1-\delta)K_{t-1}+Z_tK^{\alpha}_{t-1}-K_t+\phi_t-\bar{R}^F_t\phi_{t-1},$$

- $NFL_t=\phi_t$.
- $Y_t=\omega^H+Z_tK^{\alpha}_{t-1}$. $GDP_t=G_t+Y_t$.
- $NFA_t-NFA_{t-1}=CA_t=Y_t-C_t-I_t-D^F_{t-1}(\bar{R}^F_{t-1}-1)$.

Banks

- The FOC for D_t yields,

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1}-\bar{R}_t^D)(1-\gamma)dF(e_{t+1}^z)=0.$$

- The FOC for N_t yields,

$$\frac{\gamma}{1-\gamma}-\lambda_t+\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1})(1-\gamma)dF(e_{t+1}^z)=0.$$

- The shadow value of equity, λ_{t+1}, affects the marginal (net) benefits of the loans.
- λ_{t+1} captures the intertemporal effects.
- If λ_{t+1} is independent of e_{t+1}^z: two-period model.
- Market clearing condition:

$$C_t=\omega^H+(1-\delta)K_{t-1}+Z_tK_{t-1}^{\alpha}-K_t+\phi_t-\bar{R}_t^F\phi_{t-1},$$

- $NFL_t=\phi_t$.
- $Y_t=\omega^H+Z_tK_{t-1}^{\alpha}$. $GDP_t=G_t+Y_t$.
- $NFA_t-NFA_{t-1}=CA_t=Y_t-C_t-I_t-D_{t-1}^F(\bar{R}_{t-1}^F-1)$.

Banks

- The FOC for D_t yields,

$$\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1}-\bar{R}_t^D)(1-\gamma)dF(e_{t+1}^z)=0.$$

- The FOC for N_t yields,

$$\frac{\gamma}{1-\gamma}-\lambda_t+\beta \int_{e_{t+1}^{z,*}}^{+\infty} \lambda_{t+1}(1-\delta+Z_{t+1}\alpha K_t^{\alpha-1})(1-\gamma)dF(e_{t+1}^z)=0.$$

- The shadow value of equity, λ_{t+1}, affects the marginal (net) benefits of the loans.
- λ_{t+1} captures the intertemporal effects.
- If λ_{t+1} is independent of e_{t+1}^z: two-period model.
- Market clearing condition:

$$C_t=\omega^H+(1-\delta)K_{t-1}+Z_tK_{t-1}^{\alpha}-K_t+\phi_t-\bar{R}_t^F\phi_{t-1},$$

- $NFL_t=\phi_t$.
- $Y_t=\omega^H+Z_tK_{t-1}^{\alpha}$. $GDP_t=G_t+Y_t$.
- $NFA_t-NFA_{t-1}=CA_t=Y_t-C_t-I_t-D_{t-1}^F(\bar{R}_{t-1}^F-1)$.

Domestic Social Planner

- The social planner aims to maximize the welfare of the domestic economy: Utility of HHs, W_t.
- The planner chooses K_t, by maximizing W_t subject to,

$$C_t = \omega^H + (1-\delta)K_{t-1} + Z_t K_{t-1}^{\alpha} - K_t + \phi_t - \bar{R}_t^F \phi_{t-1},$$

- Socially efficient level of loans,

$$K_t = \left(\frac{\mathbb{E}_t\{Z_{t+1}\}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}},$$

  - where,

$$\mathbb{E}_t\{Z_{t+1}\} = exp(\mu_z(1-\rho_z) + \rho_z log(Z_t) + 0.5\sigma_{ez}^2.$$

- K_t is independent of γ.

Domestic Social Planner

- The social planner aims to maximize the welfare of the domestic economy: Utility of HHs, W_t.

- The planner chooses K_t, by maximizing W_t subject to,

$$C_t = \omega^H + (1-\delta)K_{t-1} + Z_t K_{t-1}^{\alpha} - K_t + \phi_t - \bar{R}_t^F \phi_{t-1},$$

- Socially efficient level of loans,

$$K_t = \left(\frac{\mathbb{E}_t\{Z_{t+1}\}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}},$$

  - where,

$$\mathbb{E}_t\{Z_{t+1}\} = exp(\mu_z(1-\rho_z) + \rho_z log(Z_t) + 0.5\sigma_{e^z}^2.$$

- K_t is independent of γ.

Domestic Social Planner

- The social planner aims to maximize the welfare of the domestic economy: Utility of HHs, W_t.

- The planner chooses K_t, by maximizing W_t subject to,

$$C_t = \omega^H + (1-\delta)K_{t-1} + Z_t K_{t-1}^{\alpha} - K_t + \phi_t - \bar{R}_t^F \phi_{t-1},$$

- Socially efficient level of loans,

$$K_t = \left(\frac{\mathbb{E}_t\{Z_{t+1}\}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}},$$

  - where,

$$\mathbb{E}_t\{Z_{t+1}\} = exp(\mu_z(1-\rho_z) + \rho_z log(Z_t) + 0.5\sigma_{e^z}^2.$$

- K_t is independent of γ.

Domestic Social Planner

- The social planner aims to maximize the welfare of the domestic economy: Utility of HHs, W_t.
- The planner chooses K_t, by maximizing W_t subject to,

$$C_t = \omega^H + (1-\delta)K_{t-1} + Z_t K_{t-1}^{\alpha} - K_t + \phi_t - \bar{R}_t^F \phi_{t-1},$$

- Socially efficient level of loans,

$$K_t = \left(\frac{\mathbb{E}_t\{Z_{t+1}\}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}},$$

  - where,

$$\mathbb{E}_t\{Z_{t+1}\} = exp(\mu_z(1-\rho_z) + \rho_z log(Z_t) + 0.5\sigma_{e^z}^2.$$

- K_t is independent of γ.

Domestic Social Planner

- The social planner aims to maximize the welfare of the domestic economy: Utility of HHs, W_t.
- The planner chooses K_t, by maximizing W_t subject to,

$$C_t = \omega^H + (1-\delta)K_{t-1} + Z_t K_{t-1}^{\alpha} - K_t + \phi_t - \bar{R}_t^F \phi_{t-1},$$

- Socially efficient level of loans,

$$K_t = \left(\frac{\mathbb{E}_t\{Z_{t+1}\}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}},$$

  - where,

$$\mathbb{E}_t\{Z_{t+1}\} = exp(\mu_z(1-\rho_z) + \rho_z log(Z_t) + 0.5\sigma_{e^z}^2.$$

- K_t is independent of γ.

Comparing the SP and CE equilibriums

- Is capital inefficiently high under limited liability (as in the two period version)?
- The socially efficient level of loans is,

$$K_t^{SP} = \left(\frac{\mathbb{E}_t\{Z_{t+1}\}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}}.$$

- In the competitive equilibrium (LL + DI) loans are,

$$K_t^{CE} = \left(\frac{\frac{\mathbb{E}_t\{Z_{t+1}\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\}}{\mathbb{E}_t\{\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\}}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}},$$

  - *SP*: Planner equilibrium. *CE*: Competitive equilibrium.

- Rewriting K_t^{CE}:

$$K_t^{CE} = \left(\frac{\left[\mathbb{E}_t\{Z_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} + \frac{Cov_t\{Z_{t+1}\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\}}{\mathbb{E}_t\{\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\}}\right]\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}}.$$

Comparing the SP and CE equilibriums

- Is capital inefficiently high under limited liability (as in the two period version)?
- The socially efficient level of loans is,

$$K_t^{SP} = \left(\frac{\mathbb{E}_t\{Z_{t+1}\}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}}.$$

- In the competitive equilibrium (LL + DI) loans are,

$$K_t^{CE} = \left(\frac{\frac{\mathbb{E}_t\{Z_{t+1}\lambda_{t+1} | e^z_{t+1} \geq e^{z,*}_{t+1}\}}{\mathbb{E}_t\{\lambda_{t+1} | e^z_{t+1} \geq e^{z,*}_{t+1}\}}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}},$$

  - *SP*: Planner equilibrium. *CE*: Competitive equilibrium.

- Rewriting K_t^{CE}:

$$K_t^{CE} = \left(\frac{\left[\mathbb{E}_t\{Z_{t+1} | e^z_{t+1} \geq e^{z,*}_{t+1}\} + \frac{Cov_t\{Z_{t+1}\lambda_{t+1} | e^z_{t+1} \geq e^{z,*}_{t+1}\}}{\mathbb{E}_t\{\lambda_{t+1} | e^z_{t+1} \geq e^{z,*}_{t+1}\}}\right]\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}}.$$

Comparing the SP and CE equilibriums

- Is capital inefficiently high under limited liability (as in the two period version)?
- The socially efficient level of loans is,

$$K_t^{SP} = \left(\frac{\mathbb{E}_t\{Z_{t+1}\}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}}.$$

- In the competitive equilibrium (LL + DI) loans are,

$$K_t^{CE} = \left(\frac{\frac{\mathbb{E}_t\{Z_{t+1}\lambda_{t+1} | e^z_{t+1} \geq e^{z,*}_{t+1}\}}{\mathbb{E}_t\{\lambda_{t+1} | e^z_{t+1} \geq e^{z,*}_{t+1}\}}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}},$$

  - *SP*: Planner equilibrium. *CE*: Competitive equilibrium.
- Rewriting K_t^{CE}:

$$K_t^{CE} = \left(\frac{\left[\mathbb{E}_t\{Z_{t+1} | e^z_{t+1} \geq e^{z,*}_{t+1}\} + \frac{Cov_t\{Z_{t+1}\lambda_{t+1} | e^z_{t+1} \geq e^{z,*}_{t+1}\}}{\mathbb{E}_t\{\lambda_{t+1} | e^z_{t+1} \geq e^{z,*}_{t+1}\}} \right]\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}}.$$

Comparing the SP and CE equilibriums

- Is capital inefficiently high under limited liability (as in the two period version)?
- The socially efficient level of loans is,

$$K_t^{SP} = \left(\frac{\mathbb{E}_t\{Z_{t+1}\}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}}.$$

- In the competitive equilibrium (LL + DI) loans are,

$$K_t^{CE} = \left(\frac{\frac{\mathbb{E}_t\{Z_{t+1}\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\}}{\mathbb{E}_t\{\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\}}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}},$$

  - *SP*: Planner equilibrium. *CE*: Competitive equilibrium.

- Rewriting K_t^{CE}:

$$K_t^{CE} = \left(\frac{\left[\mathbb{E}_t\{Z_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} + \frac{Cov_t\{Z_{t+1}\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\}}{\mathbb{E}_t\{\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\}}\right]\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}}.$$

Comparing the SP and CE equilibriums

- Is capital inefficiently high under limited liability (as in the two period version)?
- The socially efficient level of loans is,

$$K_t^{SP} = \left(\frac{\mathbb{E}_t\{Z_{t+1}\}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}}.$$

- In the competitive equilibrium (LL + DI) loans are,

$$K_t^{CE} = \left(\frac{\frac{\mathbb{E}_t\{Z_{t+1}\lambda_{t+1}|e_{t+1}^z \geq e_{t+1}^{z,*}\}}{\mathbb{E}_t\{\lambda_{t+1}|e_{t+1}^z \geq e_{t+1}^{z,*}\}}\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}},$$

  - *SP*: Planner equilibrium. *CE*: Competitive equilibrium.
- Rewriting K_t^{CE}:

$$K_t^{CE} = \left(\frac{\left[\mathbb{E}_t\{Z_{t+1}|e_{t+1}^z \geq e_{t+1}^{z,*}\} + \frac{Cov_t\{Z_{t+1}\lambda_{t+1}|e_{t+1}^z \geq e_{t+1}^{z,*}\}}{\mathbb{E}_t\{\lambda_{t+1}|e_{t+1}^z \geq e_{t+1}^{z,*}\}}\right]\alpha}{1/\beta - (1-\delta)} \right)^{\frac{1}{1-\alpha}}.$$

Comparing the SP and CE equilibriums

- By definition $\mathbb{E}_t\{Z_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} \geq \mathbb{E}_t\{Z_{t+1}\}$. From the FOCs of D_t and N_t,

$$\lambda_t = \int_{e^{z,*}_{t+1}}^{+\infty} \lambda_{t+1} dF(e^z_{t+1})(1-\gamma) + \frac{\gamma}{1-\gamma}.$$

- λ_{t+1} is not independent of e^z_{t+1}. Numerical results: $Cov_t\{Z_{t+1}\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} > 0$, then

$$K^{CE}_t > K^{SP}_t.$$

- The lower the productivity shock, e^z_t, the higher likelihood that banks default at $t+1$ and thus the lower the probability that an exogenous unit of bank's equity at t increases bank's capacity to accumulate equity at $t+1$.

- In an infinity time period model the excess bank risk-taking is amplified:
  - Since banks have limited liability and deposit insurance not only in the present but also in the future, they inefficiently overestimate even by more the marginal benefits of loans.

- The excess marginal benefits of loans, θ_t, is found in:

$$(1-\delta) + \alpha\mathbb{E}_t\{Z_{t+1}\}(K^{CE}_t)^{\alpha-1} + \theta_t = R^B.$$

Comparing the SP and CE equilibriums

- By definition $\mathbb{E}_t\{Z_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} \geq \mathbb{E}_t\{Z_{t+1}\}$. From the FOCs of D_t and N_t,

$$\lambda_t = \int_{e^{z,*}_{t+1}}^{+\infty} \lambda_{t+1} dF(e^z_{t+1})(1-\gamma) + \frac{\gamma}{1-\gamma}.$$

- λ_{t+1} is not independent of e^z_{t+1}. Numerical results: $Cov_t\{Z_{t+1}\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} > 0$, then

$$K^{CE}_t > K^{SP}_t.$$

- The lower the productivity shock, e^z_t, the higher likelihood that banks default at $t+1$ and thus the lower the probability that an exogenous unit of bank's equity at t increases bank's capacity to accumulate equity at $t+1$.
- In an infinity time period model the excess bank risk-taking is amplified:
  - Since banks have limited liability and deposit insurance not only in the present but also in the future, they inefficiently overestimate even by more the marginal benefits of loans.
- The excess marginal benefits of loans, θ_t, is found in:

$$(1-\delta) + \alpha\mathbb{E}_t\{Z_{t+1}\}(K^{CE}_t)^{\alpha-1} + \theta_t = R^B.$$

Comparing the SP and CE equilibriums

- By definition $\mathbb{E}_t\{Z_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} \geq \mathbb{E}_t\{Z_{t+1}\}$. From the FOCs of D_t and N_t,

$$\lambda_t = \int_{e^{z,*}_{t+1}}^{+\infty} \lambda_{t+1} dF(e^z_{t+1})(1-\gamma) + \frac{\gamma}{1-\gamma}.$$

- λ_{t+1} is not independent of e^z_{t+1}. Numerical results: $Cov_t\{Z_{t+1}\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} > 0$, then

$$K_t^{CE} > K_t^{SP}.$$

- The lower the productivity shock, e^z_t, the higher likelihood that banks default at $t+1$ and thus the lower the probability that an exogenous unit of bank's equity at t increases bank's capacity to accumulate equity at $t+1$.

- In an infinity time period model the excess bank risk-taking is amplified:
  - Since banks have limited liability and deposit insurance not only in the present but also in the future, they inefficiently overestimate even by more the marginal benefits of loans.

- The excess marginal benefits of loans, θ_t, is found in:

$$(1-\delta) + \alpha\mathbb{E}_t\{Z_{t+1}\}(K_t^{CE})^{\alpha-1} + \theta_t = R^B.$$

Comparing the SP and CE equilibriums

- By definition $\mathbb{E}_t\{Z_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} \geq \mathbb{E}_t\{Z_{t+1}\}$. From the FOCs of D_t and N_t,

$$\lambda_t = \int_{e^{z,*}_{t+1}}^{+\infty} \lambda_{t+1} dF(e^z_{t+1})(1-\gamma) + \frac{\gamma}{1-\gamma}.$$

- λ_{t+1} is not independent of e^z_{t+1}. Numerical results: $Cov_t\{Z_{t+1}\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} > 0$, then

$$K^{CE}_t > K^{SP}_t.$$

- The lower the productivity shock, e^z_t, the higher likelihood that banks default at $t+1$ and thus the lower the probability that an exogenous unit of bank's equity at t increases bank's capacity to accumulate equity at $t+1$.

- In an infinity time period model the excess bank risk-taking is amplified:
  - Since banks have limited liability and deposit insurance not only in the present but also in the future, they inefficiently overestimate even by more the marginal benefits of loans.

- The excess marginal benefits of loans, θ_t, is found in:

$$(1-\delta) + \alpha\mathbb{E}_t\{Z_{t+1}\}(K^{CE}_t)^{\alpha-1} + \theta_t = R^B.$$

Comparing the SP and CE equilibriums

- By definition $\mathbb{E}_t\{Z_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} \geq \mathbb{E}_t\{Z_{t+1}\}$. From the FOCs of D_t and N_t,

$$\lambda_t = \int_{e^{z,*}_{t+1}}^{+\infty} \lambda_{t+1} dF(e^z_{t+1})(1-\gamma) + \frac{\gamma}{1-\gamma}.$$

- λ_{t+1} is not independent of e^z_{t+1}. Numerical results: $Cov_t\{Z_{t+1}\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} > 0$, then

$$K^{CE}_t > K^{SP}_t.$$

- The lower the productivity shock, e^z_t, the higher likelihood that banks default at $t+1$ and thus the lower the probability that an exogenous unit of bank's equity at t increases bank's capacity to accumulate equity at $t+1$.

- In an infinity time period model the excess bank risk-taking is amplified:
  - Since banks have limited liability and deposit insurance not only in the present but also in the future, they inefficiently overestimate even by more the marginal benefits of loans.

- The excess marginal benefits of loans, θ_t, is found in:

$$(1-\delta) + \alpha \mathbb{E}_t\{Z_{t+1}\}(K^{CE}_t)^{\alpha-1} + \theta_t = R^B.$$

Comparing the SP and CE equilibriums

- By definition $\mathbb{E}_t\{Z_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} \geq \mathbb{E}_t\{Z_{t+1}\}$. From the FOCs of D_t and N_t,

$$\lambda_t = \int_{e^{z,*}_{t+1}}^{+\infty} \lambda_{t+1} dF(e^z_{t+1})(1-\gamma) + \frac{\gamma}{1-\gamma}.$$

- λ_{t+1} is not independent of e^z_{t+1}. Numerical results: $Cov_t\{Z_{t+1}\lambda_{t+1}|e^z_{t+1} \geq e^{z,*}_{t+1}\} > 0$, then

$$K^{CE}_t > K^{SP}_t.$$

- The lower the productivity shock, e^z_t, the higher likelihood that banks default at $t+1$ and thus the lower the probability that an exogenous unit of bank's equity at t increases bank's capacity to accumulate equity at $t+1$.

- In an infinity time period model the excess bank risk-taking is amplified:
  - Since banks have limited liability and deposit insurance not only in the present but also in the future, they inefficiently overestimate even by more the marginal benefits of loans.

- The excess marginal benefits of loans, θ_t, is found in:

$$(1-\delta) + \alpha\mathbb{E}_t\{Z_{t+1}\}(K^{CE}_t)^{\alpha-1} + \theta_t = R^B.$$

Calibration

Table 1: Parameters

Description		Value	*Source / Target*
Discount factor	β	0.986	Gross domestic rate = 1.060 (annual)
Gross foreign interest rate	R^F	1.003	Gross foreign rate = 1.0124 (annual)
Capital's shares in output	α	0.330	Standard value
Capital depreciation ratio	δ	0.120	Bank Leverage ratio
Dividend policy	γ	0.540	Short-term dynamics of p_t
Foreign borrowing limit	ϕ	2.066	NFL to GDP ratio
Government Expenses	G	0.975	Bank Credit to GDP ratio
Households' exogenous income	ω^H	3.906	Consumption to GDP ratio
Mean of log Z_1	μ_z	0.000	Normalized
Std. Dev. of the productivity shock	σ_{e^z}	0.952	Default Probability= 3% (annual)
Persistence of the shock	ρ_z	0.850	Standard value

Each period represents a quarter.

Stochastic Steady State

Table 2: Stochastic Steady State

Description	Variables	(1) SP	(2) CE	(3) CE †	(4) CE-ULL
Bank leverage ratio	K_{ss}/N_{ss}	-	9.53	9.14	9.07
NFL to GDP ratio (%)	$\phi/(4.GDP_{ss})$ (%)	7.57	7.54	7.56	7.57
Bank credit to GDP ratio (%)	$K_{ss}/(4.GDP_{ss})$ (%)	27.49	28.38	27.63	27.49
Consumption to GDP ratio (%)	C_{ss}/GDP_{ss} (%)	72.44	72.07	72.39	72.44
NFL to credit ratio (%)	ϕ/K_{ss} (%)	27.51	26.56	27.37	27.51
Bank default probability (%)	p_{ss} (%)	-	0.74	0.37	0.32
Excess marginal benefits (%)	θ_{ss} (%)	-	0.31	0.05	-
	$K_{ss}^{CE}/K_{ss}^{SP}-1$ (%)	-	3.58	0.54	-

$CE^{\dagger}$: Competitive equilibrium abstracting from the intertemporal channel, i.e. assuming λ_t is independent of e_t^z.
$CE-ULL$: Competitive equilibrium under unlimited liability. NFL = Net foreign liabilities=ϕ. NFL to GDP ratio = ϕ/GDP_{ss}. $GPD_{ss}=G+Y_{ss}$. $Y_{ss}=\omega^H+Z_{ss}K_{ss}^{\alpha}$

1998 Sudden Stop Simulation

- The economy starts from its stochastic steady state at time $t = 0$.
- The sudden stop simulation: A 87% reduction of ST NFL, ϕ.
- This is in order to capture a reduction of the ST NFL to GDP ratio from 7.5% to 1%.
- The adjustment of the borrowing limit is gradual,

$$log(\phi_t) = \rho_\phi log(\phi_{t-1}) + (1-\rho_\phi) log(\phi^{new}),$$

- for $t \geq 1$.
- The initial fall in the foreign borrowing limit happening in $t = 1$ is not anticipated by agents.
- From the period 1 on, agents correctly anticipate the path of ϕ_t.
- I set $\rho_\phi = 0.92$ in order to match the dynamics of the ST NFL to GDP ratio.

1998 Sudden Stop Simulation

- The economy starts from its stochastic steady state at time $t = 0$.
- The sudden stop simulation: A 87% reduction of ST NFL, ϕ.
- This is in order to capture a reduction of the ST NFL to GDP ratio from 7.5% to 1%.
- The adjustment of the borrowing limit is gradual,

$$log(\phi_t) = \rho_\phi log(\phi_{t-1}) + (1 - \rho_\phi) log(\phi^{new}),$$

- for $t \geq 1$.
- The initial fall in the foreign borrowing limit happening in $t = 1$ is not anticipated by agents.
- From the period 1 on, agents correctly anticipate the path of ϕ_t.
- I set $\rho_\phi = 0.92$ in order to match the dynamics of the ST NFL to GDP ratio.

1998 Sudden Stop Simulation

- The economy starts from its stochastic steady state at time $t = 0$.
- The sudden stop simulation: A 87% reduction of ST NFL, ϕ.
- This is in order to capture a reduction of the ST NFL to GDP ratio from 7.5% to 1%.
- The adjustment of the borrowing limit is gradual,

$$log(\phi_t) = \rho_\phi log(\phi_{t-1}) + (1 - \rho_\phi) log(\phi^{new}),$$

- for $t \geq 1$.
- The initial fall in the foreign borrowing limit happening in $t = 1$ is not anticipated by agents.
- From the period 1 on, agents correctly anticipate the path of ϕ_t.
- I set $\rho_\phi = 0.92$ in order to match the dynamics of the ST NFL to GDP ratio.

1998 Sudden Stop Simulation

- The economy starts from its stochastic steady state at time $t = 0$.
- The sudden stop simulation: A 87% reduction of ST NFL, ϕ.
- This is in order to capture a reduction of the ST NFL to GDP ratio from 7.5% to 1%.
- The adjustment of the borrowing limit is gradual,

$$log(\phi_t) = \rho_\phi log(\phi_{t-1}) + (1-\rho_\phi) log(\phi^{new}),$$

- for $t \geq 1$.
- The initial fall in the foreign borrowing limit happening in $t = 1$ is not anticipated by agents.
- From the period 1 on, agents correctly anticipate the path of ϕ_t.
- I set $\rho_\phi = 0.92$ in order to match the dynamics of the ST NFL to GDP ratio.

1998 Sudden Stop Simulation

- The economy starts from its stochastic steady state at time $t = 0$.
- The sudden stop simulation: A 87% reduction of ST NFL, ϕ.
- This is in order to capture a reduction of the ST NFL to GDP ratio from 7.5% to 1%.
- The adjustment of the borrowing limit is gradual,

$$log(\phi_t) = \rho_\phi log(\phi_{t-1}) + (1 - \rho_\phi) log(\phi^{new}),$$

- for $t \geq 1$.
- The initial fall in the foreign borrowing limit happening in $t = 1$ is not anticipated by agents.
- From the period 1 on, agents correctly anticipate the path of ϕ_t.
- I set $\rho_\phi = 0.92$ in order to match the dynamics of the ST NFL to GDP ratio.

1998 Sudden Stop Simulation

- The economy starts from its stochastic steady state at time $t = 0$.
- The sudden stop simulation: A 87% reduction of ST NFL, ϕ.
- This is in order to capture a reduction of the ST NFL to GDP ratio from 7.5% to 1%.
- The adjustment of the borrowing limit is gradual,

$$log(\phi_t) = \rho_\phi log(\phi_{t-1}) + (1 - \rho_\phi) log(\phi^{new}),$$

- for $t \geq 1$.
- The initial fall in the foreign borrowing limit happening in $t = 1$ is not anticipated by agents.
- From the period 1 on, agents correctly anticipate the path of ϕ_t.
- I set $\rho_\phi = 0.92$ in order to match the dynamics of the ST NFL to GDP ratio.

1998 Sudden Stop Simulation

- The economy starts from its stochastic steady state at time $t = 0$.
- The sudden stop simulation: A 87% reduction of ST NFL, ϕ.
- This is in order to capture a reduction of the ST NFL to GDP ratio from 7.5% to 1%.
- The adjustment of the borrowing limit is gradual,

$$log(\phi_t) = \rho_\phi log(\phi_{t-1}) + (1 - \rho_\phi) log(\phi^{new}),$$

- for $t \geq 1$.
- The initial fall in the foreign borrowing limit happening in $t = 1$ is not anticipated by agents.
- From the period 1 on, agents correctly anticipate the path of ϕ_t.
- I set $\rho_\phi = 0.92$ in order to match the dynamics of the ST NFL to GDP ratio.

1998 Sudden Stop Simulation

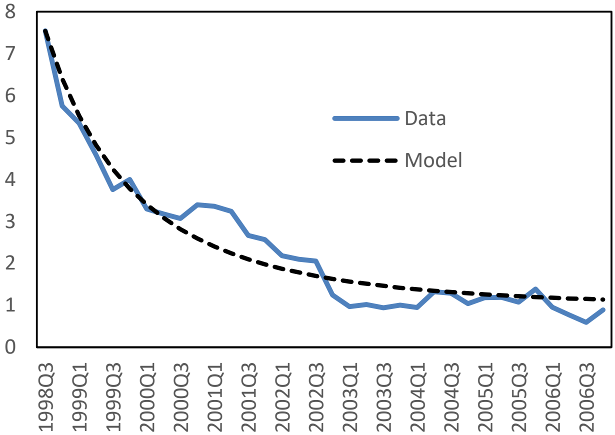
- The economy starts from its stochastic steady state at time $t = 0$.
- The sudden stop simulation: A 87% reduction of ST NFL, ϕ.
- This is in order to capture a reduction of the ST NFL to GDP ratio from 7.5% to 1%.
- The adjustment of the borrowing limit is gradual,

$$log(\phi_t) = \rho_\phi log(\phi_{t-1}) + (1 - \rho_\phi) log(\phi^{new}),$$

- for $t \geq 1$.
- The initial fall in the foreign borrowing limit happening in $t = 1$ is not anticipated by agents.
- From the period 1 on, agents correctly anticipate the path of ϕ_t.
- I set $\rho_\phi = 0.92$ in order to match the dynamics of the ST NFL to GDP ratio.

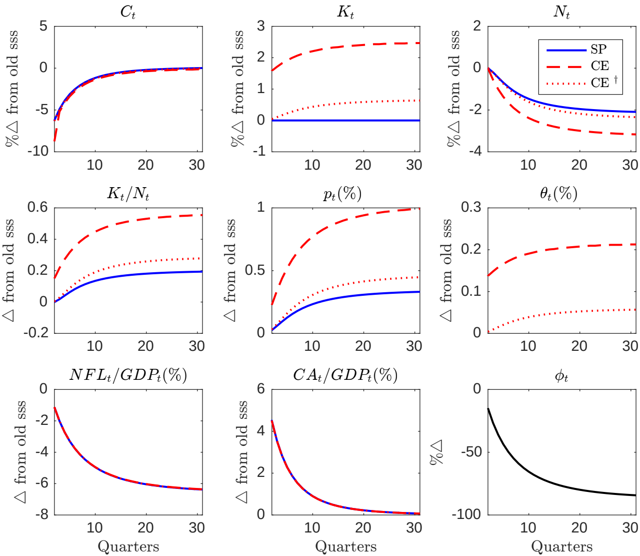
1998 Sudden Stop Simulation

Figure 2: ST NFL to GDP (%)



Data: NFL = short-term foreign obligations of the financial system. Model: NFL=foreign borrowing limit. Source: CRBP.

1998 Sudden Stop Simulation



$CE^{\dagger}$: Competitive equilibrium when abstracting from the intertemporal channel.

1998 Sudden Stop Simulation

- In the long-term:
  - The (quarterly) default probability moves from 0.7% to 1.8%.
  - The relative excess loans moves from 3.6% to 6.2%.
  - The excess marginal benefits increases from 0.31% to 0.52%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
  - The excess marginal benefits of loans becomes 1.5 times its initial value.
  - These account for the 23%, 63% and 64% of their long-term movements.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect, the short-term responses are (1.1, 1.1 and 1.1 respectively) and those account for the 8.5%, 6.8% and 6.5% of their long-term movements.

1998 Sudden Stop Simulation

- In the long-term:
  - The (quarterly) default probability moves from 0.7% to 1.8%.
  - The relative excess loans moves from 3.6% to 6.2%.
  - The excess marginal benefits increases from 0.31% to 0.52%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
  - The excess marginal benefits of loans becomes 1.5 times its initial value.
  - These account for the 23%, 63% and 64% of their long-term movements.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect, the short-term responses are (1.1, 1.1 and 1.1 respectively) and those account for the 8.5%, 6.8% and 6.5% of their long-term movements.

1998 Sudden Stop Simulation

- In the long-term:
  - The (quarterly) default probability moves from 0.7% to 1.8%.
  - The relative excess loans moves from 3.6% to 6.2%.
  - The excess marginal benefits increases from 0.31% to 0.52%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
  - The excess marginal benefits of loans becomes 1.5 times its initial value.
  - These account for the 23%, 63% and 64% of their long-term movements.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect, the short-term responses are (1.1, 1.1 and 1.1 respectively) and those account for the 8.5%, 6.8% and 6.5% of their long-term movements.

1998 Sudden Stop Simulation

- In the long-term:
  - The (quarterly) default probability moves from 0.7% to 1.8%.
  - The relative excess loans moves from 3.6% to 6.2%.
  - The excess marginal benefits increases from 0.31% to 0.52%.

- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
  - The excess marginal benefits of loans becomes 1.5 times its initial value.
  - These account for the 23%, 63% and 64% of their long-term movements.

- This is in line with the behavior of the morosity ratio.

- When abstracting from the intertemporal effect, the short-term responses are (1.1, 1.1 and 1.1 respectively) and those account for the 8.5%, 6.8% and 6.5% of their long-term movements.

1998 Sudden Stop Simulation

- In the long-term:
  - The (quarterly) default probability moves from 0.7% to 1.8%.
  - The relative excess loans moves from 3.6% to 6.2%.
  - The excess marginal benefits increases from 0.31% to 0.52%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
  - The excess marginal benefits of loans becomes 1.5 times its initial value.
  - These account for the 23%, 63% and 64% of their long-term movements.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect, the short-term responses are (1.1, 1.1 and 1.1 respectively) and those account for the 8.5%, 6.8% and 6.5% of their long-term movements.

1998 Sudden Stop Simulation

- In the long-term:
  - The (quarterly) default probability moves from 0.7% to 1.8%.
  - The relative excess loans moves from 3.6% to 6.2%.
  - The excess marginal benefits increases from 0.31% to 0.52%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
  - The excess marginal benefits of loans becomes 1.5 times its initial value.
  - These account for the 23%, 63% and 64% of their long-term movements.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect, the short-term responses are (1.1, 1.1 and 1.1 respectively) and those account for the 8.5%, 6.8% and 6.5% of their long-term movements.

1998 Sudden Stop Simulation

- In the long-term:
  - The (quarterly) default probability moves from 0.7% to 1.8%.
  - The relative excess loans moves from 3.6% to 6.2%.
  - The excess marginal benefits increases from 0.31% to 0.52%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
  - The excess marginal benefits of loans becomes 1.5 times its initial value.
  - These account for the 23%, 63% and 64% of their long-term movements.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect, the short-term responses are (1.1, 1.1 and 1.1 respectively) and those account for the 8.5%, 6.8% and 6.5% of their long-term movements.

1998 Sudden Stop Simulation

- In the long-term:
  - The (quarterly) default probability moves from 0.7% to 1.8%.
  - The relative excess loans moves from 3.6% to 6.2%.
  - The excess marginal benefits increases from 0.31% to 0.52%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
  - The excess marginal benefits of loans becomes 1.5 times its initial value.
  - These account for the 23%, 63% and 64% of their long-term movements.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect, the short-term responses are (1.1, 1.1 and 1.1 respectively) and those account for the 8.5%, 6.8% and 6.5% of their long-term movements.

1998 Sudden Stop Simulation

- In the long-term:
  - The (quarterly) default probability moves from 0.7% to 1.8%.
  - The relative excess loans moves from 3.6% to 6.2%.
  - The excess marginal benefits increases from 0.31% to 0.52%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
  - The excess marginal benefits of loans becomes 1.5 times its initial value.
  - These account for the 23%, 63% and 64% of their long-term movements.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect, the short-term responses are (1.1, 1.1 and 1.1 respectively) and those account for the 8.5%, 6.8% and 6.5% of their long-term movements.

1998 Sudden Stop Simulation

- In the long-term:
  - The (quarterly) default probability moves from 0.7% to 1.8%.
  - The relative excess loans moves from 3.6% to 6.2%.
  - The excess marginal benefits increases from 0.31% to 0.52%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
  - The excess marginal benefits of loans becomes 1.5 times its initial value.
  - These account for the 23%, 63% and 64% of their long-term movements.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect, the short-term responses are (1.1, 1.1 and 1.1 respectively) and those account for the 8.5%, 6.8% and 6.5% of their long-term movements.

1998 Sudden Stop Simulation

- In the long-term:
  - The (quarterly) default probability moves from 0.7% to 1.8%.
  - The relative excess loans moves from 3.6% to 6.2%.
  - The excess marginal benefits increases from 0.31% to 0.52%.
- In the short-term:
  - The default probability of banks becomes 1.3 times its initial value.
  - The relative excess loans becomes 1.5 times its initial value.
  - The excess marginal benefits of loans becomes 1.5 times its initial value.
  - These account for the 23%, 63% and 64% of their long-term movements.
- This is in line with the behavior of the morosity ratio.
- When abstracting from the intertemporal effect, the short-term responses are (1.1, 1.1 and 1.1 respectively) and those account for the 8.5%, 6.8% and 6.5% of their long-term movements.

Conclusions

- The limited liability + deposit insurance $\Rightarrow$ Inefficient high level of loans.
- The intertemporal effect amplifies the inefficiency.
- 1998 Sudden Stop: The model explains the behavior of the morosity ratio.
- *Future research:* Optimal policies. Risk-averse agents.

Conclusions

- The limited liability + deposit insurance ⇒ Inefficient high level of loans.
- The intertemporal effect amplifies the inefficiency.
- 1998 Sudden Stop: The model explains the behavior of the morosity ratio.
- *Future research:* Optimal policies. Risk-averse agents.

Conclusions

- The limited liability + deposit insurance ⇒ Inefficient high level of loans.
- The intertemporal effect amplifies the inefficiency.
- 1998 Sudden Stop: The model explains the behavior of the morosity ratio.
- *Future research:* Optimal policies. Risk-averse agents.

Conclusions

- The limited liability + deposit insurance $\Rightarrow$ Inefficient high level of loans.
- The intertemporal effect amplifies the inefficiency.
- 1998 Sudden Stop: The model explains the behavior of the morosity ratio.
- *Future research:* Optimal policies. Risk-averse agents.