Financial Integration in a Small Open Economy

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• Examining a dynamic, stochastic, general equilibrium framework with informational frictions and foreign borrowing in the case of monetary and technology shocks for a small open economy

• Analyzing the implications of varying degrees of financial integration for the impact of shocks on the economy
• Increasing financial integration amplifying the impact of temporary money growth shocks on the economy

• Varying the degree of financial integration turning out to have hardly any implication for the effect of temporary technology shocks on the economy
Brief Outline

Introduction

Model

Simulation

Conclusion
Framework

• A dynamic, stochastic, general equilibrium framework that incorporates financial integration

• A small, open economy with a fixed exchange rate regime

• Informational frictions necessitating financial intermediation in the economy

• Uncertainty in the production process leading to collateralized borrowing by firms

• Stochastic trends in money growth and technology processes
Collateralized Borrowing

- **Kiyotaki and Moore (1997)** - some durable asset, like land, as collateral
  
  - Lenders unable to force borrowers to repay unless the debts are secured
  
  - Borrowers’ assets like land serving both as factors of production and as collateral

- **von Hagen and Zhang (forthcoming)**
  
  - Land used as collateral and factor of production in a real, small, open economy to analyze the welfare implications of financial liberalization
  
  - Capital controls in the form of limitations of foreign borrowing by the financial intermediaries
Financial Integration

• As the process resulting from reduction in financial frictions that prevent capital from freely flowing across international borders

• Perfect integration of financial markets implying that all potential market participants with the same relevant characteristics face the same set of rules, constraints etc. in the financial transactions they perform

• Impact of financial integration on economic growth, macroeconomic volatility, effectiveness of government policy rules depending on
  
  • structure of the financial system
  
  • quality of financial supervision and regulation
  
  • soundness of financial institutions
  
  • rapidity of the integration process
Empirical Literature on Financial Integration

- **Arteta et al. (2003)**
  
  Implications of financial integration turning out to be highly sensitive to measure of openness, method of estimation and time period covered

  
  Standard of monetary and fiscal policies, structure of financial systems and quality of financial supervision mattering in analysis of financial integration

- **Eichengreen and Leblang (2003)**
  
  Lack of robustness of results regarding the relationship between financial integration and growth in the literature attributed to failure to account for the impact of capital controls in limiting sudden financial outflows during crises
Modeling Financial Integration/Related Literature

- **Sutherland (1996)**

  Increasing financial market integration raising the volatility of nominal exchange rate and output in the case of monetary shocks while reducing the volatility of most variables in the case of real demand or supply shocks.

- **Senay (1998)**

  Higher degrees of financial market integration increasing the effectiveness of monetary policy while diminishing the effectiveness of fiscal policy.

- **Buch et al. (2002)**

  The link between financial openness and business cycle volatility depending on the nature of the underlying shock.
A cash-in-advance (CIA) model, similar in spirit to that by Nason and Cogley (1994), modified in a way so as to incorporate financial integration.

All decisions made after, therefore completely reflecting, current period surprise change in money growth and technology.

"Stock as of the end of the period" convention used for timing of stock variables, namely, money and capital.

Economy consisting of four central agents; households, firms, foreign lenders and financial intermediaries; and a secondary agent with a minor role; the central bank.
Households

A typical infinitely-lived household maximizing an expected utility function of the form

$$E_0 \left\{ \sum_{t=0}^{\infty} \beta^t [(1 - \phi) \ln C_t + \phi \ln (1 - H_t)] \right\}, \quad 0 < \beta, \phi < 1$$

subject to the CIA constraint

$$P_t C_t \leq M_{t-1} + W_t H_t - DD_t$$

to the budget constraint

$$M_t = M_{t-1} + W_t H_t - P_t C_t + r_{Ht} DD_t + F_t + B_t$$

and to the nonnegativity constraint

$$0 \leq DD_t$$

where $P_t$ and $W_t$ denoting the price level of the consumption good and the nominal wage rate, respectively

$r_{Ht}$ being the net nominal interest rate on household deposits

$DD_t$ denominated in domestic currency
Firms

- Firms trading off paying households larger dividends or accumulating more capital

- Holmstrom-Tirole (1997) type of uncertainty in production process:
  - Two available project choices to produce output; both subject to idiosyncratic risk, differing with respect to their probabilities of success with $p^H$ in the case of project "good" and $p^L$ in the case of project "bad", where $p^L < p^H$
  
  - The incentive of the firm to choose project "bad" arising from some private benefits, PB, project "bad" yields to the firm

- Project outcome perfectly verifiable by the financial intermediary having the exclusive technology to do so

- Households and foreign lenders lacking this exclusive technology
Firms

A typical firm maximizing the expected infinite horizon discounted stream of dividends paid to households:

$$E_0 \left\{ \sum_{t=0}^{\infty} \beta^{t+1} \frac{F_t}{C_{t+1}P_{t+1}} \right\}$$

Three constraints faced by the firm:

1. The budget constraint:

$$\frac{F_t}{P_t} \leq p^H[L_t + P_tC_t - W_tN_t - R_{Ft}L_t]/P_t + (1 - p^H)[-\mu(1 - \delta)K_{t-1}r_K]$$

2. The borrowing constraint:

$$W_tN_t \leq L_t$$

3. The incentive constraint:

$$Y_t - \frac{R_{Ft}L_t}{P_t} \geq \frac{PB}{(p^H - p^L)P_t}$$
The production function of the firm given by

$$Y_t = K_{t-1}^\alpha (A_t N_t)^{1-\alpha}$$

where $A_t$ denoting technology, the shock process of which being a unit root with drift in the log of technology, given as

$$\ln A_t = \gamma + \ln A_{t-1} + \epsilon_{A,t}, \quad \epsilon_{A,t} \sim N(0, \sigma_A^2)$$

The law of motion of capital determining gross investment as follows:

$$K_t = p^H[l_t + (1 - \delta)K_{t-1}] + (1 - p^H)[(1 - \mu)(1 - \delta)K_{t-1}], \quad 0 < \delta < 1$$

where $\delta$ representing the constant physical depreciation rate of capital
Financial Intermediary

Financial intermediary maximizing the net present value of future dividends

\[ E_0 \left\{ \sum_{t=0}^{\infty} \beta^{t+1} \frac{B_t}{C_{t+1} P_{t+1}} \right\} \]

subject to the budget constraint

\[
\frac{B_t}{P_t} \leq \frac{X_t}{P_t} + [p^H R_{Ft} \frac{L_t}{P_t} + (1-p^H)\mu(1-\delta)K_{t-1}r_K] - (R_{Ht}-1) \frac{DD_t}{P_t} - (R^*-1) \frac{FD_t}{P_t^*} - \frac{L_t}{P_t}
\]

where \( FD_t \geq 0 \) denominated in foreign currency with \( P_t^* \) as the foreign price level

- Purchasing power parity (PPP) holding such that \( P_t = E_t P_t^* \), where \( E_t \) denoting the nominal exchange rate (the domestic currency value of one unit of the foreign currency)
Financial Intermediary

and to the balance sheet constraint

\[ D_t \leq X_t + L_t \]

where \( D_t = DD_t + FD_tE_t \) and \( FD_tE_t = \psi D_t, \quad DD_t = (1 - \psi)D_t \)

\( \psi \) as the parameter representing the degree of financial integration

Monetary injection during date \( t \) given by

\[ X_t = M_t - M_{t-1} \]

The exogenous stochastic process for the growth rate of the monetary injection as follows:

\[ lnm_t = (1 - \rho)lnm^* + \rho lnm_{t-1} + \epsilon_{M,t}, \quad \epsilon_{M,t} \sim N(0, \sigma^2_M) \]

where \( m_t = \frac{M_t}{M_{t-1}} \)
Foreign Lenders

- Foreign lenders preferring to lend firms through the financial intermediary rather than directly, due to their
  - lack of the exclusive technology to perfectly verify project outcomes of firms
  - limited familiarity with the domestic economy
- Foreign funds assumed to be supplied inelastically at a constant interest rate lower than the domestic loan rate
Market Clearance Conditions

- **Goods market**
  
  \[ C_t + I_t + NX_t = K_t^{\alpha} (A_t \cdot N_t)^{1-\alpha} \]
  
  with \( NX_t \) denoting net exports, the return on which being used for the net interest payment on foreign deposits:
  
  \[ P_t \cdot NX_t = (R^* - 1) \cdot FD_t \cdot E_t \]

- **Labor market**
  
  \[ N_t = H_t \]

- **Money market**
  
  \[ P_t \cdot C_t = M_{t-1} + X_t \]

- **Credit market**
  
  \[ D_t = X_t + L_t \]
Solution of the Model

- The system of equations consisting of first order conditions of agents’ optimization problems and market clearance conditions

- The model first made stationary so that it can be linearized around the steady-state and that it returns to the steady-state after a shock

- Stationarity satisfied through stochastic detrending of real variables with technology, $A$; nominal variables with money stock, $M$; and prices with the ratio of the two, $M/A$

- The model then linearized before it is simulated
System of Equations 1/2

\[(1 - \phi)(1 - N_t)\hat{L}_t = \phi \hat{P}_t \hat{C}_t N_t\]  
\(\text{(1)}\)

\[m_t \hat{C}_{t+1} \hat{P}_{t+1} = \beta R_{Ht} \hat{C}_t \hat{P}_t\]  
\(\text{(2)}\)

\[
\frac{\beta \hat{P}_{t+1} \left[ p^L a^{-\alpha} Z a_t^{-\alpha} + p^H (1 - \delta) / a_{t+1} - (1 - p^H) \mu (1 - \delta) a^2 Z a_{t+1}^{-\alpha}\right]}{\hat{C}_{t+2} \hat{P}_{t+2}} = \frac{m_{t+1} \hat{P}_t}{m_t \hat{C}_{t+1} \hat{P}_{t+1}} \\
\text{(3)}
\]

where \(Z = \hat{K}_{t}^{-\alpha} N_{t+1}^{1-\alpha}\)

\[R_{Ft} = \frac{\hat{P}_t \hat{K}_{t-1}^\alpha (1 - \alpha) a^{-\alpha} N_t^{-\alpha}}{\hat{W}_t}\]  
\(\text{(4)}\)

\[p^H R_{Ft} = (1 - \psi) R_{Ht} + \psi R^*\]  
\(\text{(5)}\)

\[\hat{W}_t N_t = \hat{L}_t\]  
\(\text{(6)}\)
System of Equations 2/2

\[ \hat{C}_t + \hat{I}_t + (R^* - 1)\psi(\hat{L}_t + m_t - 1)/\hat{P}_t = \hat{K}_{t-1}a_t^{-\alpha}N_t^{1-\alpha} \]  
(7)

\[ \hat{P}_t \hat{C}_t = m_t \]  
(8)

\[ \hat{D}\hat{D}_t = (1 - \psi)(m_t - 1 + \hat{L}_t) \]  
(9)

\[ \hat{Y}_t = \hat{K}_{t-1}a_t^{-\alpha}N_t^{1-\alpha} \]  
(10)

\[ \hat{I}_t = \hat{K}_t/p^H - (1 - \delta)\hat{K}_{t-1}/a_t - (1 - p^H)(1 - \delta)(1 - \mu)\hat{K}_{t-1}/a_tp^H \]  
(11)

\[ \hat{N}\hat{X}_t = (R^* - 1)\psi(\hat{L}_t + m_t - 1)/\hat{P}_t \]  
(12)
• Given the system of equations (1)-(12) and the shock processes, expected future paths of the variables \([Y_t, C_t, I_t, NX_t, P_t, DD_t, L_t, N_t, K_t, W_t, R_{Ft}, R_{Ht}]\) conditional on one-time, temporary money growth and technology shocks in period 1, obtained
Values assigned to the structural parameters of the model:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>capital share in the production function</td>
<td>0.32</td>
</tr>
<tr>
<td>$\beta$</td>
<td>time discount factor</td>
<td>0.99</td>
</tr>
<tr>
<td>$\phi$</td>
<td>parameter for disutility of labor</td>
<td>0.76</td>
</tr>
<tr>
<td>$\delta$</td>
<td>physical depreciation rate of capital</td>
<td>0.1</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>drift parameter in the technology process</td>
<td>0.003</td>
</tr>
<tr>
<td>$\rho$</td>
<td>persistence in the money growth process</td>
<td>0.7</td>
</tr>
</tbody>
</table>
Parameters 2/2

- For the success probability of project "bad", $p^L = 0.4$ used

- Fraction of the capital stock to be handed over by the firms to the FI in the case of failure assumed to be $\mu = 0.1$

- The unconditional mean of monetary injection growth taken as $m^* = 1.01$

- Parameters of interest:
  - The degree of financial integration $\psi = [0.01, 0.5, 0.99]$
  - The success probability of project "good" $p^H = [0.7, 0.8, 0.9]$
  - The gross interest rate on foreign deposits $R^* = [1.1, 1.01, 1.0001]$
Impulse Response Functions-1

Figure: Monetary Shock
Figure: Technology Shock
**Impulse Response Functions-3**

*Figure:* Monetary Shock with Varying Degrees of Financial Integration
Concluding Remarks

- Increasing financial integration amplifying the impact of temporary monetary shocks on most of the variables with output, labor demand and net exports exhibiting the greatest variation in response to the shock.

- Varying the degree of financial integration turning out to have hardly any implication for the effect of temporary technology shocks on the economy.

- The success probability of project "good" as well as the interest rate on foreign funds emerging to play crucial roles in the analyses due to their link to the degree of financial integration.
Appendix 1/4

Figure: Technology Shock with Varying Degrees of Financial Integration
Figure: Monetary Shock with Varying Degrees of Financial Integration ($\sigma_A = 0.006$, $\sigma_M = 0.002$)
Figure: Technology Shock with Varying Degrees of Financial Integration ($\sigma_A = 0.006$, $\sigma_M = 0.002$)
### TABLE A-1. Example of Scoring for United States, Sweden, and India Based on 1979 IMF Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Exchange Restrictions Text</th>
<th>Comments</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UNITED STATES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>The United States formally notified the Fund on December 10, 1946, that it was prepared to accept the obligations of Article VIII, Sections 2, 3, and 4, of the Fund Agreement (p. 423).</td>
<td>One point assigned on basis of Article VIII status.</td>
<td>1.0</td>
</tr>
<tr>
<td>Current:</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Payment for</td>
<td>There are no restrictions on foreign payments, except those imposed for security reasons. . . Imports of Cuban, Kampuchea, North Korean, and Vietnamese origin are prohibited under Treasury regulations, unless specifically licensed. Imports of petroleum and petroleum products from Iran are prohibited (p. 423).</td>
<td>Essentially free. A few agricultural commodities and products from some Communist countries are restricted.</td>
<td>2.0</td>
</tr>
<tr>
<td>Imports</td>
<td>Payments and transfers abroad may be made freely, except for payments to or for the account of the authorities, instrumentalities, or controlled entities of Iran, . . . Cuba, Democratic Kampuchea, North Korea, and Vietnam (p. 424).</td>
<td>Free.</td>
<td>2.0</td>
</tr>
<tr>
<td>Capital:</td>
<td>Incoming or outgoing capital payments by residents or non-residents are not subject to exchange controls. In addition, inward and outward direct or portfolio investment is generally free of any other form of approval (p. 424).</td>
<td>Free.</td>
<td>2.0</td>
</tr>
<tr>
<td>Payment</td>
<td>The proceeds of exports are not subject to exchange controls. . . Under the authority of the Export Administration Act of 1979, the President can suspend the export of goods for reasons of national security, foreign policy, or short supply in the domestic economy, although every effort is made to make sparing use of such authority (p. 424).</td>
<td>Essentially free.</td>
<td>2.0</td>
</tr>
<tr>
<td>Current:</td>
<td>Payments and transfers abroad may be made freely, except for payments to or for the account of the authorities, instrumentalities, or controlled entities of Iran, . . . Cuba, Democratic Kampuchea, North Korea, and Vietnam (p. 424).</td>
<td>Free.</td>
<td>2.0</td>
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<tr>
<td>Receipts for</td>
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<tr>
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<tr>
<td>Invisibles</td>
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<tr>
<td>Capital:</td>
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</tr>
<tr>
<td>Receipts</td>
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<tr>
<td><strong>SWEDEN</strong></td>
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<tr>
<td>Agree</td>
<td>Sweden formally accepted the obligations of Article VII, Sections 2, 3, and 4, of the Fund Agreement, as from February 15, 1961 (p. 382).</td>
<td>One point assigned on basis of Article VII status: 0.5 point for membership in European Free Trade Association (EFAT).</td>
<td>1.5</td>
</tr>
<tr>
<td>Current:</td>
<td>With the exception of some agricultural and fishery products, practically all goods are free from quantitative restriction and import licensing . . . Payments for imports, including normal advance payments, may, as current payments, be made without permission through authorized banks and without the formality of presenting an import license (p. 383).</td>
<td>Essentially free.</td>
<td>2.0</td>
</tr>
<tr>
<td>Payment for</td>
<td>Persons domiciled in Sweden may make (current payments) without restriction in favor of persons domiciled abroad. The payments must be made through authorized banks in order to ensure that capital payments are not made in the guise of current payments. . . The export by travelers of Swedish banknotes in denominations larger than Skr 100 is prohibited . . . No traveler</td>
<td>Mostly free. Approval process exists to verify transactions and to prevent capital restrictions from being</td>
<td>1.5</td>
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<tr>
<td>Imports</td>
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