Non-Fundamental Dynamics and Financial Markets Integration

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Financial Integration and Asset Prices: Two Stylized Facts
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- increase in financial markets integration since mid-1990's
Financial Integration and Asset Prices: Two Stylized Facts

Chinn-Ito Index of Capital Account Openness
increase in financial markets integration since mid-1990's
Financial Integration and Asset Prices: Two Stylized Facts

- increase in financial markets integration since mid-1990's
- major bubble-like fluctuations in asset prices in advanced economies
Financial Integration and Asset Prices: Two Stylized Facts

US Stocks, US Real Estate and Gold
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this paper: theoretical model that can predict 2 from 1
Financial Integration and Asset Prices: This Paper
Financial Integration and Asset Prices: This Paper

Framework

- two-region global equilibrium model
- heterogeneous financial development
- financial investors' sentiments
Financial Integration and Asset Prices: This Paper

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predictions

- in financial autarky sentiments remain “dormant”
- under financial integration sentiments can drive fluctuations
Financial Integration and Asset Prices: This Paper

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- under financial integration sentiments can drive fluctuations

key mechanism: non-monotonic impact of financial development
Related Literature

financial globalization and macroeconomic volatility

- Kose, Prasad, Rogoff and Wei (*HDE*, 2009)

more closely related

- Tirole (*ECMA*, 1985), Martin and Ventura (*AER*, 2012)
- Caballero, Farhi and Gourinchas (*AER*, 2008)
Plan of the Talk

i the model and equilibrium

ii closed economy

iii global economy
The Model: Basics

neoclassical growth model with overlapping generations
neoclassical growth model with overlapping generations

- 3 generations: young, adult and old, each of measure 1
- consumption linearly valued only when old, $E_{it-1}(c_{it+1})$
- output technology
  \[ y_t = k_t^\alpha \ell_t^{1-\alpha}, \quad \alpha \in (0, 1) \]
- capital fully depreciates after production
- factors are paid at marginal return, unitary prices $R^k_t$ and $w_t$
- young supply 1 unit of labor inelastically, adult and old do not work
The Model: Basics

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- capital fully depreciates after production
- factors are paid at marginal return, unitary prices $R_t^k$ and $w_t$
- young supply 1 unit of labor inelastically, adult and old do not work
- young and adult can invest output at $t$ in production of $t + 1$ capital
  \[ k_{it+1} = A_{it+1} x_{it} \]
- $A_{it+1}$ productivity specific to investing agent $i$
- young and adult can deposit output with an intermediary with return $R_t^d$
The Model: Invest or Deposit Decision

$t - 1$  $t$  $t + 1$
The Model: Invest or Deposit Decision

$t - 1$  \hspace{1cm}  t  \hspace{1cm}  t + 1$

\[ \ldots \]

young
The Model: Invest or Deposit Decision

\[ t - 1 \rightarrow t \rightarrow t + 1 \]

- young
  - invest: \( A_{it} R_t^k \)
  - deposit: \( R_t^d \)
The Model: Invest or Deposit Decision

The model considers an individual's decision between investing or depositing at three points in time: $t-1$, $t$, and $t+1$. For a young individual at time $t$, the decision is influenced by the following equations:

- **Invest:** $A_{it} R_t^k$
- **Deposit:** $R_t^d$

Where $A_{it} = a$.
The Model: Invest or Deposit Decision

$t - 1$  \hspace{2cm} $t$  \hspace{2cm} $t + 1$

**young**  

\[ A_{it} R^k_t \]

\[ [A_{it} = a] \]

**adult**  

\[ R^d_t \]
The Model: Invest or Deposit Decision

$t - 1$  

young  

invest: $A_i t R_k^t$  

$[A_i t = a]$  

deposit: $R_d^t$

$t$  

adult  

invest: $A_i t + 1 R_k^{t+1}$

deposit: $R_d^{t+1}$

$t + 1$
The Model: Invest or Deposit Decision

\[ t - 1 \quad \quad t \quad \quad t + 1 \]

- **young**
  - invest: \( A_{it}R_t^k \)
  - deposit: \( R_t^d \)

- **adult**
  - investigate: \( A_{it+1}R_{t+1}^k \)
  - deposit: \( R_{t+1}^d \)

\[ [A_{it} = a] \quad [A_{it+1} \sim G(a, \bar{a})] \]
The Model: Invest or Deposit Decision

\[ A_{it} R_t^k \quad \text{invest: } \]
\[ A_{it+1} R_{t+1}^k \quad \text{invest: } \]
\[ R_t^d \quad \text{deposit: } \]
\[ R_{t+1}^d \quad \text{deposit: } \]

\[ A_{it} = a \quad \text{[young]} \]
\[ A_{it+1} \sim G(a, \bar{a}) \quad \text{[old: consume]} \]
The Model: Invest or Deposit Decision

\[ t - 1 \quad \rightarrow \quad t \quad \rightarrow \quad t + 1 \]

**young**
- invest: \( A_{it} R_t^k \)
- deposit: \( R_t^d \)

\[ [A_{it} = a] \]

**adult**
- invest: \( A_{it+1} R_{t+1}^k \)
- deposit: \( R_{t+1}^d \)

\[ [A_{it+1} \sim G(a, \bar{a})] \]

**old**: consume

let \( \rho \equiv R^d / R^k \), then if \( A_i \geq \rho \) invest, deposit otherwise
The Model: Invest or Deposit Decision

\[t-1\]  \hspace{2cm} \[t\]  \hspace{2cm} \[t+1\]

- **young**: Invest: \(A_{it}R^k_t\)
  - Deposit: \(R^d_t\)

- **adult**: Invest: \(A_{it+1}R^k_{t+1}\)
  - Deposit: \(R^d_{t+1}\)

- **old**: Consume

let \(\rho \equiv \frac{R^d}{R^k}\), then if \(A_i \geq \rho\) invest, deposit otherwise

**Example.** Suppose \(\rho_t > \overline{a}\) and \(\rho_{t+1} > \overline{a}\)

- **young**: Deposit
- **adult**: Invest: \(1 - G(\rho_{t+1})\)
  - Deposit: \(G(\rho_{t+1})\)
- **old**: Consume
The Model: Financial Friction
The Model: Financial Friction

- investing agent \( i \) at \( t \) can borrow amount \( l_{it+1} \), at gross interest rate \( R_{t+1}^f \)

- limited pledgeability of capital investment income

\[
l_{it+1} R_{t+1}^f \leq \theta R_{t+1}^k k_{it+1} \quad \text{where} \quad \theta \in [0, 1]
\]

[microfoundation: moral hazard problem, Holmstrom and Tirole (2010)]
The Model: Financial Intermediation
The Model: Financial Intermediation

representative intermediary, operating under price-taking and zero-profit

- issue one-period deposit contracts $d_t$, return $R_{t+1}^d$
- extend one-period loans $l_t$, return $R_{t+1}^f$

in equilibrium $R_{t+1}^f = R_{t+1}^d$ and intermediary balance sheet

$$l_t = d_t$$
The Model: Aggregate Leverage
The Model: Aggregate Leverage

- linear investment technology implies investing agents borrow to the limit
- aggregate capital produced by investing adults

\[ k_{t+1} = \rho_{t+1}U(\rho_{t+1})w_t^A \]

- where \( U \) is “leverage function”

\[ U(\rho) \equiv \int_{A \geq \rho} \frac{A}{\rho} \frac{1}{1 - \theta \frac{A}{\rho}} dG \]

features of \( U \): decreasing in \( \rho \), increasing in \( \theta \), non-linear in \( A \)
The Model: Pledgeability, Productivity and Leverage

leverage

pledgeability $\theta$

high productivity investors

low productivity investors
The Model: Fundamental Equilibrium
The Model: Fundamental Equilibrium

\[
\rho_{t+1} d_t = \bar{a} \\
\bar{a} = \theta U(\rho_{t+1}) \\
\rho = G(\rho_{t+1})
\]

asset demand \((d_t = G(\rho_{t+1}))\)

asset supply \((l_t = \theta U(\rho_{t+1}))\)
The Model: Fundamental Equilibrium with low θ

\[ \rho_{t+1} = \bar{a} \] [economy has severe asset supply "shortage"]

asset demand \( d_t = G(\rho_{t+1}) \)

asset supply \( l_t = \theta U(\rho_{t+1}) \)
The Model: Introducing the Non-Fundamental Asset $b_t$
The Model: Introducing the Non-Fundamental Asset $b_t$

- intermediary can trade on a “non-fundamental” asset with value $b_t$
- supply of asset is fixed (or out of control of agents and intermediary)
- return on asset is from capital gain
  \[ R_{t+1}^b = \frac{E_t(b_{t+1})}{b_t} \]
- intermediary balance sheet
  \[ b_t + l_t = d_t \]
- $b_t$ is purchased by current depositors and sold to future depositors
- conditions to hold $b_t$: **competitive** return, **affordable** to future depositors
The Model: Non-Fundamental Asset, Crowding-out and Crowding-in

existence of $b_t$ asset operates transfer of funds (completes markets)

- **crowding-out**: low productivity investors (young) turn depositors
- **crowding-in**: high productivity investors (adult) have more internal funds
Stationary Stochastic Equilibrium
define

\[ z_t \equiv \frac{b_t}{W_t} \]
Stationary Stochastic Equilibrium

define

\[ z_t \equiv \frac{b_t}{W_t} \]

focus on Stationary Stochastic Equilibrium (SSE)

\[ \rho^*, z^* > 0 \]

[similar to Weil (1987), Kocherlakota (2009), Farhi and Tirole (2011)]
Non-Fundamental Equilibrium in the Closed Economy

Proposition

A SSE of the closed economy \((\rho^*, z^*)\) is the solution to

\[
\alpha = (1 - \alpha) \bar{U}_\theta(\rho^*), \quad \text{(U)}
\]

\[
z^* = \frac{1}{2} \left[ G(\rho^*) - \theta \frac{\alpha}{1 - \alpha} \right] > 0. \quad \text{(Z)}
\]
Non-Fundamental Equilibrium in the Closed Economy

Proposition

A SSE of the closed economy \((\rho^*, z^*)\) is the solution to

\[\alpha = (1 - \alpha)U_\theta(\rho^*),\]  \hspace{1cm} (U)

\[z^* = \frac{1}{2} \left[ G(\rho^*) - \theta \frac{\alpha}{1 - \alpha} \right] > 0.\]  \hspace{1cm} (Z)

how do (U) and (Z) depend on degree of pledgeability \(\theta\)?
Degree of Pledgeability $\theta$ and Existence of SSE
Degree of Pledgeability $\theta$ and Existence of SSE

sufficient condition for non-existence of SSE when $\theta = 0$

$$\alpha > (1 - \alpha)U_0(a)$$
sufficient condition for non-existence of SSE when $\theta = 0$

$$\alpha > (1 - \alpha)U_0(a)$$

increase $\theta > 0$, existence condition (U) eventually met

$$\alpha = (1 - \alpha)U_\theta(\rho^*)$$
Degree of Pledgeability $\theta$ and Existence of SSE

sufficient condition for non-existence of SSE when $\theta = 0$

\[
\alpha > (1 - \alpha)U_0(a)
\]

increase $\theta > 0$, existence condition (U) eventually met

\[
\alpha = (1 - \alpha)U_{\theta}(\rho^*)
\]

for $z^* > 0$ at $\rho^*$ there must be a *fundamental asset supply shortage*

\[
z^* = \frac{1}{2} \left[ G(\rho^*) - \theta \frac{\alpha}{1 - \alpha} \right] > 0 \quad (Z)
\]
sufficient condition for non-existence of SSE when $\theta = 0$

$$\alpha > (1 - \alpha)U_0(\alpha)$$

increase $\theta > 0$, existence condition (U) eventually met

$$\alpha = (1 - \alpha)U_\theta(\rho^*)$$

for $z^* > 0$ at $\rho^*$ there must be a *fundamental asset supply shortage*

$$z^* = \frac{1}{2} \left[ G(\rho^*) - \theta \frac{\alpha}{1 - \alpha} \right] > 0 \quad (Z)$$

as $\theta$ gets bigger, (Z) eventually violated
Degree of Pledgeability $\theta$ and Existence of SSE

recall $l_\theta(\rho) = \theta U(\rho)$
Degree of Pledgeability $\theta$ and Existence of SSE

Recall $l_\theta(\rho) = \theta U(\rho)$
Degree of Pledgeability $\theta$ and Existence of SSE

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Degree of Pledgeability $\theta$ and Existence of SSE

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Degree of Pledgeability $\theta$ and Existence of SSE

recall $l_\theta(\rho) = \theta U(\rho)$
Corollary

*Equilibria with non-fundamental dynamics, $b_t > 0$ ($z_t > 0$), are possible for intermediate values of the degree of pledgeability $\theta$.***
Global Economy
Global Economy

global equilibrium, two regions, North and South
- financial capital free to move
- physical capital must be used where produced
- output good free to move
- agents cannot move
global equilibrium, two regions, North and South

- financial capital free to move
- physical capital must be used where produced
- output good free to move
- agents cannot move

pledgeability of investment income

- autarky: North region $\theta$, South region $\tilde{\theta} \approx 0$
- financial integration:
  
  $\phi$ fraction of North pledgeability now possible for South investors

  $\tilde{\theta} = \phi \theta$
express variables in terms of wealth in North $W_t$

$$z_t^* \equiv \frac{b_t^*}{W_t}$$

relative size of wealth across regions

$$v_t = \frac{\tilde{W}_t}{W_t}$$

relative return on physical capital

$$q_{t+1} \equiv \frac{R_{t+1}^k}{\tilde{R}_{t+1}^k}$$
Corollary

*A GSSE of the global economy \((\rho^*, q^*, z^*, v^*)\) is the solution to*

\[
U_\theta(\rho^*) = \frac{\alpha}{1 - \alpha}, \quad (U)
\]

\[
U_\phi\theta(q^* \rho^*) = \frac{\alpha}{1 - \alpha}, \quad (U')
\]

\[
z^* = \frac{1}{2} \left[ G(\rho^*) + v^* [G(q^* \rho^*)] - \theta \frac{\alpha}{1 - \alpha} (1 + \phi v^*) \right] > 0, \quad (Z)
\]

*with \(v^* = q^* \frac{\alpha}{1 - \alpha} \).
can a GSSE exist when no SSE’s exist for the two regions in autarky?
Non-Fundamental Equilibrium in the Global Economy

can a GSSE exist when no SSE’s exist for the two regions in autarky?

Suppose:
can a GSSE exist when no SSE’s exist for the two regions in autarky?

Suppose:

no SSE in South, due to limited leveraging potential

\[ \alpha > (1 - \alpha)U_0(a) \]
can a GSSE exist when no SSE’s exist for the two regions in autarky?

Suppose:

no SSE in South, due to limited leveraging potential

\[ \alpha > (1 - \alpha)U_0(a) \]

no SSE in North, due to sufficient fundamental asset supply

\[ G(\rho^*) \leq \theta \frac{\alpha}{1 - \alpha} \quad \text{for} \quad \rho^* : U_\theta(\rho^*) = \frac{\alpha}{1 - \alpha} \]
Non-Fundamental Equilibrium in the Global Economy

$\rho_d, \rho_l$

North

$\frac{\alpha}{1-\alpha} \theta$

$d(\rho)$

South

$\frac{\alpha}{1-\alpha} \tilde{\theta}$

$\tilde{d}(\tilde{\rho})$

$a_a$

$1, d(\rho^*)$

$d, l$

$l_\theta(a)$

$v$

$\tilde{a}$

$\tilde{d}, \tilde{l}$
Non-Fundamental Equilibrium in the Global Economy

\[ \rho^{\ast} = \frac{\alpha}{1-\alpha} \theta \]

\[ \tilde{\rho} = \frac{\alpha}{1-\alpha} \tilde{\theta} \]

North

South
Non-Fundamental Equilibrium in the Global Economy

\[ \rho, \theta, d, l \]

\[ \bar{\rho}, \bar{\theta}, \bar{d}, \bar{l} \]

\[ l_\theta(\rho) \]

\[ d(\rho) \]

\[ l_\bar{\theta}(\bar{\rho}) \]

\[ \bar{d}(\bar{\rho}) \]

\[ \rho^* \]

\[ \alpha \frac{\theta}{1 - \alpha} \]

\[ \alpha \frac{\tilde{\theta}}{1 - \alpha} \phi \theta \]

\[ \alpha \frac{\theta}{1 - \alpha} \]

\[ \alpha \frac{\tilde{\theta}}{1 - \alpha} \phi \theta \]

\[ \rho, d, l \]

\[ \bar{\rho}, \bar{\theta}, \bar{d}, \bar{l} \]
Non-Fundamental Equilibrium in the Global Economy

$$\rho$$  \hspace{1cm} \bar{a}  \hspace{1cm} \tilde{\rho}$$

North

$$l_\theta(\rho)$$  \hspace{1cm} \frac{\alpha}{1-\alpha} \theta  \hspace{1cm} d(\rho)$$

South

$$l_{\tilde{\theta}}$$  \hspace{1cm} \frac{\alpha}{1-\alpha} \tilde{\theta}  \hspace{1cm} \frac{\alpha}{1-\alpha} \phi \theta$$
Corollary

*Suppose that in autarky equilibria with Non-Fundamental Dynamics are not possible in both the North and South regions.*

*Equilibria with Non-Fundamental Dynamics are possible when financial markets integrate if*

- the North region is “close” to asset supply shortage ($l^*$ small)
- financial integration results in an intermediate increase in the degree of pledgeability for the South region ($\phi$ intermediate).
global equilibrium model with investors’ sentiment shocks
Summary

- global equilibrium model with investors’ sentiment shocks
- relevance of shocks depends non-monotonically on financial development
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next: risk considerations in intermediary portfolio allocation
Measures of Financial Integration

Chinn-Ito Index of Capital Account Openness
Asset Prices in Advanced Economies

US Stocks, US Real Estate and Gold
Interpretation of Non-Fundamental Asset
Interpretation of Non-Fundamental Asset

- capital investment and next period production done by “entrepreneurs”
- to become entrepreneurs agents must purchase an “empty firm” in the stock market
- if adult agent \(i\) purchases a firm at price \(b_t^i\) she can borrow up to \(b_t^i\) plus the pledgeable income
- after production the intermediary seizes the pledgeable income plus the empty firm from entrepreneur \(i\)
- the intermediary sells the empty firms to next period entrepreneurs in the stock market
- in the end, because adult can borrow entirely against purchased empty firm, depositors are those holding the non-fundamental value of the empty firm through the intermediary
Equilibrium: Recursive Representation

variables in terms of wealth in the economy at the end of time $t$

$$W_t = w_t + w_t^A,$$

$$n_t \equiv \frac{w_t^A}{W_t},$$

$$z_t \equiv \frac{b_t}{W_t}.$$  

wealth of adult at $t+1$ in terms of wealth at $t$

$$1 - n_t$$

wealth of young at $t+1$ in terms of wealth at $t$

$$\frac{1 - \alpha}{\alpha} U_\theta(\rho_{t+1}) n_t$$
Proposition

The non-negative stochastic process \( \{z_t\}_{t=0}^{\infty} \) and the sequence \( \{n_t, \rho_{t+1}\}_{t=0}^{\infty} \), are an equilibrium if

(a) expected return of non-fundamental asset

\[
E_t(z_{t+1}) = \frac{z_t}{1 - n_t + \frac{1-\alpha}{\alpha} U_\theta(\rho_{t+1}) n_t}
\]

(b) asset market clearing

\[
\theta U_\theta(\rho_{t+1}) n_t + z_t = 1 - n_t + n_t G(\rho_{t+1})
\]

(c) intergenerational wealth distribution

\[
n_{t+1} = \frac{1 - n_t}{1 - n_t + \frac{1-\alpha}{\alpha} U_\theta(\rho_{t+1}) n_t}
\]
numerical simulation of non-fundamental dynamics in global economy
numerical simulation of non-fundamental dynamics in global economy

- distribution $G$ is Uniform in $[a, \bar{a}]$
- parameters: $\alpha = .73$, $a = .5$, $\bar{a} = 1.5$, $\theta = .36$, $\phi = .6$
- non-fundamental state: $p = .15$ and $r = .05$
- new asset supply: $z^A_t = 0.002$ and $\tilde{z}^A_t = 0.001$ when $\omega_t = NF$
- no SSE in autarky, GSSE is $z^* = .08$
- allocation of non-fundamental risk on deposits: $\mu = .5$, $\varphi = \tilde{\varphi} = .5$

Caveats:

agents do not take probability of non-fundamental asset creation into account

One specific realization of investors’ sentiments shocks reported
Non-Fundamental Equilibrium: Numerical Simulation

- Non Fundamental Asset
- Trade Balance North
- Output North
- Output South
- Consumption North
- Consumption South
- Financial Interest Rate
- Capital Return Differential