

*The complexity of financial crisis in a long-period  
perspective: facts, theory and models*  
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FINANCIAL FRAGILITY IN A MACRO MODEL  
À LA MINSKY WITH REGIME SWITCHING

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# Outline of the Presentation



- Background and Motivations
- Objectives and Methodology
- The Model
- Results
- Conclusions and Perspectives

# Background and Motivation



# Objectives and Methodology

## □ **Targets:**

- Evaluation of present evolution of the economy
- insert the Minskian “triad” (hedge, speculative and Ponzi units) into a macroeconomic context where there is a sharp distinction between a solvent regime and a crisis regime

## ■ **Novelty of the approach with respect to Minsky :**

- Dynamic setting with regime-switching (ideally similar to Minsky’s ceilings and floors); the dynamic properties of the model depend on what happens:
  - Within each state;
  - Between the two states;
  - Time spent in each regime.
- Financial instability introduced by means of a particular aggregate investment function

# Objectives and Methodology

- Technical features of the model:
  - Dynamic model where AD is integrated with AS
    - AD where Investment is affected by debt
  - Boundedly rational agents
    - Learning in order to make forecasts
  - Stochastic component introduced through threshold
    - Complex dynamics hence need to deal with simulations
- These phenomena are compatible with:
  - Endogenous cycles (due to expectations and financial variables)
  - Run-away dynamics (run-away inflation, debt deflation...)
  - Extreme events and fundamental uncertainty

# The Minskian Triad



# The Macro Threshold

Solvency condition (stocks):  $PR_{t-1} > R_{t-1}D_{t-1}$

Debt ratio:  $d_t = \frac{D_t}{P_{t-1}Y_{t-1}}$

Solvency condition (flows):  $(1 + g_{t-1})(1 + \pi_{t-1}) > \frac{R_{t-1}d_{t-1}}{(1 - \omega_{t-1})}$

Crisis Regime

Solvent Regime

$$(1 + \bar{E}_t g_{t+1})(1 + \bar{E}_t \pi_{t+1}) > \frac{R_{t-1}d_{t-1}}{(1 - \omega_{t-1})} + \varepsilon_t$$

# The Model

$$R_t = R_j^* + \psi_1 (\bar{E}_t \pi_{t+1} - \pi_{0j}) - \psi_2 (\bar{E}_t g_{t+1} - g_{0j})$$

$$d_t = \frac{d_{t-1} (1 + R_{t-1})}{(1 + g_{t-1})(1 + \pi_{t-1})} + \frac{i_{t-1}}{(1 + g_{t-1})} - (1 - \omega_{0j}^*)$$

$$r_t = \frac{(1 + R_t)}{(1 + \bar{E}_t \pi_{t+1})} - 1$$

$$i_t = \eta_1 + \eta_{2j} (1 - \omega_{0j}^*) (1 + \bar{E}_t g_{t+1}) - \eta_{2j} \frac{R_{tdt}}{(1 + \bar{E}_t \pi_{t+1})} - \eta_{3j} r_t + \eta_{4j} \bar{E}_t g_{t+1}$$

$$g_t = i_t + c_1 (1 + \bar{E}_t g_{t+1}) + c_2 - 1$$

$$\tau_t = \tau_{1j} + \tau_{2j} i_t$$

$$l_t = l_{t-1} \frac{(1 + g_t)}{(1 + \tau_t)}$$

$$u_t = 1 - l_t$$

$$\pi_t = \phi_1 \bar{E}_t \pi_{t+1} - \sigma_1 (u_t - u_{0j}^*) + (1 - \phi_1) \pi_{t-1}$$

# The Model: crisis regime (1)

$$R_t = R_1^* + \psi_1 (\bar{E}_t \pi_{t+1} - \pi_{01}) - \psi_2 (\bar{E}_t g_{t+1} - g_{01})$$

$$d_t = \frac{d_{t-1} (1 + R_{t-1})}{(1 + g_{t-1})(1 + \pi_{t-1})} + \frac{i_{t-1}}{(1 + g_{t-1})} - (1 - \omega_{01}^*)$$

$$r_t = \frac{(1 + R_t)}{(1 + \bar{E}_t \pi_{t+1})} - 1$$

$$i_t = \eta_1 - \eta_3 r_t$$

$$g_t = i_t + c_1 (1 + \bar{E}_t g_{t+1}) + c_2 - 1$$

$$\tau_t = \tau_{11} + \tau_2 i_t$$

$$l_t = l_{t-1} \frac{(1 + g_t)}{(1 + \tau_t)}$$

$$u_t = 1 - l_t$$

$$\pi_t = \phi_1 \bar{E}_t \pi_{t+1} - \sigma_1 (u_t - u_{01}^*) + (1 - \phi_1) \pi_{t-1}$$

## The Model: solvent regime (2)

$$R_t = R_2^* + \psi_1 (\bar{E}_t \pi_{t+1} - \pi_{02}) - \psi_2 (\bar{E}_t g_{t+1} - g_{02})$$

$$d_t = \frac{d_{t-1}(1 + R_{t-1})}{(1 + g_{t-1})(1 + \pi_{t-1})} + \frac{i_{t-1}}{(1 + g_{t-1})} - (1 - \omega_{02}^*)$$

$$r_t = \frac{(1 + R_t)}{(1 + \bar{E}_t \pi_{t+1})} - 1$$

$$i_t = \eta_1 + \eta_2 (1 - \omega_{0j}^*) (1 + \bar{E}_t g_{t+1}) - \eta_2 \frac{R_t dt}{(1 + \bar{E}_t \pi_{t+1})} + \eta_4 \bar{E}_t g_{t+1}$$

$$g_t = i_t + c_1 (1 + \bar{E}_t g_{t+1}) + c_2 - 1$$

$$\tau_t = \tau_{12} + \tau_2 i_t$$

$$l_t = l_{t-1} \frac{(1 + g_t)}{(1 + \tau_t)}$$

$$u_t = 1 - l_t$$

$$\pi_t = \varphi_1 \bar{E}_t \pi_{t+1} - \sigma_1 (u_t - u_{02}^*) + (1 - \varphi_1) \pi_{t-1}$$

# The Steady States

## Crisis Regime

$$g_{01} = \frac{(c_1 + c_2 - 1)\tau_2 - \tau_{11}}{(1 - c_1)\tau_2 - 1} = 0.0218$$

$$i_{01} = \frac{g_{01} - \tau_{11}}{\tau_2} = 0.208$$

$$\tau_{01} = \tau_{11} + \tau_2 i_{01} = 0.0218$$

$$d_{01} = \frac{i_{01} - (1 + g_{01})(1 - \omega_{01}^*)}{g_{01} - r_{01}} = 0.65$$

$$\pi_{01} = \left[ \frac{1 + R_{01}}{1 + r_{01}} \right] - 1 = 0.0392$$

## Solvent Regime

$$g_{02} = \frac{(c_1 + c_2 - 1)\tau_2 - \tau_{12}}{(1 - c_1)\tau_2 - 1} = 0.042$$

$$i_{02} = \frac{g_{02} - \tau_{12}}{\tau_2} = 0.22$$

$$\tau_{02} = \tau_{12} + \tau_2 i_{02} = 0.042$$

$$d_{02} = \frac{i_{02} - (1 + g_{02})(1 - \omega_{02}^*)}{g_{02} - r_{02}} = 0.53$$

$$\pi_{02} = \left[ \frac{1 + R_{02}}{1 + r_{02}} \right] - 1 = 0.0751$$

# Expectations

Individual forecast:

$$\bar{E}_t^{opt} g_{t+1} = g_{02}$$

$$\bar{E}_t^{pess} g_{t+1} = g_{01}$$

$$\bar{E}_t \pi_{t+1} = \pi_{01}$$

$$\bar{E}_t \pi_{t+1} = \pi_{02}$$

If regime 1

If regime 2

Market forecast:

$$\bar{E}_t g_{t+1} = \alpha_{opt,t} \bar{E}_t^{opt} g_{t+1} + \alpha_{pess,t} \bar{E}_t^{pess} g_{t+1}$$

$$\alpha_{opt,t} + \alpha_{pess,t} = 1$$

Selection mechanism:

$$U_{opt,t} = -\sum_{k=1}^{\infty} \chi_k \left[ g_{t-k} - \bar{E}_{t-k-1}^{opt} g_{t-k} \right]^2$$

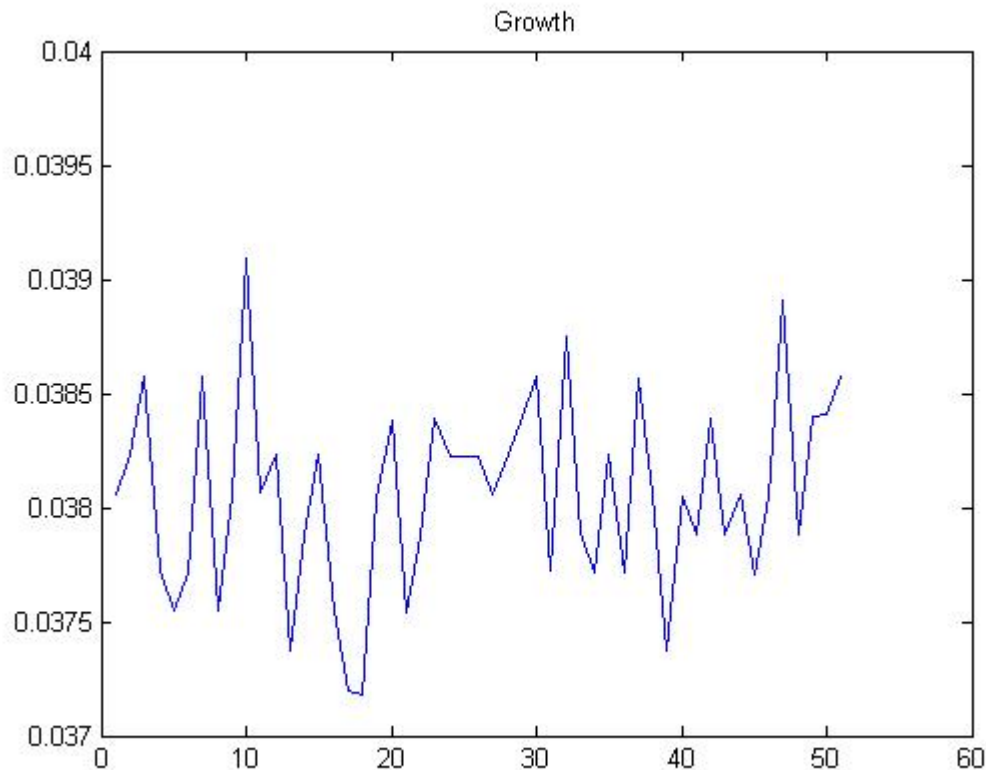
$$U_{pess,t} = -\sum_{k=1}^{\infty} \chi_k \left[ g_{t-k} - \bar{E}_{t-k-1}^{pess} g_{t-k} \right]^2$$

Proportions:

$$\alpha_{opt,t} = \frac{\exp(\gamma U_{opt,t})}{\exp(\gamma U_{opt,t}) + \exp(\gamma U_{pess,t})}$$

$$\alpha_{pess,t} = \frac{\exp(\gamma U_{pess,t})}{\exp(\gamma U_{opt,t}) + \exp(\gamma U_{pess,t})}$$

# The Dynamics of the Model



|                       |                                   |                   |
|-----------------------|-----------------------------------|-------------------|
| $u_{01}^* = 0.05$     | $\phi_1 = 0.70$                   | $\sigma_1 = 0.02$ |
| $u_{02}^* = 0.03$     |                                   |                   |
| $\tau_{11} = 0.001$   | $\tau_2 = 0.10$                   | $\eta_1 = 0.201$  |
| $\tau_{12} = 0.02$    |                                   |                   |
| $\eta_{21} = 0$       | $\eta_{31} = 0.3$ $\eta_{32} = 0$ | $c_1 = 0.40$      |
| $\eta_{22} = 0.1$     | $\eta_{41} = 0$ $\eta_{42} = 0.3$ |                   |
| $c_2 = 0.405$         | $\psi_1 = 2.50$                   | $\psi_2 = 0.8$    |
| $\omega_{01} = 0.825$ | $R_1^* = 0.015$                   | $N = 500$         |
| $\omega_{02} = 0.8$   | $R_2^* = 0.08$                    |                   |

# Conclusions and Perspectives

- The model shows persistent fluctuations that do not explode but remain bounded. The switching of the economy is therefore persistent.
- Sources of the result:
  - ▣ Presence and nature of the two regimes
  - ▣ Interdependence (organic/complex) nature of the model
  - ▣ Role of financial factors
  - ▣ Value of the threshold
  - ▣ Type of expectations
  - ▣ Not necessarily policy driven (robustness to changes in Taylor rule)

# Conclusions and Perspectives

Ways towards further developments:

- Improve theoretical justification of equations
  - ▣ Especially find a way to deal with “fundamental” uncertainty
- Integrate liquidity constraints and deeper foundation of financial sector
- Improve formal aspects of the model
  - ▣ More attention to the role of heterogeneity

Main open question:

- Model fit to data

# The Steady States

## Crisis Regime

$$g_{01} = \frac{(c_1 + c_2 - 1)\tau_2 - \tau_{11}}{(1 - c_1)\tau_2 - 1} = 0.0218$$

$$i_{01} = \frac{g_{01} - \tau_{11}}{\tau_2} = 0.208$$

$$\tau_{01} = \tau_{11} + \tau_2 i_{01} = 0.0218$$

$$r_{01} = \frac{\eta_1 - i_{01}}{\eta_3} = -0.023$$

$$d_{01} = \frac{i_{01} - (1 + g_{01})(1 - \omega_{01}^*)}{g_{01} - r_{01}} = 0.65$$

$$u_{01} = u_{01}^* = 0.05$$

$$R_{01} = R_1^* = 0.015$$

$$\pi_{01} = [(1 + R_{01}) / (1 + r_{01})] - 1 = 0.0392$$

## Solvent Regime

$$g_{02} = \frac{(c_1 + c_2 - 1)\tau_2 - \tau_{12}}{(1 - c_1)\tau_2 - 1} = 0.042$$

$$i_{02} = \frac{g_{02} - \tau_{12}}{\tau_2} = 0.22$$

$$\tau_{02} = \tau_{12} + \tau_2 i_{02} = 0.042$$

$$r_{02} = \frac{Dg_{02} - B}{B + D} = \text{?????}$$

$$d_{02} = \frac{i_{02} - (1 + g_{02})(1 - \omega_{02}^*)}{g_{02} - r_{02}} = 0.53$$

$$u_{02} = u_{02}^* = 0.03$$

$$R_{02} = R_2^* = 0.08$$

$$\pi_{02} = [(1 + R_{02}) / (1 + r_{02})] - 1 = 0.0751$$