The Great Recession: A Self-Fulfilling Global Panic

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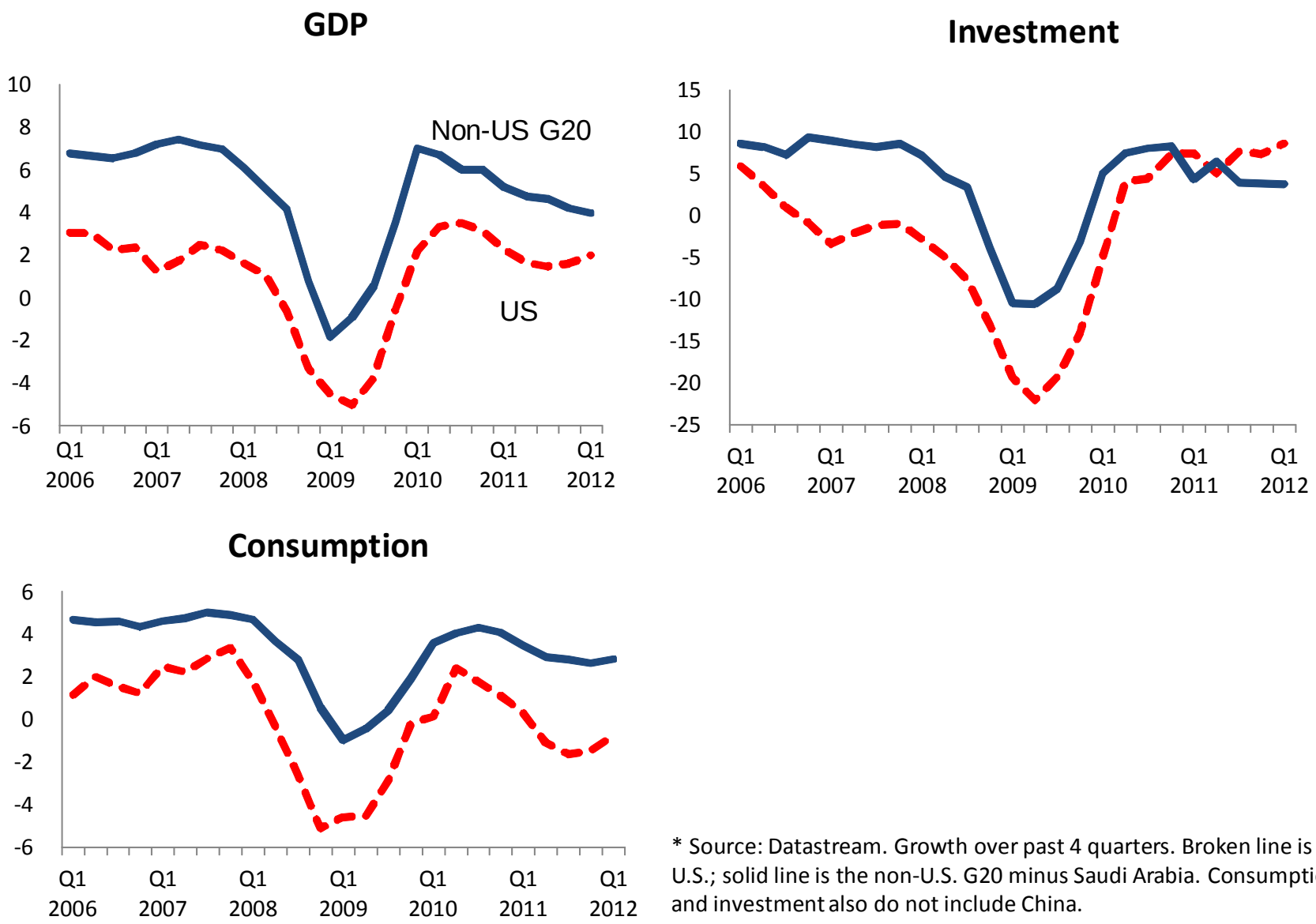
Motivation

1. Global business cycles were very synchronized during the Great Recession, especially during the worst of it (second half of 2008 and first quarter of 2009)

2. This co-movement is unusual in comparison to past recessions, both the Great Depression and more recent recessions

- The aim of the paper is to shed light on this

Figure 1 Global Growth (Percent; Annual; Real)*



* Source: Datastream. Growth over past 4 quarters. Broken line is the U.S.; solid line is the non-U.S. G20 minus Saudi Arabia. Consumption and investment also do not include China.

Two Questions

1. What can explain this co-movement, especially in light of standard theory, where transmission is partial at best due to home bias in goods and asset markets?

2. What can explain the difference relative to previous recessions?

Transmission

- For strong co-movements, need specific types of shocks and full integration
  - e.g., productivity shocks give negative comovements
- Recent literature focuses on credit shocks or balance sheet shocks
  - Generate positive co-movements
  - E.g., Devereux and Sutherland (2011), Kollmann, Enders and Muller (2010) , Perri and Quadrini (2012)
- But need full integration to have full comovements
  - van Wincoop (2013): transmission of balance sheet shocks of leveraged financial institutions is limited for realistic level of financial home bias
  - Rose and Spiegel (2010) and Kamin and Pounder (2012): little relationship between financial linkages of countries with the U.S. and decline in GDP growth and asset prices during 2008-2009

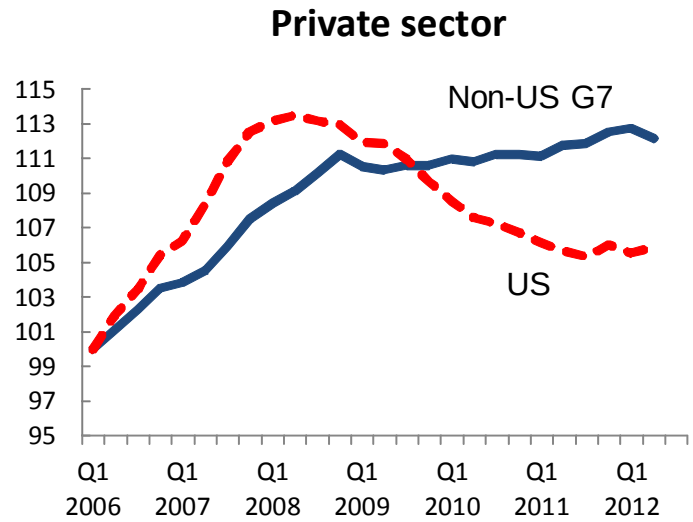
Credit, Wealth, Profits

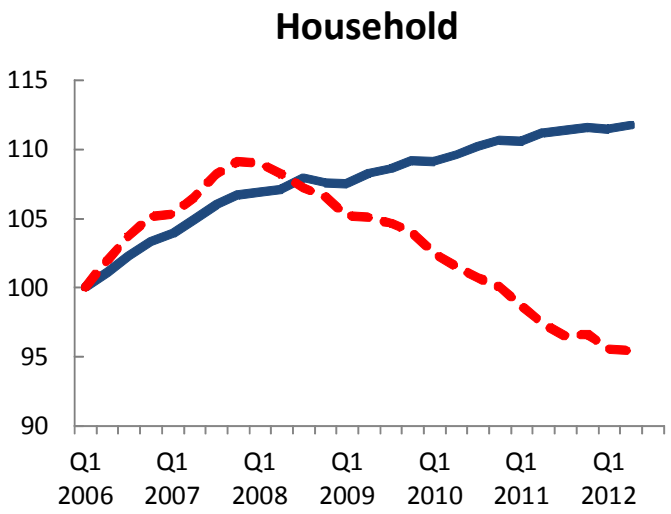
- Common to model the Great Recession as resulting from financial balance sheet shocks, impacting the real economy through a decline in credit and wealth

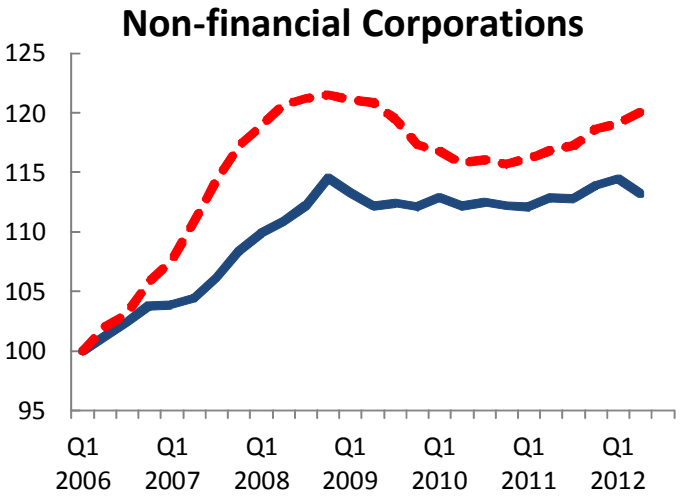
- Bank credit
  - did not go down in 2008: Chari, Christiano and Kehoe (2008)
  - did fall in 2009 in U.S., but much less in the rest of the world
- Household wealth
  - went down far less in the rest of the world than in the U.S.
  - the decline in housing wealth was mainly a U.S. phenomenon

- But firm profits declined in a synchronized way

Figure 4 Total Credit

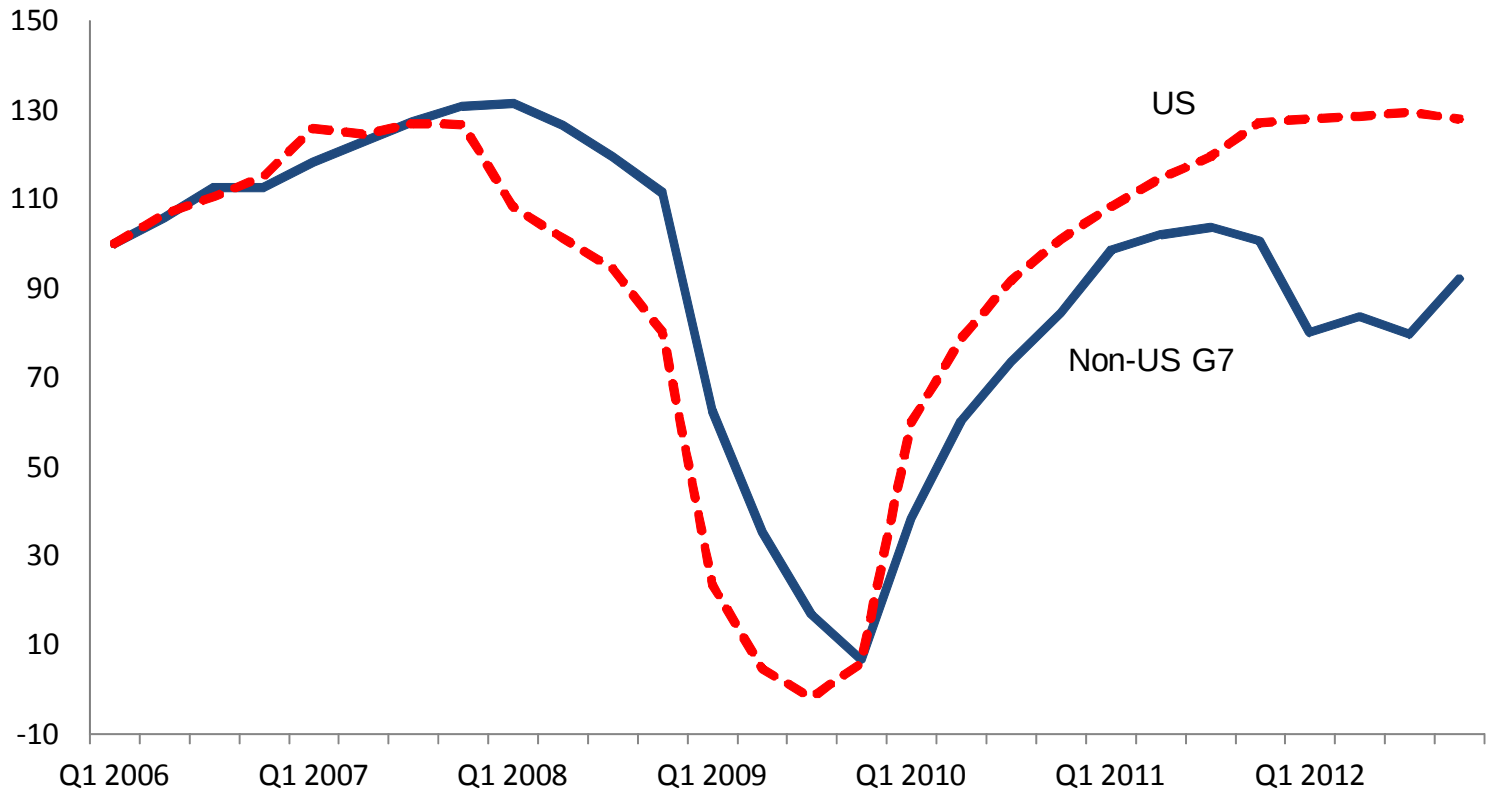






Source: Bank for International Settlements, *Long series on credit to private non-financial sectors*. The credit series are divided by the GDP deflator and normalized at 100 in 2006:Q1. The non-US G7 series is computed using relative PPP-adjusted GDP weights.

Figure 7 Corporate Profits



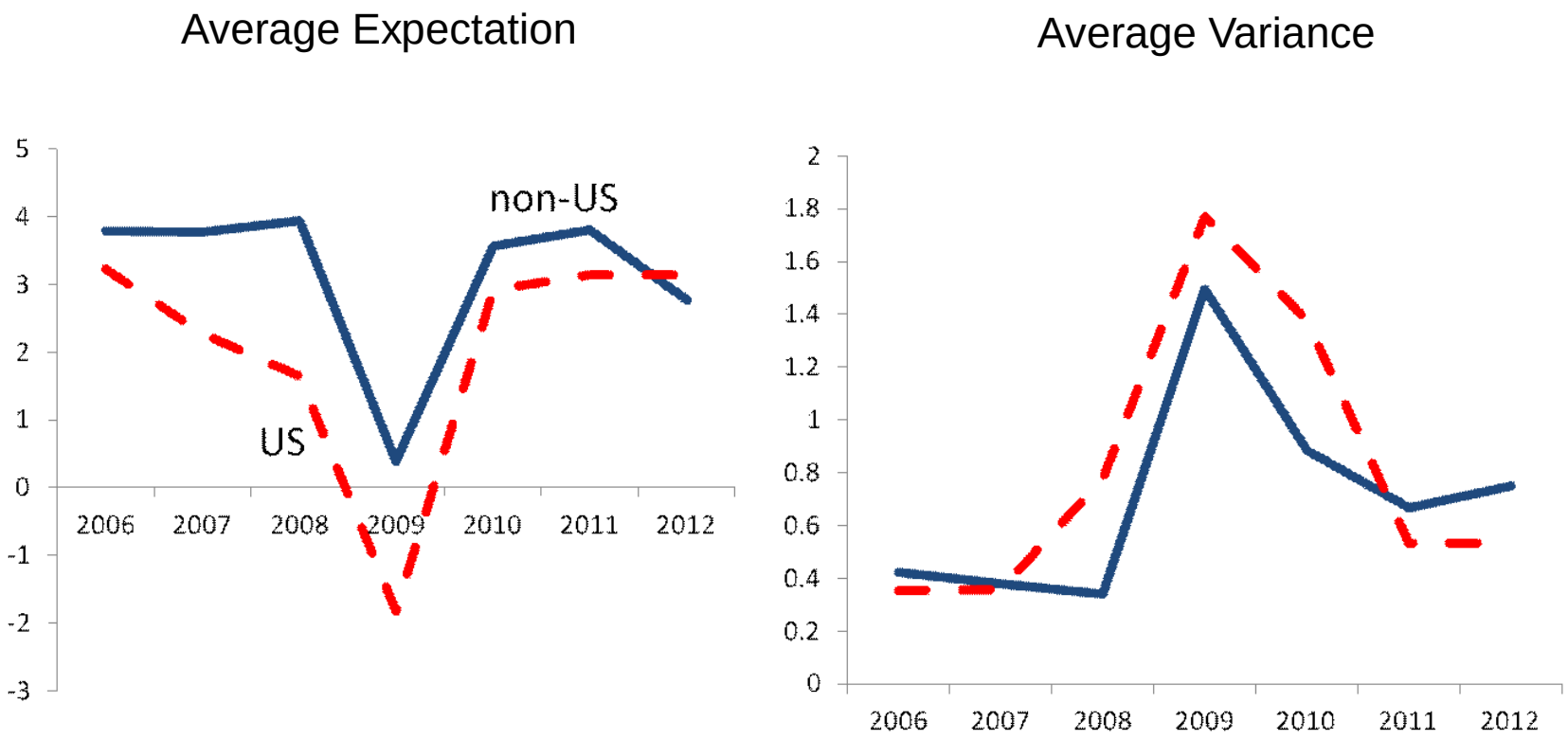
Source: Worldscope, *Net profits (income)*. Profits are aggregated over continuing firms firms within each country, divided by the GDP deflator, and normalized at 100 in 2006:Q1. The non-US G7 series is computed using relative PPP-adjusted GDP weights.

Our Explanation

- Key features of the model:

1. Recession is the result of a self-fulfilling panic
2. A panic is necessarily synchronized across countries as long as there is a minimum level of economic integration
3. Several factors generate particular vulnerability to a global panic in 2008: tight credit, zero lower bound, unresponsive fiscal policy, increased economic integration

Figure 3 GDP Growth Forecasts Probabilities: Expectation and Variance*

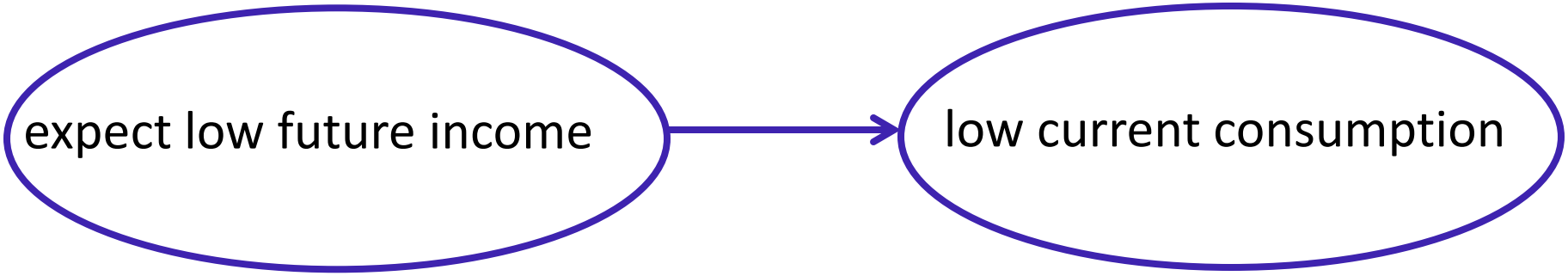


*Data from Consensus Forecasts, based on one-year ahead forecast probabilities. See Appendix A for a description. Non-US: Australia, China, Hong Kong, India, Indonesia, Malaysia, New Zealand, Singapore, South Africa, Taiwan, Thailand, Japan, Germany, France, U.K., Italy, Canada

Intuition Behind Self-Fulfilling Panic

expect low future income

Intuition Behind Self-Fulfilling Panic



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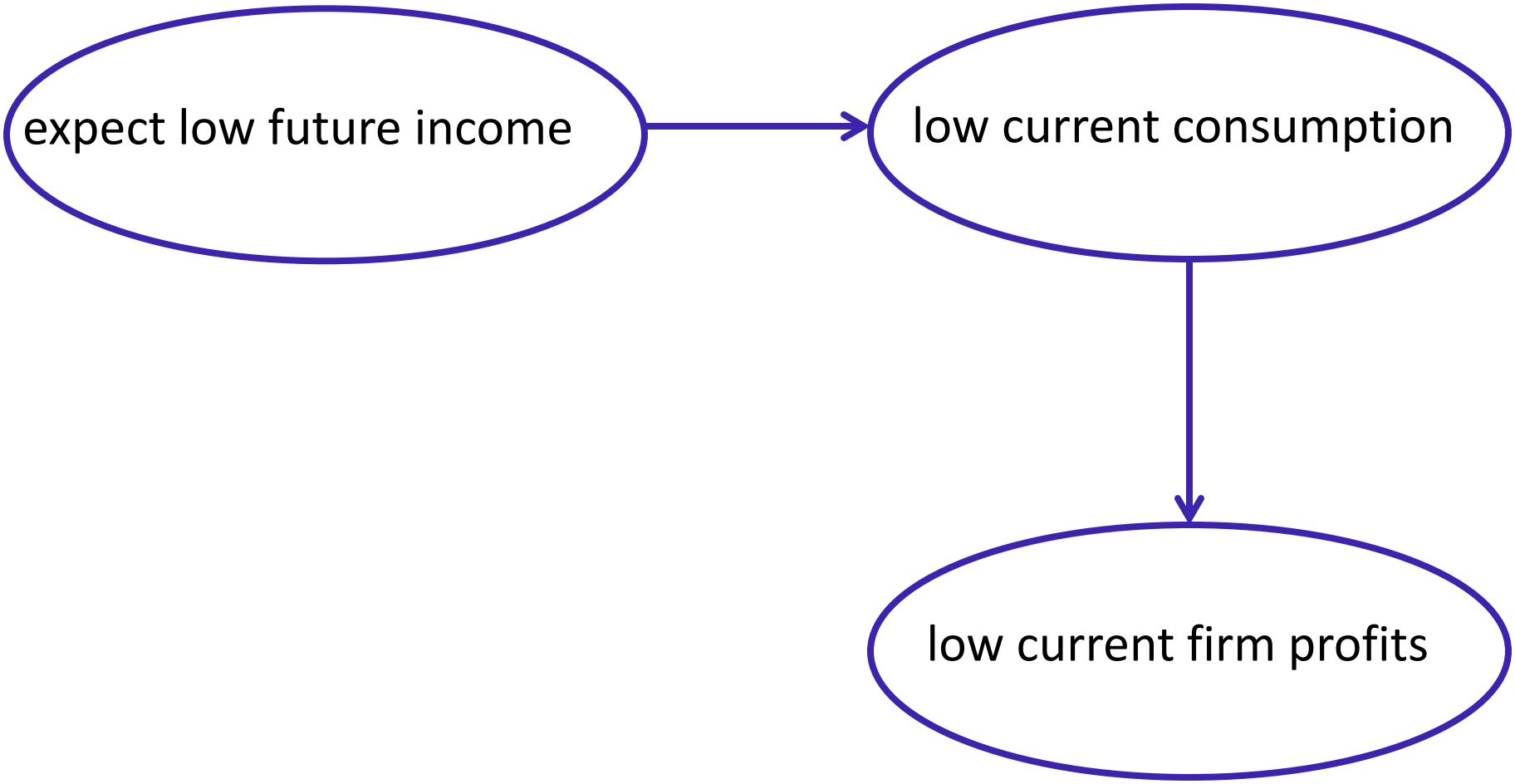

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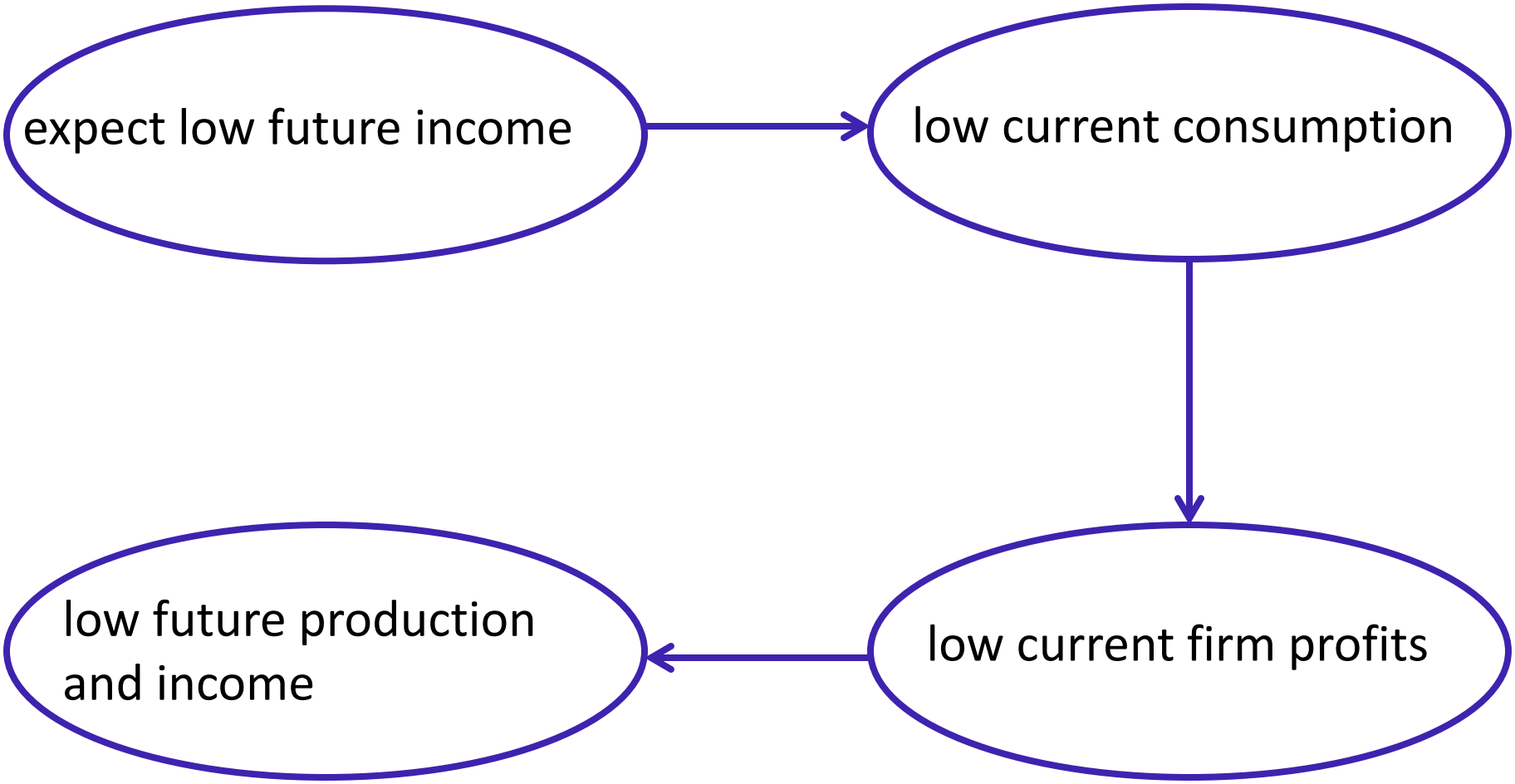
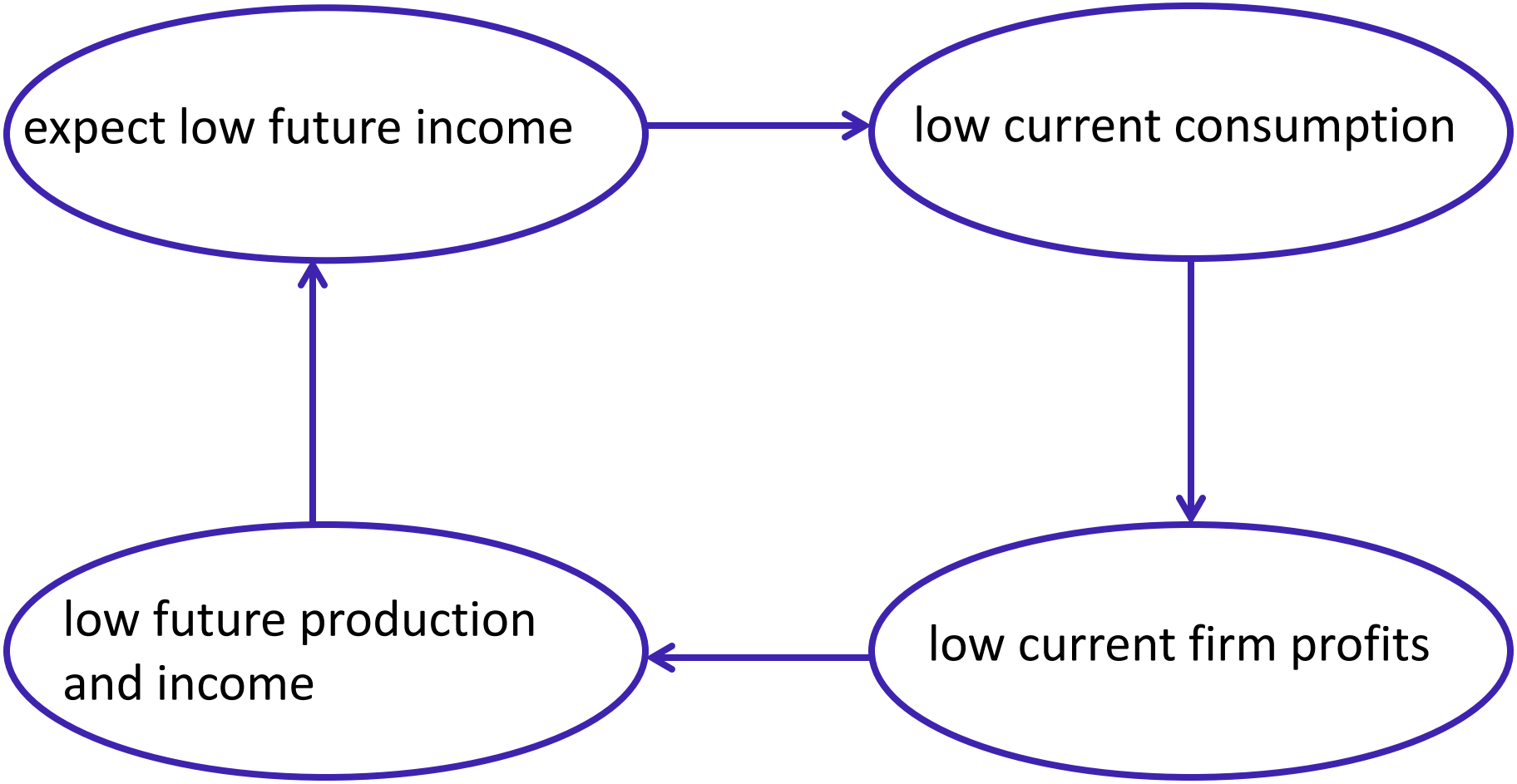


Intuition Behind Self-Fulfilling Panic



Intuition behind Synchronicity

- Consider a world of 2 countries, H and F
- If a panic only happens in H, it will face strong demand from country F that does not panic
- Under financial integration it will also receive a net transfer from country F
- Both increase income, demand and output in H
- Only a limited extent of economic integration is then enough to make sure that a panic in H only is not an equilibrium
- Either neither country panics or they both panic

Overview

- We develop a New Keynesian model with self-fulfilling business cycle panics
- Limited integration is sufficient to have complete co-movements
- A panic more likely to occur
  1. when credit is tight
  2. at low interest rates
  3. when fiscal policy cannot be strongly counter cyclical
- In 2008-2009, the world economy was ripe for a panic

Related Literature

- Several papers explain aspects of the crisis in the financial sector with models exhibiting multiple equilibria
  - E.g., in Bacchetta, Tille, and van Wincoop (AER, 2012) we focus on risk panics in asset prices
  - But do not explain the real sector
- Some recent papers have modeled self-fulfilling business cycles
  - e.g., Farmer (2012a,b), Heathcote and Perri (2012), Benhabib, Wang and Wen (2012)
  - Closed economy models that do not address the co-movement question
- Perri and Quadrini (2012) have an open-economy model with self-fulfilling credit shocks, but they assume perfect integration of goods and financial markets

The Model

- 2 countries (Home and Foreign), 2 periods (1 and 2)
- Households, firms, a government and a central bank
- Focus on benchmark model
  - Only consumption (no investment)
  - Only goods trade (no asset trade)
  - No uncertainty
- Money with cash-in-advance constraint
- New keynesian environment

Households

- Households in the Home country maximize

$$\frac{1}{1-\gamma}c_1^{1-\gamma} + \lambda l_1 + \beta\left(\frac{1}{1-\gamma}c_2^{1-\gamma} + \lambda l_2\right) \tag{1}$$

where :

$$c_t = \left(\frac{c_{H,t}}{\psi}\right)^{\psi}\left(\frac{c_{F,t}}{1-\psi}\right)^{1-\psi} \tag{2}$$

$$c_{H,t} = \left(\int_0^{n_{H,t}} c_{H,t}(j)^{\frac{\mu-1}{\mu}}dj\right)^{\frac{\mu}{\mu-1}} \tag{3}$$

$$c_{F,t} = \left(\int_0^{n_{F,t}} c_{F,t}(j)^{\frac{\mu-1}{\mu}}dj\right)^{\frac{\mu}{\mu-1}} \tag{4}$$

- Face a cash-in-advance constraint:

$$P_{H,t}c_{H,t} + S_t P_{F,t} c_{F,t} \leq M_t \tag{5}$$

- Price index:

$$P_t = P_{H,t}^{\psi}[S_t P_{F,t}]^{1-\psi}$$

Household First Order Conditions

$$c_1^{-\gamma} = \beta(1+i)\frac{P_1}{P_2}c_2^{-\gamma} \tag{6}$$

$$c_{H,t}(j) = \left(\frac{P_{H,t}(j)}{P_{H,t}}\right)^{-\mu} c_{H,t} \tag{7}$$

$$c_{F,t}(j) = \left(\frac{P_{F,t}(j)}{P_{F,t}}\right)^{-\mu} c_{F,t} \tag{8}$$

$$c_{H,t} = \psi\frac{P_t}{P_{H,t}}c_t \tag{9}$$

$$c_{F,t} = (1-\psi)\frac{P_t}{S_t P_{F,t}}c_t \tag{10}$$

$$\frac{W_t}{P_t} = \lambda c_t^{\gamma} \tag{11}$$

Government

- The government only buys domestic goods
- Same index as for private Home consumption
- Same allocation across goods:

$$g_t(j) = \left(\frac{P_{H,t}(j)}{P_{H,t}} \right)^{-\mu} g_t$$

- Different assumptions about g_t: 0, constant ($g_t = \bar{g}$) or countercyclical
- Assume balanced budget:

$$T_t = P_{H,t} g_t \tag{12}$$

Central Bank

- Central bank controls money supply in period 2, M_2, and interest in period 1, i_1
- Uses M_2 to achieve zero inflation target, so $P_1 = P_2$
  - Can control P_2 because cash-in-advance constraint holds with equality: $P_2 c_2 = M_2$
- Monetary policy in period 1 may become impotent if it hits the zero lower bound
- For now we assume that i_1 is set such that $(1+i)\beta = 1$

Firms

- Output of Home firm j in period t is

$$y_t(j) = AL_t(j)^{\alpha} \tag{13}$$

- Prices are set at the start of each period
- Firms in period 1 simply produce whatever the demand is
  - from Home and Foreign consumers and the Home government
- Prices for period 2 same as optimal flexible prices
  - No uncertainty in period 2

Number of Firms

- In period 1 the number of firms is given and normalized at 1
- At the end of period 1 firms either go bankrupt or continue to operate in period 2
- In period 2 n firms in the Home country and n^* in the Foreign country
- In a panic, $n = \overline{n} < 1$
- With no panic, $n = 1$
- Focus the description on Home firms

- Bankruptcy can occur at the end of period 1
- Firms are ex ante identical but some firms face a fixed cost ex post
- A fraction $1 - \overline{n}$ firms face a real cost z
  - Could be modeled as a negative productivity shock, but additive cost is analytically more convenient
- We assume that z does not affect aggregate resources
  - Transferred to an agency, which operates at no cost and transfers its income to households

- In good time firms can borrow from consumers to finance z, but in a panic they have insufficient funds
- Revenue minus labor cost

$$\Pi_1 = P_{H,1} y_1 - W_1 L_1$$

- Firms have a maximum borrowing limit:

$$(1 + i_1) D(j) \leq \phi \Pi_2(j) \tag{14}$$

- Firm j goes bankrupt when its funds are insufficient to cover its cost:

$$\Pi_1 + \frac{\phi \Pi_2(j)}{1 + i_1} < P_1 z(j) \tag{15}$$

- Define real available funds

$$\pi \equiv \pi_1 + \phi \frac{\pi_2}{1 + i_1} \tag{16}$$

where $\pi_1 = \Pi_1 / P_1$ and $\pi_2 = \Pi_2 / P_2$.

- From (15), firm j will go bankrupt when

$$\pi < z(j) \tag{17}$$

Market Clearing

$$y_t(j) = c_{H,t}(j) + g_t(j) + c^*_{H,t}(j) \quad t = 1, 2 \tag{18}$$

$$n_{H,t} L_t = 1 - l_t \quad t = 1, 2 \tag{19}$$

$$M_t = \overline{M}_t \quad t = 1, 2 \tag{20}$$

$$B(s) = D(s) \tag{21}$$

- Balanced trade condition

$$S_t P_{F,t} c_{F,t} = P_{H,t} c^*_{H,t} \tag{22}$$

Implies

$$P_t c_t = S_t P^*_t c^*_t \tag{23}$$

Equilibrium

- The model can be boiled down to a system in c_1, c_1^*, π, π^*, c_2 and c_2^*
- First consider symmetric equilibria where $c_1 = c_1^*$, $\pi = \pi^*$
- Assumimg $g_t = 0$ and $\phi = 0$

$$c_1 = \frac{n^\zeta}{\theta} \tag{24}$$

$$\pi = c_1 - \frac{\lambda}{A} c_1^{\gamma + 1/\alpha} \tag{25}$$

$$\text{with} \qquad n = \begin{cases} \overline{n} & \text{if } \pi < z \\ 1 & \text{if } \pi \geq z \end{cases} \tag{26}$$

Two Assumptions

1. $z < [\mu(1-\alpha)+\alpha]/(\mu\theta)$
2. $\pi(1) > \pi(\bar{n})$

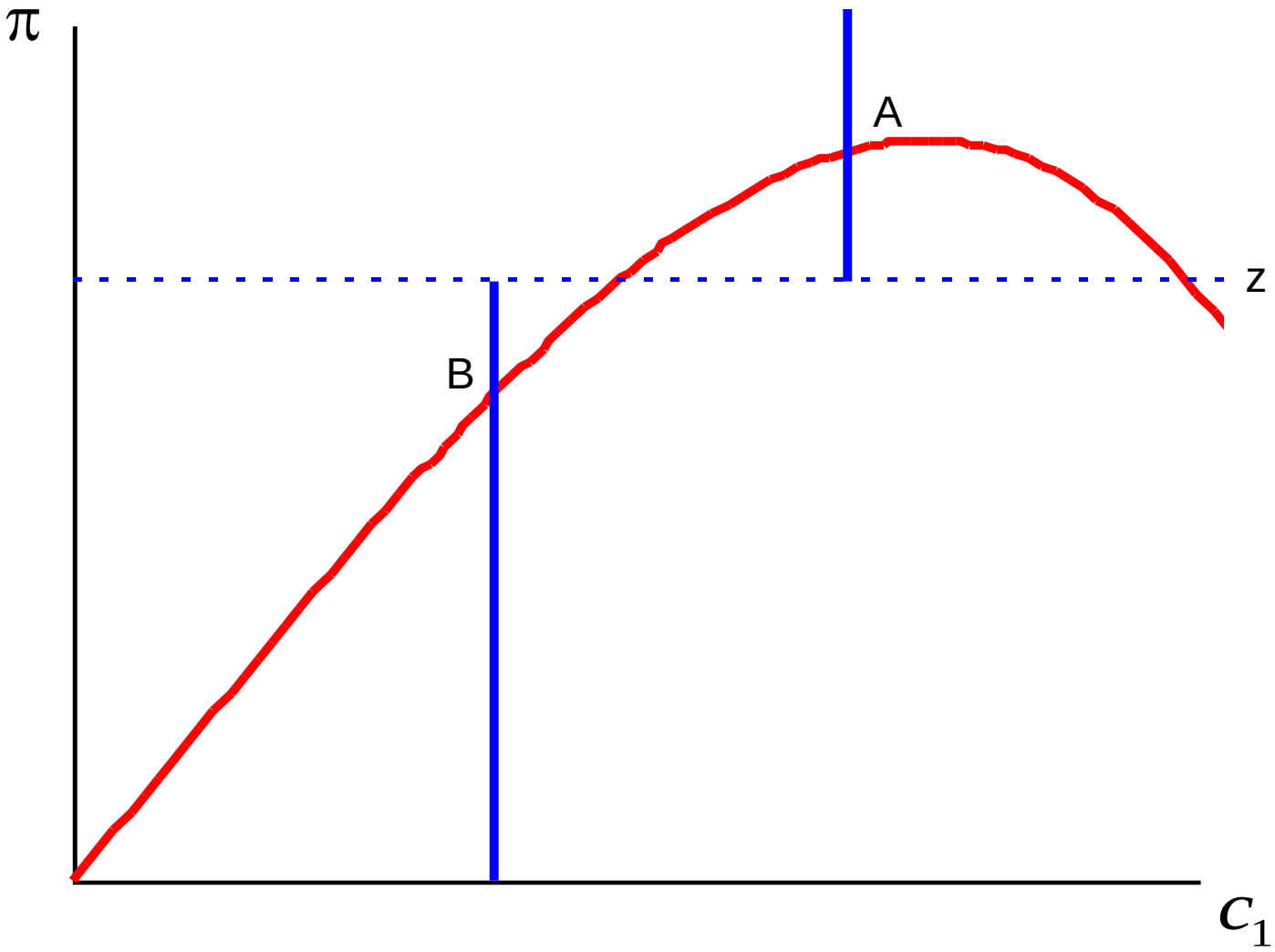
- Assumption 1 implies that first period profits are positive in equilibrium when prices are flexible (no bankruptcy under flexible prices); it also implies $z < \pi(1)$
- Assumption 2 implies that parameters are such that profits are lower in a bad equilibrium with firm bankruptcies and low consumption

Proposition

When Assumptions 1 and 2 hold, there are one or two symmetric equilibria. They are characterized by:

1. $(n, c_1) = (1, 1/\theta)$ *if* $\pi(\overline{n}) \geq z$
2. $(n, c_1) = (1, 1/\theta)$ *or* $(n, c_1) = (\bar{n}, \overline{n}^{\zeta}/\theta)$ *if* $\pi(\overline{n}) < z < \pi(1)$

Figure 5 Symmetric Equilibria*



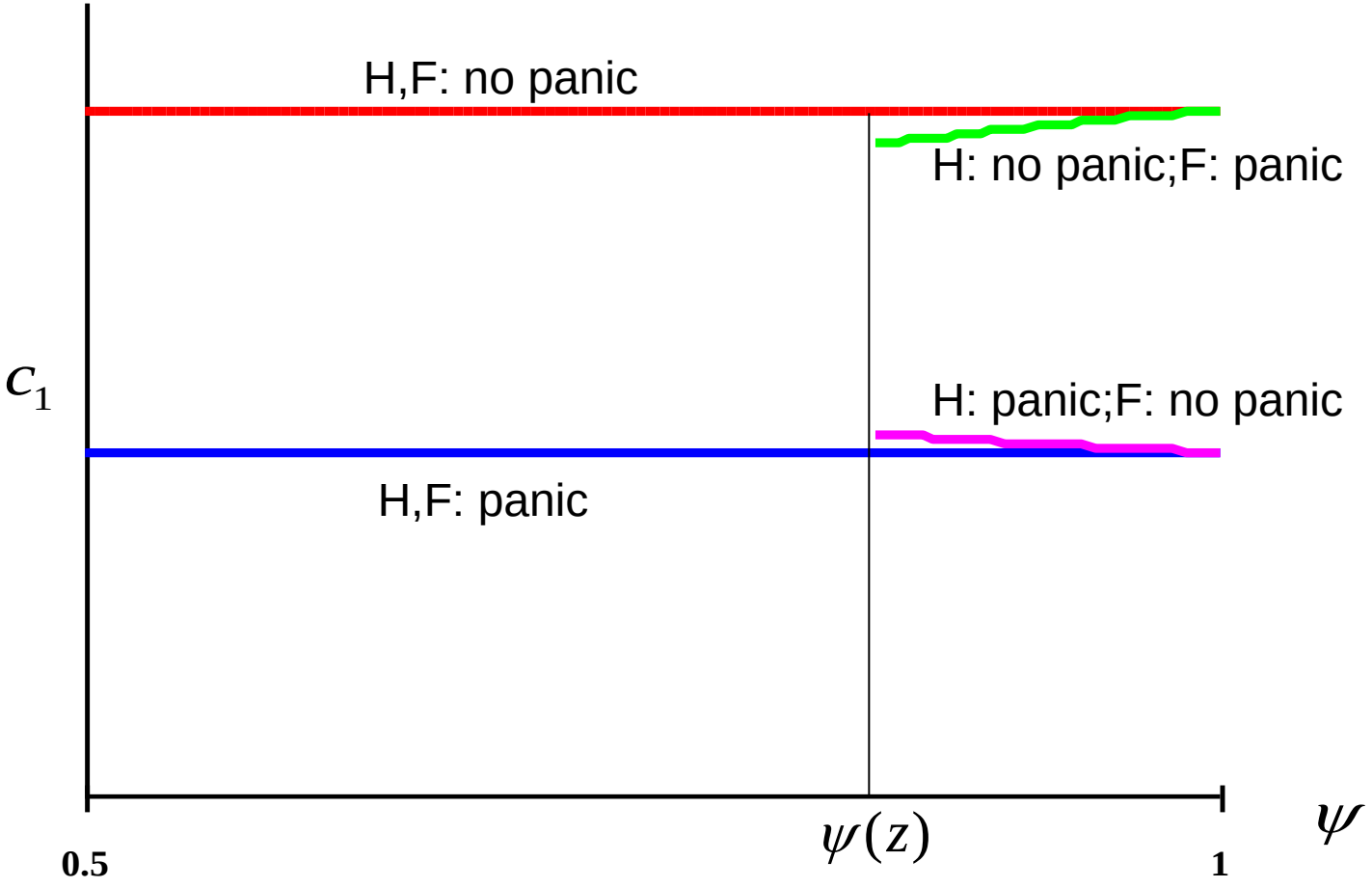
Full Set of Equilibria

- Symmetric equilibrium also describes economies in autarky
- In autarky there are four possible equilibria
- What happens when countries start to trade, i.e., $\psi < 1$?

- **Proposition:** There is a threshold $\psi(z) > 0.5$ such that only the symmetric equilibria exist when $\psi < \psi(z)$.

- Global spillover without full integration

Figure 6 All Equilibria: Role of Trade Integration



Intuition

- First, consider an asymmetric equilibrium where Home panics but not Foreign
- As trade increases, Home firms are helped by Foreign consumption
- But Foreign firms suffer from low Home consumption
- Home profits increase with trade integration and Home may avoid the panic
- Foreign profits decrease with trade integration and Foreign may be drawn into a panic
- Either way, the equilibrium cannot be asymmetric

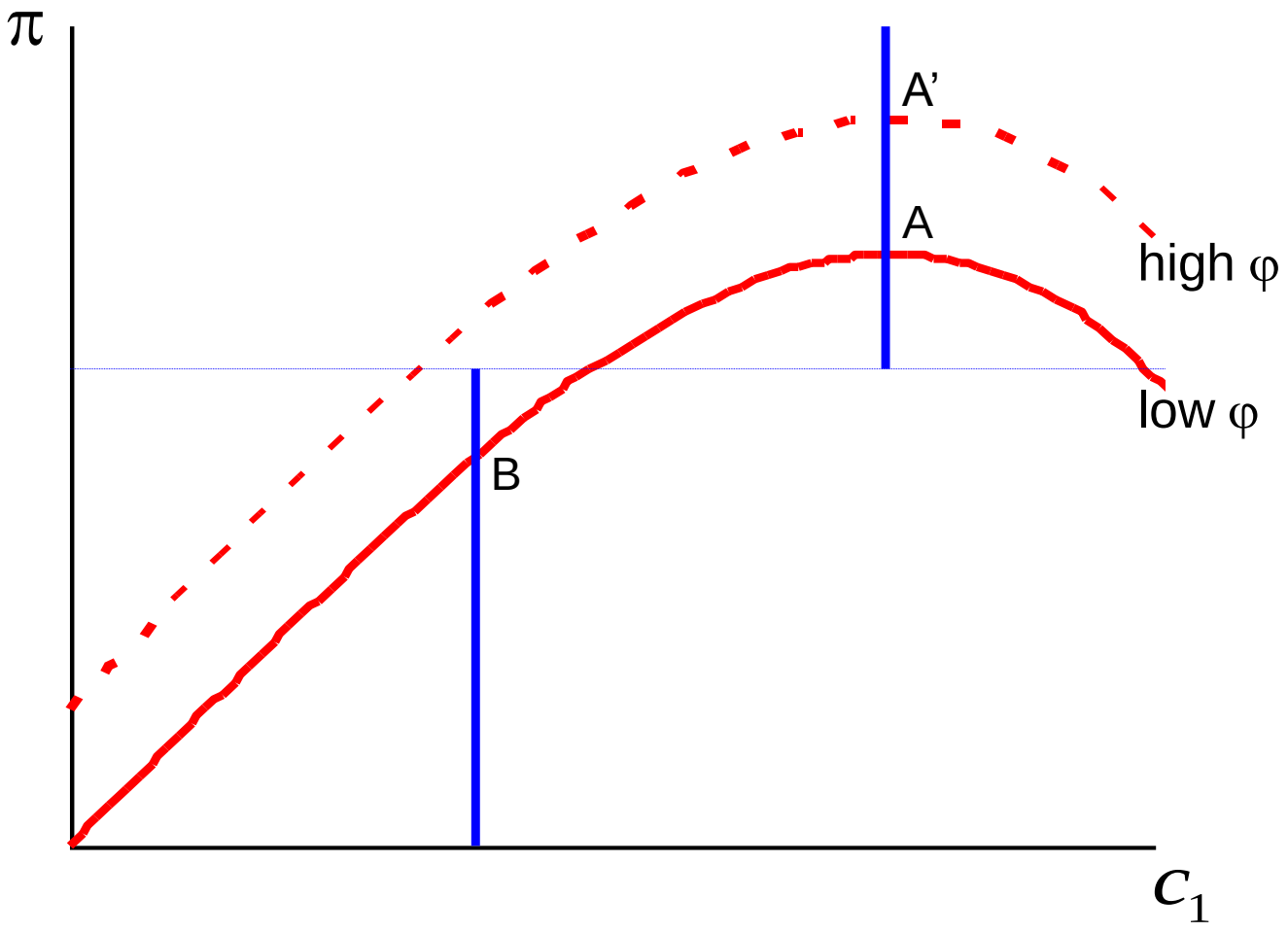
Vulnerabilities

- What makes a panic more likely?
- Focus on symmetric equilibria
- Three main features related to the Great Recession
  1. Lower borrowing limit
  2. Low interest rate
  3. "Rigid" fiscal policy

Low Borrowing Limit

- A lower ϕ means that firms have fewer funds to cover their cost z
- Increases the likelihood of a panic

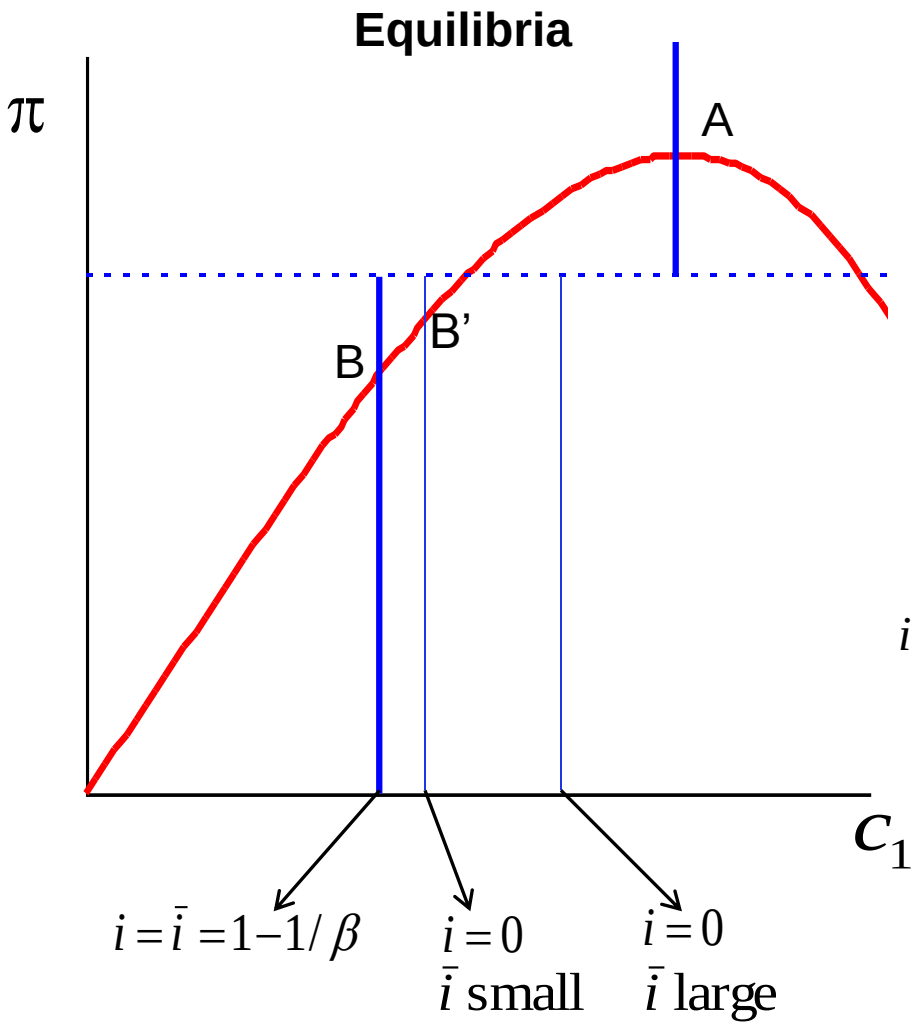
Figure 9 Panic Vulnerability: Role of Credit

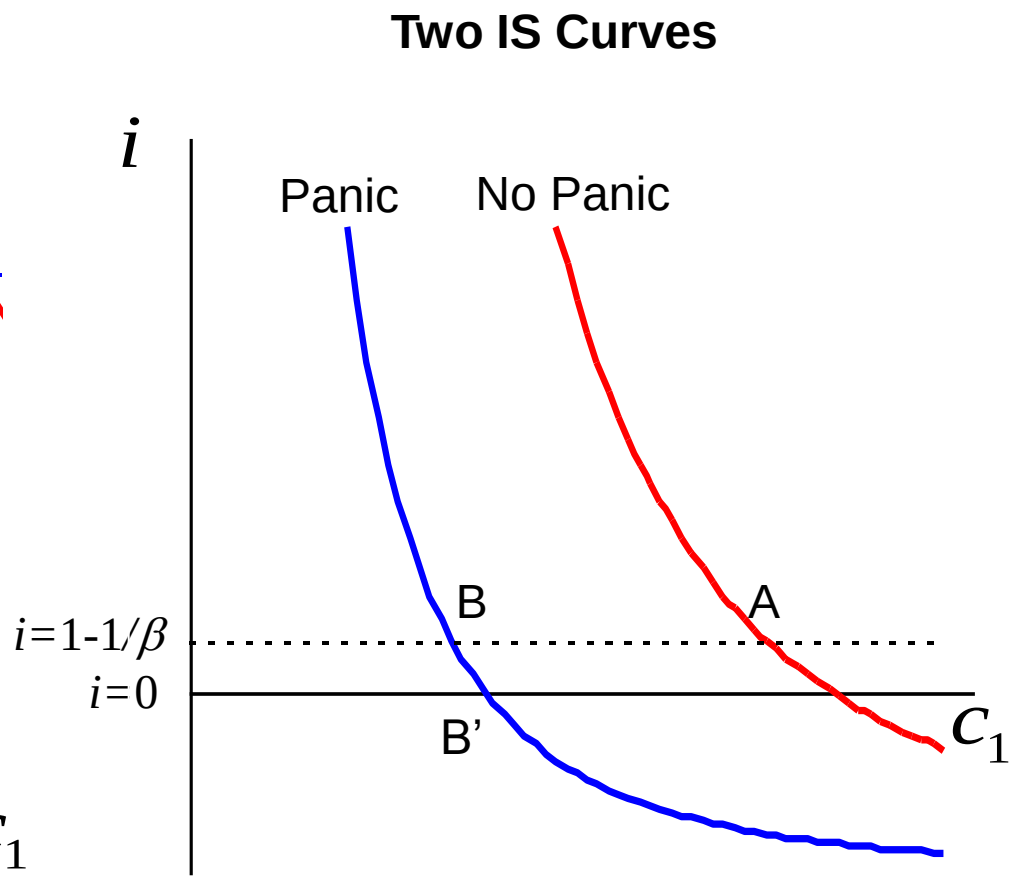


Low Interest Rate

- In a panic, the central bank should lower the interest rate to stimulate demand
- But it may reach the zero lower bound
- A high "initial" interest rate gives more room for manoeuvre
- Our equilibrium is derived for a given interest rate
- Assume the interest rate is set to reproduce the flexible price interest rate
- We have $1 + i = 1/\beta$
- We could argue that β was high in 2008

Figure 10 Panic Vulnerability: Role of Monetary Policy





"Rigid" fiscal policy

- A strongly countercyclical fiscal policy could avoid a panic
- Assume that government spending is strongly *countercyclical*

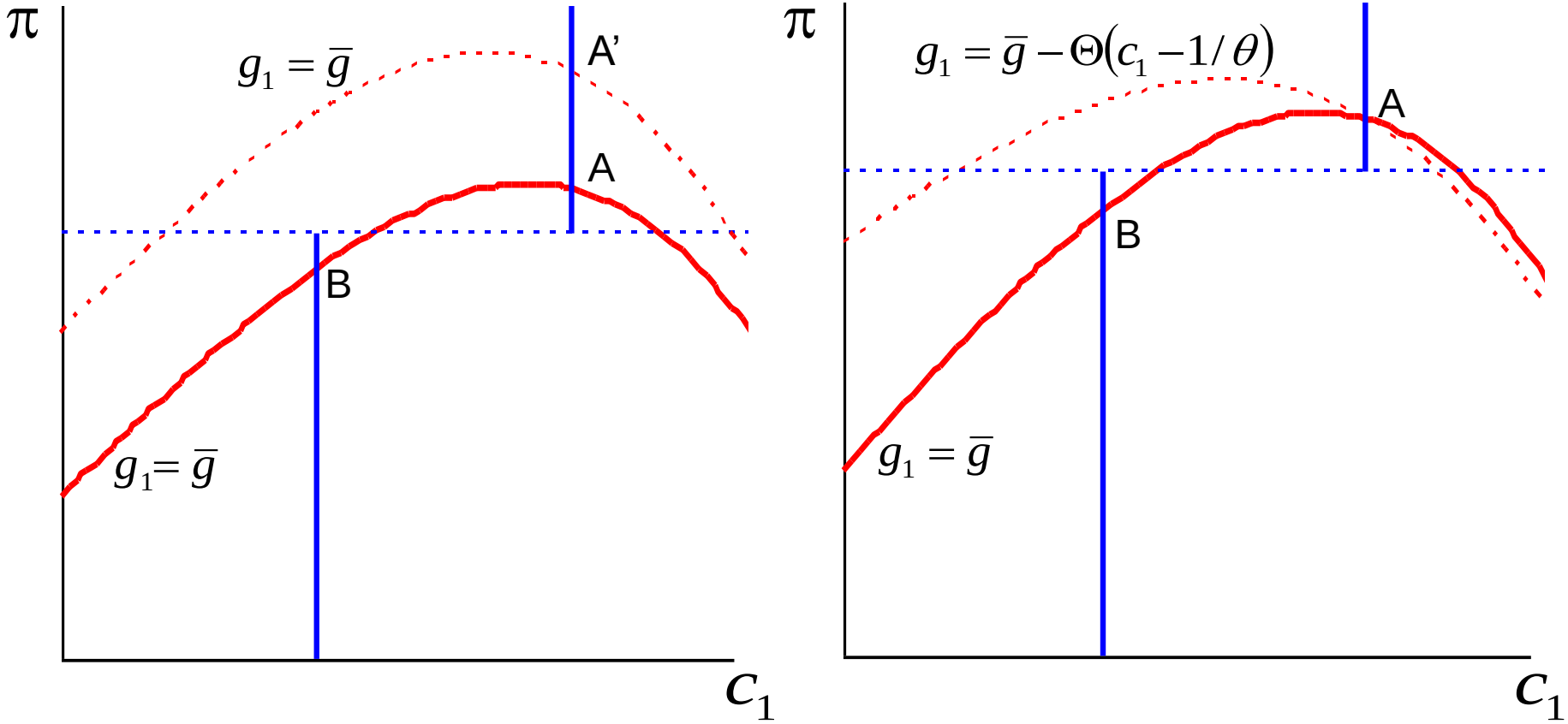
$$g_t = \bar{g} - \Theta(c_1 - \bar{c})$$

with $\bar{c}$ consumption in the non-panic equilibrium of the model.

  - If Θ is large enough, can avoid the panic

- Notice also that the *level* of government spending $\bar{g}$ reduces the risk of a panic
  - As $\bar{g}$ is not affected by consumers expectations it brings stability

Figure 11 Panic Vulnerability: Role of Fiscal Policy*



Extension I: Uncertainty

- Assume uncertainty about z
- In good equilibrium, we still have $n = 1$
- In a panic, we may have $n = \overline{n}$ or $n = 1$

- Three implications of introducing uncertainty

1. In a panic equilibrium there is a probability of default rather than certain default
2. Business cycle uncertainty is endogenous and only arises during a panic
   - without a panic, consumption and profits are strong; no defaults even if z is high; therefore no uncertainty
   - with a panic, consumption and profits are weak; firms are then vulnerable to a bad z-shock; creates uncertainty
3. The spike in uncertainty during a global panic is synchronized across countries, consistent with the survey evidence

Extension II: Investment

- The presence of investment reinforces the results: if you expect a panic, invest less
- In a panic, $1 - \overline{n}$ firms that faces the cost z will not invest
- With a minimum level of integration, panics are again perfectly synchronized across countries, with an equal to drop in consumption, output, investment and profits
- Paradox of thrift

Extension III: Financial Integration

- We consider an extension with perfect risk sharing
- We find that analogous to trade integration, financial integration also contributes to making a joint panic more likely
- It further breaks the self-fulfilling linkages that could contribute to a panic in just one country
- In particular, bankruptcy of domestic firms now has even less effect on domestic income because of net transfers to the Home country (GNP>GDP)
- But again, only partial integration is needed for full co-movement

Extension IV: Sticky Nominal Wages

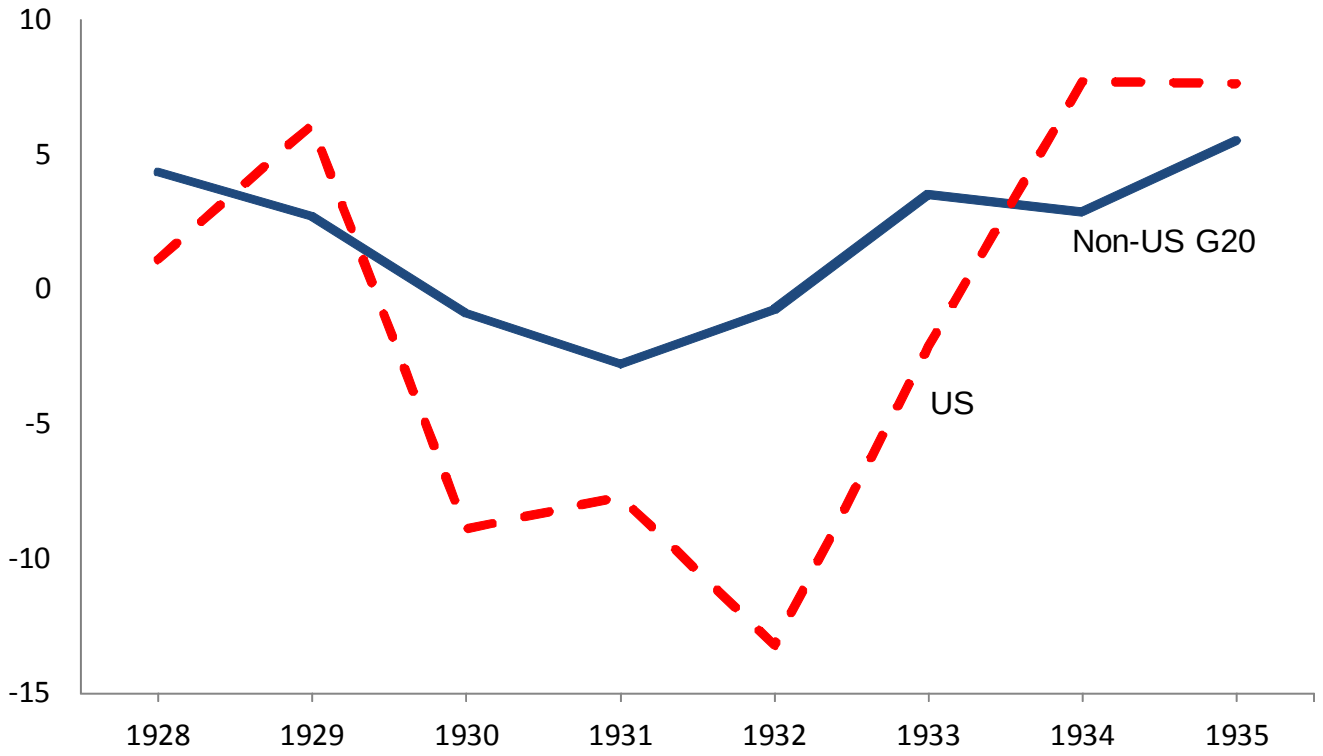
- So far wages were flexible
- In a panic wages collapse in line with consumption
- Would consumption still collapse with fixed nominal wages?
- Yes, consumers work less
- Still need limited integration to have a global panic

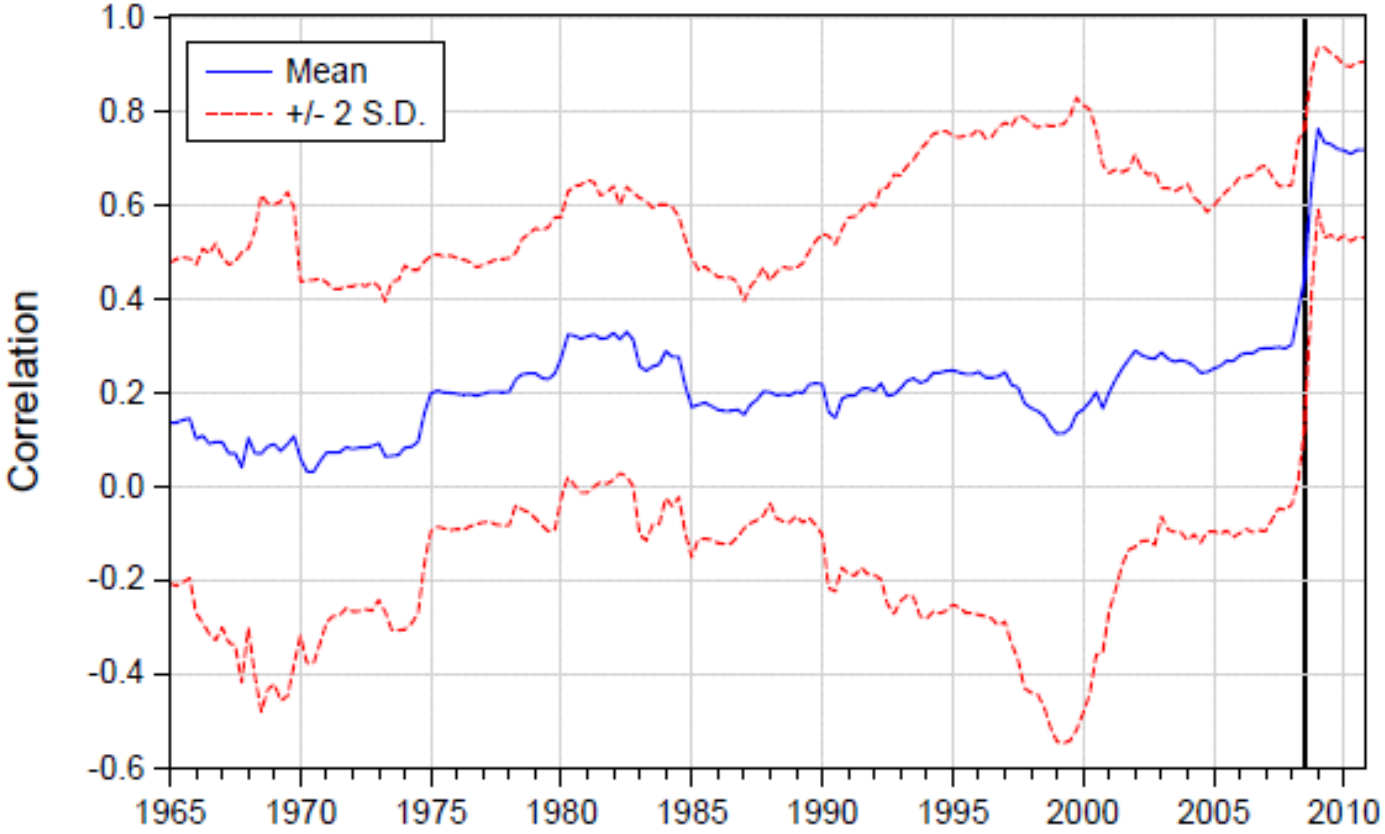
Conclusions

- We have developed a two-country model with self-fulfilling business cycle panics
- The model can explain:

1. The equal drop in output, consumption and investment across countries in the rest of the world as in the U.S. during the Great recession, even under partial integration
2. The difference relative to previous recessions; 2008 was a period that was particularly vulnerable to global panics because of (i) tight credit, (ii) the zero lower bound, (iii) increased trade and financial integration across countries, (iv) limits to counter-cyclical fiscal policies

Figure 2 Real GDP Growth During the Great Depression



*Source: Angus Maddison. Broken line is the U.S.; solid line is the non-U.S. G20 minus Saudi Arabia minus South Africa.

Average Correlation of quarterly GDP growth among G7 countries using 10 year rolling windows