

The Great Recession: A Self-Fulfilling Global Panic

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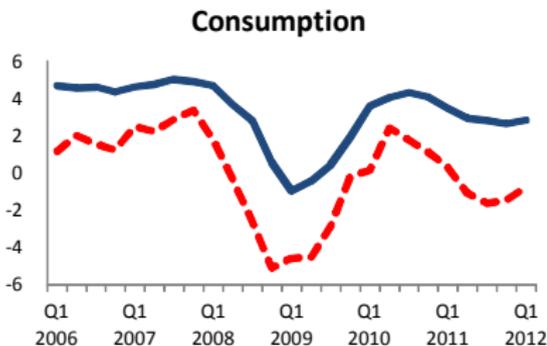
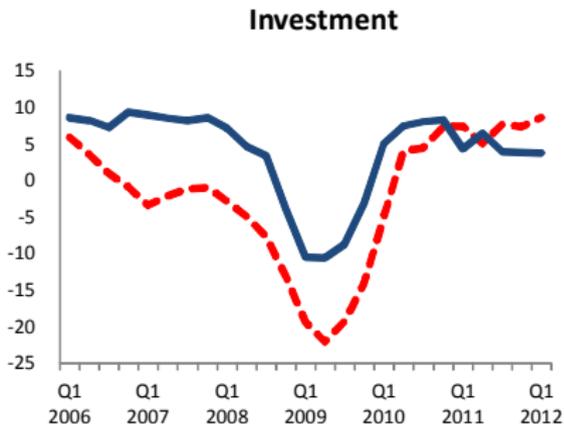
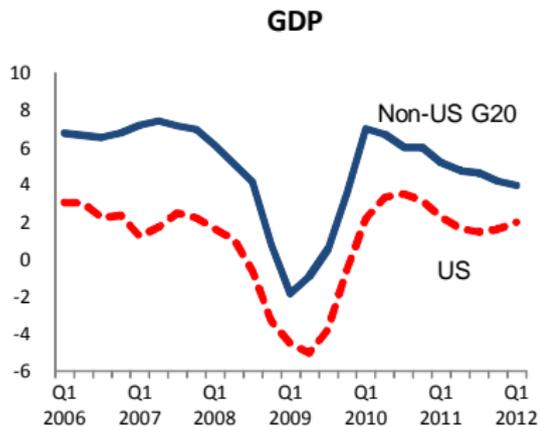
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Motivation

- 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

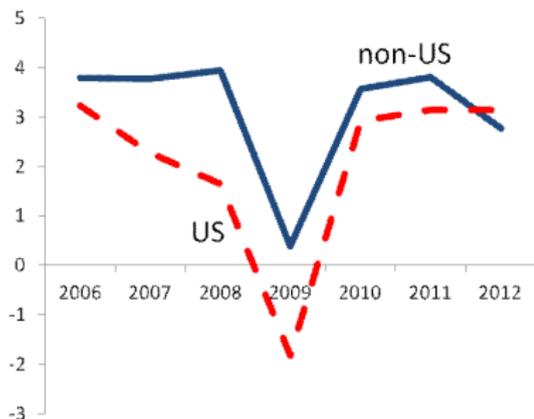
Figure 1 Global Growth (Percent; Annual; Real)*



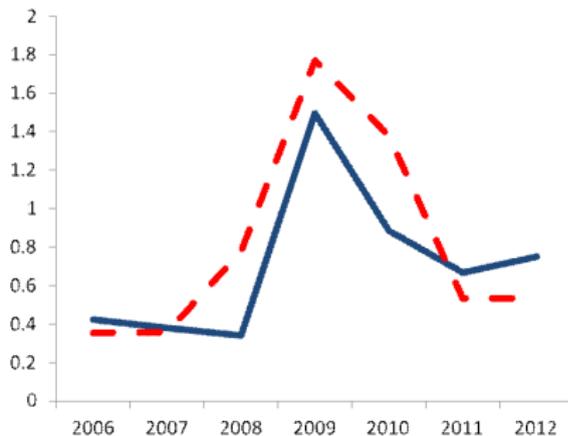
* Source: Datastream. Growth over past 4 quarters. Broken line is the U.S.; solid line is the non-U.S. G20 minus Saudi Arabia. Consumption and investment also do not include China.

Figure 3 GDP Growth Forecasts Probabilities: Expectation and Variance*

Average Expectation



Average Variance

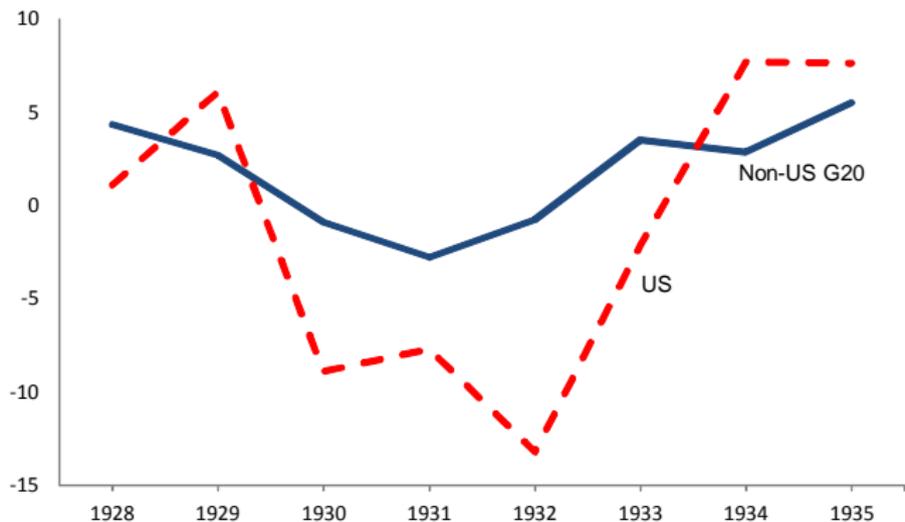


*Data from Consensus Forecasts, based on one-year ahead forecast probabilities. See Appendix A for a description. Non-US: Australia, China, Hong Kong, India, Indonesia, Malaysia, New Zealand, Singapore, South Africa, Taiwan, Thailand, Japan, Germany, France, U.K., Italy, Canada

Much less Co-movement in prior Recessions

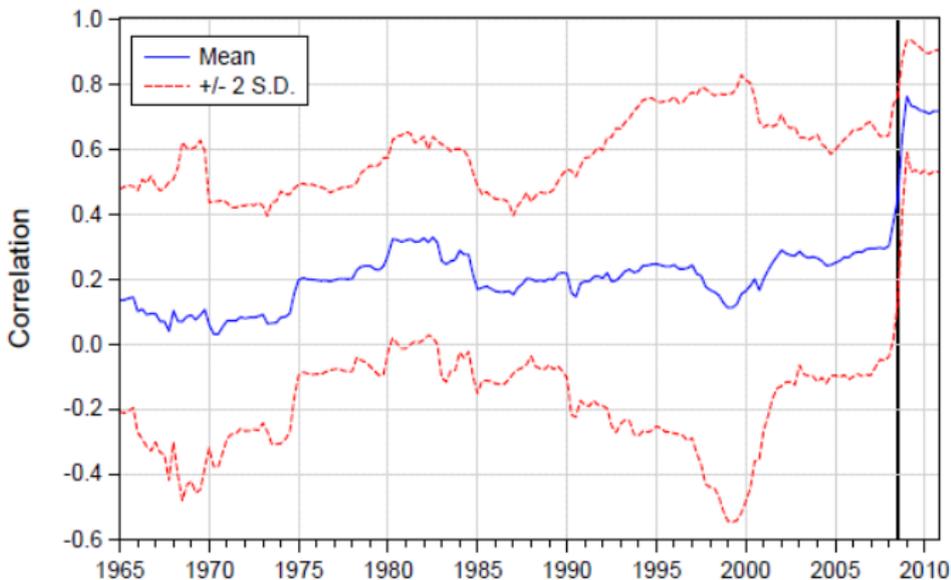
- Great Depression: far less synchronicity
- Post WWII recessions: far less synchronicity (Perri and Quadri (2012))
- Hirata, Kose and Otrok (2013): over last 25 years the global component of business cycles has actually declined relative to local components (region and country-specific)

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



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?

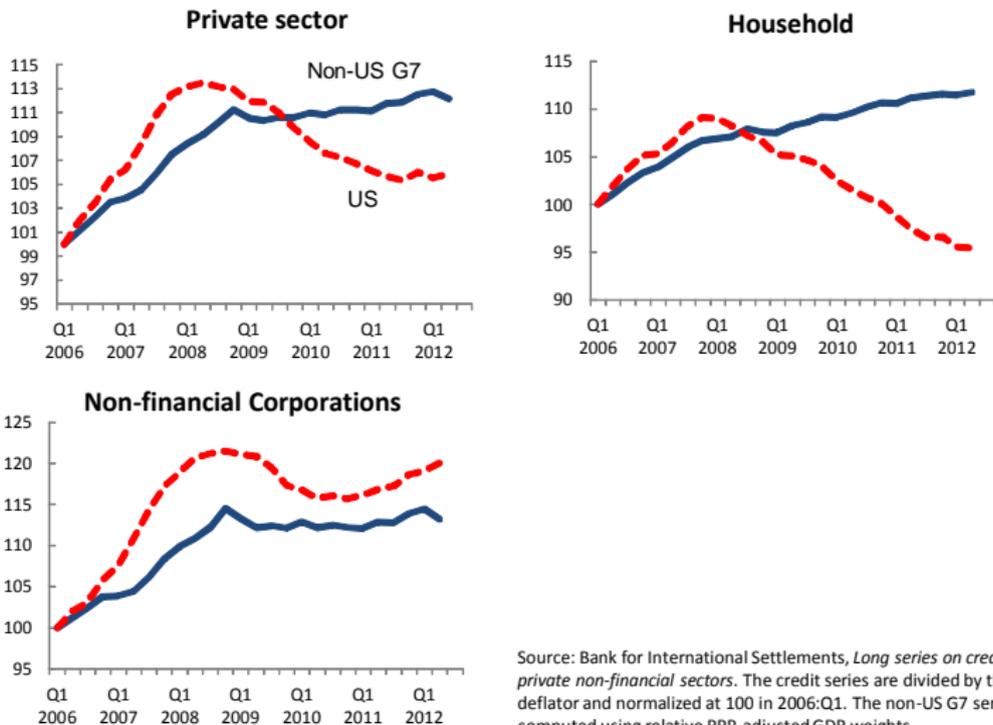
Transmission

- 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

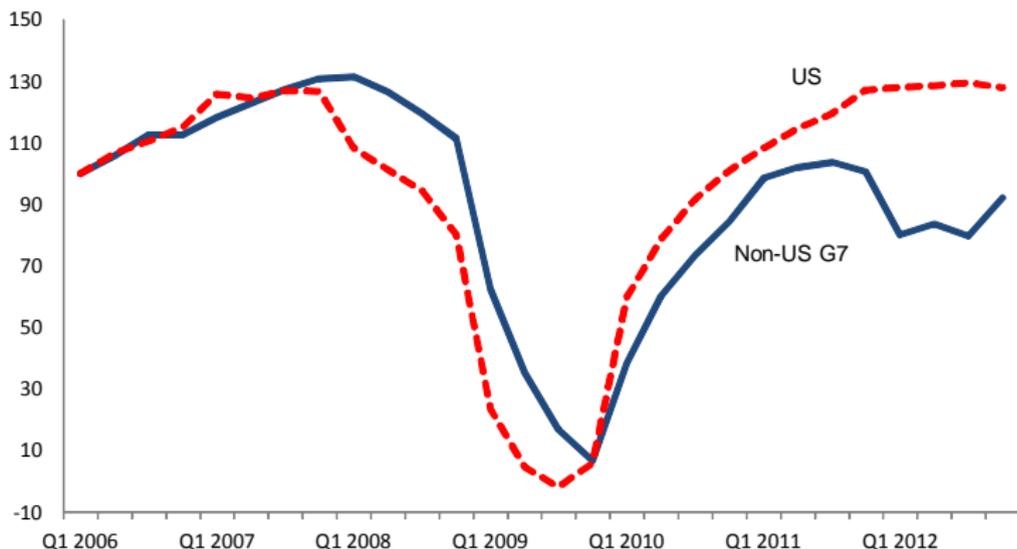
- Common to model the Great Recession as resulting from financial balance sheet shocks, impacting the real economy through a decline in credit and wealth
- Bank credit
 - did not go down in 2008: Chari, Christiano and Kehoe (2008)
 - did fall in 2009 in U.S., but much less in the rest of the world
- 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

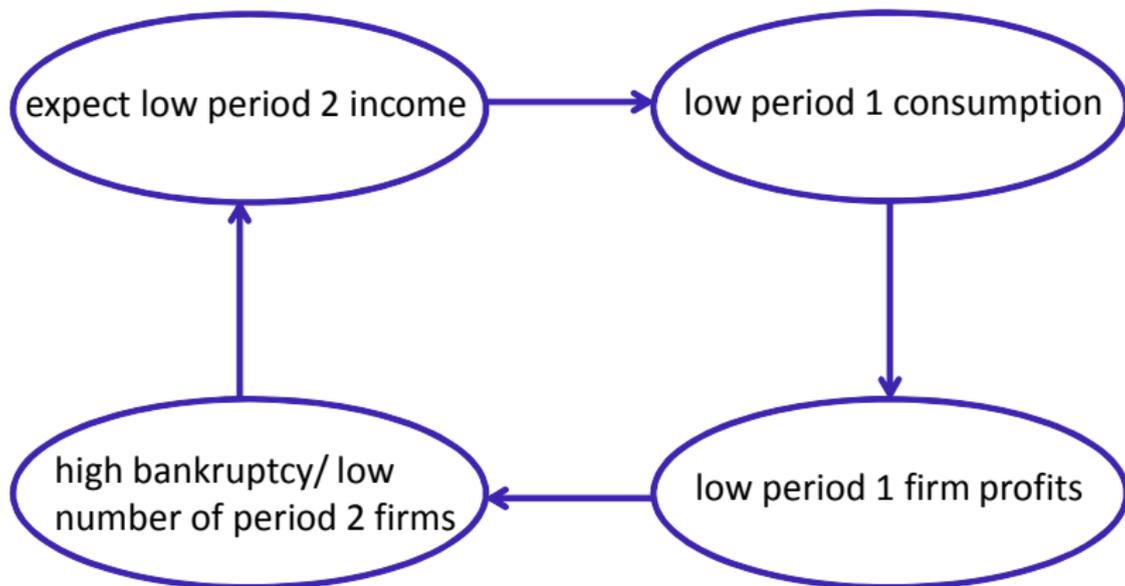


Source: Worldscope, *Net profits (income)*. Profits are aggregated over continuing firms within each country, divided by the GDP deflator, and normalized at 100 in 2006:Q1. The non-US G7 series is computed using relative PPP-adjusted GDP weights.

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

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
- We develop a New Keynesian model with self-fulfilling business cycle panics

Main Results

- 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

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

where :

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

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

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

- Face a cash-in-advance constraint:

$$P_{H,t}c_{H,t} + S_t P_{F,t}c_{F,t} \leq M_t \quad (5)$$

- Price index:

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

Household First Order Conditions

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

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

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

$$c_{H,t} = \psi \frac{P_t}{P_{H,t}} c_t \quad (9)$$

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

$$\frac{W_t}{P_t} = \lambda c_t^\gamma \quad (11)$$

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 $(1 + i)\beta = 1$

- Output of Home firm j in period t is

$$y_t(j) = AL_t(j)^\alpha \quad (13)$$

- 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, $n = \bar{n} < 1$
- 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 $1 - \bar{n}$ 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

$$\Pi_1 = P_{H,1}y_1 - W_1L_1$$

- Firms have a maximum borrowing limit:

$$(1 + i_1)D(j) \leq \phi\Pi_2(j) \quad (14)$$

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

$$\Pi_1 + \frac{\phi\Pi_2(j)}{1 + i_1} < P_1z(j) \quad (15)$$

- Define real available funds

$$\pi \equiv \pi_1 + \phi \frac{\pi_2}{1 + i_1} \quad (16)$$

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

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

$$\pi < z(j) \quad (17)$$

Market Clearing

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

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

$$M_t = \bar{M}_t \quad t = 1, 2 \quad (20)$$

$$B(s) = D(s) \quad (21)$$

- Balanced trade condition

$$S_t P_{F,t} c_{F,t} = P_{H,t} c_{H,t}^* \quad (22)$$

Implies

$$P_t c_t = S_t P_t^* c_t^* \quad (23)$$

Equilibrium

- The model can be boiled down to a system in c_1 , c_1^* , π_1 , π_1^* , c_2 and c_2^*
- First consider symmetric equilibria where $c_1 = c_1^*$, $\pi_1 = \pi_1^*$
- Assuming $g_t = 0$ and $\phi = 0$

$$c_1 = \frac{n^\zeta}{\theta} \quad (24)$$

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

$$\text{with } n = \begin{cases} \bar{n} & \text{if } \pi < z \\ 1 & \text{if } \pi \geq z \end{cases} \quad (26)$$

Two Assumptions

① $z < [\mu(1 - \alpha) + \alpha] / (\mu\theta)$

② $\pi(1) > \pi(\bar{n})$

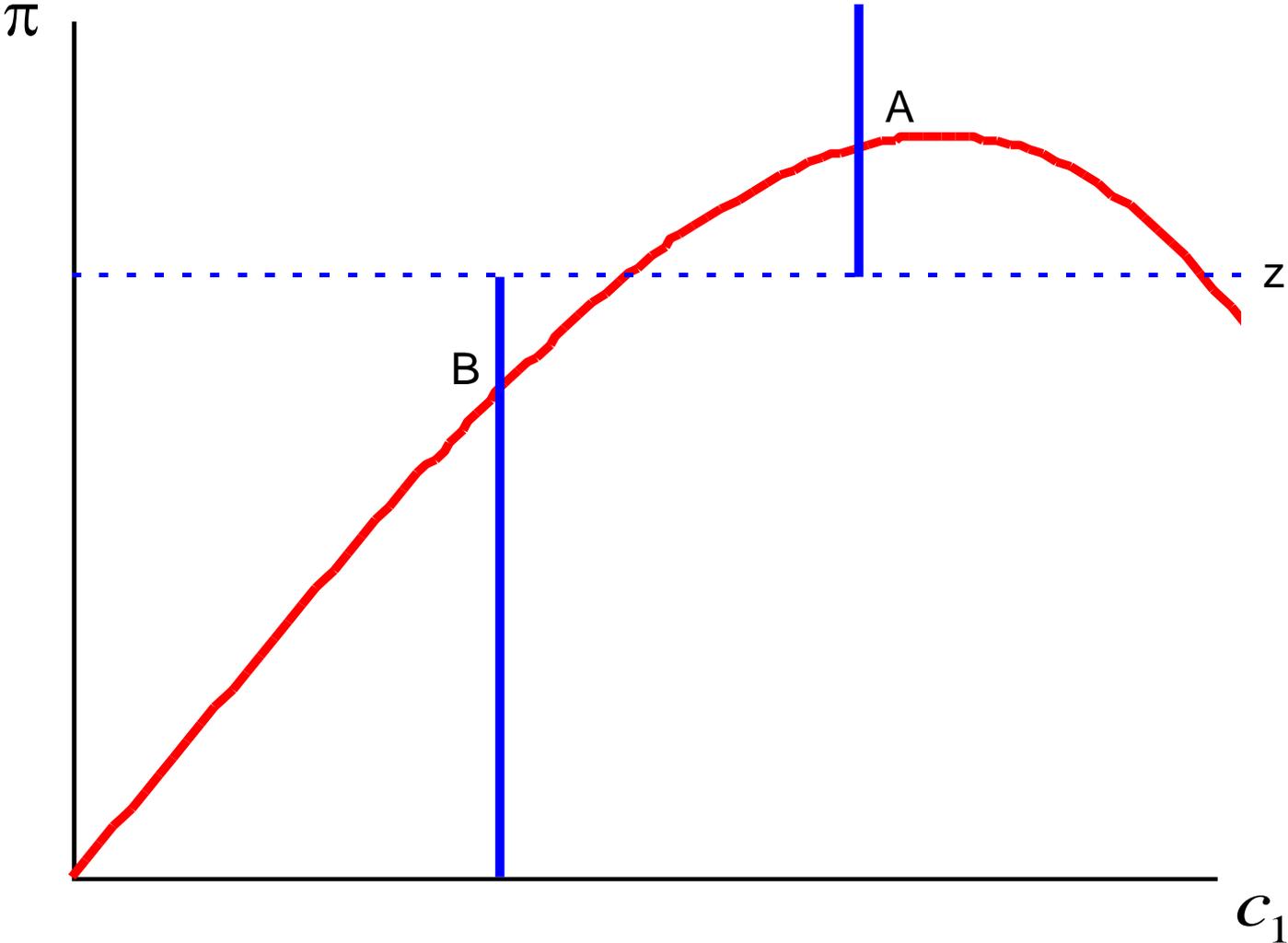
- Assumption 1 implies that first period profits are positive in equilibrium when prices are flexible (no bankruptcy under flexible prices); it also implies $z < \pi(1)$
- Assumption 2 implies that parameters are such that profits are lower in a bad equilibrium with firm bankruptcies and low consumption

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

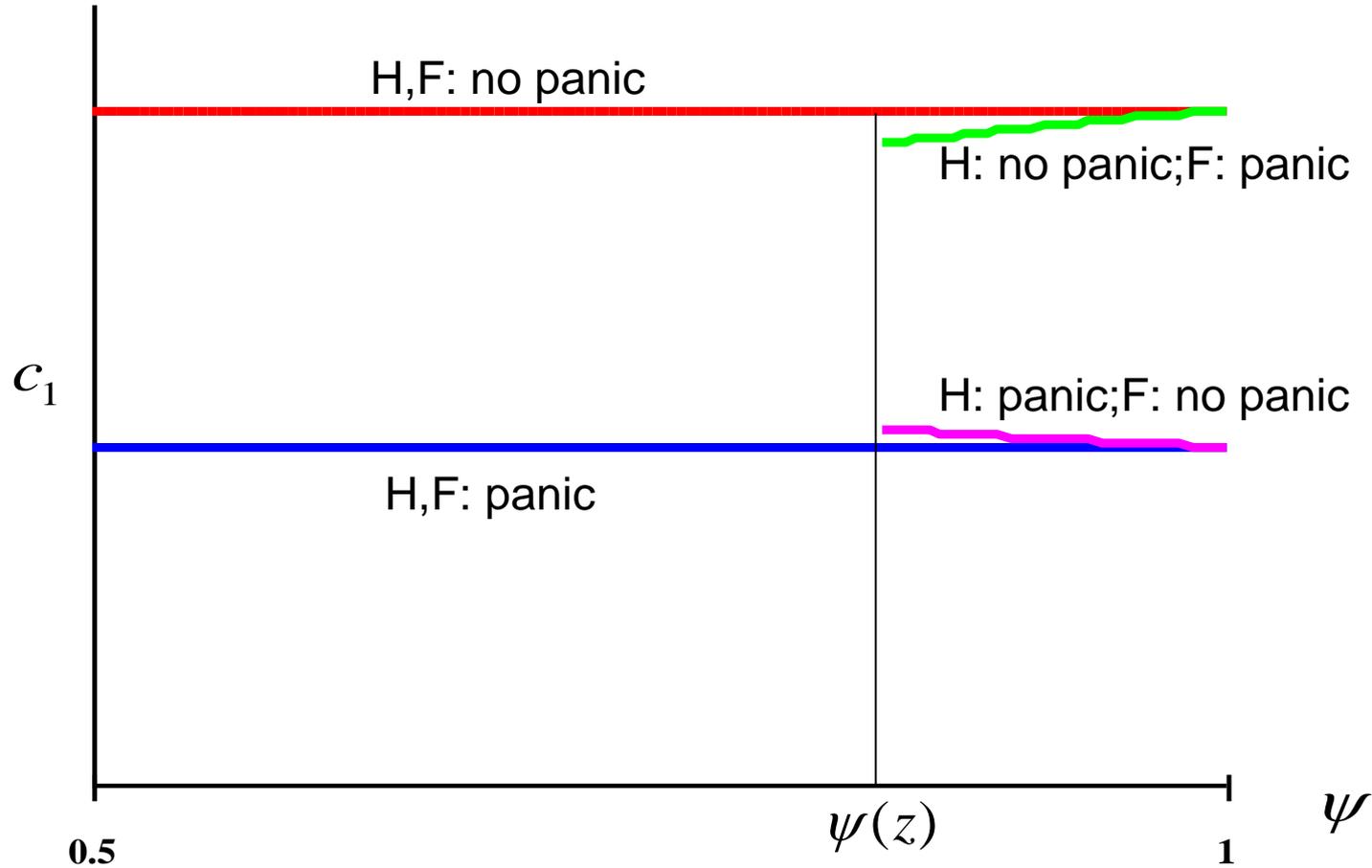
Figure 5 Symmetric Equilibria*



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

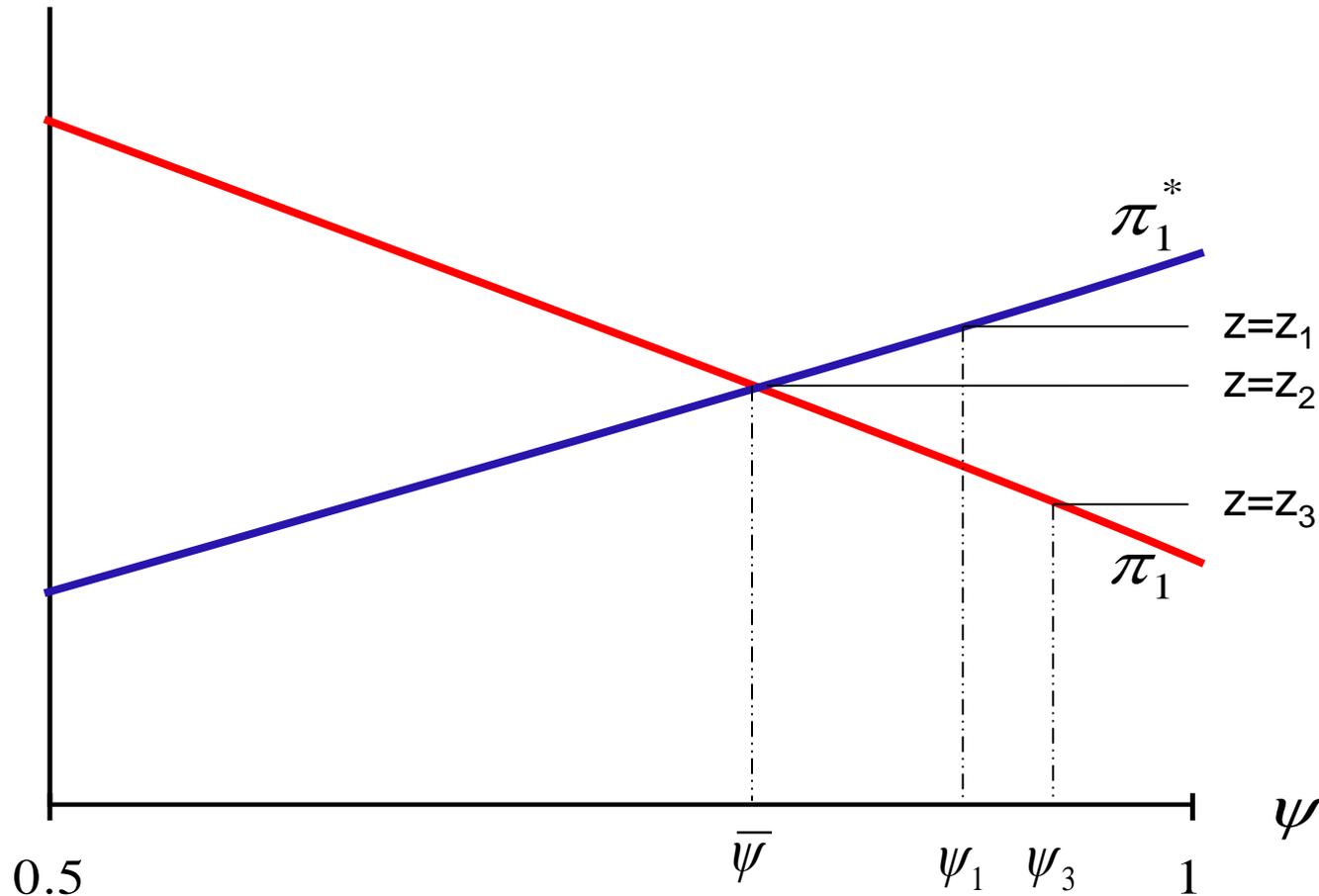
Figure 6 All Equilibria: Role of Trade Integration



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

Figure 8 On Existence of Asymmetric Equilibria*

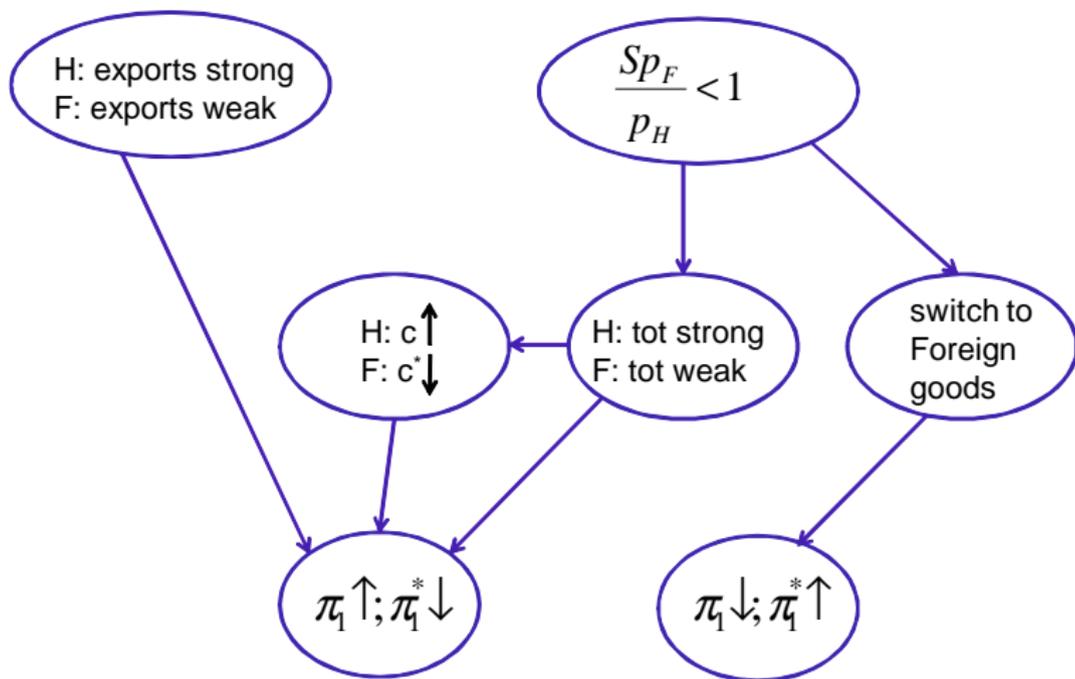


* The profit schedules are drawn under the assumption that there is a panic in Home and no panic in Foreign. When $z=z_i$ a mixed equilibrium exists as long as $\psi > \psi_1$ for $i=1$ and $i=3$. When $z=z_2$ a mixed equilibrium exists as long as $\psi > \bar{\psi}$.

Spillover Channels

- Again consider the case where only Home panics
- In that case $c_1 > c_1^*$
- The higher Foreign consumption has a favorable impact on the Home profits through various channels

Effect of Trade on Profits in Asymmetric Equilibrium ($n < 1$ and $n^* = 1$)



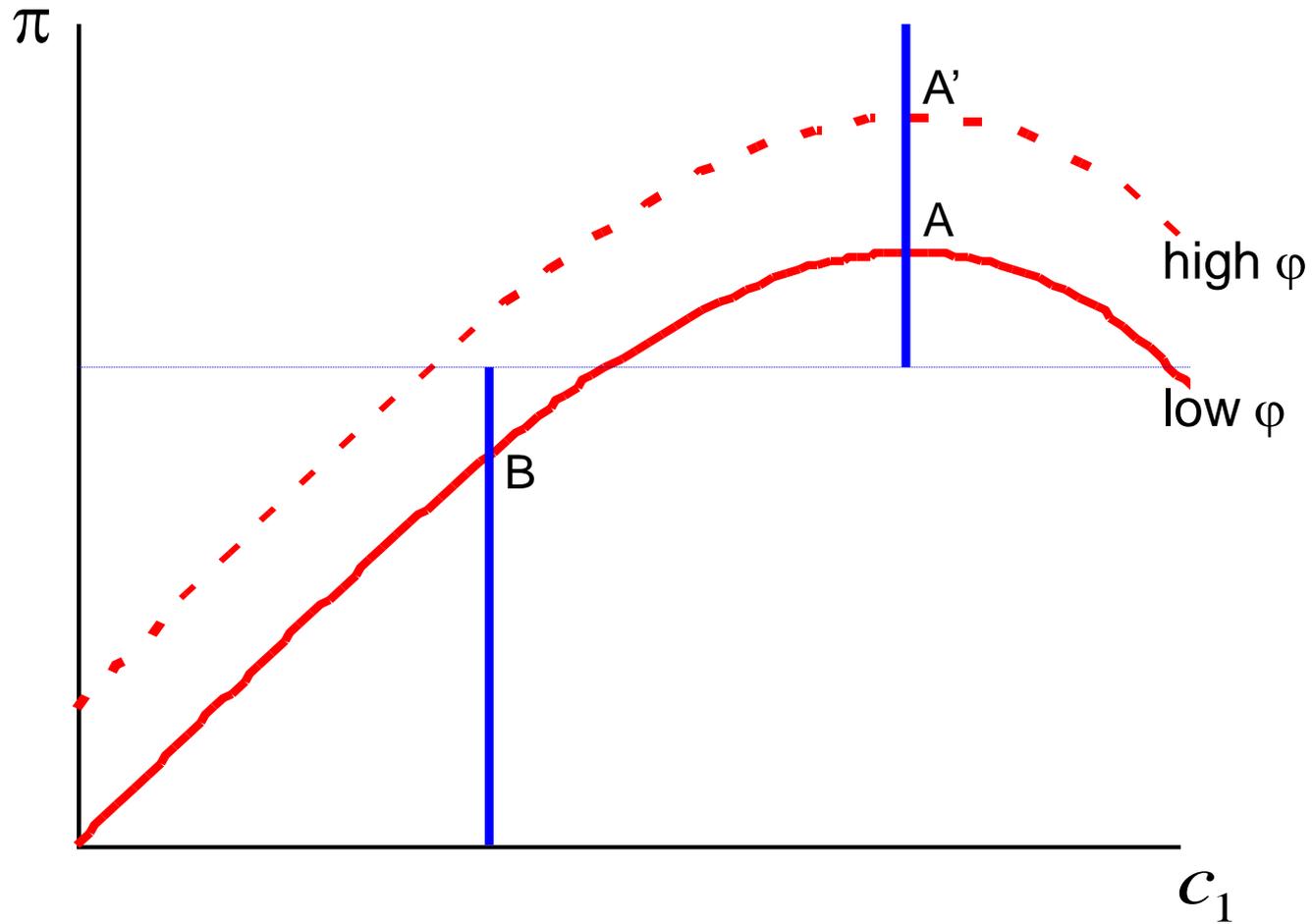
Vulnerabilities

- 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

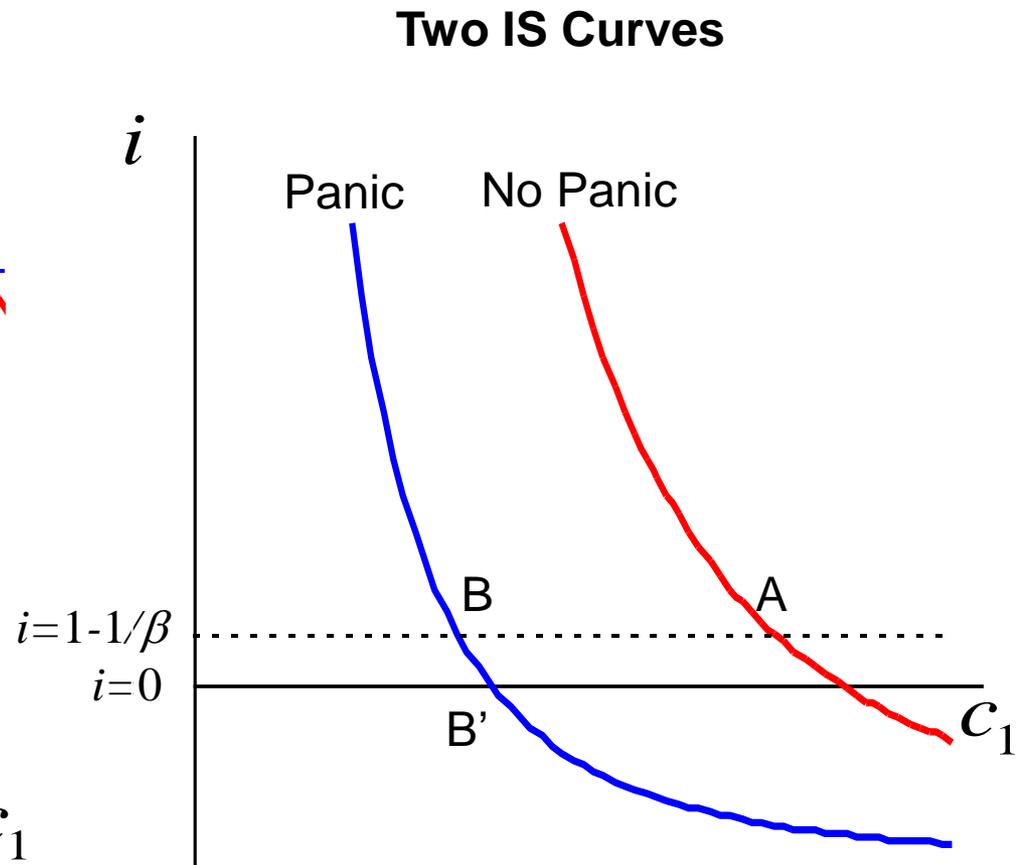
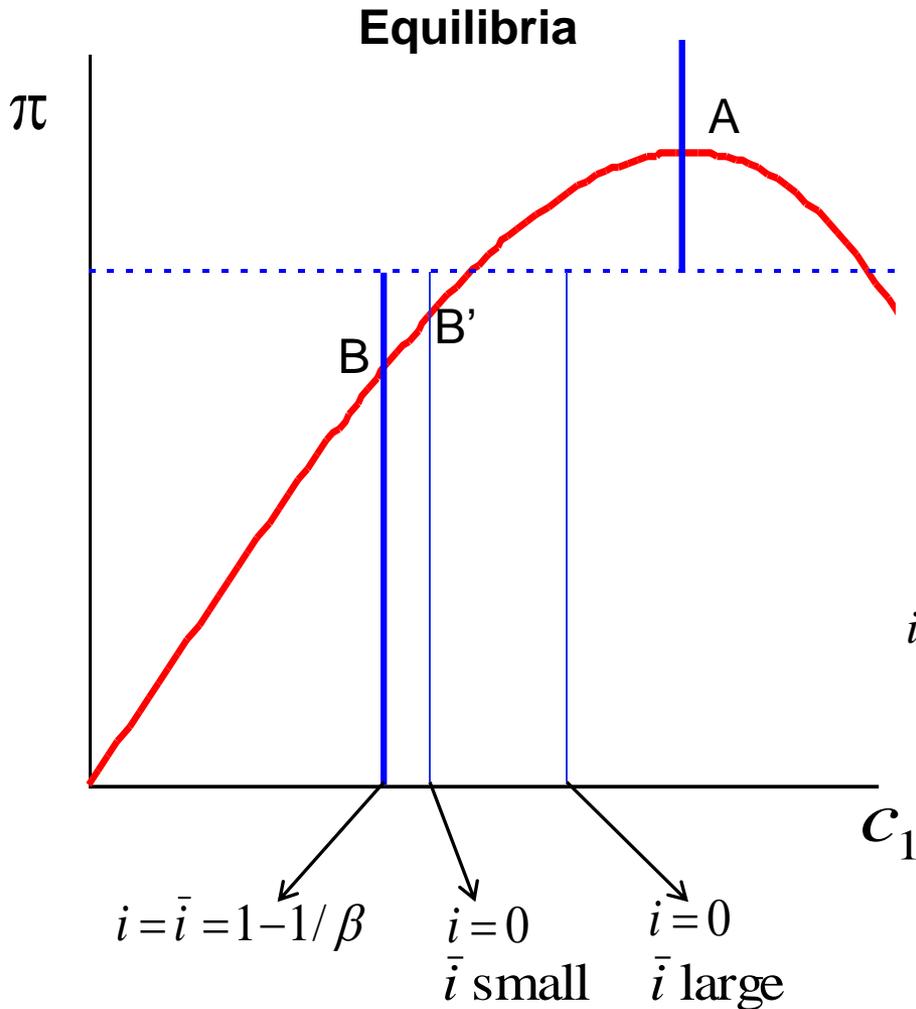
Figure 9 Panic Vulnerability: Role of Credit



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

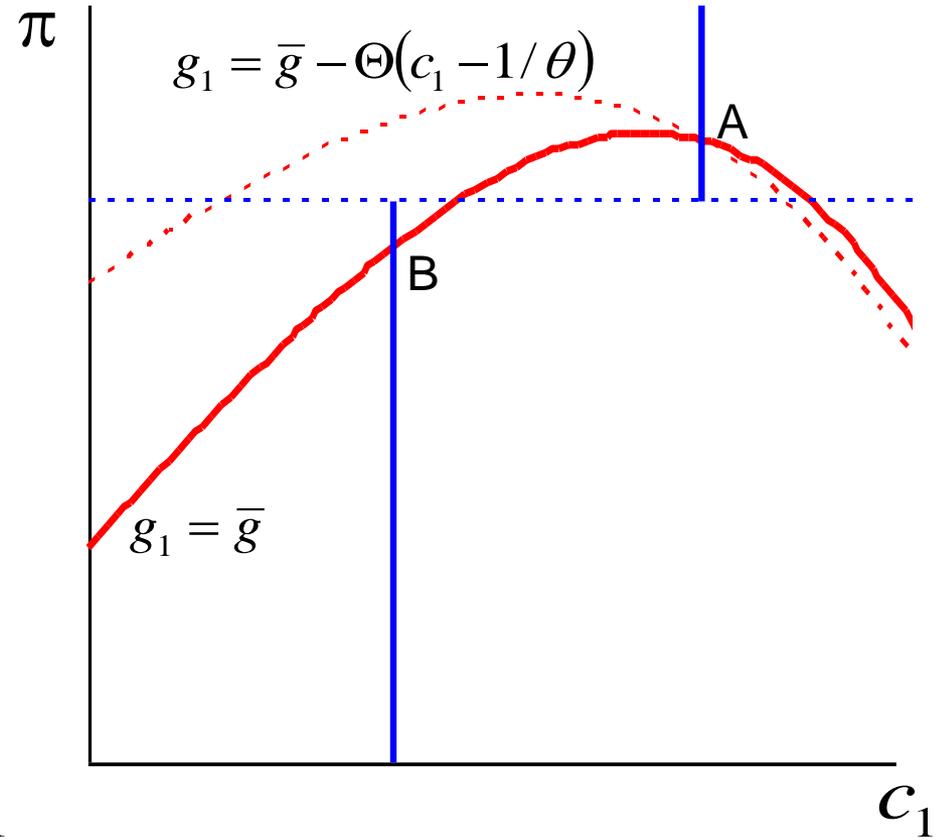
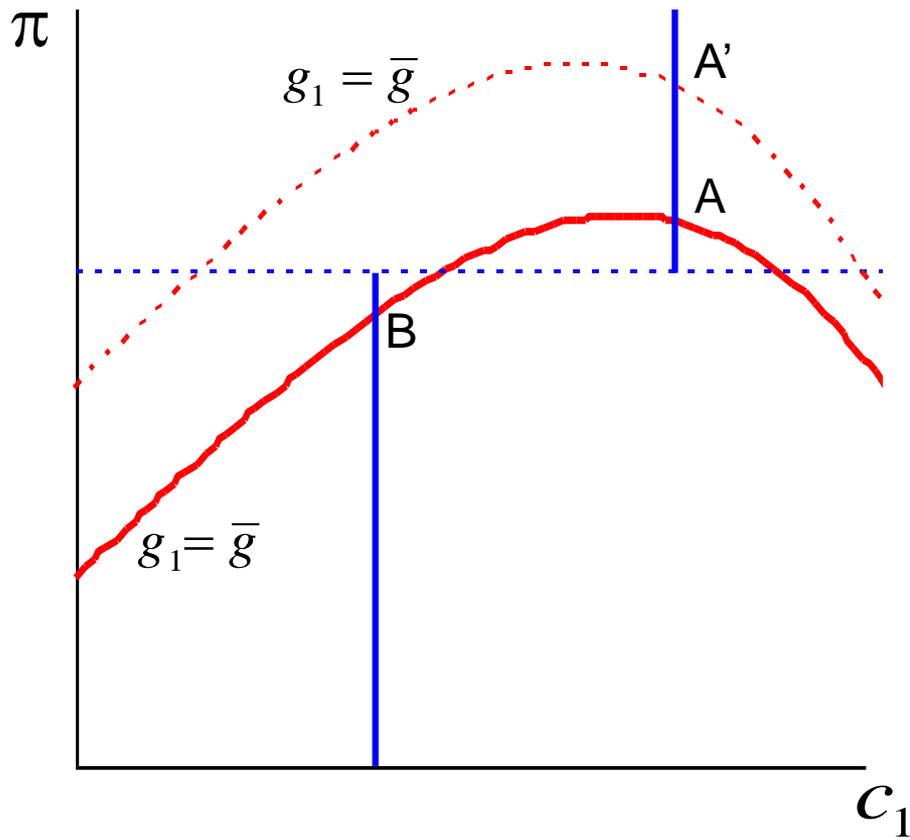
- A strongly countercyclical fiscal policy could avoid a panic
- Assume that government spending is strongly *countercyclical*

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

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 $n = \bar{n}$ 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, $1 - \bar{n}$ 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

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