Inflation and Time Inconsistency

$(\pi^* = 0)$

Central bank

<table>
<thead>
<tr>
<th>Coop solution</th>
<th>Discretion</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\pi = 0$</td>
<td>$\pi = \pi^D$</td>
</tr>
<tr>
<td>$Y = Y_n$</td>
<td>$Y_n &lt; Y &lt; kY_n$</td>
</tr>
<tr>
<td>$L = L^C$</td>
<td>$L = L^D$</td>
</tr>
</tbody>
</table>

workers

$\pi^\text{exp} = 0$

$\pi^\text{exp} = \pi^D = \pi^\text{RE}$

Rational exp equil

$Y = Y_n$

$L = L^{RE}$
The Crisis: where are we?

“Deleveraging”, “Quantitative Easing” and “Tapering”

14.02 Spring 2014
Real house prices (indices, 2000=100)

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Source: IMF, World Economic Outlook, October 2013
House prices and household debt (mortgages)

**leverage = 10**

<table>
<thead>
<tr>
<th>house</th>
<th>debt and equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>house</td>
<td>100</td>
</tr>
<tr>
<td>equity</td>
<td>10</td>
</tr>
<tr>
<td>debt</td>
<td>90</td>
</tr>
</tbody>
</table>

**leverage = 9.18**

<table>
<thead>
<tr>
<th>house</th>
<th>debt and equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>house</td>
<td>101</td>
</tr>
<tr>
<td>equity</td>
<td>11</td>
</tr>
<tr>
<td>debt</td>
<td>90</td>
</tr>
</tbody>
</table>

• The additional 9$ borrowed are spent

• Leverage and amplification
  • 1$ increase in house price
  • 9$ increase in spending

**leverage = 10**

<table>
<thead>
<tr>
<th>house</th>
<th>debt and equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>house</td>
<td>101</td>
</tr>
<tr>
<td>equity</td>
<td>11</td>
</tr>
<tr>
<td>cash</td>
<td>9</td>
</tr>
<tr>
<td>debt</td>
<td>99</td>
</tr>
</tbody>
</table>
Households’ leverage ratios: debt to disposable income

Source: IMF, World Economic Outlook, October 2008
House prices and household debt (mortgages)

Source: IMF, World Economic Outlook, October 2013
Deleveraging: US Household saving (percent of disposable income)

Deleveraging: US Household consumption
(constant dollars)

The consequences of Banks’ Deleveraging
### Asset prices and banks’ leverage

#### Leverage = 10

<table>
<thead>
<tr>
<th>assets</th>
<th>liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>liabilities</td>
<td>90</td>
</tr>
</tbody>
</table>

#### Leverage = 19

<table>
<thead>
<tr>
<th>assets</th>
<th>capital</th>
<th>liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>liabilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>90</td>
</tr>
</tbody>
</table>

#### Leverage = 10

<table>
<thead>
<tr>
<th>assets</th>
<th>liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>liabilities</td>
<td>45</td>
</tr>
</tbody>
</table>

After a fall in asset values, banks sell asset: Demand function slopes the wrong way!
The leverage cycle

Adjust leverage

Weaker balance sheets

Reduce B/S size

Asset price decline
Banks deleveraging: an example

Figure 4
Leverage Ratio for Investment Banks

as of Fiscal Year End, 2002 - 2008

Leverage Ratio

35
30
25
20
15
10

2002  2003  2004  2005  2006  2007  2008

Note: Leverage ratio calculated as total assets divided by stockholders' equity.

Source: Company 10-K SEC filings

Courtesy of the Federal Reserve Bank of Boston. Used with permission.
Banks’ leverage and deleveraging

Chart 5.6 Major UK banks’ leverage ratios

Sources: Published accounts and Bank calculations.

(a) For explanatory notes see Chart 2.4.
Bank deleveraging and bank lending to firms

Chart 5.12 Lending to UK businesses by size

Percentage changes on a year earlier

Sources: Bank of England, British Bankers’ Association (BBA), Department for Business, Innovation and Skills (BIS) and Bank calculations.

(a) Rate of growth in the stock of loans. Data are non seasonally adjusted.
(b) Data cover both sterling and foreign currency loans. The latest observation is September 2011.
(c) BIS data and Bank calculations. Stock of sterling and foreign currency lending, expressed in sterling terms, by four UK lenders to enterprises with an annual bank account debit turnover of less than £25 million. The latest observation is August 2011.
(d) BBA data. Stock of sterling lending by seven UK lenders to commercial businesses with an annual bank account debit turnover of up to £1 million. Data are quarterly until September 2009 and monthly thereafter. The last observation is June 2011: www.bba.org.uk/statistics/article/small-business-support-december-2010/small-business/.

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Bank deleveraging and bank lending to households and firms

Source: IMF, World Economic Outlook, October 2013

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How long does a deleveraging cycle last?

Source: Koo, 2008
Reducing leverage: Japan 1990 - 2010

Funds Raised by Non-Financial Corporate Sector

(% Nominal GDP, 4Q Moving Average)

CD 3M rate
(right scale)

Borrowings from Financial Institutions (left scale)

Funds raised in Securities Markets (left scale)

Sources: Bank of Japan, Cabinet Office, Japan

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Per-capita income after a banking crisis

average of 88 episodes

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Source: IMF, World Economic Outlook, October 2009
Macroeconomics

how it responded to the crisis and the challenges today
Source: IMF, World Economic Outlook, April 2014
How did monetary and fiscal policy respond?
However they responded, it worked!

This crisis and the Great Depression in the 1930s

Source: Eichengreen and O’Rourke, Vox-EU, March 2010
Fiscal policy

Source: IMF, World Economic Outlook
US Federal Government debt (percent GDP, 1940-2013)

Image is in the public domain courtesy of the Congressional Budget Office.
Decomposition of Government Debt Increase, 2007–14 (total debt increase: 35.5 percent of GDP)

- Fiscal stimulus (3.5)
- Financial support (3.0)
- Higher interest payments (4.0)
- Revenue loss from lower asset prices and financial profits (9.0)
- Automatic stabilizers (10.0)
- Other (6.0)

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Monetary policy

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Zero Lower Bound: the “Liquidity Trap”

• Spending shock shifts IS to IS ‘

• Monetary policy response shifts LM to LM ‘

• Zero Lower Bound

• Central bank buys asset, prints money: Quantitative Easing

• IS ‘ shifts up to IS ”
Quantitative Easing and the Holmstrom-Tirole model

- $\rho = i + x$ : interest rate at which firms can borrow
- $\text{Investment} = I(Y, \rho)$
- Crisis reduces banks’ capital (slide 11)
  - $x = f(\text{capital of banks and own resources of entrepreneurs, } A)$
    - for given $i$, Investment ↓
    - Quantitative Easing raises banks’ capital $x$ ↓
      - For given $i$, Investment ↑
The «asset side» of the Federal Reserve’s balance sheet, before the crisis

SOMA Holdings, 1970-2007

Billions of 2012 dollars

Note: The consumer price index was used to convert historical values to 2012 dollars.

Image is in the public domain courtesy of the Federal Reserve of New York.
The «asset side» of the Federal Reserve’s balance sheet, today
## Quantitative easing

### before

**Central Bank**

<table>
<thead>
<tr>
<th>assets</th>
<th>liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gvt bills 100</td>
<td>cash 80</td>
</tr>
<tr>
<td>bank reserves</td>
<td>20</td>
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**Commercial Bank**

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<tr>
<td>Mortgage backed securities</td>
<td>deposits 90</td>
</tr>
<tr>
<td>reserves 20</td>
<td>equity 10</td>
</tr>
</tbody>
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### after

**Central Bank**

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<tr>
<td>reserves 0</td>
<td>equity 10</td>
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</tbody>
</table>
Quantitative easing and Credit easing

Fed «Tapering» and its consequences

![Graph showing net capital flows to emerging markets](image)

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