Liquidity Trap and Excessive Leverage

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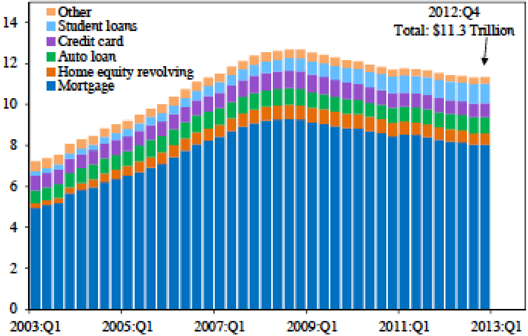
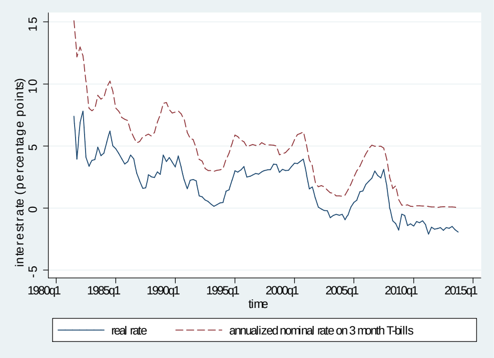
Deleveraging played important role in recession



Source: Federal Reserve Bank of New York, Quarterly Report on Household Debt and Credit.

- Micro evidence: Deleveraging explains much of job losses (Mian-Sufi).

One view: Low rates and the liquidity trap



- Formalized by: Eggertsson-Krugman, Hall, Guerrieri-Lorenzoni...
- Stimulated policy analysis. Ex-post focus. Ignored debt market.

This paper: Ex-ante/macroprudential policies.

Main results: Excessive leverage and underinsurance

Model of **deleveraging and liquidity trap**:

- **Deleveraging shifts wealth** from borrowers (high MPC) to lenders (low MPC) $\rightarrow$ lower aggregate demand
- May push economy into **liquidity trap**

Main results:

- Competitive equilibrium is **constrained inefficient: Excessive leverage** and **underinsurance**.
- Pareto improvement by **macroprudential policies** targeted towards reducing leverage, e.g., **debt limits** and **mandatory insurance.**

Main results: Excessive leverage and underinsurance

Source of inefficiency:

- Aggregate demand externalities
  = **novel motive for macroprudential regulation**
- should become part of the **standard toolkit of macro stabilization** policy, in addition to monetary and fiscal policy
- particularly important if countries lose independent monetary policy (and if fiscal policy is constrained)

→ see also "Macroprudential Policy Beyond Banking Regulation" (with Olivier Jeanne, BdF Financial Stability Review)

Interest rate policy is not the ideal tool to reduce leverage

- Common argument: Raising r can curb leverage.
- Under reasonable conditions: **Higher r may actually raise leverage**!
  $\longrightarrow$ Conventional wisdom dominated by general equilibrium effects.
- Even when conventional wisdom dominates, raising r is inefficient
- Problem is **misallocation of wealth between borrowers-lenders.**
- **Macroprudential policies** target this. Interest rate policy does not.

Related literature

Deleveraging and the liquidity trap: Eggertsson-Krugman...

- We focus on debt market policies and ex-ante policies.

Aggregate demand externalities:

- Older literature, e.g., Blanchard-Kiyotaki (1987). Different context.
- More recent work by Schmitt-Grohe-Uribe and Farhi-Werning
- We focus on AD externalities in a liquidity trap

Excessive leverage: Optimism, moral hazard, fire-sale externalities.

- New mechanism. Complementary, but important differences.

Environment with anticipated borrowing constraints

- Single good (dollar) and dates $t \in \{0, 1, ..\}$.
- Households $h \in \{b, l\}$, with equal mass normalized to $1/2$.
- Types identical except $\beta^b \leq \beta^l$ and $d_0 \equiv d_0^b = -d_0^l \geq 0$.
- **First ingredient: Future borrowing constraints:**
  - For each $t \geq 1$, agents face borrowing constraint $d_{t+1}^h \leq \phi$, which may force them to delever
  - This is fully **anticipated** in baseline setup.
- Let r_{t+1} denote the real interest rate between t and $t+1$.

Main ingredient: Lower bound on the interest rate

- Key ingredient is **the lower bound on the real interest rate**:

$$r_{t+1} \geq \underline{r} \text{ for each } t \geq 1.$$

- In practice, the lower bound emerges from two features:
  1. **Zero lower bound on the nominal interest rate:**

$$i_{t+1} \geq 0 \text{ for each } t \geq 0.$$

  2. **Sticky inflation expectations:**

$$E_t \left[P_{t+1}/P_t \right] = 1 + \zeta \text{ for each } t \geq 1.$$

- The combination gives the bound on the real rate with $\underline{r} \simeq -\zeta$.

Demand side: Household optimization

- Baseline preferences $u\left(\tilde{c}_t^h - v\left(n_t^h\right)\right)$ – generalized in appendix.
- Define $c_t^h = \tilde{c}_t^h - v\left(n_t^h\right)$ as net consumption. Households solve:

$$\begin{aligned}
\max_{\left\{c_t^h, d_{t+1}^h, n_t^h\right\}_t} \quad & \sum_{t=0}^{\infty} \left(\beta^h\right)^t u\left(c_t^h\right) \\
\text{s.t. } c_t^h \quad &= \quad e_t^h - d_t^h + \frac{d_{t+1}^h}{1 + r_{t+1}} \text{ for all } t, \\
\text{where } e_t^h \quad &= \quad w_t n_t^h + \Pi_t - v\left(n_t^h\right) \text{ denotes net income,} \\
\text{and } d_{t+1}^h \quad &\leq \quad \phi \text{ for each } t \geq 1.
\end{aligned}$$

Supply side: Linear technology

- Technology: 1 unit of labor to 1 unit of consumption good.
- Efficient level of output maximizes net income:

$$e^* = \max_{n_t} n_t - v(n_t).$$

- If $r_{t+1} \geq \underline{r}$ binding, price of current consumption too high.
  $\rightarrow$ Insufficient demand.

Supply side: Rationing when interest rate is too high

- Final good firms solve:

$$\Pi_t = \max_{n_t} n_t - w_t n_t \quad \text{s.t.} \quad \begin{cases} 0 \leq n_t, & \text{if } r_{t+1} > \underline{r} \\ 0 \leq n_t \leq \frac{\tilde{c}_t^b + \tilde{c}_t^l}{2}, & \text{if } r_{t+1} = \underline{r} \end{cases}.$$

- If $r_{t+1} > \underline{r}$, firms optimize as usual.
- If $r_{t+1} = \underline{r}$, firms are subject to additional **rationing constraint**. (For simplicity, we normalize $\underline{r} = 0$.)

- Rationing equilibrium as in Barro-Grossman, Malinvaud, Benassy.
- NK model: Similar rationing from sticky (monopolistic) prices.

Equilibrium after deleveraging is complete

- Dates $t \geq 2$: Steady state with $1 + r_{t+1} = 1/\beta^l$.
- Output is at its efficient level: $e_t = e^*$.
- Agents' consumption is given by:

$$c_2^l = e^* + \phi \left(1 - \beta^l\right) \text{ and } c_2^b = e^* - \phi \left(1 - \beta^l\right).$$

- Next consider date 1, the date at which deleveraging happens...

Equilibrium during the deleveraging episode

Borrowers' (constrained) consumption: $c_1^b = e_1 - \left(d_1 - \frac{\phi}{1+r_2}\right)$.

Lenders' (unconstrained) consumption: $c_1^l = e_1 + \left(d_1 - \frac{\phi}{1+r_2}\right)$.

- Deleveraging mediated by reduction in real rates (Euler):

$$u'\left(c_1^l\right) = \beta^l \left(1 + r_2\right) u'\left(e^* + \phi(1 - \beta^l)\right).$$

- Constraint $r_2 \geq 0$, implies **upper bound on lender consumption**:

$$c_1^l \leq \overline{c}_1^l \text{ where } u'\left(\overline{c}_1^l\right) = \beta^l u'\left(e^* + \phi(1 - \beta^l)\right).$$

Equilibrium during the deleveraging episode

Equilibrium depends on:

$$\underbrace{d_1 - \phi}_{\text{leverage adjustment at 0 rate}} \lesseqgtr \underbrace{\overline{c}_1^l - e^*}_{\text{unconstrained agents' buffer at 0 rate}},$$

- If adjustment is sufficiently small, then $r_2 > 0$ and $e_1 = e^*$.
- Otherwise, if leverage adjustment is sufficiently high:

$$d_1 \geq \overline{d}_1 = \phi + \overline{c}_1^l - e^*,$$

then $r_2 = 0$ and we are in the constrained/rationing regime...

Liquidity trap, Keynesian cross, and Keynesian multiplier

- Net income is then determined by aggregate demand:

$$e_1 = \frac{c_1^b + c_1^l}{2}$$

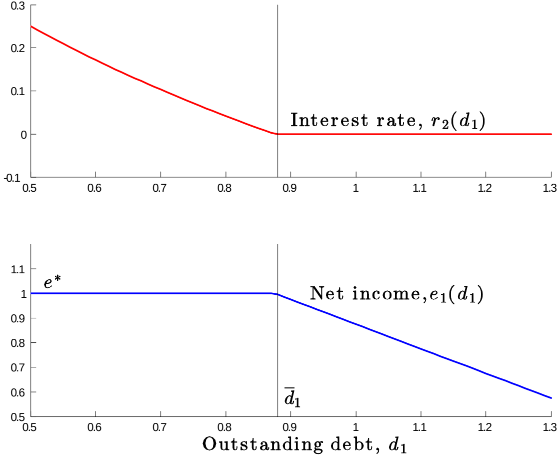
- Agents' consumption are $c_1^b = e_1 - (d_1 - \phi)$ and $c_1^l = \overline{c}_1^l$, and thus:

$$e_1 = \frac{e_1 - (d_1 - \phi) + \overline{c}_1^l}{2}.$$

- This is a Keynesian cross with associated Keynesian multiplier.
- Solving it, we obtain the equilibrium net income:

$$e_1 = \overline{c}_1^l + \phi - d_1.$$

Graphical illustration of equilibrium



Borrowing in the decentralized equilibrium

- Date 0 equilibrium determined by Euler equations:

$$1 + r_1 = \frac{u'\left(c_0^l\right)}{\beta^l u'\left(c_1^l\right)} = \frac{u'\left(c_0^b\right)}{\beta^b u'\left(c_1^b\right)}.$$

- Anticipated recession if $d_1 > \overline{d}_1$.
- Is this efficient? We turn to welfare analysis...

Pecuniary externalities hurt some agents, benefit others

- Define agents' date 1 welfare as a function of debt:

$$V^b\left(\underbrace{d_1}_{\text{own}},\underbrace{D_1}_{\text{aggregate}}\right)=u\left(e_1\left(D_1\right)-d_1+\frac{\phi}{1+r_2\left(D_1\right)}\right)+\text{continuation}.$$

- If $D_1<\bar{d}_1$, then $r_2>\underline{r}$ and pecuniary externalities in r_2 apply:

$$\frac{\partial V^h}{\partial D_1}=\begin{cases}-\eta u'\left(c_1^h\right)<0, \text{ if } h=l\\ \eta u'\left(c_1^h\right)>0, \text{ if } h=b\end{cases} \quad \text{where } \eta\in(0,1).$$

- Externalities net out. Equilibrium is constrained efficient in this range.

Aggregate demand externalities hurt all agents

- If $D_1 > \bar{d}_1$, then **aggregate demand externalities** imply $e_1 < e^*$:

$$\frac{\partial V^h}{\partial D_1} = \frac{\partial e_1}{\partial D_1} u'\left(c_1^h\right) = -u'\left(c_1^h\right) < 0, \text{ for each } h \in \{b, l\}.$$

- Unlike price externalities, **AD externalities negative for all agents**.

- Analyze a planner who can impose a debt limit coupled with a date 0 transfer to trace the Pareto frontier.

Proposition

Any equilibrium with $D_1 > \bar{d}$ is constrained inefficient.

If limit is binding, constrained efficiency requires

$$\frac{\beta^l u'\left(c_1^l\right)}{u'\left(c_0^l\right)} > \frac{\beta^b u'\left(c_1^b\right)}{u'\left(c_0^b\right)}.$$

Interesting but extreme result: Ex-post inefficiency

- We can obtain even **ex-post Pareto improvement** by writing down all borrowers' debt to $\overline{d}_1$, so that $D_1 = \overline{d}_1$.
- Borrowers are clearly better off.
- Lenders are indifferent since they continue to consume $\overline{c}_1^l$ (lower D_1 increases incomes and offsets lenders' losses)

$\longrightarrow$ Ex-post inefficiency is interesting, but requires specific circumstances (unlike ex-ante inefficiency)

Consider version with uncertainty

Uncertainty: Permanent states $s \in \{H, L\}$ starting date 1 with:

- $d_{t+1,L} \leq \phi$ for each $t \geq 1$
- $d_{t+1,H}$ unconstrained for each $t \geq 1$.
- Probability of each state $\{\pi_s^h\}$, with $\pi_L^h > 0$ for each h.

Complete one-period markets at date 0:

- AD securities with $q_{1,L}$ and $q_{1,H}$. Let $1 + r_1 = 1/\left(q_{1,L} + q_{1,H}\right)$.
- Agents choose outstanding debt/assets: $\left\{d_{1,L}^h, d_{1,H}^h\right\}_h$.

Proposition

Decentralized allocations with $D_{1,L} > \overline{d}_1$ are constrained inefficient.

$\rightarrow$ Case for mandatory insurance (Shiller...)

Preventive monetary policies

1. Higher inflation target (Blanchard et al., 2010)
    - Relaxes the ZLB constraint: $r_{t+1} \geq \underline{r}$
    - Effective tool to mitigate AD externalities.

2. Contractionary interest rate policy $\underline{r}_1$: three effects:
    - **Substitution effect:** Higher $\underline{r}_1$ reduces d_1^b but raises d_1^l.
    - **Income (recession) effect:** e_0 falls: increases d_1^b, lowers d_1^l.
    - **Redistribution:** Higher $\underline{r}_1$ transfers wealth from b to l, raising d_1^b.

For CRRA preferences, the latter dominates: $d_1^{\prime}\left(\underline{r}_1\right) > 0$.
→ higher interest rate may actually increase leverage!
→ monetary policy targets **wrong wedge** (between date 0 and 1)
→ macroprudential **wedge** (between b and l) is required
[conventional wisdom focuses only on substitution effect]

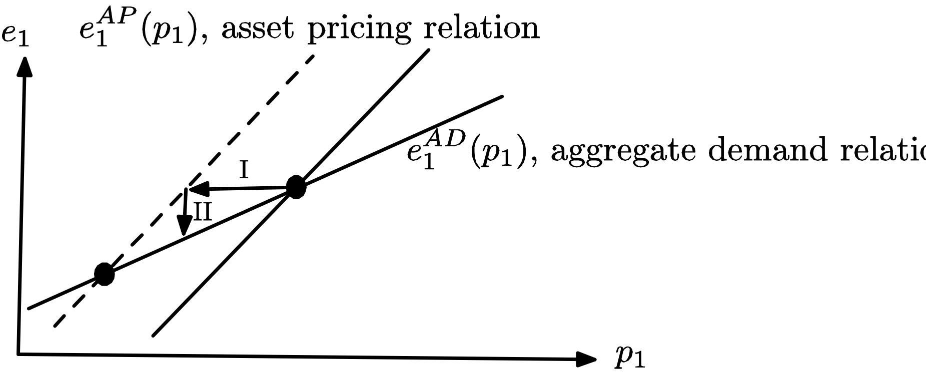
Extension with asset fire sales

- Borrowers have $a_t = 1$ units of tree that gives dividends.
- Borrowing limit depends on the value of the tree:

$$d_{t+1} / (1 + r_{t+1}) \leq \phi_{t+1} a_{t+1} p_t,$$

where ϕ_{t+1} is the fraction of the tree that can be collateralized.
- Similar to before, suppose $\phi_1 = 1$ and $\phi_{t+1} = \phi < 1$ for each $t \geq 1$.
- Equilibrium at $t = 1$ characterized by two equations in e_1 and p_1...

Fire sales reinforce the drop in AD and output



Channel I: Price reductions/fire sales

Channel II: Demand reductions/deleveraging

Fire sale externalities reinforce AD externalities

- The externalities from debt in this case can be written as:

$$\begin{aligned}\frac{\partial V^l}{\partial D_1} &= u'\left(c_1^l\right)\frac{de_1}{dD_1}, \\ \frac{\partial V^b}{\partial D_1} &= u'\left(c_1^b\right)\frac{de_1}{dD_1} + \phi\frac{dp_1}{dD_1}\left[u'\left(c_1^b\right) - \beta u'\left(c_2^b\right)\right].\end{aligned}$$

- As before, negative AD externalities on all agents.
- In addition, negative fire-sale externalities on borrowers.
- Fire-sale and AD externalities are highly complementary.

Conclusion: Liquidity trap and excessive leverage

Model of a liquidity trap driven by deleveraging:

- Excessive leverage and underinsurance.
- Source: Aggregate demand externalities.

New rationale for macroprudential policies that regulate leverage.