Liquidity Trap and Excessive Leverage

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Deleveraging played important role in recession

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

Korinek and Simsek (2014)
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) → 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!**
  → Conventional wisdom dominated by general equilibrium effects.
- Even when conventional wisdom dominates, raising $r$ is inefficient
- Problem is **misallocation of wealth between borrowers-lenders.**
- **Macropudential policies** target this. Interest rate policy does not.

Korinek and Simsek (2014)
Deleveraging and the liquidity trap: Eggertsson-Krugman...
- We focus on debt market policies and ex-ante policies.

Aggregate demand externalities:
- 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 $d_0 \equiv d^b_0 = -d^l_0 \geq 0$.
- **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**: \( r_{t+1} \geq r \) for each \( t \geq 1 \).

- In practice, the lower bound emerges from two features:
  1. **Zero lower bound on the nominal interest rate**: \( i_{t+1} \geq 0 \) for each \( t \geq 0 \).
  2. **Sticky inflation expectations**:
     \[ E_t [P_{t+1}/P_t] = 1 + \zeta \] for each \( t \geq 1 \).

- The combination gives the bound on the real rate with \( r \approx -\zeta \).
Demand side: Household optimization

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

$$\max_{\{c_t^h, d_{t+1}^h, n_t^h\}_t} \sum_{t=0}^{\infty} (\beta^h)^t u(c_t^h)$$

subject to

$$c_t^h = e_t^h - d_t^h + \frac{d_{t+1}^h}{1 + r_{t+1}}$$

for all $t$,

where $e_t^h = w_t n_t^h + \Pi_t - v(n_t^h)$ denotes net income,

and $d_{t+1}^h \leq \phi$ for each $t \geq 1$. 

Korinek and Simsek (2014)
Supply side: Linear technology

- Technology: 1 unit of labor to 1 unit of consumption good.
- Efficient level of output maximizes net income:
  $$e^* = \max_{n_t} n_t - \nu(n_t).$$
- If $r_{t+1} \geq r$ binding, price of current consumption too high. → Insufficient demand.
Supply side: Rationing when interest rate is too high

- Final good firms solve:

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

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

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

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

Borrowers’ (constrained) consumption: \( c_b^1 = e_1 - \left( d_1 - \frac{\phi}{1+r_2} \right) \).

Lenders’ (unconstrained) consumption: \( c_l^1 = e_1 + \left( d_1 - \frac{\phi}{1+r_2} \right) \).

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

\[
u' \left( c_l^1 \right) = \beta^l \left( 1 + r_2 \right) u' \left( e^* + \phi(1 - \beta^l) \right).
\]

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

\[
c_l^1 \leq \bar{c}_l^1 \text{ where } u' \left( \bar{c}_l^1 \right) = \beta^l u' \left( e^* + \phi(1 - \beta^l) \right).
\]
Equilibrium depends on:

\[ d_1 - \phi \] 

leverage adjustment at 0 rate

\[ \leq \] 

\[ c_1' - e^* \]

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:

\[ d_1 \geq d_1' = \phi + c_1' - e^* , \]

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:

\[ e_1 = \frac{c^b_1 + c^l_1}{2} \]

- Agents’ consumption are \( c^b_1 = e_1 - (d_1 - \phi) \) and \( c^l_1 = \bar{c}^l_1 \), and thus:

\[ e_1 = \frac{e_1 - (d_1 - \phi) + \bar{c}^l_1}{2}. \]

- This is a Keynesian cross with associated Keynesian multiplier.

- Solving it, we obtain the equilibrium net income:

\[ e_1 = \bar{c}^l_1 + \phi - d_1. \]
Graphical illustration of equilibrium

\[ \text{Interest rate, } r_2(d_1) \]

\[ \text{Net income, } e_1(d_1) \]

\[ e^* \]

\[ \bar{d}_1 \]

Outstanding debt, \( d_1 \)
Borrowing in the decentralized equilibrium

- Date 0 equilibrium determined by Euler equations:

\[ 1 + r_1 = \frac{u'(c_0^l)}{\beta^l u'(c_1^l)} = \frac{u'(c_0^b)}{\beta^b u'(c_1^b)}. \]

- Anticipated recession if \( d_1 > \bar{d}_1 \).

- 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:

\[ V^b \left( \begin{array}{c} d_1 \\ \text{own} \\ D_1 \\ \text{aggregate} \end{array} \right) = u \left( e_1(D_1) - d_1 + \frac{\phi}{1 + r_2(D_1)} \right) + \text{continuation.} \]

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

\[
\frac{\partial V^h}{\partial D_1} = \begin{cases} 
-\eta u'(c_1^h) < 0, & \text{if } h = l \\
\eta u'(c_1^h) > 0, & \text{if } h = b 
\end{cases}
\]

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 $e_1 < e^*$:

$$\frac{\partial V^h}{\partial D_1} = \frac{\partial e_1}{\partial D_1} u'(c^h_1) = -u'(c^h_1) < 0, \text{ for each } h \in \{b, l\}.$$

- 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

$$\frac{\beta^l u'(c^l_1)}{u'(c^l_0)} > \frac{\beta^b u'(c^b_1)}{u'(c^b_0)}.$$
Interesting but extreme result: Ex-post inefficiency

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

→ 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 \( \{\pi^h_s\} \), with \( \pi^h_L > 0 \) for each \( h \).

**Complete one-period markets at date 0:**

- AD securities with \( q_{1,L} \) and \( q_{1,H} \). Let \( 1 + r_1 = 1 / (q_{1,L} + q_{1,H}) \).
- Agents choose outstanding debt/assets: \( \{d^h_{1,L}, d^h_{1,H}\} \).

**Proposition**

*Decentralized allocations with \( D_{1,L} > \bar{d}_1 \) are constrained inefficient.*

→ Case for mandatory insurance (Shiller...)
Preventive monetary policies

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

2. Contractionary interest rate policy $r_1$: three effects:
   - **Substitution effect:** Higher $r_1$ reduces $d_{1b}$ but raises $d_{1l}$.
   - **Income (recession) effect:** $e_0$ falls: increases $d_{1b}$, lowers $d_{1l}$.
   - **Redistribution:** Higher $r_1$ transfers wealth from $b$ to $l$, raising $d_{1b}$.

For CRRA preferences, the latter dominates: $d'_{1} (r_1) > 0$.
→ 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]
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 $\phi_{t+1}$ 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:

$$\frac{\partial V^l}{\partial D_1} = u'(c^l_1) \frac{de_1}{dD_1},$$

$$\frac{\partial V^b}{\partial D_1} = u'(c^b_1) \frac{de_1}{dD_1} + \phi \frac{dp_1}{dD_1} \left[ u'(c^b_1) - \beta u'(c^b_2) \right].$$

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.