Liquidity Trap and Excessive Leverage

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June 2013, Istanbul
Deleveraging and the recession might be related.
Micro evidence: Deleveraging explains much of job losses (Mian-Sufi).

Theory: Eggertsson-Krugman, Hall, Guerrieri-Lorenzoni...

Emphasis on liquidity trap exacerbated by deleveraging.

Stimulated policy analysis: Ex-post focus. Ignored debt market.

This paper: Ex-ante/preventive policies in debt markets.
Main results: Excessive leverage and underinsurance

Model with anticipated deleveraging and liquidity trap.

- Contributing factors: Impatience, previous leverage, optimism...

Competitive equilibrium is constrained inefficient:

- **Main results:** Excessive leverage and underinsurance.
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Key channel: **Aggregate demand (AD) externalities:**

- Greater leverage $\rightarrow$ Greater deleveraging $\rightarrow$ Smaller AD/output.
- Smaller insurance $\rightarrow$ Greater deleveraging $\rightarrow$ Smaller AD/output.

Pareto improvement by **debt limits** and **mandatory insurance**.

- More broadly, preventive financial regulation (macroprudential).
Related literature

Policy at the liquidity trap: Monetary, fiscal, tax policies...
  - We focus on ex-ante policies.

Deleveraging and the liquidity trap: Eggertsson-Krugman...
  - We focus on debt market policies and ex-ante policies.

Aggregate demand externalities: Farhi-Werning, Schmitt-Grohe/Uribe
  - We focus on the liquidity trap application.

Excessive leverage: Optimism, moral hazard, fire-sale externalities.
  - New mechanism. Complementary, with some differences.
1. Baseline model without uncertainty: Excessive leverage and debt limits.

2. Extension with uncertainty: Underinsurance and mandatory insurance.

3. Role of preventive monetary policies.
Environment with anticipated constraints

- Single good and periods $t \in \{0, 1, ..\}$
- Households $h \in \{b, l\}$ subject to exogenous BC, $d_{t+1}^h \leq \phi_{t+1}$.

**Key ingredient:** Anticipated tightening of BC:

$$\phi_1 = \infty \text{ and } \phi_{t+1} \equiv \phi \text{ for each } t \geq 1.$$  

No uncertainty in baseline for simplicity. Generalized later. Captures:

- Decrease in value of durable goods.
- Decrease in loan to value ratios (increase in uncertainty).
- Increase in precautionary motive (increase in uncertainty).
Key friction: Lower bound on the real rate

- Let $r_{t+1}$ denote the real rate between $t$ and $t+1$.
- Nominal variables, $i_{t+1}, P_t$. Cashless limit.

**Key ingredient is ZLB on the real rate:**

$$r_{t+1} \geq 0.$$

From Fisher equation, $1 + r_{t+1} = (1 + i_{t+1}) \frac{P_t}{P_{t+1}}$, and two assumptions:

**A1. ZLB on the nominal rate:**

$$i_{t+1} \geq 0.$$

**A2. Sticky inflation expectations:**

$$P_{t+1}/P_t = 1.$$
How to obtain sticky inflation expectations?

A2-1. Taylor rule (ex-post efficient):

$$
\log (1 + i_{t+1}) = \max \left( 0, \log (1 + r^n_{t+1}) + \psi_\pi \log \tilde{\Pi}_t \right)
$$

where \( 1 + r^n_{t+1} = \min_{h \in \{b,l\}} u' \left( c_t^h \right) \beta^h u' \left( c_{t+1}^h \right) \) and \( \psi_\pi > 1 \).

A2-2. NK model with sticky prices or wages.


We adopt A2-1. But A2-2 and A2-3 work very similarly.
Demand side: Household optimization

- Baseline preferences \( u(\tilde{c}_t^h - \nu(n_t^h)) \). Generalized in appendix.
- Define \( c_t^h = \tilde{c}_t^h - \nu(n_t^h) \) as net consumption. Households solve:

\[
\begin{align*}
\max & \quad \left\{ c_t^h, d_{t+1}^h, n_t^h \right\}_t \\
\text{s.t.} & \quad c_t^h = e_t^h - d_t^h + \frac{d_{t+1}^h}{1 + r_{t+1}} \\
\text{where} & \quad e_t^h = w_t n_t^h + T_t - \nu(n_t^h), \\
\text{and} & \quad d_{t+1}^h \leq \phi_{t+1} \text{ for each } t \geq 1.
\end{align*}
\]
Supply side: Rationing when the ZLB binds

- Final good sector:
  
  \[
  \max_{n_t} y_t (1 - \tau_t) - w_t n_t, \text{ where } y_t = n_t.
  \]

  Planner sets the wedge, \( \tau_t \), to maximize net income, \( e^h_t \).

  - If the ZLB doesn’t bind, the planner sets \( \tau_t = 0 \), which yields:
    
    \[ e^h_t = e^* \equiv \max_n n - v(n). \]

  - Otherwise, forced to set \( \tau_t > 0 \), which yields \( e^h_t < e^* \).

  Reduced form modeling of rationing. Best case scenario.

**Equilibrium:** \( \{ (c^h_t, d^h_{t+1}, n^h_t), y_t \}_t, \{ w_t, r_{t+1}, P_t, i_{t+1} \}_t, \{ \tau_t \}_t \) such that...
Equilibrium after deleveraging is complete

- Dates $t \geq 2$: Steady state with $1 + r_t = 1/\beta^l > 0$ and:
  \[ c_t^l = e^* + \phi \left( 1 - \beta^l \right) \text{ for } t \geq 2.\]

- Taylor rule ensures: $P_t = P_1$ for each $t \geq 2$.
- Date $t = 1$: **Expected inflation is zero:** $P_2 = P_1$.
- This implies the real ZLB constraint: $r_2 = i_2 \geq 0$...
Equilibrium during the deleveraging episode

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

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

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

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

- ZLB implies **upper bound on lenders’ consumption**:

\[ c_l^1 \leq \overline{c}_l^1 \text{ where } u' \left( \overline{c}_l^1 \right) = \beta^l u' \left( e^* + \phi \left( 1 - \beta^l \right) \right). \]
Large leverage adjustment triggers a recession

Equilibrium depends on:

\[
\begin{align*}
\frac{d_1 - \phi}{\text{leverage adjustment at 0 rate}} & \leq \frac{c_1^l - e^*}{\text{buffer/slack at 0 rate}},
\end{align*}
\]

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

\[
d_1 > \overline{d}_1 = \phi + \overline{c}_1^l - e^*,
\]

there is a demand driven recession: \( r_2 = 0, \ c_1^l = \overline{c}_1^l \), and:

\[
e_1 = \overline{c}_1^l + \phi - d_1 < e^*.
\]
Greater leverage triggers a greater recession.
Conditions for an anticipated recession

Date 0 equilibrium determined by Euler equations:

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

Proposition: Consider one of the following two scenarios:

1. Leveraging: \( d_0 = 0 \) but \( \beta^b \leq \bar{\beta}^b < \beta^l \),
2. Deleveraging: \( \beta^l = \beta^b \) but \( d_0 \in (\bar{d}_0, \tilde{d}_0) \).

In either scenario, \( d_1 > \bar{d}_1 \). There is a demand driven recession at date 1, i.e., \( e_1 < e^* \) and \( r_2 = 0 \), but not at date 0, i.e., \( e_0 = e^* \) and \( r_1 > 0 \).
Ex-post inefficiency and debt writedowns

Recession is anticipated. Is it efficient? Is there room for policy?

- Main result is about ex-ante policies. But useful to start ex-post.

Proposition: Starting at date 1, writing all borrowers’ debt down to $d_1$ generates a Pareto improvement.

Proof: Policy increases $c^b_1$ and leaves $c^l_1 = c'^l_1$ unchanged.

- AD externalities: Reduction in $d_1$ increases AD and output.
- Extreme result from $u(c - v(n))$ but externalities more general.

Ex-post writedowns might be difficult to implement. How about ex-ante?
Suppose planner can impose **endogenous debt limit**: \( d_{1}^{h} \leq \phi_{1}^{pl} \).

Suppose the planner can also transfer \( T_{0}^{pl} \) to borrowers.

**Proposition:** There exists policies, \( \phi_{1}^{pl} \) and \( T_{0}^{pl} \), that generate a Pareto improvement. The resulting allocation satisfies:

\[
1 + r_{1} = \frac{u'(c_{0}^{l})}{\beta^{l}u'(c_{1}^{l})} < \frac{u'(c_{0}^{b})}{\beta^{b}u'(c_{1}^{b})} .
\]  

(1)

**Proof:** Set \( \phi_{1}^{pl} = \bar{d}_{1} \) and choose \( T_{0}^{pl} \) to induce pre-policy consumption.
Main result is general

Planning problem and constrained efficiency:

- The result applies for general $U(c, n)$.
- Efficient allocations (when the ZLB binds at date 1) satisfy:
  1. No recession at date 0 (when ZLB does not bind).
  2. Distorted Euler equation (1) at date 1.
  3. Can be implemented by a debt limit.

- AD externalities. First order gains vs. second order losses.
Uncertainty and underinsurance

**Uncertainty:** States $s \in \{H, L\}$ from date 1 onwards with:

- $\phi_{t+1, L} \equiv \phi$ for each $t \geq 1$
- $\phi_{t+1, H} = \infty$ for each $t \geq 1$.

**Preferences:**

- $\beta_{t, H}^{h} \equiv \beta^{l}$ for $t \geq 1$ (simplicity) and $\beta^{b} \leq \beta^{l}$ at other dates.
- Probability of $L$ state is $\pi^{b}, \pi^{l} > 0$.

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

- AD securities with $q_{1, L}$ and $q_{1, H}$. Let $1 + r_{1} = 1 / (q_{1, L} + q_{1, H})$.
- Outstanding debt $\left\{ d_{1, L}^{h}, d_{1, H}^{h} \right\}$.
Anticipated recession with uncertainty

- Equilibrium starting state \((1, L)\): Same as before. Liquidity trap.
- Equilibrium starting state \((1, H)\): \(1 + r_{t+1} = 1/\beta^l > 0\) and \(e_t = e^*\).
- Equilibrium at date 0: Determined by Euler and **full-insurance**:

\[
\frac{q_{1,H}}{q_{1,L}} = \frac{1 - \pi^l}{\pi^l} \frac{u'(c_{1,H})}{u'(c_{1,L})} = \frac{1 - \pi^b}{\pi^b} \frac{u'(c_{1,H})}{u'(c_{1,L})}.
\]

- **Proposition**: Recession at \((1, L)\) under the same scenarios plus:

3. Disagreement: \(d_0 = 0, \beta^l = \beta^b, \) but \(\pi^b \leq \bar{\pi}^b < \pi^l\).
Suppose planner can impose **mandatory insurance** $d_{1,L} \leq \phi_{1,L}^p$.

**Proposition:** There exists policies, $\phi_{1,L}^p$ and $T_0^p$, that generate a Pareto improvement. The resulting allocation satisfies:

$$\frac{q_{1,H}}{q_{1,L}} = \frac{1 - \pi^l}{\pi^l} \frac{u'(c_{1,H}^l)}{u'(c_{1,L}^l)} < \frac{1 - \pi^b}{\pi^b} \frac{u'(c_{1,H}^b)}{u'(c_{1,L}^b)}.$$  

Result is general. Representative of constrained efficient allocations.
The case for mandatory insurance

Distinct type of efficiency with empirical relevance:

- Old idea: Indexing mortgages to house prices (Shiller, 1993).
- Households do not seem to be interested.
- Our model: **Make it mandatory**, especially for large and national price declines.

Relationship between disagreement and AD externalities:

- Complementary sources of underinsurance.
- But the latter creates a stronger case for mandatory insurance.
We also extend the model to incorporate fire-sale externalities:

- Version with durable asset (housing). Borrowers are natural buyers.

Result with only fire-sale externalities (no ZLB):

1. If borrowers are net sellers (at date 1), then there is overleverage.
2. If borrowers are net buyers (at date 1), then there is underleverage.

- Intuition as in Lorenzoni (or Geanakoplos-Polemarchakis).
- Differences with AD externalities: (i) direction (possibly), (ii) scope.
- For the net seller case, AD and fire-sale externalities complementary.
Preventive monetary policies

Are preventive monetary policies desirable?

Blanchard et al. proposed higher inflation target $\Pi > 1$:

- Relaxes the ZLB constraint: $r \geq -\pi$ where $\pi = \frac{\Pi - 1}{\Pi} > 0$.
- Effective tool to mitigate AD externalities. Weigh against costs.

Others proposed contractionary monetary policy at date 0...
Interest rate policy might not be the ideal tool

- We capture this with $\tau_0 > 0$, which triggers a recession: $e_0 < e^*$.
- Suppose no debt limits. Date 0 equilibrium determined by:

$$1 + r_1 = \frac{u' \left( e_0 + d_0 - \frac{d_1}{1+r_1} \right)}{\beta^l u' \left( \bar{c}^l_1 \right)} \Rightarrow \frac{u' \left( e_0 - d_0 + \frac{d_1}{1+r_1} \right)}{\beta^b u' \left( \bar{c}^l_1 - 2 (d_1 - \phi) \right)}.$$

- Lower $e_0$ leads to higher $r_1$ but not necessarily lower $d_0$.
- Even when it does, contractionary policy is not constrained efficient:
  - 1. Inefficient recession at date 0.
  - 2. Usual Euler equation holds at date 1 as opposed to distorted.

Interest rate policy is a crude solution. Focus on macroprudential policy.
Conclusion: Liquidity trap and excessive leverage

Model with anticipated liquidity trap:

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

New rationale for macroprudential policies that regulate leverage.
Consider preferences $U(c, n)$ with $U_c > 0$, $U_{cc} < 0$ and $U_n < 0$.

Planner’s commitment constraints at date 2 (given $d_2 \in [-\phi, \phi]$):

\begin{align*}
y_t & \equiv y \text{ where } -U_n(y, y)/U_c(y, y) = 1, \text{ and} \\
c_t^b & = y - d_2 \left(1 - \beta^t\right) \text{ and } c_t^l = y + d_2 \left(1 - \beta^t\right) \text{ for each } t \geq 2.
\end{align*}
Constrained planning problem

Planner’s equilibrium constraints at dates 0 and 1:

- ZLB constraint:

\[ \beta^h U_c \left( c^h_{t+1}, n^h_{t+1} \right) \leq U_c \left( c^h_t, n^h_t \right) \text{ for each } t \in \{0, 1\} \text{ and } h. \]  (3)

- Resource constraint:

\[ \sum_{h \in \{b, l\}} c^h_t \leq \sum_{h \in \{b, l\}} n^h_t \text{ for each } t \in \{0, 1\}. \]  (4)

Implicit wedge: \( \tau^h_t = 1 + \frac{U_n(c_t, n_t)}{U_c(c_t, n_t)} \). Separate wedges allowed.
Constrained planning problem

Consider the planning problem:

\[
\max \sum_{t=0}^{\infty} \left( \beta^b \right)^t U \left( c_t^b, n_t^b \right)
\]

subject to \( \sum_{t=0}^{\infty} \left( \beta^l \right)^t U \left( c_t^l, n_t^l \right) \geq U^l \) and Eqs. (2) – (4).
**Proposition:** Suppose ZLB constraint binds at date 1 and only for lenders.

1. Households’ date 0 and 1 consumption allocations satisfy:

\[
\frac{U_c (c^l_0, n^l_0)}{\beta^l U_c (c^l_1, n^l_1)} < \frac{U_c (c^b_0, n^b_0)}{\beta^b U_c (c^b_1, n^b_1)}.
\]

2. No recession at date 0, that is: \(\tau^h_0 = 0\) for each \(h\).

3. Recession at date 1 (for lenders), that is: \(\tau^b_1 = 0\), and \(\tau^l_t \geq 0\).

[with strict inequality if \(U_{cn} (c^l_t, n^l_t) < -U_{cc} (c^l_t, n^l_t)\).]