Liquidity Trap and Excessive Leverage

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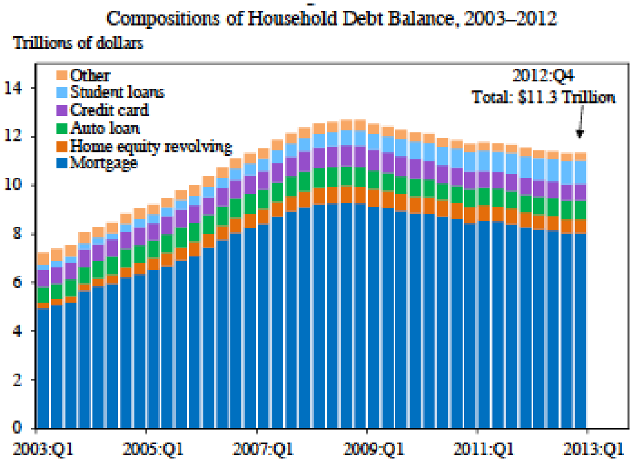
Deleveraging and the recession might be related



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

One explanation: Deleveraging and the liquidity trap

- 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**.

Main results: Excessive leverage and underinsurance

Key channel: **Aggregate demand (AD) externalities:**

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

Outline

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):**

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

$$\text{where} \quad 1+r_{t+1}^n = \min_{h\in\{b,l\}} \frac{u'\left(c_t^h\right)}{\beta^h u'\left(c_{t+1}^h\right)} \text{ and } \psi_\pi > 1.$$

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

A2-3. **Bounded rationality with sticky inflation expectations.**

We adopt A2-1. But A2-2 and A2-3 work very similarly.

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:

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

$$\text{s.t. } c_t^h = e_t^h - d_t^h + \frac{d_{t+1}^h}{1 + r_{t+1}} \text{ for all } t,$$

$$\text{where } e_t^h = \underbrace{w_t n_t^h + T_t - v\left(n_t^h\right)}_{\text{net income}},$$

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

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, τ_t, to maximize net income, e_t^h.

- If the ZLB doesn't bind, the planner sets $\tau_t = 0$, which yields:

$$e_t^h = e^* \equiv \max_n n - v(n).$$

- Otherwise, forced to set $\tau_t > 0$, which yields $e_t^h < e^*$.
- Reduced form modeling of rationing. Best case scenario.

Equilibrium: $\left\{ \left(c_t^h, d_{t+1}^h, n_t^h \right), y_t \right\}_t, \left\{ w_t, r_{t+1}, P_t, i_{t+1} \right\}_t, \left\{ \tau_t \right\}_t$ 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: $c_1^b = e_1 - \left(d_1 - \frac{\phi}{1+r_2}\right)$.

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

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

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

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

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

Large leverage adjustment triggers a recession

Equilibrium depends on:

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

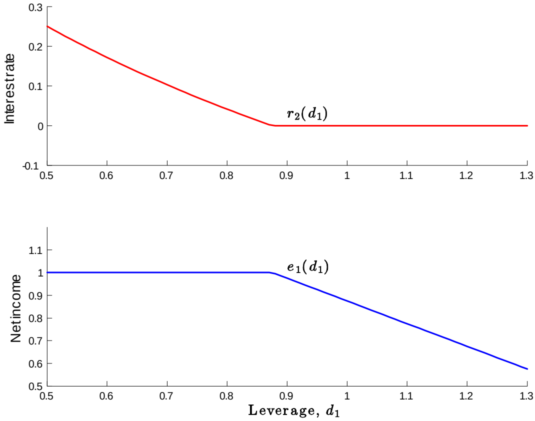
- If adjustment is sufficiently small, then $r_2 > 0$ and $e_1 = e^*$.
- Otherwise, equivalently, if leverage is sufficiently high:

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

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

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

Equilibrium during the deleveraging episode



Greater leverage triggers a greater recession.

Conditions for an anticipated recession

- Date 0 equilibrium determined by Euler equations:

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

Proposition: Consider one of the following two scenarios:

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

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 $\overline{d}_1$ generates a Pareto improvement.

Proof: Policy increases c_1^b and leaves $c_1^l = \overline{c}_1^l$ unchanged.

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

Ex-post writedowns might be difficult to implement. How about ex-ante?

Main result: Excessive leverage and debt limits

- 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, ϕ_1^{pl} and T_0^{pl}, that generate a Pareto improvement. The resulting allocation satisfies:

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

Proof: Set $\phi_1^{pl} = \overline{d}_1$ 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:

- $\beta^h_{t,H} \equiv \beta^l$ 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 $1 + r_1 = 1/\left(q_{1,L} + q_{1,H}\right)$.
- Outstanding debt $\left\{d^h_{1,L}, d^h_{1,H}\right\}_h$.

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**:

$$\frac{q_{1,H}}{q_{1,L}} = \frac{1-\pi^l}{\pi^l} \frac{u'\left(c^l_{1,H}\right)}{u'\left(c^l_{1,L}\right)} = \frac{1-\pi^b}{\pi^b} \frac{u'\left(c^b_{1,H}\right)}{u'\left(c^b_{1,L}\right)}.$$

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

3. Disagreement: $d_0 = 0$, $\beta^l = \beta^b$, but $\pi^b \leq \overline{\pi}^b < \pi^l$.

Second result: Underinsurance and mandatory insurance

- Suppose planner can impose **mandatory insurance** $d_{1,L} \leq \phi^{pl}_{1,L}$.

Proposition: There exists policies, $\phi^{pl}_{1,L}$ and T^{pl}_{0}, that generate a Pareto improvement. The resulting allocation satisfies:

$$\frac{q_{1,H}}{q_{1,L}} = \frac{1-\pi^l}{\pi^l}\frac{u'\left(c^l_{1,H}\right)}{u'\left(c^l_{1,L}\right)} < \frac{1-\pi^b}{\pi^b}\frac{u'\left(c^b_{1,H}\right)}{u'\left(c^b_{1,L}\right)}.$$

- 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.

Interaction of AD and fire-sale externalities

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:

$$1 + r_1 = \frac{u'\left(e_0 + d_0 - \frac{d_1}{1+r_1}\right)}{\beta^l u'\left(\bar{c}_1^l\right)} = \frac{u'\left(e_0 - d_0 + \frac{d_1}{1+r_1}\right)}{\beta^b u'\left(\bar{c}_1^l - 2\left(d_1 - \phi\right)\right)}.$$

- 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.

Constrained planning problem

- Consider preferences $U(c, n)$ with $U_c > 0, U_{cc} < 0$ and $U_n < 0$.

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

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

Constrained planning problem

Planner's equilibrium constraints at dates 0 and 1:

- ZLB constraint:

$$\beta^h U_c\left(c_{t+1}^h, n_{t+1}^h\right) \leq U_c\left(c_t^h, n_t^h\right) \text{ for each } t \in \{0,1\} \text{ and } h. \quad (3)$$

- Resource constraint:

$$\sum_{h\in\{b,l\}} c_t^h \leq \sum_{h\in\{b,l\}} n_t^h \text{ for each } t \in \{0,1\}. \quad (4)$$

Implicit wedge: $\tau_t^h = 1 + \frac{U_n(c_t, n_t)}{U_c(c_t, n_t)}$. Separate wedges allowed.

Constrained planning problem

Consider the planning problem:

$$\max_{\left(c_t^h, n_t^h\right)_{h,t\in\{0,1\}}, d_2} \sum_{t=0}^{\infty} \left(\beta^b\right)^t U\left(c_t^b, n_t^b\right)$$

$$\text{subject to } \sum_{t=0}^{\infty} \left(\beta^l\right)^t U\left(c_t^l, n_t^l\right) \geq U^l \text{ and Eqs. } (2)-(4).$$

Constrained planning problem

Proposition: Suppose ZLB constraint binds at date 1 and only for lenders.

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

$$\frac{U_c\left(c_0^l, n_0^l\right)}{\beta^l U_c\left(c_1^l, n_1^l\right)} < \frac{U_c\left(c_0^b, n_0^b\right)}{\beta^b U_c\left(c_1^b, n_1^b\right)}.$$

2. No recession at date 0, that is: $\tau_0^h = 0$ for each h.
3. Recession at date 1 (for lenders), that is: $\tau_1^b = 0$, and $\tau_t^l \geq 0$. [with strict inequality if $U_{cn}\left(c_t^l, n_t^l\right) < -U_{cc}\left(c_t^l, n_t^l\right)$].