The Liquidity Coverage Ratio, Mortgage Backed Securities, and Mortgage Market Instability

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Introduction

- There was a systematic run on wholesale funding during the recent financial crisis.
- This led to the **Liquidity Coverage Ratio** (LCR) under Basel III.
- The LCR is meant to ensure:

> *that banks have an adequate stock of unencumbered high-quality liquid assets (HQLA) that can be converted [...] into cash to meet their liquidity needs for a 30 calendar day liquidity stress scenario.*
>
> — BCBS, 2013

Introduction

- **Mortgage-backed securities** (MBS) are an important asset for meeting the LCR.
- This paper argues that reliance on MBS for LCR adherence may result in mortgage-market instability.
- Furthermore, this may cause house-price volatility, mortgage default, and financial-sector losses.

Outline of Presentation

1. **Description of the LCR and HQLA**.
2. **Banking Model**: Mortgage Supply Curves.
3. **Model of Households**: Mortgage Demand Curves.
4. **Mortgage/Housing Market Equilibrium**: Instability.

LCR

- The LCR is commonly written as:

$$\frac{\textit{Stock of HQLA}}{\textit{Total Net Cash Outflows Over the Next 30 Calender Days}} \geq 100\%$$

- Assets that qualify as HQLA have two important dimensions:
  1. Inclusion Rate (50% - 100%).
  2. Inclusion Limit (15% - 100%).

The LCR's Numerator: HQLA

- Level 1 Assets (100%/100% inclusion limit/rate):
  1. Government Debt.
  2. Central Bank Liabilities.
  3. **Qualifying Canadian MBS**.
  4. **Qualifying European Covered Bonds** (70%/93%).
- Level 2A (40%/85% inclusion limit/rate):
  1. Lower Quality Government/Central Bank Liabilities.
  2. High Quality Corporate Debt (AA- or Higher).
  3. Other Covered Bonds.
- Level 2B (15% inclusion limit)
  1. Other Qualifying MBS (75% inclusion rate).
  2. Corporate Debt (BBB- to A+) (50% inclusion rate).
  3. Common Equity Shares (50% inclusion rate).

The LCR's Denominator: Net Cash Outflows

- Net Cash Outflows = Expected Cash Outflows - Min{Expected Cash Inflows; 75% of Expected Cash Inflows}.

- Expected cash outflows: multiply outstanding liabilities by their respective "run-off rates":

  1. Retail deposits (typically): 3%-10%.
  2. Wholesale funding (typically): 10%-100%.

- Expected cash inflows: "inflow rates" on contractual cash inflows - may be relatively small.

Modeling the LCR

- To simplify the analysis, banks hold 2 types of HQLA in the model:
    1. Government debt (including central-bank liabilities).
    2. Mortgage-backed securities (including covered bonds).
- This roughly constitutes the set of Level 1 HQLA.

Banks

- There is a unit measure of identical banks, which operate competitively in the mortgage market.

- Banks hold four types of one-period assets:
  1. Mortgage loans: l^m.
  2. Corporate loans: l^c.
  3. Government debt: l^g.
  4. MBS.

- Banks insure all mortgage credit against default risk at the unit cost c^I.

- Mortgages can be securitized at the unit cost c^M.

Bank Assets

- The quantity of mortgage loans demanded in period t – $l_t^m(r_t^m)$ – is determined competitively.

- The quantity of corporate loans demand in period t is exogenous and stochastic.
  - l^c always generates positive profits, I.e.:

$$\Pi^c(l^c) > 0 \, \forall \, l^c > 0$$

- Government debt is elastically supplied at the interest rate r^g.
  - Banks derive an implicit value from l^g: $F(l^g)$.
  - $F^{'}(0) = \infty$ and $\lim_{l^g \to \infty} F^{'}(l^g) = 0$.

Bank Liabilities

- Banks finance I^m, I^c, and I^g in unique funding markets.
- All three markets have perfectly elastic supply at the interest rates r^{fm}, r^{fc}, and r^{fg}, respectively.
- Furthermore, $r^{fg} < r^g$, i.e., governments have a funding advantage over banks.

Bank Problem

- Banks seek to maximize the following profit function:

$$\Pi_{i,t} = (r_t^m - r^{fm} - c^l) l_{i,t}^m - (r^{fg} - r^g) l_{i,t}^g + F(l_{i,t}^g) - c^M MBS_{i,t} + \Pi^c(l_{i,t}^c),$$

- Subject to:

1. LCR constraint:

$$\frac{(\psi^g l_{i,t}^g + \psi^m MBS_{i,t})}{(\theta^m l_{i,t}^m + \theta^c l_{i,t}^c + \theta^g l_{i,t}^g)} \geq L,$$

2. Mortgage loan constraint:

$$MBS_{i,t} \leq l_{i,t}^m,$$

3. Non-negative *MBS* constraint:

$$MBS_{i,t} \geq 0,$$

Solution: Without LCR Constraint

- The following 2 propositions characterizes the set of equilibria (in the limit as c^I and c^M go to zero).

Proposition (1)

In the absence of an LCR constraint (i.e., $L = 0$), the competitive equilibrium interest rate is r^{fm}, and banks extend:

$$I^m_{i,t} = I^m_t(r^{fm})$$

units of mortgage credit, while acquiring:

$$I^g_{i,t} = F^{'-1}(\Delta r^g)$$

units of government debt (where $\Delta r^g = r^{fg} - r^g > 0$). Furthermore, banks create no MBS.

Solution: With LCR Constraint

Proposition (2)

In the presence of an LCR constraint (i.e., $L > 0$), the competitive equilibrium interest rate is:

$$r_t^m = \begin{cases} r^{fm} & \text{if } 1 \\ r^{fm} - \frac{\psi^{MBS} - L\theta^m}{\psi^G - L\theta^g}\left[\Delta r^g - F'(I_{i,t}^g)\right] & \text{if } 2 \end{cases}$$

where:

$$1: \; L\theta^c I_t^c < (\psi^g - L\theta^g)F'^{-1}(\Delta r^g) + (\psi^m - L\theta^m)I_t^m(r_t^m),$$

$$2: \; L\theta^c I_t^c \geq (\psi^g - L\theta^g)F'^{-1}(\Delta r^g) + (\psi^m - L\theta^m)I_t^m(r_t^m).$$

Solution: With LCR Constraint

Proposition (2 Cont'd)

Furthermore, banks extend:

$$I_t^m(r_t^m)$$

units of mortgage credit, while acquiring

$$I_{i,t}^g = \begin{cases} F'^{-1}(\Delta r^g) & \text{if } 1 \\ \frac{L\theta^c I_t^c - (\psi^M - L\theta^m) I_t^m(r_t^m)}{(\psi^g - L\theta^g)} & \text{if } 2 \end{cases}$$

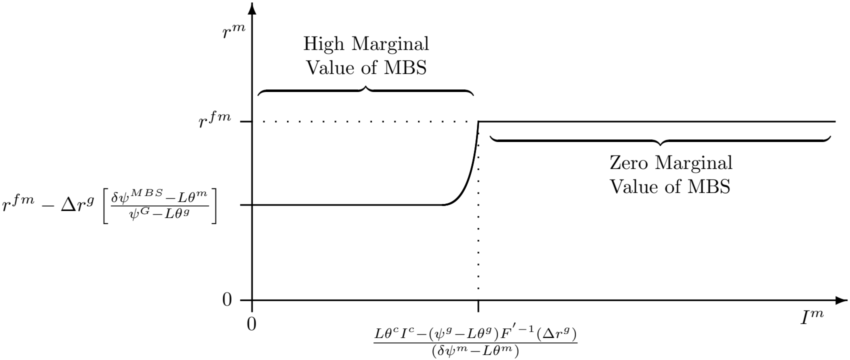
units of government debt, and create:

$$MBS_{i,t} = \begin{cases} \frac{L[\theta^c I_t^c + \theta^m I_t^m(r_t^m)] - (\psi^g - L\theta^g) F'^{-1}(\Delta r^g)}{\psi^m} & \text{if } 1 \\ I_t^m(r_t^m) & \text{if } 2 \end{cases}$$

units of MBS.

Mortgage Supply Curve

- In the presence of an LCR constraint, the following picture depicts a typical mortgage supply curve:



Households

- Consider an overlapping-generation model, where ex-ante homogeneous households live for T periods.
- Each cohort has a unit measure of households (cohorts are indexed by j).
- Each cohort has N income-generating periods, where $T = N + 1$ is the age of retirement.
- In each income-generating period, HH's are endowed with Y units of income:
  - The fraction $\alpha \in (0, 1)$ of Y is spent on consumption.
  - The fraction $1 - \alpha$ is spent on housing.

Households

- Households purchase homes in the first period of their lives using mortgages with initial loan-to-value ratios of 1.
- In subsequent periods, households refinance mortgage credit, and borrow the maximum amount possible.
- These funds are used to purchase additional housing.
- Upon retirement, households liquidate their real-estate, and consume the proceeds.

Demand for Mortgage Credit

- All mortgages have fixed-interest one-period terms (similar to variable-rate mortgages).

- Using the standard mortgage-payment calculator, we can determine each cohort j^s period-t mortgage payment:

$$M^P_{j,t} = l^m_{j,t} \frac{r^m_t (1 + r^m_t)^{A_{j,t}}}{(1 + r^m_t)^{A_{j,t}} - 1}.$$

- Taking the inverse produces cohort j^s mortgage demand in period t:

$$l^m_{j,t} = (1 - \alpha) Y \frac{[(1 + r^m_t)^{N-t+j} - 1]}{r^m_t (1 + r^m_t)^{N-t+j}}$$

Aggregate Expenditure on Housing

- Aggregate mortgage demand in period t is:

$$I_t^m = \sum_{j=t-N+1}^{t} \frac{[(1+r_t^m)^{(N-t+j)} - 1](1-\alpha)Y}{r_t^m(1+r_t^m)^{(N-t+j)}},$$

- and aggregate expenditure on housing in period t is:

$$E_t^H = I_t^m + \sum_{j=t-N+1}^{t\text{-}1} \left[P_t^H h_{j,t} - MB_{j,t} \right],$$

- where:

$$MB_{j,t} = (1+r_{t-1}^m) I_{j,t-1}^m - (1-\alpha)Y.$$

Housing Demand and Housing Equilibrium

- Housing demand in period t is:

$$H_t^D = \frac{1}{P_t^H}\left[I_t^m - \sum_{j=t-N+1}^{t-1} MB_{j,t}\right] + \sum_{j=t-N+1}^{t-1} h_{j,t}.$$

- It is assumed that housing is inelastically supplied at $\overline{H}$ units.

- The market-clearing price of housing is:

$$P_t^H = \frac{1}{\overline{H} - \sum_{j=t-N+1}^{t-1} h_{j,t}}\left[I_t^m - \sum_{j=t-N+1}^{t-1} MB_{j,t}\right].$$

Mortgage Default

Proposition (3)

Subsequent to a steady state, households in cohort j default in equilibrium whenever interest rates increase by (approximately):

$$\Delta r(j) = \frac{\sum_{\{K:N \geq K > N-t+j+1\}} \eta(j)K + (\eta(j)-1)(N-t+j) + \eta(j)}{\sum_{K=1}^{N} \eta(j) \left[\frac{K^2+K}{2}\right]},$$

where:

$$\eta(j) = \frac{h_{j,t}}{\overline{H} - \sum_{k=t-N+1}^{j} h_{k,t}}$$

is cohort $j^{'s}$ share of housing, divided by the number of unoccupied housing units.

Example

- To illustrate the model's underlying mechanism, a two-period example is provided:

  1. In the first period, corporate-loan demand is relatively high. This results in subsidized mortgage credit.

  2. In the second period, banks are hit with a negative corporate-loan demand shock. This reduces aggregate HQLA requirements, and removes the mortgage subsidy.

Example: First Period

- Suppose the mortgage and housing markets are in a steady-state, and that corporate-loan demand satisfies:

$$I_1^c > \frac{(\psi^g - L\theta^g)F'^{-1}(\Delta r^g) + (\psi^m - L\theta^m)I_t^m(r_t^m)}{L\theta^c}.$$

- This induces banks to acquire "excess" government debt:

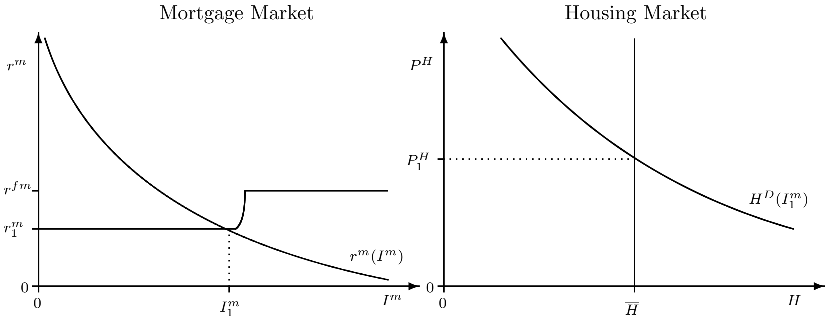
$$I_1^g > F'^{-1}(\Delta r^g),$$

- and to subsidize mortgage credit:

$$r_1^m \approx r^{fm} - \Delta r^g \left[\frac{\psi^{MBS} - L\theta^m}{\psi^G - L\theta^g}\right] < r^{fm}.$$

Example: First Period (Cont'd)

- This situation is depicted below: the equilibrium quantity of mortgage credit demanded is I_1^m, and the equilibrium price of housing is P_1^H.



Example: Second Period

- Now suppose the banking sector is hit with a negative corporate-loan demand shock, such that:

$$I_2^c \leq \frac{(\psi^g - L\theta^g)F^{'-1}(\Delta r^g) + (\psi^m - L\theta^m)I_t^m(r_t^m)}{L\theta^c}.$$

- This shifts the mortgage supply curve to the right.
- Government debt becomes:

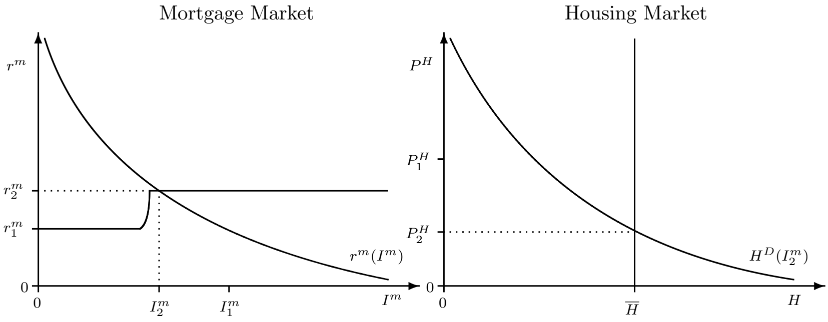
$$I_2^g = F^{'-1}(\Delta r^g).$$

- And the equilibrium mortgage interest rate becomes:

$$r_2^m = r^{fm}.$$

Example: Second Period (Cont'd)

- This situation is depicted below: the quantity of mortgage credit demanded contracts to $I_2^m < I_1^m$, and the price of housing falls to $P_2^H < P_1^H$.



Example: Second Period (Cont'd)

- Households are unable to roll-over mortgage credit in period 2.

- Given the decline in house prices, cohort j will default if:

$$r_2^m - r_1^m \approx \Delta r^g \left[\frac{\psi^{MBS} - L\theta^m}{\psi^G - L\theta^g} \right] > \frac{\sum_{\{K:N \geq K > t-(j+1)\}} \eta(j)K + (\eta(j)-1)(N-t+j) + \eta(j)}{\sum_{K=1}^{N} \eta(j) \left[\frac{K^2+K}{2} \right]}$$

Who Bears Mortgage-Default Losses?

- It was assumed that banks acquire mortgage insurance on all loans.
- As such, mortgage insurers are directly impacted by the type of default discussed herein.
- However, there are wider consequences for the financial system, e.g.:
  - Contagion.
  - Externalities from the foreclosure discount.
  - Other default.

Conclusion

- This paper argues that mortgage-backed securities are a preferred asset for meeting the LCR in many jurisdictions.
- This can lead to mortgage-market instability: intertemporal variation in HQLA demand can result in mortgage interest rate volatility.
- The resulting instability may also lead to mortgage default, house-price volatility, and financial-sector losses.