Quantitative Analysis of Haircuts:
Evidence from the Japanese Repo and Securities Lending Markets

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Bank of Japan
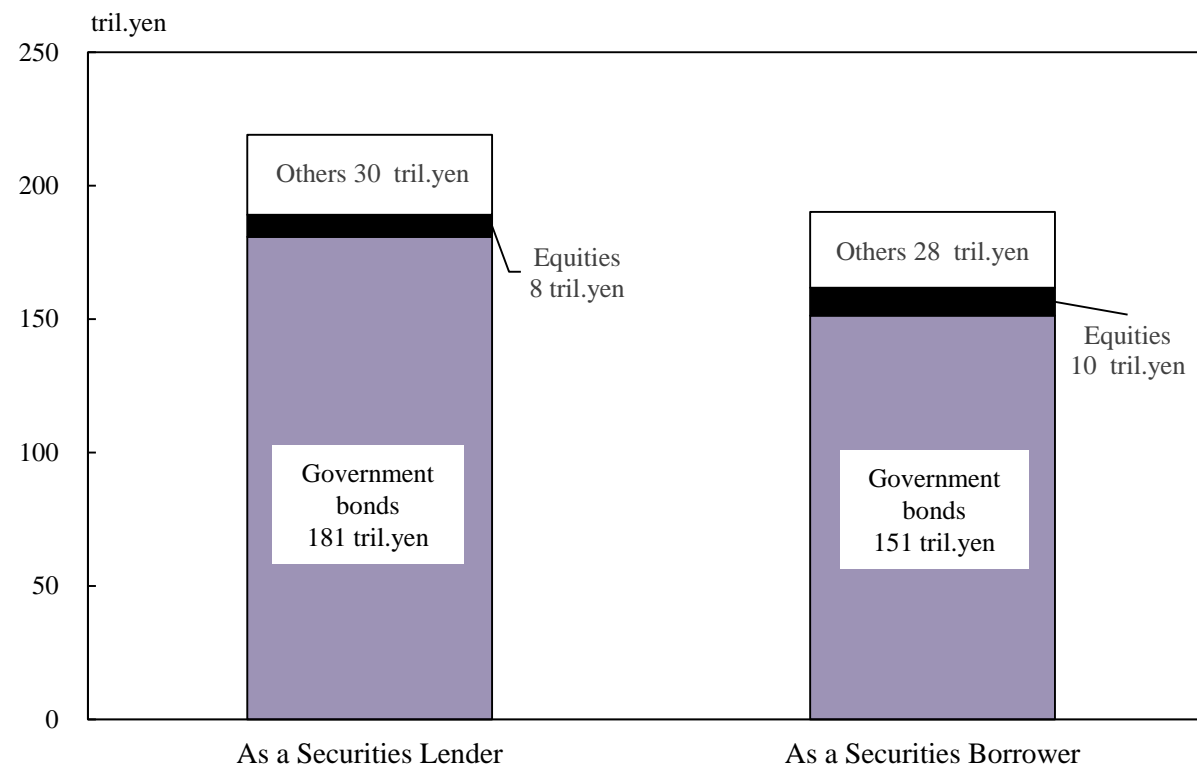
Introduction & Motivation

- Securities Financing Transactions (SFTs) were key to the risk-taking that induced the 2007–2009 global financial crisis. Funding environment rapidly deteriorated as the haircut rate was raised...

- Japan has a large SFT market, mainly in Japanese government bond transactions. The month-end average outstanding balance is 220 trillion JPY, or 2 trillion USD.

- The Federal Reserve Board estimates the total repo outstanding in the US market as of September 2020 to be approximately 4 trillion USD.

- This paper reveals:

- the market structure of Japan's SFT market

- standard haircut setting mechanisms for government bond transactions.

Outstanding balance of SFTs in Japan by security and transaction type

tril.yen

- As a Securities Lender: Government bonds 181 tril.yen, Equities 8 tril.yen, Others 30 tril.yen
- As a Securities Borrower: Government bonds 151 tril.yen, Equities 10 tril.yen, Others 28 tril.yen

Note: Average outstanding balance has been calculated at the end of every month from January 2019 to December 2021.

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Prior Studies & Our Data

■ Prior Studies includes:

➢ **Theoretical studies**: credit and market risk (Martin et al., 2014; Gottardi et al., 2019) and liquidity risk (Brunnermeier and Pedersen, 2009; Martin et al., 2014; Parlatore, 2019).

➢ **Empirical studies for the US market**: Copeland et al. (2014) use tri-party transaction data collected by the Federal Reserve Bank of New York. Additionally, Baklanova et al. (2019) use bilateral transaction data collected on a pilot basis by the Office of Financial Research and the Federal Reserve Board, and Gorton et al. (2020) use transaction data for the Emergency Facility introduced by the Federal Reserve Board during the financial crisis.

➢ **Empirical study for the UK market**: Julliard et al. (2019) use data from six major financial institutions collected by a financial authority.

■ **Our data captures over 90% of Japan's SFT market, including bilateral and CCP-uncleared transactions, which are typically challenging to ascertain**. The data is reported by approximately 50 top financial institutions, including overseas financial institutions based in Japan.

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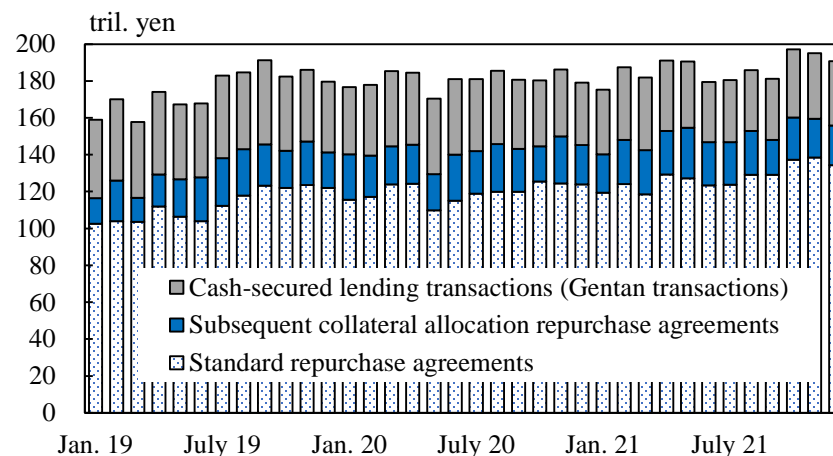# Transactions with government bonds in Japan

Transaction type

- Repurchase agreements increased following the shortening of the Japanese government bond settlement cycle to T+1 in 2018.

- Historically, cash-secured lending transactions (called "*Gentan*" transactions) have been the mainstream in Japan. Despite the decline with the expansion of repurchase agreements, they continue to comprise a certain proportion.
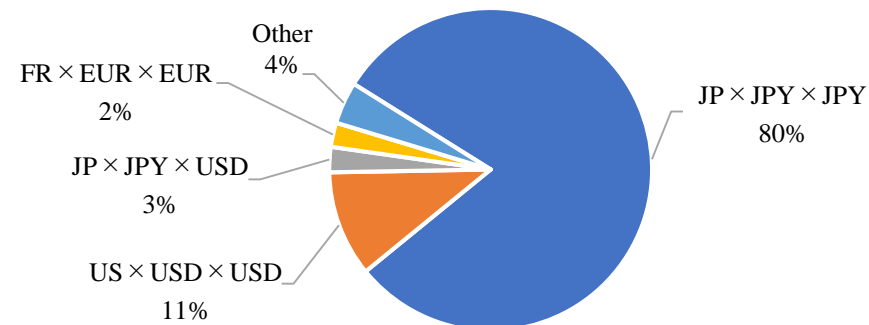
Combination of government bond and cash

- The exchange of Japanese government bonds for yen accounts for 80% of standard repurchase agreements.

- Moreover, US government bonds are exchanged for US dollars or European government bonds are exchanged for euros.

- Japanese government bonds are also exchanged for US dollars.

Outstanding balance of transactions using government bonds by transaction type

□ Cash-secured lending transactions (Gentan transactions)
■ Subsequent collateral allocation repurchase agreements
□ Standard repurchase agreements

Combination by jurisdiction of government bond, currency of government bond, and currency of cash

Other 4%

FR×EUR×EUR 2%

JP×JPY×USD 3%

US×USD×USD 11%

JP×JPY×JPY 80%

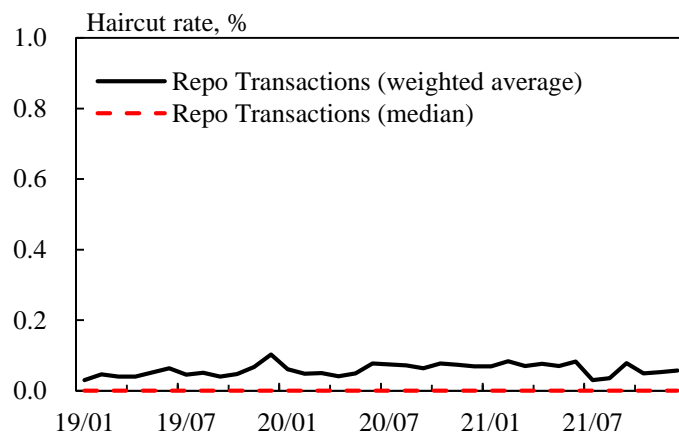Note: In legends, "JP×JPY×JPY" means jurisdiction of government bond : JP, currency of government bond : JPY, and currency of cash : JPY.

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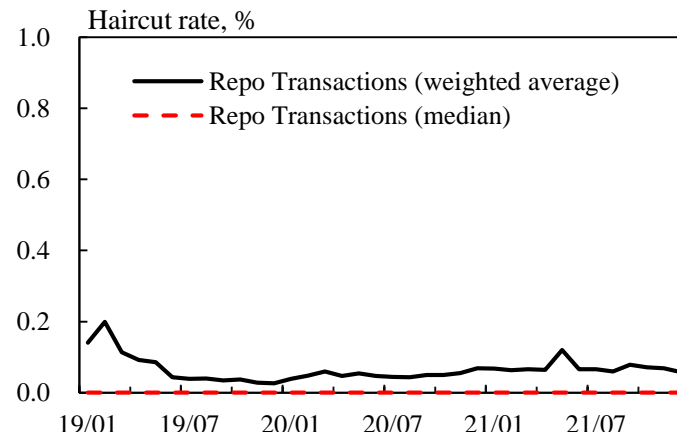BANK OF JAPAN

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Haircut rate by transaction type

■ Exchanging Japanese government bonds for Japanese yen and US government bonds for US dollars are traded at a haircut rate of almost 0%.

■ The haircut rate level in cross-currency transactions to exchange Japanese government bonds for US dollars differs significantly from that of same-currency transactions due to foreign exchange risk.

■ A time series of haircut rates have remained stable despite COVID-19 turmoil upsetting the financial markets.
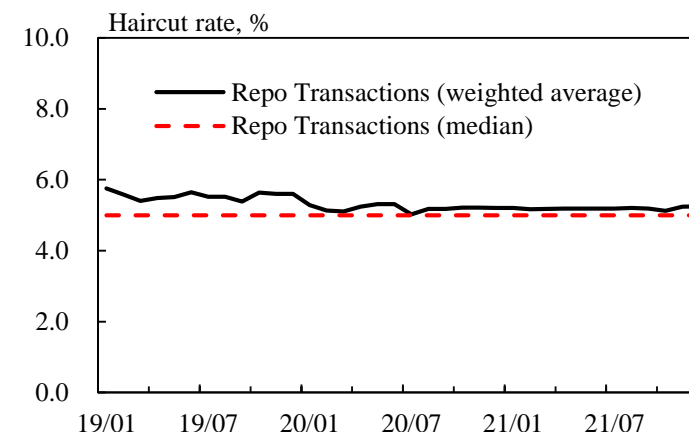
Japanese government bonds and JPY

US government bonds and USD

Japanese government bonds and USD

Note: Latest data as at December 2021.

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Regression Model

■ Analysis is conducted with an OLS dummy variable model.

$$Haircut_j = \alpha_0 + \underbrace{\sum_k \alpha_{1,k} X_{j,k} + \sum_l \delta_l \, 1(d_{j,l} = l)}_{\text{Explanatory Variables}} + \underbrace{\sum_m \rho_m \, 1(p_{j,m} = m) + \sum_n \theta_n \, 1(s_{j,n} = n)}_{\text{Fixed Effects}} + \varepsilon_j,$$

Where:

➢ $X_{j,k}$ are continuous variables (Transaction maturity days, Transaction amount, Repo rate, Network centrality)

➢ $d_{j,l}$ are dummy variables
- Characteristics of Government Bond (Collateral quality, Residual maturity)
- Transaction maturity (Open-end transactions)
- Transaction type (Cross currency, Special collateral, etc.)

➢ $p_{j,m}$ are time fixed-effects on the transacting entities (Data reporter × Counterparty × Transaction reporting date)

➢ $s_{j,n}$ are fixed-effects on the transaction types (Jurisdiction of the bond ×currency of the bond × Cash currency)

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Main Results

Characteristics of Government Bond

- **Collateral quality** : <u>The higher the credit rating, the lower the haircut rate</u>.
- **Residual maturity** : The haircut rate of government bond with <u>a long residual maturity tends to be higher</u>.

Transaction Maturity

- **Transaction maturity days** : Haircut rates increase with long transaction maturity, but the impact is not significant.
- **Open-end transactions** : Open-end transactions increase haircut rates.

Transaction Terms

- **Repo rate** : There is a positive correlation between haircut rate and repo rate.
- **Transaction amount** : The effect of transaction amount does not significantly affect the haircut rate.

Network Effect

- **Network centrality** : <u>Low haircut rate for financial institutions near the center of the network</u>.
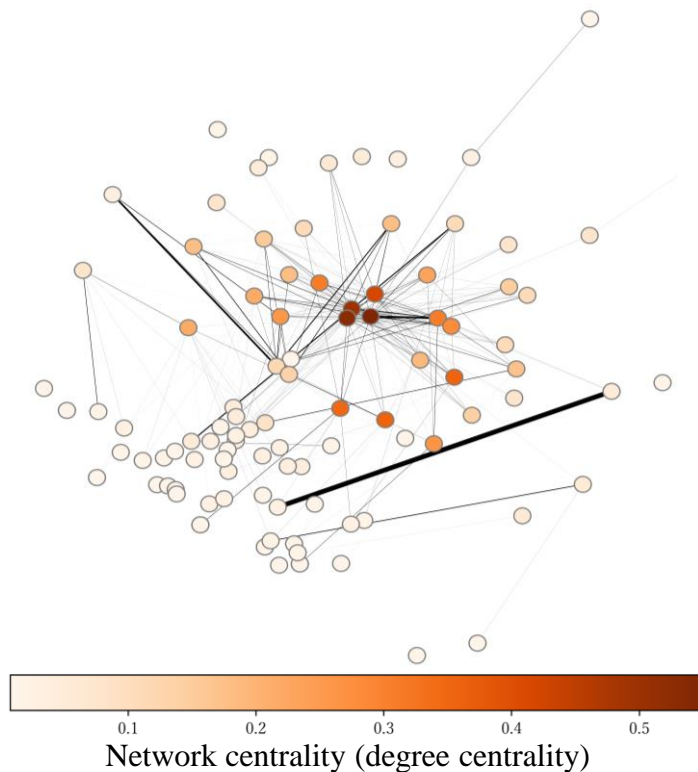
Transaction Type

- **Cross currency** : <u>Cross-currency transactions increase haircut rates</u>.
- **Special collateral** : Haircut rate for GC transactions is higher than that for SC transactions.
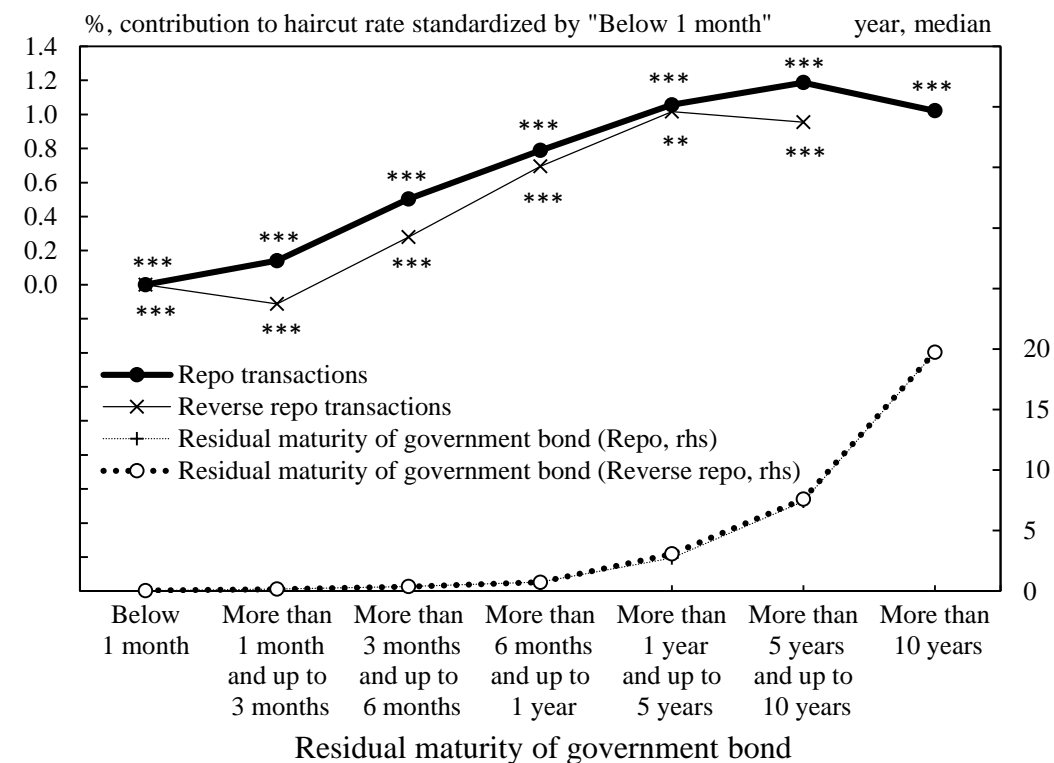
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Main Results

- Financial institutions near the center of the network can match borrowing and lending needs more efficiently.

Transaction network in standard repurchase agreements using government bonds

Network centrality (degree centrality)

- As the residual maturity increases, the haircut rate is pushed up along with the higher price volatility.

Term structure of residual maturity of government bonds (excluding zero haircuts sample)

Residual maturity of government bond

Conclusions

■ First analysis of the market structure and haircut setting mechanism of SFTs in-depth using transaction data collected by the Financial Services Agency of Japan and the Bank of Japan.

■ We determined that explanatory variables affecting credit, market, and liquidity risk, such as the collateral quality of government bonds, the residual maturity of government bonds, and the presence of foreign exchange risk, significantly impact haircut setting.

■ Financial institutions closer to the center of the network tend to set lower haircut rates.

■ The results are generally robust and of value to financial authorities and practitioners in trading and risk management of SFTs at financial institutions.

Thank you for your attention

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